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Paper 11
Entered: March 18, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

POSCO CO., LTD. et al.,
Petitioner,

v.

ARCELORMITTAL,
Patent Owner.

IPR2024-01376
Patent 10,961,602 B2

Before BARRY L. GROSSMAN, JULIA HEANEY, and BRIAN D. RANGE, *Administrative Patent Judges*.

RANGE, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

POSCO-1070
POSCO v. ArcelorMittal
IPR2025-00370

I. INTRODUCTION

POSCO Co., Ltd. ("Petitioner") filed a Petition requesting *inter partes* review of claims 1–30 of U.S. Patent No. 10,961,602 (Ex. 1001, "the '602 patent"). Paper 1 ("Pet."). ArcelorMittal ("Patent Owner") filed a Preliminary Response. Paper 6 ("Prelim. Resp."). With our authorization, Petitioner filed a Reply (Paper 7, "Pet. Reply"), and Patent Owner filed a Sur-Reply (Paper 8, "PO Prelim. Sur-Reply"). With further authorization (*see* Ex. 3001), Patent Owner filed a Supplementary Response (Paper 9, "PO *Fintiv* Resp."), and Petitioner filed a Reply to the Supplementary Response (Paper 10, "Pet. *Fintiv* Reply").

The Patent Trial and Appeal Board has authority to conduct an *inter partes* review pursuant to 35 U.S.C. § 6(b). Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted unless the information presented in the petition "shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." The Board determines whether to institute a trial on behalf of the Director. 37 C.F.R. § 42.4(a). The following findings of fact and conclusions of law are not final, but are made for the sole purpose of determining whether Petitioner meets the threshold for initiating review. Any final decision shall be based on the full trial record, including any response timely filed by Patent Owner. Any arguments not raised by Patent Owner in a timely-filed response may be deemed waived.

For the reasons stated below, we determine that Petitioner has established a reasonable likelihood that it would prevail with respect to at least one claim. We hereby institute an *inter partes* review as to claims 1–30 of the '602 patent based upon Petitioner's asserted grounds of unpatentability.

II. BACKGROUND

A. Real Parties in Interest

Petitioner identifies itself, as well as VinFast Auto, LLC, VinFast Auto Ltd., VinFast USA Distribution, LLC, Vingroup USA, LLC, and VinFast Trading and Production JSC, as the real parties in interest. Pet. 83. Patent Owner identifies itself as the real party in interest. Paper 4, 1.

B. Related Matters

> The parties identify the following matters as related to this proceeding: *Certain High-Strength Aluminum or Aluminum Alloy-Coated Steel, and Automotive Products and Automobiles Containing Same*, Inv. No. 337-TA-1402 (ITC) (filed Apr. 17, 2024); and *ArcelorMittal v. VinFast Auto, LLC et al.*, No. 2:24-cv-03128 (C.D. Cal.) (filed Apr. 16, 2024).

Pet. 83; Paper 4, 1.

C. The '602 patent

The '602 patent, titled "Coated Steel Strips, Coated Stamped Products and Methods," issued March 30, 2021, with claims 1–30. Ex. 1001, codes (45), (54), 14:59–18:24. The '602 patent claims priority as a "[c]ontinuation of application No. 15/606,770, filed on May 26, 2017, which is a continuation of application No. 13/621,015, filed on Sep. 15, 2012, now Pat. No. 9,708,683, which is a division of application No. 12/447,777, filed as application No. PCT/IB2006/004019 on Oct. 30, 2006, now Pat. No. 8,307,680." *Id.* at code (60). The '602 patent explains that "the use of pre-coated steels in hot-stamping processes for the shaping of parts has become important, especially in the automotive industry," with the fabrication including "[p]re-coating of a steel sheets by hot dipping; [t]rimming or cutting for obtaining blanks; [h]eating the blanks in order to obtain alloying of the steel

substrate with the precoating . . . and [h]ot forming followed by rapid cooling of the part." *Id.* at 1:37–46. The blanks having "an alloying of the pre-coating with the steel substrate, which has the effect of creating intermetallic alloys with high melting temperature . . . may be heated in a temperature range where austenitizing of the metallic substrate takes place, allowing further hardening by quenching." *Id.* at 1:50–55. "Heat treatments of the blanks . . . are most frequently performed in furnaces, where blanks are traveling on rollers," but problems "are experienced with the furnace operation" because "the rollers may become fouled by metallic deposits which come from the pre-coating of the blanks" and "[i]f these deposits are excessive, maintenance of the rollers has to be performed and productivity is decreased." *Id.* at 1:67–2:2. The parts that are "obtained after heating and rapid cooling display very high mechanical resistance and may be used for structural applications, for example or automotive industry applications," and "[t]hese parts must be frequently welded with others and high weldability is required." *Id.* at 2:3–7.

The '602 patent aims to provide "coated steels which may be conveniently used to prepare shaped parts by a stamping process" and "which may be used to prepare shaped parts by a stamping process which are suitable for welding," as well as "processes for preparing such coated steels and stamped parts." *Id.* at 2:27–33. Figure 1 of the '602 patent, reproduced below, illustrates a "coated part, after heat treatment and stamping," that "is particularly favorable for the further welding of the part." *Id.* at 3:52, 3:55–56.

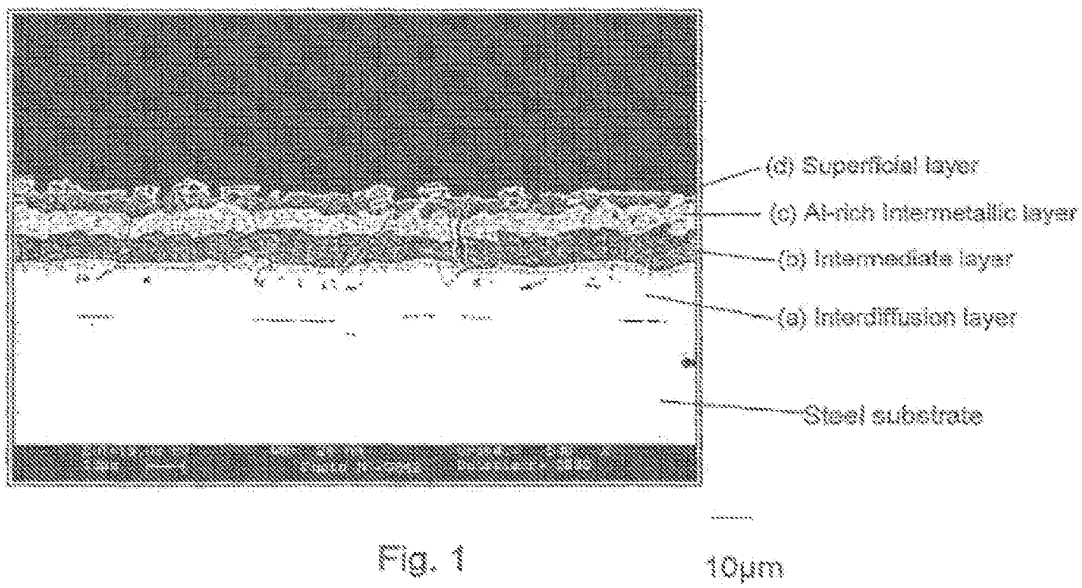


Fig. 1

Figure 1 illustrates the "succession of layers of the coating on the steel substrate is: (a) interdiffusion layer; (b) intermediate layer; (c) intermetallic layer; and (d) superficial layer." *Id.* at 3:52–55; *see id.* at 6:8–51.

D. Illustrative Claims

Claims 1, 21, and 24 are independent. The other challenged claims (claims 2–20, 22, 23, and 25–30) depend, directly or indirectly, from either claim 1, claim 21, or claim 24. *See* Ex. 1001, 14:59–15:16, 16:41–64, 17:3–18:2; 15:17–16:40, 16:65–17:3, 18:3–24.

Claim 1 (with identifiers of claim elements, *see, e.g.*, Pet. vii) is illustrative and is reproduced below.

[1pre] A precoated steel product comprising:

[1a] a strip of base steel having a first side and a second side; and

[1b] a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel,

[1c] wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating,

> [1d] and wherein the coating includes, proceeding from the base steel outwards: (a) an interdiffusion layer having a first mean iron composition,
>
> [1e] (b) an intermediate layer having a second mean iron composition different from the first mean iron composition,
>
> [1f] (c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron composition being higher than the second mean iron composition; and
>
> [1g] (d) a superficial layer having a fourth mean iron composition different from the third mean iron composition,
>
> [1h] wherein the coating has a thickness greater than 30 micrometers.

Ex. 1001, 14:59–15:16.

E. Asserted Grounds of Unpatentability

Petitioner, supported by the Declaration of Dr. Michael Miles (Ex. 1003), asserts the following grounds of unpatentability (Pet. 1):[1]

Claims Challenged	35 U.S.C. §	References/Basis
1, 9–11, 14, 18, 20–22, 24, 26, 27, 30	102(a)	Engels[2]
1, 2, 9–30	103(a)	Engels
2, 5, 6	103(a)	Engels, Cornette[3]

[1] The relevant sections of the Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, took effect on March 16, 2013. The '602 patent claims priority before this date. *See* Ex. 1001, code (60). For the purposes of this Decision, pre-AIA statutes apply.

[2] *Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels*, published 2006, Ex. 1005 ("Engels").

[3] *High Strength Steels for Automotive Safety Parts*, SAE Technical Paper Series, published 2001, Ex. 1014 ("Cornette").

Claims Challenged	35 U.S.C. §	References/Basis
3, 4, 7, 8	103(a)	Engels, Laurent[4]
3–6	103(a)	Engels, Nishibata[5]
6	103(a)	Engels, Cornette, Nishibata
8	103(a)	Engels, Cornette, Laurent
11–17, 19, 23, 25, 27–30	103(a)	Engels, Takagi[6]
1–30	103(a)	Takagi, Hein[7], GMW14400[8]
3, 4, 7, 8	103(a)	Takagi, Hein, GMW14400, Laurent
3–6	103(a)	Takagi, Hein, GMW14400, Nishibata

III. ANALYSIS

A. Legal Standard

A claim may be invalid as anticipated by a prior art reference if "each and every limitation is found either expressly or inherently in a single prior art reference." *Sanofi–Synthelabo v. Apotex, Inc.*, 470 F.3d 1368, 1375 (Fed. Cir. 2006) (internal quotation marks omitted). Anticipation under § 102 may be established by showing, as a matter of fact, that all elements arranged as specified in a claim are disclosed within the four corners of a reference, either expressly or inherently, in a manner enabling one skilled in the art to practice an embodiment of

[4] US 6,296,805 B1, issued Oct. 2, 2001, Ex. 1023 ("Laurent").

[5] WO 2004/106573 A1, published Dec. 9, 2004, Ex. 1049 ("Nishibata").

[6] US 2004/0009366 A1, published Jan. 15, 2004, Ex. 1016 ("Takagi").

[7] *Hot Stamping of USIBOR 1500 P: Part and Process Analysis Based on Numerical Simulation*, published 2006, Ex. 1019 ("Hein").

[8] *Low Carbon, Heat-Treatable Boron Steel – Uncoated or Aluminized Pre-Coated*, GM Worldwide Engineering Standards, Material Specification Metals, published Nov. 2005, Ex. 1026 ("GMW14400").

the claimed invention without undue experimentation. *See ClearValue, Inc. v. Pearl River Polymers, Inc.*, 668 F.3d 1340, 1344 (Fed. Cir. 2012).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and "the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).[9]

B. Level of Ordinary Skill in the Art

In order to determine whether an invention would have been obvious at the time the application was filed, we consider the level of ordinary skill in the pertinent art at the critical time. *Graham*, 383 U.S. at 17. The resolution of this question is important because it allows us to "maintain[] objectivity in the obviousness inquiry." *Ryko Mfg. Co. v. Nu–Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991). In assessing the level of ordinary skill in the art, various factors may be considered, including the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quotation omitted). Generally, it is easier to establish obviousness under a higher level of ordinary skill

[9] At present, the parties have not raised any issues related to objective evidence of nonobviousness.

in the art. *Innovention Toys, LLC v. MGA Entm't, Inc.*, 637 F.3d 1314, 1323 (Fed. Cir. 2011) ("A less sophisticated level of skill generally favors a determination of nonobviousness . . . while a higher level of skill favors the reverse.").

Petitioner contends that a person of ordinary skill in the art (POSITA) "would have had an undergraduate degree in materials science, manufacturing engineering, mechanical engineering, or equivalent knowledge, training, or experience, with two years of experience working in metallurgy." Pet. 6 (citing Ex. 1003, 15). Patent Owner does not dispute the level of ordinary skill in the art. Prelim Resp. 3.

For purposes of this Decision, we adopt Petitioner's proposal as reasonable and consistent with the '602 patent specification and the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art).

C. Claim Construction

In *inter partes* reviews, the Board interprets claim language using the district-court-type standard, as described in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b). Under that standard, we generally give claim terms their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history. *See Phillips*, 415 F.3d at 1313–14. Although extrinsic evidence, when available, may also be useful when construing claim terms under this standard, extrinsic evidence should be considered in the context of the intrinsic evidence. *See id.* at 1317–19.

Petitioner does not propose any claim constructions. Pet. 3. Patent Owner argues that Petitioner improperly incorporates by reference meanings of

"interdiffusion layer," "intermediate layer," "intermetallic layer," and "superficial layer" as proposed by Petitioner during IPR2019-01275 which addresses related U.S. Patent No. 9,708,683 ("the '683 Patent") (citing Pet. 19). Prelim. Resp. 8–10. Patent Owner argues that this incorporation results in the Petition not "specify[ing] where each element of the claim is found in the prior art patents or printed publications relied upon," and that the Petition should, thus, be denied for failure to satisfy 37 C.F.R. § 42.104(b)(4). *Id.* at 9–10.

While it is true that Petitioner states that the cited art "satis[fies] the meanings of [interdiffusion, intermediate, intermetallic, and superficial] as proposed by Petitioner during IPR proceedings for the '683 Patent" (Pet. 19), Petitioner is quite clear that, for this proceeding, Petitioner takes the position that no claim construction is required. Also, Patent Owner does not propose any claim constructions ("Patent Owner does not submit any terms for construction"), and, for the most part (except as we otherwise address below), does not dispute application of the prior art to the challenged claims. As such, we do not agree with Patent Owner that Petitioner's claim construction position results in a failure to specify where the claim is in the prior art and justifies denial of institution "for this reason alone." Prelim. Resp. 10.

For purposes of this Decision, we do not discern a need to construe explicitly any claim language because doing so would have no effect on our analyses below of Petitioner's asserted grounds and will not assist in resolving the present controversy between the parties. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'") (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

D. Discretionary Denial Under 35 U.S.C. § 314(a)

Patent Owner argues that, pursuant to *Apple Inc. v. Fintiv, Inc.*, IPR2022-00019, Paper No. 11 (precedential) ("*Fintiv*"), "the Board should exercise its discretion to deny institution given the late stage of the parallel ITC Investigation involving the '602 Patent and the same prior art references." PO *Fintiv* Resp. 1. Patent Owner argues that each of the six *Fintiv* factors support discretionary denial. *Id.* at 2–4. Petitioner argues that *Fintiv* does not support discretionary denial. *See* Pet. *Fintiv* Reply, *passim*.

Below, we address the framework we apply to resolve these arguments, address each of the six *Fintiv* factors, and assess whether discretionary denial is appropriate.[10]

1. Legal Background and Framework

Under 35 U.S.C. § 314(a), the Director has discretion to deny institution. In determining whether to exercise discretion on behalf of the Director, we look to, for example, the guidance provided in *NHK Spring Co. v. Intri-Plex Technologies, Inc.*, IPR2018-00752, Paper 8 (PTAB Sept. 12, 2018) (precedential), and *Apple Inc. v. Fintiv Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) ("*Fintiv*").

Fintiv sets forth six non-exclusive factors for determining "whether efficiency, fairness, and the merits support the exercise of authority to deny institution in view of an earlier trial date" in a parallel proceeding. *Fintiv*, Paper 11 at 6. These factors consider:

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[10] On June 21, 2022, the Director of the United States Patent and Trademark Office entered a memorandum relating to discretionary denials under *Fintiv*. On February 28, 2025, the Office withdrew that guidance. We, thus, do not consider the June 21, 2022, guidance in our determination.

> 1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
>
> 2. proximity of the court's trial date to the Board's projected statutory deadline for a final written decision;
>
> 3. investment in the parallel proceeding by the court and the parties;
>
> 4. overlap between issues raised in the petition and in the parallel proceeding;
>
> 5. whether the petitioner and the defendant in the parallel proceeding are the same party; and
>
> 6. other circumstances that impact the Board's exercise of discretion, including the merits.

Id.

Fintiv recognizes that there is some overlap between the identified factors and that some facts may be relevant to more than one factor. *Fintiv*, Paper 11 at 6. "Therefore, in evaluating the factors, the Board takes a holistic view of whether efficiency and integrity of the system are best served by denying or instituting review." *Id.*

2. Background

Patent Owner instituted an International Trade Commission action[11] against "Respondents VinFast Auto Ltd., VinFast Auto, LLC, VinFast USA Distribution, LLC, Vingroup USA, LLC, and VinFast Trading and Production JSC.[12]" Ex. 2002; *see also* PO *Fintiv* Resp. 1. Petitioner identifies the VinFast entities as "additional

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[11] The action is captioned *Certain High-Strength Aluminum of Aluminum Alloy-Coated Steel, and Automotive Products and Automobiles Containing Same*, Inv. No. 337-TA-1402 (ITC), filed April 17, 2024 ("the ITC Investigation"). *See* PO *Fintiv* Resp. 1.

[12] We collectively refer to the Respondents as "the VinFast entities."

real parties-in-interest." Pet. 83. The ITC set a hearing date of March 3–7, 2025, initial determination date of June 23, 2025, and target date for completion of investigation of October 23, 2025. Ex. 2002, 4; *see also* Ex. 1059–1060 (transcripts of March 5 and March 6, 2025, hearings).

3. Fintiv Factor One: Stay

Patent Owner argues that factor one heavily favors discretionary denial because there is no stay in the ITC, and the VinFast entities never requested a stay. PO *Fintiv* Resp. 2. Petitioner argues that this factor favors institution or is neutral because Patent Owner's district court case against VinFast is stayed. Pet. *Fintiv* Reply 2 (citing Ex. 1053). The district court stayed litigation pending the ITC Investigation. Ex. 1054.

Fintiv instructs that "[a] district court stay of litigation pending resolution of the PTAB trial allays concerns about inefficiency." *Fintiv* at 6. Here, however, the district court stay is a stay pending conclusion of the ITC Investigation. Ex. 1054. In such a situation, *Fintiv* indicates that the focus should be on "whether the patentability disputes before the ITC will resolve all or substantially all of the patentability disputes between the parties, regardless of the stay." *Fintiv* at 9. We address *Fintiv* factor four (overlap) below. We determine that, given *Fintiv*'s explanation of this situation, the weight of the district court's stay pending the ITC Investigation and the weight of the lack of a stay of in the ITC Investigation itself depends, in part, on factor four. Thus, we determine that factor one, by itself, is neutral or bears little weight in our overall analysis, but consideration of the district court stay pending ITC investigation elevates the importance of factor four.

4. Fintiv Factor Two: Proximity of Trial Date

Patent Owner argues that the ITC Investigation has a target completion date of October 23, 2025, which is more than five months before the statutory deadline

for a final written decision (March 24, 2026) if this *inter partes* review were instituted. PO *Fintiv* Resp. 2–3. Patent Owner thus argues that this factor heavily favors discretionary denial. *Id.*

Petitioner argues that this factor favors institution because the ITC cannot invalidate claims and that the district court proceeding is stayed. Pet. *Fintiv* Reply 2. Petitioner also argues that the ITC Investigation requires many steps after the target date so that "the Board's statutory deadline comes first." *Id.* at 3.

The Board often considers the ITC target date when considering this *Fintiv* factor. *See, e.g., SK Innov. Co., Ltd. v. LG Chem, Ltd.*, IPR2020-01240, Paper 15, 16–17 (PTAB Jan. 12, 2021) (citing *Garmin Int'l, Inc. v. Koninklijke Philips N.V.*, IPR2020-00754, Paper 11, 12 (PTAB Oct. 27, 2020); *Comcast Cable Commc'n, LLC v. Rovi Guides, Inc.*, IPR2020-00800, Paper 10, 12–13 (PTAB October 22, 2020)). This approach aligns with the language of *Fintiv* which focuses on the difficulty of maintaining a district court action where a claim is "determined to be invalid at the ITC." *Fintiv* at 9.

Here, as Patent Owner argues, the ITC Investigation has a target completion date of October 23, 2025, which is more than five months before the statutory March 24, 2026, deadline for a final written decision. Thus, proximity of trial date favors discretionary denial.

5. Fintiv Factor Three: Investment in the Parallel Proceeding

Patent Owner argues that this factor "heavily favors discretionary denial as the parties have progressed through fact and expert discovery and will complete the evidentiary hearing on March 7, 2025." PO *Fintiv* Resp. 3. Petitioner argues that this factor favors institution because "[n]o investment has occurred in a lawsuit against POSCO or in VinFast's district court case." Pet. *Fintiv* Reply 3.

Petitioner also argues that "Petitioner diligently filed its petition less than 4 months after the ITC investigation was instituted." *Id.*

For this factor, *Fintiv* instructs us to consider "the amount and type of work already completed in the parallel litigation by the court and the parties at the time of the institution decision." *Fintiv* at 9. Here, the record before us supports that the ITC and Patent Owner have completed substantial work for the ITC Investigation. This is somewhat, but not completely, mitigated by Petitioner's diligence in filing the Petition. We thus determine that this factor weighs, at least somewhat, in favor of discretionary denial.

6. Fintiv Factor Four: Overlapping Issues

Patent Owner argues that the VinFast entities asserted the same prior art references in the ITC that are asserted here. PO *Fintiv* Resp. 3. Patent Owner argues that the VinFast entities' expert report "asserts the same invalidity grounds being asserted in the Petition." *Id.* (citing Ex. 2003). Patent Owner acknowledges, however, that the VinFast entities "revised some of its invalidity grounds." *Id.*

Petitioner argues that the Petition asserts grounds "completely different from those heard by the ITC" and "addresses 16 more claims." Pet. *Fintiv* Reply 3. Petitioner emphasizes that the ITC Investigation's invalidity case focused on different prior art and that minimal hearing resources were devoted to the key prior art references asserted here, Engels and Takagi. *Id.* at 4.

Fintiv instructs that this factor should focus on "claims, grounds, arguments, and evidence *presented* in the parallel proceeding." *Fintiv* at 12 (emphasis added). Here, the record does not support that the Petition's invalidity grounds were presented to the ITC for consideration on the merits, and the record does not support that the ITC will ever adjudicate the invalidity grounds raised here. Rather, the VinFast entities presented Engels and Takagi alongside many other references

as evidence of the "State of the Art." Ex. 1058, 41, 47–50. This is, therefore, not a situation where the ITC Investigation will "resolve key issues in the petition." *Fintiv* at 13. Thus, this factor weighs heavily against discretionary denial.

7. Fintiv Factor Five: Overlapping Parties

Patent Owner argues that this factor favors discretionary denial because "both Patent Owner and RPI [the VinFast entities] are parties to the ITC investigation." PO *Fintiv* Resp. 4. Petitioner argues that Petitioner is a supplier to the VinFast entities. Pet. *Fintiv* Reply 5. Petitioner argues that discretionary denial would thwart Petitioner's ability to "efficiently resolve validity to avoid future litigation." *Id.* Petitioner emphasizes that it "named its customer, VinFast, as an RPI 'out of an abundance of caution' and 'to avoid unnecessary litigation at the PTAB.'" *Id.* Petitioner also represents that VinFast has had no involvement or control over the Petition. *Id.*

Fintiv instructs that this factor may weigh against exercising discretion where "a petitioner is unrelated to a defendant in an earlier court proceeding." *Fintiv* at 13. Here, Petitioner and VinFast have a supplier/customer relationship, but we appreciate that a supplier, like Petitioner, may have interests in resolving validity issues that are unrelated to those of a single customer. On balance, we determine that this factor is neutral given the particular circumstances presented.

8. Fintiv Factor Six: Other Circumstances

Patent Owner argues that this factor favors discretionary denial because the Petition's merits are weak. PO *Fintiv* Resp. 4. Petitioner argues that the Petition's merits are strong. Pet. *Fintiv* Reply 5.

On the present record, the merits of the Petition are strong for the reasons we explain in Section III(G), *infra*. This factor, thus, favors institution.

9. Conclusion

When considering the *Fintiv* factors, we "take[] a holistic view of whether efficiency and integrity of the system are best served by denying or instituting review." *Fintiv* at 6. Here, *Fintiv* factors one and five are neutral, factors two and three favor discretionary denial, factor four strongly weighs against discretionary denial, and favor six weighs against discretionary denial.

The integrity of the system will benefit from institution because of the strong merits the Petition presents (factor six), and the ITC Investigation will not resolve these merits (factor four). This outweighs any potential inefficiency as indicated by factors two and three. We further note that any inefficiency in resolving the grounds the Petition presents is mitigated by the stay of the district court action (factor one). We, thus, decline to exercise discretionary denial under 35 U.S.C. § 314(a).

E. Discretionary Denial Under 35 U.S.C. § 325(d)

Pursuant to 35 U.S.C. § 325(d), in determining whether to institute an inter partes review, "the Director may take into account whether, and reject the petition or request because, the same or substantially the same prior art or arguments previously were presented to the Office." In evaluating arguments under § 325(d), we use

> [A] two-part framework … (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.

Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH, IPR2019-01469, Paper 6, 8–9 (PTAB Feb. 13, 2020) (precedential) ("*Advanced Bionics*"); *see also Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586,

Paper 8 at 17–18 (PTAB Dec. 15, 2017) (precedential as to Section III.C.5, first paragraph) (listing factors to consider in evaluating the applicability of § 325(d)) ("*Becton, Dickinson*").[13]

1. First Prong

As to the first prong of the *Advanced Bionics* assessment, Petitioner argues that the "references applied against claim 1 . . . were not applied in rejections during prosecution of the '602 Patent" except for Laurent, which "is cited here only as a secondary reference against dependent claims." Pet. 81–82.

Patent Owner contends that "*[a]ll* seven references were before the Patent Office, and Petitioner's two primary references (Engels and Takagi) were discussed and/or applied during the prosecution of the '602 Patent." Prelim. Resp. 4. Petitioner does not particularly dispute this prong but instead focuses on the second prong. *See, e.g.*, Pet. Reply 1. For purposes of this decision, we determine that substantially the same art was previously before the Office.

2. Second Prong

Petitioner argues that the Examiner erred in a manner material to the patentability of the challenged claims. In particular, Petitioner argues that the prior record before the Office is "silent as to the specific prior art teachings cited in the Petition." Pet. Reply 1. Petitioner argues that, with regard to Petitioner's first ground, the Examiner's only consideration of Engels was via an information disclosure statement ("IDS") citing one hundred references alongside another IDS citing another 25 references. *Id.* (citing Ex. 2001, 699, 837–868). The Examiner

[13] By statute, the Patent Office Director determines whether to institute an *inter partes* review. 35 U.S.C. §§ 314(b), 325(d). The Director has delegated institution decisions to the Patent Trial and Appeal Board. 37 C.F.R. § 42.4. Where specific guidance from the present Director is lacking, we rely on the best available guidance. For example, here we rely on *Advanced Bionics* and related guidance.

then issued only a rejection pursuant to 35 U.S.C. § 112 because the Examiner "was unable to determine the scope of these claims." Ex., 2001 837–841. Petitioner argues that the Office only considered Engels substantively as part of a "***successful***" *inter partes* review challenge of the '683 patent ("the '683 Patent IPR"). *Id.* at 2.

Patent Owner emphasizes that Engels was submitted to the Examiner three times. Patent Owner argues that Engels was submitted via IDS twice during prosecution of the '602 patent. PO Sur-Reply 2 (citing Ex. 2001, 723–724, 726, 914–922, 936. Patent Owner argues that the Examiner reviewed the information. *Id.* (citing Ex. 2001, 914–922). Patent Owner also argues that the Examiner was provided the '683 Patent IPR where Engels was just one of seven refences. *Id.* Patent Owner further argues that the '683 Patent IPR described Engels of having a coating "approximately 40 μm thick." *Id.* at 3 (citing Ex. 1031, 25, 76–77).

With regard to Petitioner's second ground, Petitioner argues that Hein and GMW14400 were also cited in an IDS but not discussed or applied in any rejection. Pet. Reply 2–3 (citing Ex. 2001, 698, 1100). Petitioner further argues that Patent Owner argued that Takagi does not teach a coating thickness greater than 30 μm. *Id.* (citing Ex. 2001, 879, 912). But, as Petitioner argues, the present Petition does not rely on Takagi for teaching total thickness.

Patent Owner argues that, during prosecution of the '683 Patent, the Examiner issued a final rejection involving Takagi which the Board reversed. PO Sur-Reply 5. Patent Owner emphasizes that all three references were before the Examiner and "Petitioner has no evidence that the Examiner did not consider these references in combination." *Id.*

After considering the record as a whole, we determine that Petitioner has adequately demonstrated that the Office erred in a manner material to the

patentability of challenged claims. As we explain in Section III(G), *infra*, Petitioner's challenges to the '602 patent appear strong based on the current record, and Patent Owner's present arguments to the contrary are weak. Given the strength of Petitioner's challenges on the present record, this is not a situation where we would say that "reasonable minds can disagree regarding the purported treatment of the art," and we therefore determine that the Examiner erred by not considering the art in substantially the combination Petitioner proposes.

Where Patent Owner states that "evidence that the Examiner did not consider these references in combination" is lacking (PO Sur-Reply 5), we disagree. If the Examiner considered these references in combination, the Examiner would have, given the apparent strength of Petitioner's position on the merits on this record, issued a rejection. The lack of a rejection based on the combination proposed in the Petition provides some evidence that the Examiner did not consider these references in combination (because the lack of such a rejection raises the likelihood that the Examiner did not make such a consideration).

3. Conclusion

Because Petitioner adequately made a showing of material error, we decline to exercise discretion not to institute *inter partes* review under 35 U.S.C. § 325(d). *See Advanced Bionics, LLC*, IPR2019-01469, Paper 6 at 8–9.

F. Overview of the Asserted Art

1. Engels (Exhibit 1005)

Engels generally relates to "the application of ultra-high strength materials" for automotive structures using hot-stamping. Ex. 1005, Abstract. Engels describes hot-stamping of boron-alloyed steels by austenitizing blanks or parts "inside a continuous feed furnace and subsequently" bringing the austenitized blanks or

parts "into the die via a transfer unit." *Id.* at 136. "The blanks or parts are then stamped at high strain rates and kept under pressure inside the die after drawing depth is reached." *Id.* Engels explains that, "[w]hen using hot-dip aluminum coated boron steels, it is crucial to look for a correctly shaped diffusion layer with regard to layer thickness, porosity and roughness, as this layer will decisively impact the corrosion and welding properties of the hot stamped parts." *Id.* at 142. Figure 5, reproduced below, shows "a cross-section polish of the diffusion layer of the hot-dip aluminum coated boron steel."

phase number	layer thickness, µm	Al	Fe	Si	Cr	Mn
		Volume-%				
1	5 – 9	72	89,2	1,9	0,3	1,4
2	< 1µm	unmeasurable				
3	11 – 18	51,4	45,9	1,9	0,1	0,7
4	3 – 8	33,9	54,3	10,6	0,3	0,9
5	5 - 11	53,2	44,1	1,9	0,2	0,6

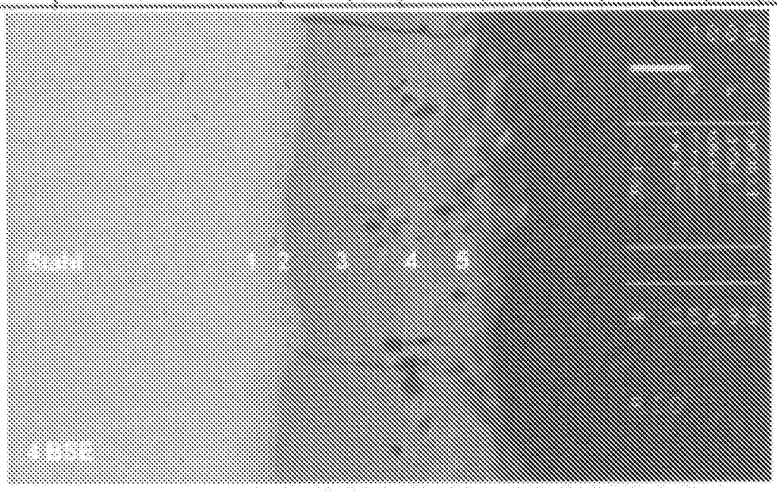


Figure 5. SEM micrograph of a cross-section polish of the diffusion layer

Figure 5 shows "[f]ive phases which differ in their layer thickness and chemical composition [that] can be easily distinguished." *Id.*

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2. Cornette (Exhibit 1014)

Cornette generally relates to "high strength steels (HSLA, DP, TRIP, etc.)" and "testing and different design solutions associated with these steel grades." Ex. 1014, Abstract. Cornette's "high and ultra high strength steels (TRIP and Boron steels)" offer "strength and formability." *Id.* at 3.

3. Laurent (Ex. 1023)

Laurent "relates to a coated, hot- and cold-rolled steel sheet comprising a very high resistance after thermal treatment." Ex. 1023, 1:6–8. Laurent describes "produc[ing] a hot- or cold-rolled steel sheet of a desired thickness, coated, and affording extensive shaping possibilities and which, after thermal treatment performed on the finished casing, makes it possible to obtain" a desired "mechanical resistance . . . a substantial resistance to shocks, fatigue, abrasion and wear, while retaining a good resistance to corrosion as well as a good capacity for painting and gluing." *Id.* at 1:37–44.

4. Nishibata (Ex. 1050)

Nishibata relates to "hot-formed members which can be produced from high-strength steel plates by using a hot-forming method and which also have stabilized strengths and toughnesses, as well a hot-forming method for producing them." Ex. 1050, 4.

5. Takagi (Ex. 1016)

Takagi relates to "an aluminum-coated structural member, such as a structural member used for motor vehicles, produced by applying heat treatment and forming operation to aluminum-coated steel sheet, and coated with an alloy layer of an Al–Si–Fe alloy for improvement in formability, weldability and corrosion resistance." Ex. 1016 ¶ 1.

6. Hein (Ex. 1019)

Hein relates to hot stamping and "ultra high strength hot-stamped boron steel." Ex. 1019, Abstract. Hein explains that hot stamping, combined with the chemical composition of boron steels, results "in a robust process window for quenching and martensitic transformation," with hot-stamping by "heating blanks," and the blanks then being "transferred very quickly on a press for the stamping." *Id.* at 1. The result is "material [that] has an excellent formability and thus quite complex shapes can be formed in a single stroke." *Id.*

7. GMW14400 (Ex. 1026)

GMW14400 relates to "the requirements for low carbon, heat-treatable boron steel used in the manufacture of structural parts requiring heat treatments to achieve high strength." Ex. 1026, 1. GMW14400 explains "austenitizing a pre cut blank or pre-stamped part, hot stamping the heated blank or pre-stamped part, and rapid cooling (quenching) the stamped part in the die" or "austenitizing a pre cut blank, hot stamping the heated blank and rapid cooling (quenching) the stamped part in the die or via water quenching." *Id.*

G. Unpatentability Grounds

1. Unpatentability over Engels (Ground 1A-102)

Petitioner asserts that claims 1, 9–11, 14, 18, 20–22, 24, 26, 27, and 30 are unpatentable under 35 U.S.C. § 102(a) as anticipated by Engels, citing the Declaration of Dr. Miles for support. Pet. 1, 6–32 (citing Ex. 1003) (Petitioner's Ground 1A-102). Patent Owner provides arguments addressing this asserted ground of unpatentability, but only as to claim 1. *See* Prelim. Resp. 10–16. We address Petitioner's assertions and Patent Owner's arguments below.

a. *Claim 1*

Petitioner argues that Engels discloses each limitation of claim 1. Pet. 9–24. Petitioner argues, for example, that the preamble of claim 1 is not limiting or, alternatively, imparts no structural distinction from Engels. *Id.* at 9–12. Petitioner further argues that Engels teaches a stamped part. *Id.* at 12–14 (citing, e.g., Ex. 1005, 135 (titling Engels as "Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels", 141; Ex. 1003 ¶¶ 28–31 (Dr. Miles explaining, for example, that Engels's Figure 5 depicts a hot stamped part). Petitioner argues that Engels teaches a strip of base steel having a first and second side. *Id.* at 14–15 (citing, e.g., Ex. 1003 ¶ 33; Ex. 1005, 137). Petitioner further argues that Engels teaches a coating that is a "diffusion layer" having five phases as depicted in Engels's Figure 5 and in the accompanying table. *Id.* at 16–21 (citing, e.g., Ex. 1003 ¶¶ 42–51; Ex. 1005, 136, 138, 141–142. Petitioner argues that Engels teaches a coating having a thickness greater than 30 µm. Ex. 1005, Fig. 5, 42; Ex. 1003 ¶¶ 52–59.

Patent Owner argues that Engels does not disclose, as claim 1 recites, "a superficial layer having a fourth mean iron composition different from the third mean iron composition." Prelim. Resp. 11. Patent Owner argues that a "superficial layer" must be a surface layer and that the Engels's phase 5 layer as depicted in Figure 5 (which Petitioner identifies as being the superficial layer (Pet. 18)) is not a surface layer. *Id.* 12. Patent Owner argues that Engels's Figure 5 phase 5 layer cannot be a surface layer because (1) Engels table states that phase 5 is 5–11 µm and thick and (2) Patent Owner measures, based on the scale on Figure 5, that the distance between the edge of phase 4 and the surface of the Engels Figure 5 composition is more than 11 µm. *Id.* at 12–14.

To assess Patent Owner's argument, we assume that claim 1's recited "superficial layer" must be a surface layer. Even with this assumption, Patent Owner's argument does not persuasively undermine Petitioner's position.

Figure 5 of Engels indicates 5 phases. *See supra* Section III(E)(2) (reproducing Engels Fig. 5). Figure 5 indicates that the rightmost phase, phase 5, is the phase at the surface. Figure 5, the accompanying table, and the text of Engels all indicate there is no phase six. Ex. 1005, 8–9 ("Five phases which differ in their layer thickness and chemical composition can easily be distinguished."). This evidence adequately supports, for institution purposes, Petitioner's position that phase 5 is a "superficial layer." *See also* Ex. 1003 ¶¶ 44–46. While Patent Owner's argument may present an issue of fact to be finally resolved at trial (if Patent Owner maintains the argument in a Patent Owner response), the evidence before us is sufficient to support that Petitioner has a reasonable likelihood of establishing, by a preponderance of the evidence, that Engels's Figure 5 phase 5 is a surface layer.

Patent Owner also argues that Petitioner's mapping of Engels is inconsistent with how Petitioner alleges that Hein satisfies claim 1. Prelim. Resp. 14–15. This argument does not persuasively undermine Petitioner's position because the argument relies on the *assumption* that "Petitioner did not identify a superficial layer that goes to the surface." *Id.* at 15. As explained above, Petitioner identified Figure 5 phase 5 of Engels as extending to the surface, and Engels provides evidence supporting this position (even if, as Patent Owner argues, the scale and table data of Engels may weigh against the position).

Patent Owner further argues that claim 1 requires that the superficial layer have "a fourth mean iron composition different from the third mean iron composition" and that Petitioner does not show this relationship. Prelim. Resp. 15–

16. This argument does not undermine Petitioner's position because it again relies on phase 5 not extending to the surface. *Id.* at 16. Also, Patent Owner's argument that Engels does not provide a "Volume-%" for the entire layer/phase at the surface does not undermine Petitioner's position because claim 1 does not require any particular "Volume-%." Rather, claim 1 only requires a different composition. Engels teaches "[f]ive phases which differ in their layer thickness and chemical composition can easily be distinguished," and the table accompanying Figure 5 indicates different iron compositions.[14] Ex. 1005, 8–9.

Based on our review and consideration of the current record, we determine that the information presented sufficiently supports, for purposes of institution, Petitioner's assertions that Engels satisfies each limitation of claim 1. *See* Pet. 6–24. We therefore determine Petitioner has met its burden to show a reasonable likelihood it would prevail in demonstrating that claim 1 is anticipated by Engels.

a. *Claim 21*

Independent claim 21 only differs from claim 1 by replacing claim limitation [1g] ("(d) a superficial layer having a fourth mean iron composition different from the third mean iron composition") with "(d) a superficial layer having a fourth mean iron composition different from the first, second and third mean iron compositions." Ex. 1001, 16:41–64.

Petitioner's contentions regarding claim 21, and Patent Owner's arguments against claim 21, are substantially the same as for claim 1. Pet. 30; Prelim. Resp. 11–16.

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[14] Engels's table accompanying Figure 5 indicates that the iron composition for phase 2 is "unmeasurable." Ex. 1005, 143. Petitioner's theory of anticipation, however, maps Engel's phases 1 and 2 combined to layer (a) of '602 patent claim 1. Pet. 18. The table provides evidence that phases 1 and 2 combined will have a different mean iron composition than the other phases. Ex. 1005, 143.

Based on our review and consideration of the current record, we determine that the information presented sufficiently supports, for purposes of institution, Petitioner's assertions that Engels satisfies each limitation of claim 21. *See* Pet. 30; Prelim. Resp. We therefore determine Petitioner has met its burden to show a reasonable likelihood it would prevail in demonstrating that claim 21 is anticipated by Engels.

a. *Claim 24*

Independent claim 24 uses "aluminum composition" rather than "iron composition," and replaces at least claim limitation [1g] ("(d) a superficial layer having a fourth mean iron composition different from the third mean iron composition") with "(d) a superficial layer having a fourth mean aluminum composition different from the first, second and third mean aluminum compositions, the second mean aluminum composition being greater than the third mean aluminum composition." Ex. 1001, 17:4–18:2.

Petitioner's contentions regarding claim 24, and Patent Owner's arguments against claim 24, are substantially the same as for claim 1. Pet. 31; Prelim. Resp. 11–16. Petitioner also argues that Engels's Table addresses aluminum composition. Pet. 31 (citing Ex. 1003 ¶ 85; reproducing Engels's Table at Ex. 1005, 9).

Based on our review and consideration of the current record, we determine that the information presented sufficiently supports, for purposes of institution, Petitioner's assertions that Engels satisfies each limitation of claim 24. *See* Pet. 31–32. We therefore determine Petitioner has met its burden to show a reasonable likelihood it would prevail in demonstrating that claim 24 is anticipated by Engels.

b. *Remaining Claims 9–11, 14, 18, 20, 22, 26, 27, and 30*

Claims 9–11, 14, 18, 20 depend from claim 1. Ex. 1001, 15:62–16:4, 16:13–17, 16:30–32, 16:38–40. Claim 22 depends from claim 21. *Id.* at 16:65–67. Claims 26, 27, and 30 depend from claim 24. *Id.* at 18:6–12, 18:21–24.

Petitioner shows sufficiently for purposes of this Decision that each element of claims 9–11, 14, 18, 20, 22, 26, 27, and 30 is disclosed by Engels. Pet. 26–32Patent Owner does not address any recitations of these dependent claims at this time. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claims 9–11, 14, 18, 20, 22, 26, 27, and 30 are anticipated by Engels.

2. Unpatentability over Engels (Ground 1A-103)

Petitioner asserts claims 1, 2, and 9–30 are unpatentable under 35 U.S.C. § 103(a) as obvious over Engels. Pet. 1, 6–24 (citing Ex. 1003) (Petitioner's Ground 1A-103). Patent Owner does not dispute Petitioner's assertions for this ground except as we address above. *See generally* Prelim. Resp.

Petitioner accounts for the limitations recited in claims 1, 2, and 9–30. Pet. 6–24. Petitioner shows sufficiently for purposes of this Decision that each element of claims 1, 2, and 9–30 is taught or suggested by the teachings of Engels, and shows reason to combine the Engels's teachings with rational underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claims 1, 2, and 9–30 are obvious in view of Engels. Furthermore, because Petitioner has demonstrated a reasonable likelihood of success in proving that at least one claim of the '602 patent is unpatentable, we include this ground in the instituted *inter partes* review. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018); *PGS*

Geophysical AS v. Iancu, 891 F.3d 1354, 1360 (Fed. Cir. 2018); 37 C.F.R. § 42.108(a).

3. Unpatentability over Engels and Cornette (Ground 1B)

Petitioner asserts claims 2, 5, and 6 are unpatentable under 35 U.S.C. § 103(a) as obvious over Engels and Cornette. Pet. 1, 32–41 (citing Ex. 1003) (Petitioner's Ground 1B). Patent Owner does not dispute Petitioner's assertions for this ground. *See generally* Prelim. Resp.

Petitioner accounts for the limitations recited in claims 2, 5, and 6. Pet. 32–41. Pet. 32–41. Petitioner shows sufficiently for purposes of this Decision that each element of claims 2, 5, and 6 is taught or suggested by the combined teachings of Engels and Cornette, and shows reason to combine the references' teachings with rational underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claims 2, 5, and 6 are obvious in view of Engels and Cornette. Furthermore, because Petitioner has demonstrated a reasonable likelihood of success in proving that at least one claim of the '602 patent is unpatentable, we include this ground in the instituted *inter partes* review. *See SAS*, 138 S. Ct. at 1354, 1359–60; *PGS Geophysical*, 891 F.3d at 1360; 37 C.F.R. § 42.108(a).

4. Unpatentability over Engels and Laurent (Ground 1C)

Petitioner asserts claims 3, 4, 7, and 8 are unpatentable under 35 U.S.C. § 103(a) as obvious over Engels and Laurent. Pet. 1, 41–42 (citing Ex. 1003) (Petitioner's Ground 1C). Patent Owner does not dispute Petitioner's assertions for this ground. *See generally* Prelim. Resp.

Petitioner accounts for the limitations recited in claims 3, 4, 7, and 8. Pet. 41–42. Pet. 41–42. Petitioner shows sufficiently for purposes of this Decision that each element of claims 3, 4, 7, and 8 is taught or suggested by the combined

teachings of Engels and Laurent, and shows reason to combine the references' teachings with rational underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claims 3, 4, 7, and 8 are obvious in view of Engels and Laurent. Furthermore, because Petitioner has demonstrated a reasonable likelihood of success in proving that at least one claim of the '602 patent is unpatentable, we include this ground in the instituted *inter partes* review. *See SAS*, 138 S. Ct. at 1354, 1359–60; *PGS Geophysical*, 891 F.3d at 1360; 37 C.F.R. § 42.108(a).

5. Unpatentability over Engels and Nishibata (Ground 1D)

Petitioner asserts claims 3–6 are unpatentable under 35 U.S.C. § 103(a) as obvious over Engels and Nishibata. Pet. 1, 42–45 (citing Ex. 1003) (Petitioner's Ground 1D). Patent Owner does not dispute Petitioner's assertions for this ground. *See generally* Prelim. Resp.

Petitioner accounts for the limitations recited in claims 3–6. Pet. 42–45. Petitioner shows sufficiently for purposes of this Decision that each element of claims 3–6 is taught or suggested by the combined teachings of Engels and Nishibata, and shows reason to combine the references' teachings with rational underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claims 3–6 are obvious in view of Engels and Nishibata. Furthermore, because Petitioner has demonstrated a reasonable likelihood of success in proving that at least one claim of the '602 patent is unpatentable, we include this ground in the instituted *inter partes* review. *See SAS*, 138 S. Ct. at 1354, 1359–60; *PGS Geophysical*, 891 F.3d at 1360; 37 C.F.R. § 42.108(a).

6. Unpatentability over Engels, Cornette, and Nishibata (Ground 1E)

Petitioner asserts claim 6 is unpatentable under 35 U.S.C. § 103(a) as obvious over Engels and Cornette. Pet. 1, 45 (citing Ex. 1003) (Petitioner's Ground 1E). Patent Owner does not dispute Petitioner's assertions for this ground. *See generally* Prelim. Resp.

Petitioner accounts for the limitations recited in claim 6. Pet. 45. Petitioner shows sufficiently for purposes of this Decision that each element of claim 6 is taught or suggested by the combined teachings of Engels, Cornette, and Nishibata, and shows reason to combine the references' teachings with rational underpinning and reasonable expectation of success. Pet. 45. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claim 6 is obvious in view of Engels, Cornette, and Nishibata. Furthermore, because Petitioner has demonstrated a reasonable likelihood of success in proving that at least one claim of the '602 patent is unpatentable, we include this ground in the instituted *inter partes* review. *See SAS*, 138 S. Ct. at 1354, 1359–60; *PGS Geophysical*, 891 F.3d at 1360; 37 C.F.R. § 42.108(a).

7. Unpatentability over Engels, Cornette, and Laurent (Ground 1F)

Petitioner asserts claim 8 is unpatentable under 35 U.S.C. § 103(a) as obvious over Engels, Cornette, and Laurent. Pet. 1, 45–46 (citing Ex. 1003) (Petitioner's Ground 1F). Patent Owner does not dispute Petitioner's assertions for this ground. *See generally* Prelim. Resp.

Petitioner accounts for the limitations recited in claim 8. Pet. 45–46. Petitioner shows sufficiently for purposes of this Decision that each element of claim 8 is taught or suggested by the combined teachings of Engels, Cornette, and Laurent, and shows reason to combine the references' teachings with rational

underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claim 8 is obvious in view of Engels, Cornette, and Laurent. Furthermore, because Petitioner has demonstrated a reasonable likelihood of success in proving that at least one claim of the '602 patent is unpatentable, we include this ground in the instituted *inter partes* review. *See SAS*, 138 S. Ct. at 1354, 1359–60; *PGS Geophysical*, 891 F.3d at 1360; 37 C.F.R. § 42.108(a).

8. Unpatentability over Engels and Takagi (Ground 1G)

Petitioner asserts claims 11–17, 19, 23, 25, and 27–30 are unpatentable under 35 U.S.C. § 103(a) as obvious over Engels and Takagi. Pet. 1, 46–49 (citing Ex. 1003) (Petitioner's Ground 1G). Patent Owner does not dispute Petitioner's assertions for this ground. *See generally* Prelim. Resp.

Petitioner accounts for the limitations recited in claims 11–17, 19, 23, 25, and 27–30. Pet. 46–49. Petitioner shows sufficiently for purposes of this Decision that each element of claims 11–17, 19, 23, 25, and 27–30 is taught or suggested by the combined teachings of Engels and Takagi, and shows reason to combine the references' teachings with rational underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claims 11–17, 19, 23, 25, and 27–30 are obvious in view of Engels and Takagi. Furthermore, because Petitioner has demonstrated a reasonable likelihood of success in proving that at least one claim of the '602 patent is unpatentable, we include this ground in the instituted *inter partes* review. *See SAS*, 138 S. Ct. at 1354, 1359–60; *PGS Geophysical*, 891 F.3d at 1360; 37 C.F.R. § 42.108(a).

9. Unpatentability over Takagi, Hein, and GMW14400 (Ground 2A), over Takagi, Hein, GMW14400, and Laurent (Ground 2B), and over Takagi, Hein, GMW14400, and Nishibata (Ground 2C)

Petitioner asserts claims 1–30 are unpatentable under 35 U.S.C. § 103(a) as obvious over Takagi, Hein, and GMW14400; that claims 3, 4, 7, and 8 are unpatentable under 35 U.S.C. § 103(a) as obvious over Takagi, Hein, GMW14400, and Laurent; and that claims 3–6 are unpatentable under 35 U.S.C. § 103(a) as obvious over Takagi, Hein, GMW14400, and Nishibata. Pet. 1–2, 49–81 (citing Ex. 1003) (Petitioner's Grounds 2A, 2B, and 2C). Patent Owner does not dispute Petitioner's assertions regarding the cited art's teachings or rationale for combining the art's teachings.

Petitioner accounts for the limitations recited in claims 1–30. Pet. 49–81. Petitioner shows sufficiently for purposes of this Decision that each element of claims 11–17, 19, 23, 25, and 27–30 is taught or suggested by the combined teachings of Engels and Takagi of the cited art and shows reason to combine the references' teachings with rational underpinning and reasonable expectation of success.

Patent Owner argues Petitioner fails to establish that GMW14400 qualifies as prior art because Petitioner fails to establish GMW14400 was publicly available before the critical date. Prelim. Resp. 17–25. Petitioner explains public availability of GMW14400 as follows:

> GMW14400 qualifies as prior art under §102(a). As June Munford explains, and as supported by Shannon Schuster, GMW14400 was publicly available no later than 12/1/2005. EX-1027. GMW14400 would have been easily located using the search features provided on its distribution website, the IHS Standards Store. *Id.*

Pet. 3. Hereafter, we refer to Exhibit 1027 as the "Munford Decl."

Patent Owner first argues that it is unclear when Munford contends GMW14400 was publicly available. Prelim. Resp. 18. We disagree. Munford states that, according to the Declaration of Schuster that Munford attaches at "Appendix SCHUSTER01" ("Schuster Decl."), GMW14400 was "available for purchase from Accuris since December 1, 2005." Munford Decl. ¶ 8; *see also* Schuster Decl. ¶ 5. This date is sufficient to qualify GMW14400 as prior art. *See* Ex. 1001, code (60) (indicating an earliest possible '602 patent priority date of Oct. 30, 2006).

Patent Owner next argues that Petitioner does not "show that an *interested* POSITA would have been able to locate GMW14400." Prelim. Resp. 19. We again disagree. The evidence before us supports that Information Handling Services (IHS) or its successor Accuris had GMW14400 available for purchase in its "Standards Store" as of December 1, 2005, or earlier. Schuster Decl. ¶¶ 3–5; Munford Decl. ¶¶ 9–14 (using the "Wayback Machine" internet archive to verify public availability of GM standards documents hosted by IHS).

Patent Owner argues Petitioner did not establish "whether an interested person would have even known of these URLs in the first place." Prelim. Resp. 21; *see also* PO Sur-Reply 8. We find that the evidence before us supports that a person having ordinary skill in the art would have known to make use of the HIS web site. The evidence supports that the purpose of the IHS web site was to "provide information for aerospace engineers." Schuster Decl. ¶ 2. The IHS web site hosted General Motors engineering standards as well as other common engineering standards. *Id.* at ¶ 3; Munford Decl. ¶ 12 (establishing that IHS provided information from "AES, AFNOR, AIA/NAS, ANSI, API, ASME, ASTM, BSI, DIN, EIA, Ford, GM, IEC, IEEE, ISO, ITU, JAA, JSA (JIS), NEMA, SAE, and TIA"). Moreover, Petitioner's witness, Dr. Miles, testifies that the purpose of a material specification like GMW14400 was for General Motors "to

inform steel makers of the requirements of steel to be used in GM vehicles." Ex. 1003 ¶ 140. The evidence before us, as a whole, supports that IHS, for years, ran an online business selling a variety of engineering standards to engineers. This fact provides evidence[15] that engineers would have known to make use of this online business. *See also* Pet. Reply 6–8.

Patent Owner also criticizes Munford's evidence from the internet archive as not proving that GMW14400 in particular was available in 2003. Prelim. Resp. 22–25; PO Sur-Reply 6. The Schuster Declaration, however, is sufficient to establish GMW14400 was available for purchase on the IHS web site as of December 2005. Schuster Decl. ¶ 5. Munford's evidence from the internet archive serves to further evidence the nature of the IHS web site and what kinds of materials the IHS web site hosted. *See, e.g.,* Munford Decl. ¶ 12. Munford's evidence from 2003 combined with Schuster's testimony concerning the ongoing business of Accuris and IHS provides evidence of a continued business having a searchable index selling online standards.

We note that, while Petitioner has presented some evidence supporting publication of GMW14400 as of December 2005 (as explained above), Patent Owner does not factually dispute this point or present evidence to the contrary. Based on the entire record before us, we determine that Petitioner has a reasonable likelihood of establishing, by a preponderance of evidence at trial, that GMW14400 qualifies as prior art.

Thus, for the reasons above, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claims 1–30 are obvious in view

[15] The fact that IHS, for years, ran an online business for selling engineering standards to engineers raises the likelihood that engineers knew about this online business.

of the cited art. Also, because Petitioner has demonstrated a reasonable likelihood of success in proving that at least one claim of the '602 patent is unpatentable, we include these ground in the instituted *inter partes* review. *See SAS*, 138 S. Ct. at 1354, 1359–60; *PGS Geophysical*, 891 F.3d at 1360; 37 C.F.R. § 42.108(a).

IV. CONCLUSION

For the reasons above, we determine that the information presented in the Petition establishes that there is a reasonable likelihood that Petitioner would prevail with respect to challenged claims 1–30 of the '602 patent. At this juncture in the proceeding, we have not made a final determination with respect to the patentability of the challenged claims, or with respect to claim construction.

V. ORDER

For the foregoing reasons, it is

ORDERED that pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 1–30 of the '602 patent is hereby instituted with respect to all grounds of unpatentability set forth in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; the trial will commence on the entry date of this Decision.

IPR2024-01376
Patent 10,961,602 B2

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AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Central District of California on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
	4/16/2024	Central District of California

PLAINTIFF	DEFENDANT
ARCELORMITTAL	VINFAST AUTO, LLC; VINFAST USA DISTRIBUTION, LLC; VINGROUP USA, LLC; VINFAST TRADING AND PRODUCTION JSC; and VINFAST AUTO LTD.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	10,961,602	3/30/2021	ArcelorMittal
2	11,326,227	5/10/2022	ArcelorMittal
3			
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 **Director of the U.S. Patent and Trademark Office** **P.O. Box 1450** **Alexandria, VA 22313-1450**	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Central District of California on the following

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	4/16/2024	Central District of California

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ARCELORMITTAL	VINFAST AUTO, LLC; VINFAST USA DISTRIBUTION, LLC; VINGROUP USA, LLC; VINFAST TRADING AND PRODUCTION JSC; and VINFAST AUTO LTD.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	10,961,602	3/30/2021	ArcelorMittal
2	11,326,227	5/10/2022	ArcelorMittal
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In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
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5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

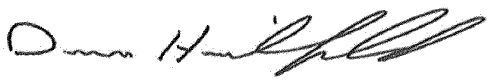
PATENT NO. : 10,961,602 B2
APPLICATION NO. : 16/413799
DATED : March 30, 2021
INVENTOR(S) : Pascal Drillet et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification

In Column 7, Line 8, -- . -- should be inserted between "ABCD" and "For sheets"
In Column 7, Line 27, -- (e.g., -- should be inserted before "7.7"
In Column 12, Line 19, -- . -- should be inserted between "coating" and "On series A"
In Column 13, Line 12, -- . -- should be inserted between "surface" and "Resis-"

Signed and Sealed this
Eighteenth Day of May, 2021



Drew Hirshfeld
Performing the Functions and Duties of the
Under Secretary of Commerce for Intellectual Property and
Director of the United States Patent and Trademark Office

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Application of:	ARCELORMITTAL
Inventor(s):	Drillet et al.
Application No.:	16/413,799
Filed:	May 16, 2019
Patent No. :	10,961,602 B2
Issued:	March 30, 2021
Attorney Docket No.:	20631.1028CON5
Confirmation No.:	7637
Examiner:	Daniel J. Schleis
Title:	Coated Steel Strips, Coated Stamped Products and Methods

Submitted electronically via EFS-WEB April 19, 2021

REQUEST FOR CERTIFICATE OF CORRECTION UNDER 37 C.F.R. § 1.323

Sir:

Pursuant to 35 U.S.C. § 255 and 37 C.F.R. § 1.323, Applicant hereby requests that the U.S. Patent and Trademark Office issue a Certificate of Correction for the above-identified patent to correct mistakes of a clerical nature, typographical nature.

The following corrections are requested:

1) In column 7, line 8, -- . -- should be inserted between "ABCD" and "For sheets";
2) In column 7, line 27, -- (e.g., -- should be inserted before "7.7";
3) In column 12, line 19, -- . -- should be inserted between "coating" and "On series A"; and
4) In column 13, line 12, -- . -- should be inserted between "surface" and "Resis-".

Applicant submits that these corrections do not require changes which would constitute new matter or require reexamination.

The appropriate fees under 37 C.F.R. 1.20(a) in the amount of $ 160.00 are submitted herewith. In the event that fees are due, the Commissioner is hereby authorized to charge the fee required for this correction to Deposit Account No. 50-0552.

Respectfully submitted,
DAVIDSON, DAVIDSON & KAPPEL, LLC

By: /Oleg Ioselevich/

(Oleg Ioselevich, Reg. No. 56,963)

Davidson, Davidson & Kappel, LLC
589 Eighth Ave, 22nd Floor
New York, New York 10018

PTO/SB/44 (09-07)
Approved for use through 03/31/2023. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 10,961,602

APPLICATION NO.: 16/413,799

ISSUE DATE : Mar. 30, 2021

INVENTOR(S) : Pascal Drillet et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In column 7, line 8, -- . -- should be inserted between “ABCD” and “For sheets”
In column 7, line 27, -- (e.g., -- should be inserted before “7.7”
In column 12, line 19, -- . -- should be inserted between “coating” and “On series A”
In column 13, line 12, -- . -- should be inserted between “surface” and “Resis-”

MAILING ADDRESS OF SENDER (Please do not use Customer Number below):

Davidson, Davidson & Kappel, LLC
589 Eighth Ave, 22nd Floor
New York, New York 10018

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	16413799
Filing Date:	16-May-2019
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Filer:	Oleg Ioselevich
Attorney Docket Number:	20631.1028CON5

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
CERTIFICATE OF CORRECTION	1811	1	160	160

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**160**

Electronic Acknowledgement Receipt	
EFS ID:	42487161
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	Oleg Ioselevich
Filer Authorized By:	
Attorney Docket Number:	20631.1028CON5
Receipt Date:	19-APR-2021
Filing Date:	16-MAY-2019
Time Stamp:	13:57:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$160
RAM confirmation Number	E20214IE00144345
Deposit Account	500552
Authorized User	Oleg Ioselevich
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Certificate of Correction	206311028con5ReqCerCor_19 April21.pdf	501958 b18e05364e397d816e1a3750878a2530c9a afe64	no	2
Warnings:					
Information:					
2	Request for Certificate of Correction	sb0044_19April2021.pdf	228629 a40453527dc4118408b141873fb57ba99a0 d1acf	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30308 cbe6bf49f357b36c47fb6e6c84fb6f851b898 a41	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	760895		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	03/30/2021	10961602	20631.1028CON5	7637

23280 7590 03/10/2021

Davidson, Davidson & Kappel, LLC
589 8th Avenue
22nd Floor
New York, NY 10018

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Pascal DRILLET, Rozerieulles, FRANCE;
ArcelorMittal, Luxembourg, LUXEMBOURG;
Dominique Spehner, Balan, FRANCE;
Ronald Kefferstein, Saint Mitre Les Ramparts, FRANCE;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IR103 (Rev. 10/09)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23280 7590 02/09/2021
Davidson, Davidson & Kappel, LLC
589 8th Avenue
22nd Floor
New York, NY 10018

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Simon Steiner	(Typed or printed name)
/Simon Steiner/	(Signature)
February 9, 2021	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637

TITLE OF INVENTION: Coated Steel Strips, Coated Stamped Products and Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	05/10/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
SCHLEIS, DANIEL J	1784	428-653000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Davidson, Davidson & Kappel, LLC
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
ArcelorMittal	Luxembourg, Luxembourg

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 500552

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /williamcgehris/ Date February 9, 2021

Typed or printed name William C. Gehris Registration No. 38156

Electronic Acknowledgement Receipt	
EFS ID:	42017791
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	William C. Gehris/Simon Steiner
Filer Authorized By:	William C. Gehris
Attorney Docket Number:	20631.1028CON5
Receipt Date:	25-FEB-2021
Filing Date:	16-MAY-2019
Time Stamp:	09:19:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	IssueFees.PDF	141611 f8c22c57b9bd7a6e9aaae2d5d836226444eb7991	no	1

Warnings:

Information:	
Total Files Size (in bytes):	141611

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
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National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16413799
Filing Date	2019-05-16
First Named Inventor	Pascal DRILLET
Art Unit	
Examiner Name	SCHLEIS, DANIEL J
Attorney Docket Number	20631.1028CON5

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
Change(s) applied to document, /P.H./ 2/18/2021	1	5116645	A	1992-05-26	Boston et al. ~~ARMCO STEEL CO LP~~	
	2	4257549	A	1981-03-24	Bricmont ~~ROBERTSON CO HH~~	
	3	5495736	A	1996-03-05	Nishi et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020114884	A1	2002-08-22	FRIEDERSDORF FRITZ J et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	19749706	DE	C1	1999-03-04	MANNESMANN AG	See English Abstract and EPO machine translation	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /DJS/

Electronic Patent Application Fee Transmittal

Application Number:	16413799
Filing Date:	16-May-2019
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Filer:	William C. Gehris/Simon Steiner
Attorney Docket Number:	20631.1028CON5

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt	
EFS ID:	41878012
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	William C. Gehris/Simon Steiner
Filer Authorized By:	William C. Gehris
Attorney Docket Number:	20631.1028CON5
Receipt Date:	09-FEB-2021
Filing Date:	16-MAY-2019
Time Stamp:	14:55:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1200
RAM confirmation Number	E202129E55560588
Deposit Account	500552
Authorized User	Simon Steiner
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	IF.PDF	141026 c2a03d638a9e47237fc317afc897868a2f1dbca0	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30545 96c30217e94cededede5504277a2a52555eeaff743	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	171571		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Best Available Copy

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23280 7590 02/09/2021
Davidson, Davidson & Kappel, LLC
589 8th Avenue
22nd Floor
New York, NY 10018

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Simon Steiner	(Typed or printed name)
/Simon Steiner/	(Signature)
February 9, 2021	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637

TITLE OF INVENTION: Coated Steel Strips, Coated Stamped Products and Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	05/10/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
SCHLEIS, DANIEL J	1784	428-653000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Davidson, Davidson & Kappel, LLC
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: ArcelorMittal

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Luxembourg, Luxembourg

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 500552

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /williamcgehris/ Date February 9, 2021

Typed or printed name William C. Gehris Registration No. 38156

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

23280 7590 02/09/2021

Davidson, Davidson & Kappel, LLC
589 8th Avenue
22nd Floor
New York, NY 10018

EXAMINER	
SCHLEIS, DANIEL J	
ART UNIT	PAPER NUMBER
1784	

DATE MAILED: 02/09/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637

TITLE OF INVENTION: Coated Steel Strips, Coated Stamped Products and Methods

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nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	05/10/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

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CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23280 7590 02/09/2021
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(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637

TITLE OF INVENTION: Coated Steel Strips, Coated Stamped Products and Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	05/10/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
SCHLEIS, DANIEL J	1784	428-653000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

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❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637

23280 7590 02/09/2021

Davidson, Davidson & Kappel, LLC
589 8th Avenue
22nd Floor
New York, NY 10018

EXAMINER	
SCHLEIS, DANIEL J	

ART UNIT	PAPER NUMBER
1784	

DATE MAILED: 02/09/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/413,799	Applicant(s) DRILLET et al.	
	Examiner Daniel J Schleis	Art Unit 1784	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to RCE filed 01/08/2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 48-77 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 01/08/2021.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/Daniel J. Schleis/
Primary Examiner, Art Unit 1784

Reasons for Allowance

The following is an examiner's statement of reasons for allowance:

A search of the prior art failed to turn up a single reference or an appropriate combination of references that teaches each and every claimed limitation. In particular, the precoated steel product with the coating having the interdiffusion layer, intermediate layer, intermetallic layer, and superficial layer with a thickness greater than 30 micrometers and having the claimed iron compositions, in particular the intermetallic layer having a third mean composition being higher than the second mean iron composition.

As set forth in Applicant's remarks submitted on 8 January 2021, the previously applied prior art does not teach a process that is identical or substantially identical to that of the instant application. In particular, the prior art has no hot stamping with the parameters required to produce the claimed product, including the particular heating parameters. Accordingly, Applicant's remarks are persuasive and the previously applied prior art rejections are withdrawn.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel J Schleis whose telephone number is (571)270-5636. The examiner can normally be reached on 10 AM to 4 PM Monday through Friday.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

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Daniel J. Schleis
Primary Examiner
Art Unit 1784

/Daniel J. Schleis/
Primary Examiner, Art Unit 1784

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/413,799	DRILLET et al.
	Examiner	**Art Unit**
	Daniel J Schleis	1784

CPC						
Symbol					**Type**	**Version**
C21D	/	9	/	46	F	2013-01-01
B32B	/	15	/	012	I	2013-01-01
C23C	/	2	/	12	I	2013-01-01
C23C	/	2	/	26	I	2013-01-01
C23C	/	2	/	40	I	2013-01-01
Y10T	/	428	/	12389	A	2015-01-15
Y10T	/	428	/	12396	A	2015-01-15
Y10T	/	428	/	12757	A	2015-01-15

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/Daniel J. Schleis/ Primary Examiner, Art Unit 1784	30 January 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	48

U.S. Patent and Trademark Office — Part of Paper No.: 20210129

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	**Art Unit**
	Daniel J Schleis	1784

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CLAIMED				
C21D	/	9	/	46

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
428	653

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/Daniel J. Schleis/ Primary Examiner, Art Unit 1784	30 January 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	48

U.S. Patent and Trademark Office — Part of Paper No.: 20210129

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/413,799	DRILLET et al.
	Examiner	**Art Unit**
	Daniel J Schleis	1784

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	48	10	57	19	66	28	75								
2	49	11	58	20	67	29	76								
3	50	12	59	21	68	30	77								
4	51	13	60	22	69										
5	52	14	61	23	70										
6	53	15	62	24	71										
7	54	16	63	25	72										
8	55	17	64	26	73										
9	56	18	65	27	74										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	30	
/Daniel J. Schleis/ Primary Examiner, Art Unit 1784	30 January 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	48

U.S. Patent and Trademark Office — Part of Paper No.: 20210129

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	Art Unit
	Daniel J Schleis	1784

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Final	Original	01/29/2021								
1	48	=								
2	49	=								
3	50	=								
4	51	=								
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27	74	=								
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30	77	=								

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	Examiner	Art Unit
	Daniel J Schleis	1784

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Symbol	Date	Examiner

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	Examiner	Art Unit
	Daniel J Schleis	1784

Search Notes		
Search Notes	**Date**	**Examiner**
Inventor Name Search	07/08/2019	Schleis
Assignee Name Search	07/08/2019	Schleis
Reviewed Global Dossier	07/08/2019	Schleis
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Reviewed File Wrappers of related applications: 12447777, 13621015, 15606770, 16414022, 16413774, 16413825, 16413729	01/29/2021	Schleis
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US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
C21D	9/46	01/29/2021	Schleis
c23C	2/12, 2/40, 2/26	01/29/2021	Schleis
B32B	15/012	01/29/2021	Schleis
Y10T	428/12389, 428/12396, 428/12757	01/29/2021	Schleis

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16413799
Filing Date	2019-05-16
First Named Inventor	Pascal DRILLET
Art Unit	
Examiner Name	SCHLEIS, DANIEL J
Attorney Docket Number	20631.1028CON5

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5116645	A	1992-05-26	ARMCO STEEL CO LP	
	2	4257549	A	1981-03-24	ROBERTSON CO H H	
	3	5495736	A	1996-03-05	Nishi et al.	

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	1	19749706	DE	C1	1999-03-04	MANNESMANN AG	See English Abstract and EPO machine translation	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	Pascal DRILLET
	Art Unit	
	Examiner Name	SCHLEIS, DANIEL J
	Attorney Docket Number	20631.1028CON5

	2	0724919	EP	A2	1996-08-07	HITACHI LTD	In English	
	3	1657004	EP	A1	2006-05-17	ARVEDI GIOVANNI	In English	
	4	2573226	CA	A1	2006-01-19	NIPPON STEEL CORP	In English	
	5	0692549	EP	A1	1996-01-17	UNITAS SA	In English	
	6	1063314	EP	A1	2000-12-27	KAWASAKI STEEL CO	In English	
	7	2720079	FR	A1	1995-11-24	LORRAINE LAMINAGE	See English Abstract and EPO machine translation	
	8	622697	AU	B2	1992-04-16	ARMCO INC	In English	
	9	H08144037	JP	A	1996-06-04	SUMITOMO METAL IND	See English Abstract and EPO machine translation	
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	12							

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	Examiner Name	SCHLEIS, DANIEL J
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	1	Stahl und Eisen 120 (2000) Nr. 8, Seiten 51 bis 56, "Die neue Verzinkungsanlage 2 bei Eko Stahl", "The new No. 2 hot-dip galvanizing line at Eko Stahl", Autoren: Karl Döring, Jürgen Nathow, Dietrich Kern, Michael Breiter und Dietmar Lowenberg.	
	2	Andrews, K.W. Empirical Formulae for the Calculation of Some Transformation Temperatures. Journal of the Iron and Steel Institute, 203, Part 7, July 1965, 721-727.	
	3	Enlarged Fig. 7 of U.S. 16413825 (present application)	
	4	Low Carbon, Heat-Treatable Boron Steel - Uncoated or Aluminized PreCoated, GM Worldwide Engineering Standards, GMW14400.	
	5	Patent Trial and Appeal Board Final Decision in IPR2019-01275, US 9708683, dated January 5, 2021	
	6	Gokhale, Arun M., "Report on quantitative characterization of the microstructure of Aluminium alloy surface coating on hot-stamped US BOR 1500 steel blanks" School of Materials Science and Engineering, Georgia Institute of Technology, 13 May 2019	
	7	Fan, Dong Wei et al., "Formation of an Aluminide Coating on Hot Stamped Steel" ISIJ International, Vol. 50, No. 11, 2010, pp 1713-1718	
	8	Summons in EP proceeding for EP 09701846, dated 11/18/2016	

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	9	Bourouga, Brahim, "Report on the heating of coated steel blanks for hot stamping" Laboratoire de therminque et enqerie de Nantes, 30 Aprill 2019	
	10	Imose, Masayuki, "Heating and Cooling Technology in the Continuous Annealing" Transactions ISIJ, Vol. 25, 1985, 911-932	
	11	Kolleck, R. et al., "Investigation on induction heating for hot stamping of boron alloyed steel" CIRP Annals - Manufacturing Technology 58, (2009), 275-278	
	12	Kahl, Martin, "Some like it hot" Technology focus - Hot stamping, September/October 2004 AMS	
	13	Self-study programme 339, The Passat 2006	

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EXAMINER SIGNATURE

Examiner Signature	/Daniel J. Schleis/	Date Considered	01/29/2021

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	Filing Date	2019-05-16
	First Named Inventor	Pascal DRILLET
	Art Unit	
	Examiner Name	SCHLEIS, DANIEL J
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Signature	/William C. Gehris/	Date (YYYY-MM-DD)	2021-01-07
Name/Print	William C. Gehris	Registration Number	38,156

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        587791 0-0.2/MAC
        208026 TI/MAC
L7       72787 0-0.2 TI/MAC
                (0-0.2/MAC (P) TI/MAC)

=> search 0.0005-0.08b/mac

L8           0 0.0005-0.08B/MAC

=> 0.0005-0.08 B/MAC

0.0005-0.08 IS NOT A RECOGNIZED COMMAND

The previous command name entered was not recognized by the system.
For a list of commands available to you in the current file, enter
"HELP COMMANDS" at an arrow prompt (=>).

=> search 0.0005-0.08 B/MAC

        159789 0.0005-0.08/MAC
        107957 B/MAC
L9        5567 0.0005-0.08 B/MAC
                (0.0005-0.08/MAC (P) B/MAC)

=> search fe/mac

L10     735777 FE/MAC

=> search l1 and l2 and l4 and l6 and l7 and l9 and l10

L11        170 L1 AND L2 AND L4 AND L6 AND L7 AND L9 AND L10

=> file caplus

COST IN U.S. DOLLARS                            SINCE FILE      TOTAL
                                                     ENTRY    SESSION
FULL ESTIMATED COST                                184.93     185.14

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substance identification.

=> search l11 and steel

           425 L11
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       1372430 STEEL
        218954 STEELS
       1386360 STEEL
                 (STEEL OR STEELS)
L12        398 L11 AND STEEL

=> search l12 and (coat or coated or coating or layer or laminate or clad)

        113012 COAT
         23266 COATS
        130099 COAT
                 (COAT OR COATS)
        987769 COATED
             2 COATEDS
        987771 COATED
                 (COATED OR COATEDS)
       1836564 COATING
        593243 COATINGS
       1936535 COATING
                 (COATING OR COATINGS)
       3350197 LAYER
       1164171 LAYERS
       3887169 LAYER
                 (LAYER OR LAYERS)
        168019 LAMINATE
         91370 LAMINATES
        198456 LAMINATE
                 (LAMINATE OR LAMINATES)
         46554 CLAD
          1066 CLADS
         47172 CLAD
                 (CLAD OR CLADS)
           332 CLOTHED
         47503 CLAD
                 (CLAD OR CLOTHED)
L13        103 L12 AND (COAT OR COATED OR COATING OR LAYER OR LAMINATE OR CLAD)

=> display ibib abs retable hitstr hitind l12 1-103


L12  ANSWER 1 OF 398  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2020:2713368  CAPLUS Full-text
DOCUMENT NUMBER:         174:278826
TITLE:                   Steel sheet comprising carbon, silicon and titanium
                         with high strength and excellent collision resistance
INVENTOR(S):             Nakano, Katsuya; Takeda, Kengo; Kawata, Hiroyuki;
                         Uenishi, Akihiro; Suzuki, Yuya
PATENT ASSIGNEE(S):      Nippon Steel Corporation, Japan
SOURCE:                  PCT Int. Appl., 58pp.
                         CODEN: PIXXD2
DOCUMENT TYPE:           Patent
LANGUAGE:                Japanese
FAMILY ACC. NUM. COUNT:  1
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     WO 2020262651        A1   20201230    WO 2020-JP25352          20200626
PRIORITY APPLN. INFO.:                     JP 2019-121092       A   20190628
                                           JP 2019-121093       A   20190628
AB   A steel sheet which has a metal structure that contains, in terms of
     vol. fraction, 95% or more of tempered martensite and a total of 5% or
     less of one or more structures selected from among ferrite, pearlite,
     bainite, as-quenched martensite and residual austenite.  This steel
     sheet has a tensile strength of 1,100 MPa or more; the std. deviation of
     the Vickers hardness is 30 or less as measured under a load of 9.8 N at 30
     points in a 300μm square area that is centered at the position of t/2,
     where t is the sheet thickness, in a cross-section of the steel sheet
     10, said cross-section being parallel to the sheet thickness direction;
     and if nanohardness is measured under a max. load of 1 mN at 100 points in
     a 100μm square area that is centered at the position of t/2, the ratio
     of the measurement points that have a nanohardness difference of 3 GPa or
     more from 8 adjacent measurement points is 10% or less.
```

IT 2572991-88-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
RN 2572991-88-7 CAPLUS
CN Iron alloy, base, Fe 85-99,Mn 0.6-5,Si 0-2.5,Cr 0-2,Al 0-1,Co 0-1,Ni 0-1,Cu 0-0.5,Mo 0-0.5,V 0-0.5,C 0.2-0.4,B 0-0.1,Nb 0-0.1,Ta 0-0.1,Ti 0-0.1,W 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	85	-	99	7439-89-6
Mn	0.6	-	5	7439-96-5
Si	0	-	2.5	7440-21-3
Cr	0	-	2	7440-47-3
Al	0	-	1	7429-90-5
Co	0	-	1	7440-48-4
Ni	0	-	1	7440-02-0
Cu	0	-	0.5	7440-50-8
Mo	0	-	0.5	7439-98-7
V	0	-	0.5	7440-62-2
C	0.2	-	0.4	7440-44-0
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
Ta	0	-	0.1	7440-25-7
Ti	0	-	0.1	7440-32-6
W	0	-	0.1	7440-33-7

IPCI C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-60 [I]
IPCR C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-60 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST carbon silicon titanium steel sheet
IT Galvanizing
(electrogalvanizing, layer; steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT Hot-dip galvanizing
(layer; steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT Collisions
(resistance; steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT Microhardness
Tensile strength
Vickers hardness
(steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT 12597-69-2, Steel, properties
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(sheet; steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT 2572991-88-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)

L12 ANSWER 2 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:2557482 CAPLUS Full-text
DOCUMENT NUMBER: 174:294718
TITLE: Steel pipe, its preparation method and application in petroleum and/or natural gas field
INVENTOR(S): Tian, Yan; Yan, Wei; Zou, Xiyang; Shi, Xianbo; Zhuo, Zhao; Yang, Ke; Shan, Yiyin; Zheng, Qiuyan
PATENT ASSIGNEE(S): Hengyang Valin Steel Tube Co., Ltd., Peop. Rep. China; Institute of Metal Research, Chinese Academy of Sciences
SOURCE: Faming Zhuanli Shenqing, 13pp.

CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 112063922	A	20201211	CN 2020-10912257	20200902

PRIORITY APPLN. INFO.: CN 2020-10912257 20200902

AB The invention provides a steel pipe, a prepn. method and application in petroleum and/or natural gas field, which has the advantages of high strength, high toughness, high sulfide stress corrosion resistance and microbial corrosion resistance. The steel pipe contains the following raw materials in percentage by wt.: C 0.08-0.30%, Si≤0.5%, Mn≤1.0%, Cu 0.5-2.0%, Al≤1.0%, Ce 0.01-0.2%, Cr 0.5-1.5%, Mo 0.5-1.5%, V≤0.3%, N≤0.005%, O≤0.005%, S≤0.005%, P≤0.005% and the balance Fe. The prepn. method comprises the following steps: smelting, pouring, electroslag remelting, rolling and heat treatment.

IT 2567490-07-5P, Carbon 0.08-0.30, aluminum 0-1.0, boron 0-0.1, calcium 0-0.1, cerium 0.01-0.2, chromium 0.5-1.5, copper 0.5-2.0, manganese 0-1.0, molybdenum 0.5-1.5, niobium 0-0.1, silicon 0-0.5, titanium 0-0.1, vanadium 0-0.3, iron bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(steel pipe, its prepn. method and application in petroleum and/or natural gas field)

RN 2567490-07-5 CAPLUS

CN Iron alloy, base, Fe 91-98,Cu 0.5-2,Cr 0.5-1.5,Mo 0.5-1.5,Al 0-1,Mn 0-1,Si 0-0.5,C 0.1-0.3,V 0-0.3,Ce 0-0.2,B 0-0.1,Ca 0-0.1,Nb 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	98	7439-89-6
Cu	0.5	-	2	7440-50-8
Cr	0.5	-	1.5	7440-47-3
Mo	0.5	-	1.5	7439-98-7
Al	0	-	1	7429-90-5
Mn	0	-	1	7439-96-5
Si	0	-	0.5	7440-21-3
C	0.1	-	0.3	7440-44-0
V	0	-	0.3	7440-62-2
Ce	0	-	0.2	7440-45-1
B	0	-	0.1	7440-42-8
Ca	0	-	0.1	7440-70-2
Nb	0	-	0.1	7440-03-1
Ti	0	-	0.1	7440-32-6

IPCI C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-20; C22C0038-22; C22C0038-24; C22C0038-26; C22C0038-28; C22C0038-32; C21D0001-18; C21D0006-00; C21D0008-10; C21D0009-08; C22C0033-04

IPCR C22C0038-02 [I]; C21D0001-18 [I]; C21D0006-00 [I]; C21D0008-10 [I]; C21D0009-08 [I]; C22C0033-04 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-20 [I]; C22C0038-22 [I]; C22C0038-24 [I]; C22C0038-26 [I]; C22C0038-28 [I]; C22C0038-32 [I]

CC 55-3 (Ferrous Metals and Alloys)

ST steel pipe prepn petroleum natural gas

IT Casting of metals
(electroslag; steel pipe, its prepn. method and application in petroleum and/or natural gas field)

IT Metals
RL: IMF (Industrial manufacture); PUR (Purification or recovery); PREP (Preparation)
(refining; steel pipe, its prepn. method and application in petroleum and/or natural gas field)

IT Corrosion-resistant materials
Heat treatment
Hot rolling
Pipes and Tubes
(steel pipe, its prepn. method and application in petroleum

and/or natural gas field)
IT Oxides (inorganic)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(steel pipe, its prepn. method and application in petroleum and/or natural gas field)
IT Smelting
(vacuum induction; steel pipe, its prepn. method and application in petroleum and/or natural gas field)
IT 1344-28-1, Alumina, formation (nonpreparative) 12173-93-2, Martensite, formation (nonpreparative)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(steel pipe, its prepn. method and application in petroleum and/or natural gas field)
IT 2567490-07-5P, Carbon 0.08-0.30, aluminum 0-1.0, boron 0-0.1, calcium 0-0.1, cerium 0.01-0.2, chromium 0.5-1.5, copper 0.5-2.0, manganese 0-1.0, molybdenum 0.5-1.5, niobium 0-0.1, silicon 0-0.5, titanium 0-0.1, vanadium 0-0.3, iron bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(steel pipe, its prepn. method and application in petroleum and/or natural gas field)
IT 1333-74-0, Hydrogen, processes
RL: REM (Removal or disposal); PROC (Process)
(steel pipe, its prepn. method and application in petroleum and/or natural gas field)

L12 ANSWER 3 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:2500863 CAPLUS Full-text
DOCUMENT NUMBER: 174:278824
TITLE: HB450 grade high wear resistant thin steel sheet and production method thereof
INVENTOR(S): Zhang, Tao; Ji, Wenbo; Yang, Ying; Lin, Tianzi; Zhang, Zhe; Wang, Yubo
PATENT ASSIGNEE(S): Angang Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 10pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 112048672	A	20201208	CN 2020-10939769	20200909

PRIORITY APPLN. INFO.: CN 2020-10939769 20200909
AB The invention discloses a HB450 grade high wear resistant thin steel sheet and prodn. method thereof, which has the advantages of simple prodn. process, good forming performance and good wear resistance. The high wear resistant thin steel sheet comprises the following components in percentage by wt.: C 0.18%-0.22%, Si 0.10%-0.30%, Mn 1.0%-1.5%, Cr 0.20%-0.40%, B 0.005%-0.010%, Ti 0.03%-0.06%, Ti/B≥3.0, Als 0.015%-0.045%, and balance of Fe and inevitable impurities.
IT 2574491-27-1DP, Carbon 0.2, boron 0-3.0, chromium 0.20-0.40, manganese 1.0-1.5, silicon 0.10-0.30, titanium 0-3, titanium 0.03-0.06, iron bal., Al 0.015-0.045
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(hB450 grade high wear resistant thin steel sheet and prodn. method thereof)
RN 2574491-27-1 CAPLUS
CN INDEX NAME NOT YET ASSIGNED

Component	Component Percent	Component Registry Number
Fe	92 - 98	7439-89-6
B	0 - 3	7440-42-8
Ti	0 - 3	7440-32-6
Mn	1 - 1.5	7439-96-5
Cr	0.2 - 0.4	7440-47-3
Si	0.1 - 0.3	7440-21-3
C	0.2	7440-44-0

IPCI C22C0038-02; C22C0038-04; C22C0038-32; C22C0038-28; C22C0038-06;
C21D0008-02
IPCR C22C0038-02 [I]; C21D0008-02 [I]; C22C0038-04 [I]; C22C0038-06 [I];
C22C0038-28 [I]; C22C0038-32 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST HB450 high wear resistant thin steel sheet prodn
IT Sheet materials
Wear-resistant materials
(hB450 grade high wear resistant thin steel sheet and prodn. method thereof)
IT 2574491-27-1DP, Carbon 0.2, boron 0-3.0, chromium 0.20-0.40, manganese 1.0-1.5, silicon 0.10-0.30, titanium 0-3, titanium 0.03-0.06, iron bal., Al 0.015-0.045
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(hB450 grade high wear resistant thin steel sheet and prodn. method thereof)

L12 ANSWER 4 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:2453019 CAPLUS Full-text
DOCUMENT NUMBER: 174:38459
TITLE: Manufacture of welded components made of a deformed high-strength steel
INVENTOR(S): Otto, Manuel
PATENT ASSIGNEE(S): Salzgitter Flachstahl GmbH, Germany
SOURCE: Ger. Offen., 15pp.
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102019114090	A1	20201203	DE 2019-102019114090	20190527
WO 2020239671	A1	20201203	WO 2020-EP64399	20200525
PRIORITY APPLN. INFO.:			DE 2019-102019114090 A	20190527

AB A method for producing a welded component achieves mech. properties in the welding seam region, in particular fatigue strength, comparable to those in the non-influenced base material, preferably even with a higher degree of strength than in the base material. This method comprises: producing a hot-rolled steel product made of a high-strength air-hardenable steel with a material thickness ≥1.5 mm, the hot-rolled steel product contg., by wt.%: C: 0.03-0.4, preferably 0.08-0.1; Mn: 1-4, preferably 1.8-2; Si: 0.09-2, preferably 0.25-0.3; Al: 0.02-2, preferably 0.02-0.05; P 0-0.1, preferably ≤0.020; S 0-0.1, preferably ≤ 0.01; N: 0.001-0.5, preferably 0.003-0.008; Ti: 0.01-0.2, preferably 0.02-0.03; Cr: 0.05-2, preferably 0.7-0.8; B: 0.001-0.1, preferably 0.0025-0.0035; Mo: 0.01-1, preferably 0.15-0.3; V: 0.01-0.2, preferably 0.05-0.08; optionally: Ni: 0.02-1; Nb: 0.01-0.1; and balance in iron including conventional steel-accompanying elements; air hardening the produced hot-rolled steel product; then deforming the hot-rolled steel product in the air-hardened state to form a component; and producing welding connections using a fusion welding process on the component.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 10023488 A1	CAPLUS
Anon				DE 102004053620 A1	CAPLUS
Anon				WO 2011000351 A1	CAPLUS
Anon				DE 4446709 A1	CAPLUS

IT 2550686-17-2P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(manuf. of welded components made of a deformed high-strength steel)
RN 2550686-17-2 CAPLUS
CN Iron alloy, base, Fe 86-99,Mn 1-4,Si 0.1-2,Al 0-2,Cr 0-2,Mo 0-1,Ni 0-1,N 0-0.5,C 0-0.4,Ti 0-0.2,V 0-0.2,B 0-0.1,Nb 0-0.1,P 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	86 - 99	7439-89-6
Mn	1 - 4	7439-96-5
Si	0.1 - 2	7440-21-3
Al	0 - 2	7429-90-5
Cr	0 - 2	7440-47-3
Mo	0 - 1	7439-98-7
Ni	0 - 1	7440-02-0
N	0 - 0.5	17778-88-0
C	0 - 0.4	7440-44-0
Ti	0 - 0.2	7440-32-6
V	0 - 0.2	7440-62-2
B	0 - 0.1	7440-42-8
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0
S	0 - 0.1	7704-34-9

IPCI C21D0008-00 [I]; C22C0038-04 [I]
IPCR C21D0008-00 [I]; C22C0038-04 [I]
CC 55-9 (Ferrous Metals and Alloys)
ST welding deformation strength steel rolling
IT Automobile bodies
(chassis; manuf. of welded components made of a deformed high-strength steel)
IT Welding of metals
(gas metal-arc welding; manuf. of welded components made of a deformed high-strength steel)
IT Appliances
Automotive bumpers
Deep drawing of materials
Elongation at break
Forging
Hot rolling
Laser welding
Metalworking
Yield strength
(manuf. of welded components made of a deformed high-strength steel)
IT 12427-23-5, Bainite
RL: FMU (Formation, unclassified); PRP (Properties); FORM (Formation, nonpreparative)
(manuf. of welded components made of a deformed high-strength steel)
IT 2550686-17-2P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(manuf. of welded components made of a deformed high-strength steel)

L12 ANSWER 5 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:2453018 CAPLUS Full-text
DOCUMENT NUMBER: 174:38458
TITLE: Manufacture of welded components made of a deformed high-strength steel
INVENTOR(S): Otto, Manuel
PATENT ASSIGNEE(S): Salzgitter Flachstahl GmbH, Germany
SOURCE: PCT Int. Appl., 32pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020239671	A1	20201203	WO 2020-EP64399	20200525
DE 102019114090	A1	20201203	DE 2019-102019114090	20190527

PRIORITY APPLN. INFO.: DE 2019-102019114090 A 20190527
AB A method for producing a welded component achieves mech. properties in the

welding seam region, in particular fatigue strength, comparable to those in the non-influenced base material, preferably even with a higher degree of strength than in the base material. This method comprises: producing a hot-rolled steel product made of a high-strength air-hardenable steel with a material thickness ≥1.5 mm, the hot-rolled steel product contg., by wt.%: C: 0.03-0.4, preferably 0.08-0.1; Mn: 1-4, preferably 1.8-2; Si: 0.09-2, preferably 0.25-0.3; Al: 0.02-2, preferably 0.02-0.05; P 0-0.1, preferably ≤0.020; S 0-0.1, preferably ≤ 0.01; N: 0.001-0.5, preferably 0.003-0.008; Ti: 0.01-0.2, preferably 0.02-0.03; Cr: 0.05-2, preferably 0.7-0.8; B: 0.001-0.1, preferably 0.0025-0.0035; Mo: 0.01-1, preferably 0.15-0.3; V: 0.01-0.2, preferably 0.05-0.08; optionally: Ni: 0.02-1; Nb: 0.01-0.1; and balance in iron including conventional steel-accompanying elements; air hardening the produced hot-rolled steel product; then deforming the hot-rolled steel product in the air-hardened state to form a component; and producing welding connections using a fusion welding process on the component.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	2009			KR 20090103779 A	
BANGARU NARASIMHA-RAO V	1999			WO 9905336 A1	CAPLUS
HANSEN STEVEN S	2007			US 20070267110 A1	CAPLUS
HARA TAKUYA	2014			US 8715430 B2	CAPLUS
PAN HUI	2019			CN 109136762 A	CAPLUS
PAN HUI	2019			CN 109402499 A	CAPLUS
SCHOETTLER JOACHIM	2009			DE 102007058222 A1	CAPLUS
SCHOTTLER JOACHIM	2017			DE 102016104295 A1	CAPLUS
VON HAGEN INGO	1999			WO 9928518 A1	CAPLUS

IT 2550686-17-2P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(manuf. of welded components made of a deformed high-strength steel)

RN 2550686-17-2 CAPLUS

CN Iron alloy, base, Fe 86-99,Mn 1-4,Si 0.1-2,Al 0-2,Cr 0-2,Mo 0-1,Ni 0-1,N 0-0.5,C 0-0.4,Ti 0-0.2,V 0-0.2,B 0-0.1,Nb 0-0.1,P 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	86	-	99	7439-89-6
Mn	1	-	4	7439-96-5
Si	0.1	-	2	7440-21-3
Al	0	-	2	7429-90-5
Cr	0	-	2	7440-47-3
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
N	0	-	0.5	17778-88-0
C	0	-	0.4	7440-44-0
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0
S	0	-	0.1	7704-34-9

IPCI C21D0008-04 [I]; B23K0009-23 [I]; C22C0038-00 [I]; C22C0038-02 [I]; C22C0038-06 [I]; C22C0038-22 [I]; C22C0038-24 [I]; C22C0038-26 [I]; C22C0038-28 [I]; C22C0038-32 [I]; C22C0038-38 [I]; C22C0038-44 [I]; C22C0038-46 [I]; C22C0038-50 [I]; C22C0038-54 [I]

IPCR C21D0008-04 [I]; B23K0009-23 [I]; C22C0038-00 [I]; C22C0038-02 [I]; C22C0038-06 [I]; C22C0038-22 [I]; C22C0038-24 [I]; C22C0038-26 [I]; C22C0038-28 [I]; C22C0038-32 [I]; C22C0038-38 [I]; C22C0038-44 [I]; C22C0038-46 [I]; C22C0038-50 [I]; C22C0038-54 [I]

CC 55-9 (Ferrous Metals and Alloys)

ST welding deformation strength steel rolling

IT Automobile bodies
(chassis; manuf. of welded components made of a deformed high-strength steel)

IT Welding of metals

(gas metal-arc welding; manuf. of welded components made of a deformed high-strength steel)
IT Appliances
Automotive bumpers
Deep drawing of materials
Elongation at break
Forging
Hot rolling
Laser welding
Metalworking
Yield strength
(manuf. of welded components made of a deformed high-strength steel)
IT 12427-23-5, Bainite
RL: FMU (Formation, unclassified); PRP (Properties); FORM (Formation, nonpreparative)
(manuf. of welded components made of a deformed high-strength steel)
IT 2550686-17-2P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(manuf. of welded components made of a deformed high-strength steel)

L12 ANSWER 6 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:2383485 CAPLUS Full-text
DOCUMENT NUMBER: 174:174308
TITLE: Steel comprising specific amount of oxygen, sulfur, and cerium, its manufacturing method, and application
INVENTOR(S): Zou, Xiyang; Shi, Xianbo; Tian, Yan; Yan, Wei; Zhou, Zhengping; Yang, Ke; Li, Duanzheng; Shan, Yiyin; Zeng, Tianyi
PATENT ASSIGNEE(S): Hengyang Valin Steel Tube Co., Ltd., Peop. Rep. China; Institute of Metal Research, Chinese Academy of Sciences
SOURCE: Faming Zhuanli Shenqing, 13pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 111961976	A	20201120	CN 2020-10911376	20200902

PRIORITY APPLN. INFO.: CN 2020-10911376 20200902
AB A steel having high strength, high toughness, resistance to sulfide stress corrosion and microbial corrosion, and realizing the integration of structure and function is provided. The steel comprises the following raw materials in wt.%: 0.08-0.30 of carbon, 0-0.5 of silicon, 0-1.0 of manganese, 0.5-2.0 of copper, 0-1.0 of aluminum, 0.01-0.2 of cerium, 0.5-1.5 of chromium, 0.5-1.5 of molybdenum, 0-0.3 of vanadium, 0-0.005 of nitrogen, 0-0.005 of oxygen, 0-0.005 of sulfur, 0-0.005 of phosphorous, 0-0.1 of niobium, 0-0.1 of calcium, 0-0.1 of titanium, 0-0.1 of boron, and balance is iron. The manufg. method comprises: smelting the raw materials in a vacuum induction furnace, or sequentially passing the raw materials through an elec. furnace and refining outside the furnace, or the raw materials are sequentially subjecting to primary refining and refining outside the furnace, pouring and post-processing to obtain a steel.
IT 2567490-07-5, Aluminum 0-1.0, boron 0-0.1, calcium 0-0.1, carbon 0.08-0.30, cerium 0.01-0.2, chromium 0.5-1.5, copper 0.5-2.0, manganese 0-1.0, molybdenum 0.5-1.5, niobium 0-0.1, silicon 0-0.5, titanium 0-0.1, vanadium 0-0.3, iron bal.
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(steel comprising specific amt. of oxygen, sulfur, and cerium, its manufg. method, and application)
RN 2567490-07-5 CAPLUS
CN Iron alloy, base, Fe 91-98,Cu 0.5-2,Cr 0.5-1.5,Mo 0.5-1.5,Al 0-1,Mn 0-1,Si 0-0.5,C 0.1-0.3,V 0-0.3,Ce 0-0.2,B 0-0.1,Ca 0-0.1,Nb 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	98	7439-89-6
Cu	0.5	-	2	7440-50-8
Cr	0.5	-	1.5	7440-47-3
Mo	0.5	-	1.5	7439-98-7
Al	0	-	1	7429-90-5
Mn	0	-	1	7439-96-5
Si	0	-	0.5	7440-21-3
C	0.1	-	0.3	7440-44-0
V	0	-	0.3	7440-62-2
Ce	0	-	0.2	7440-45-1
B	0	-	0.1	7440-42-8
Ca	0	-	0.1	7440-70-2
Nb	0	-	0.1	7440-03-1
Ti	0	-	0.1	7440-32-6

IPCI C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-20; C22C0038-22; C22C0038-24; C21D0008-00; C21D0001-18
IPCR C22C0038-02 [I]; C21D0001-18 [I]; C21D0008-00 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-20 [I]; C22C0038-22 [I]; C22C0038-24 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST oxygen sulfur cerium steel
IT Casting of metals
Forging
Hot rolling
Purification
Smelting
(steel comprising specific amt. of oxygen, sulfur, and cerium, its manufg. method, and application)
IT 12597-69-2P, Steel, preparation
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(steel comprising specific amt. of oxygen, sulfur, and cerium, its manufg. method, and application)
IT 2567490-07-5, Aluminum 0-1.0, boron 0-0.1, calcium 0-0.1, carbon 0.08-0.30, cerium 0.01-0.2, chromium 0.5-1.5, copper 0.5-2.0, manganese 0-1.0, molybdenum 0.5-1.5, niobium 0-0.1, silicon 0-0.5, titanium 0-0.1, vanadium 0-0.3, iron bal.
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(steel comprising specific amt. of oxygen, sulfur, and cerium, its manufg. method, and application)

L12 ANSWER 7 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:2291871 CAPLUS Full-text
DOCUMENT NUMBER: 174:84430
TITLE: 1200Mpa grade ultra high strength thick steel plate and production method thereof
INVENTOR(S): Bao, Haiyan; Liang, Baozhu; Zhu, Yingjun; Su, Liang; Yan, Min; Du, Tao; Zhang, Huan; Yu, Hongwei; Yi, Xun; Wang, Xiaodong
PATENT ASSIGNEE(S): Baowu Group Echeng Iron and Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 9pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 111910129	A	20201110	CN 2020-10804778	20200812

PRIORITY APPLN. INFO.: CN 2020-10804778 20200812
AB The invention discloses a 1200Mpa grade ultra-high strength thick steel plate and its prodn. method, which has the advantages of high tensile strength, low yield ratio and low cost. The steel plate contains the following elements by wt.: C: 0.12-0.20; Si: 0.10-0.40; Mn: 1.10-1.50; P ≤ 0.0010; S ≤ 0.0005; ALs: 0.015-0.045%; Cr: 0.10-0.50; Mo:

0.10-0.70; Ni: 0.05-0.20; N: ≤ 0.0045; H: ≤ 0.0002, Nb + Ti + V + B ≤ 0.10, Ti / N ≥ 3.0, balance of Fe and unavoidable impurities.

IT 2559769-05-8P, Boron 0-0.10, carbon 0.12-0.20, chromium 0.10-0.50, manganese 1.10-1.50, molybdenum 0.10-0.70, nickel 0.05-0.20, niobium 0-0.1, silicon 0.10-0.40, titanium 0-0.1, vanadium 0-0.1, iron bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(1200Mpa grade ultra high strength thick steel plate and prodn. method thereof)

RN 2559769-05-8 CAPLUS

CN Iron alloy, base, Fe 96-98,Mn 1.1-1.5,Mo 0.1-0.7,Cr 0.1-0.5,Si 0.1-0.4,C 0.1-0.2,Ni 0-0.2,B 0-0.1,Nb 0-0.1,Ti 0-0.1,V 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6
Mn	1.1	-	1.5	7439-96-5
Mo	0.1	-	0.7	7439-98-7
Cr	0.1	-	0.5	7440-47-3
Si	0.1	-	0.4	7440-21-3
C	0.1	-	0.2	7440-44-0
Ni	0	-	0.2	7440-02-0
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
Ti	0	-	0.1	7440-32-6
V	0	-	0.1	7440-62-2

IPCI C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-44; C22C0038-46; C22C0038-48; C22C0038-54; C21D0008-02; C22C0033-04

IPCR C22C0038-02 [I]; C21D0008-02 [I]; C22C0033-04 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-44 [I]; C22C0038-46 [I]; C22C0038-48 [I]; C22C0038-54 [I]

CC 55-3 (Ferrous Metals and Alloys)

ST steel plate prepn

IT Plates
Quenching (cooling)
Rolling (metals)
Tempering
(1200Mpa grade ultra high strength thick steel plate and prodn. method thereof)

IT Group 8 elements
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(1200Mpa grade ultra high strength thick steel plate and prodn. method thereof)

IT 2559769-05-8P, Boron 0-0.10, carbon 0.12-0.20, chromium 0.10-0.50, manganese 1.10-1.50, molybdenum 0.10-0.70, nickel 0.05-0.20, niobium 0-0.1, silicon 0.10-0.40, titanium 0-0.1, vanadium 0-0.1, iron bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(1200Mpa grade ultra high strength thick steel plate and prodn. method thereof)

L12 ANSWER 8 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2020:2054532 CAPLUS Full-text

DOCUMENT NUMBER: 173:899795

TITLE: Strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets

AUTHOR(S): Jo, Min Cheol; Jo, Min Chul; Yoo, Jisung; Song, Taejin; Kim, Sang-Heon; Sohn, Seok Su; Lee, Sunghak

CORPORATE SOURCE: Center for Advanced Aerospace Materials, Pohang University of Science and Technology, Pohang, 37673, S. Korea

SOURCE: Materials Science & Engineering, A: Structural Materials: Properties, Microstructure and Processing (2021), 800, 140319

CODEN: MSAPE3; ISSN: 0921-5093
DIGITAL OBJECT ID: 10.1016/j.msea.2020.140319
PUBLISHER: Elsevier B.V.
DOCUMENT TYPE: Journal; (online computer file)
LANGUAGE: English
AB Layered architectures have been applied to twinning-induced plasticity (TWIP) steel in terms of configuring multi-layered TWIP and martensitic steel (MLS) sheets to overcome the limitation of low yield strength. However, hydrogen embrittlement (HE) inevitably appears in materials used for high-strength purposes, with the interfacial layers presenting localization sites of hydrogen, thereby limiting the materials' broad structural applications. Here, we present a novel design for MLS sheets that exhibit both strong resistance to HE and a good strength-ductility balance via surface shielding. Our hydrogen penetration data demonstrates that the proposed austenitic shielding structure effectively acts as a barrier to hydrogen due to the reduced hydrogen diffusivity, compared with existing MLS sheets. We propose the optimal surface thickness required to play the role of shielding layer based on the quantified diffusivity and the rule of mixts. of the layer fractions, which presents a plausible novel design for layered architectures that exhibit strong resistance to HE and possess tunable mech. properties.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1991		261	Electron Probe Quant	
Anon	2004			ISO 17081 Method of	
Ashby, M	2003	51	5801	Acta Mater	CAPLUS
Ashby, M	2013	68	4	Scripta Mater	CAPLUS
Barabash, R	2014	45	98	Metall Mater Trans	CAPLUS
Beachem, C	1972	3	441	Metall Mater Trans B	
Bouaziz, O	2008	10	24	Adv Eng Mater	CAPLUS
Bouaziz, O	2016	18	56	Adv Eng Mater	CAPLUS
Cetin, A	2012	60	2265	Acta Mater	CAPLUS
Chin, K	2018	24	489	Met Mater Int	CAPLUS
Cho, L	2018	734	416	Mater Sci Eng, A	CAPLUS
Cho, L	2018	735	448	Mater Sci Eng, A	CAPLUS
De Cooman, B	2011			New Trends and Devel	
Devanathan, M	1962	270	90	Proc R Soc A	CAPLUS
Dunne, D	2012	706	1568	Mater Sci Forum	
Dwivedi, S	2018	43	21603	Int J Hydrogen Energ	CAPLUS
Enomoto, M	2012	43	572	Metall Mater Trans	CAPLUS
Fang, T	2011	331	1587	Science	CAPLUS
Grassel, O	2000	16	1391	Int J Plast	CAPLUS
Gutierrez-Urrutia, I	2010	527	3552	Mater Sci Eng, A	
Gwon, H	2017	696	416	Mater Sci Eng, A	CAPLUS
Han, D	2015	99	45	Scripta Mater	CAPLUS
He, J	2018	726	288	Mater Sci Eng, A	CAPLUS
Huang, M	2018	153	235	Acta Mater	CAPLUS
Ichimura, M	1991	32	1109	Mater Trans, JIM	CAPLUS
Inoue, J	2008	59	1055	Scripta Mater	CAPLUS
Jin, J	2012	60	1680	Acta Mater	CAPLUS
Jo, M	2019	50	4085	Metall Mater Trans	CAPLUS
Jo, S	2015	627	374	J Alloys Compd	CAPLUS
Kim, J	2018	147	304	Acta Mater	CAPLUS
Kim, J	2009	505	105	Mater Sci Eng, A	
Kim, J	2017	682	164	Mater Sci Eng, A	CAPLUS
Kim, J	2019	25	912	Met Mater Int	CAPLUS
Kim, J	2019	9	6829	Sci Rep	
Koseki, T	2014	55	227	Mater Trans	CAPLUS
Koyama, M	2013	61	4607	Acta Mater	CAPLUS
Koyama, M	2017	355	1055	Science	CAPLUS
Kubin, L	2003	48	119	Scripta Mater	CAPLUS
Kwon, Y	2018	43	10129	Int J Hydrogen Energ	CAPLUS
Lee, J	2019	9	5219	Sci Rep	
Li, Y	2013	61	2588	J Mech Phys Solid	CAPLUS
Mohtadi-Bonab, M	2019	25	1109	Met Mater Int	CAPLUS
Oh, S	2020	188	366	Acta Mater	CAPLUS
Park, C	2019	25	584	Met Mater Int	CAPLUS
Park, I	2015	93	63	Corrosion Sci	CAPLUS
Park, J	2017	686	160	Mater Sci Eng, A	CAPLUS
Park, J	2019	759	320	Mater Sci Eng, A	CAPLUS

Ritchie, R	2011	10	817	Nat Mater	CAPLUS
Seok, M	2016	121	164	Acta Mater	CAPLUS
Song, E	2014	87	9	Scripta Mater	CAPLUS
Takai, K	2003	43	520	ISIJ Int	CAPLUS
Wang, M	2005	398	37	Mater Sci Eng, A	
Wang, Y	2002	419	912	Nature	CAPLUS
Wang, Y	2018	150	22	Scripta Mater	CAPLUS
Wei, Y	2014	5	3580	Nat Commun	
Wu, X	2014	2	185	Mater Res Lett	CAPLUS
Yanagimoto, J	2010	59	287	CIRP Ann - Manuf Tec	
Yokota, T	2003	43	534	ISIJ Int	CAPLUS
Yu, W	2018	727	70	Mater Sci Eng, A	CAPLUS
Zhang, Y	2019	165	15	Scripta Mater	CAPLUS

IT 2522569-69-1, C 0.35, Mn 1.3, Si 0.15, Mo 0.1, Cr 0.2, Ti 0-0.06, B 0-0.06, Fe bal., processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

RN 2522569-69-1 CAPLUS

CN Steel, Fe 98,Mn 1.3,C 0.4,Cr 0.2,Si 0.2,Mo 0.1,B 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	98			7439-89-6
Mn	1.3			7439-96-5
C	0.4			7440-44-0
Cr	0.2			7440-47-3
Si	0.2			7440-21-3
Mo	0.1			7439-98-7
B	0	-	0.1	7440-42-8
Ti	0	-	0.1	7440-32-6

CC 55-8 (Ferrous Metals and Alloys)

ST TWIP steel multilayer austenite martensite shielding hydrogen embrittlement resistance

IT Diffusion
Elongation, mechanical
Fracture surface morphology
Hydrogen embrittlement
Interface
Microstructure
Multilayers
Sheet materials
Shields
Stress-strain relationship
Tensile strength
Yield strength
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

IT 1333-74-0, Hydrogen, processes
RL: OCU (Occurrence, unclassified); PEP (Physical, engineering or chemical process); OCCU (Occurrence); PROC (Process)
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

IT 12173-93-2, Martensite, processes 12244-31-4, Austenite, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

IT 2362540-95-0, C 1.2, Mn 13, Si 0.2, Fe bal. 2522569-69-1, C 0.35, Mn 1.3, Si 0.15, Mo 0.1, Cr 0.2, Ti 0-0.06, B 0-0.06, Fe bal., processes 2522569-74-8, C 0.7, Mn 17, Si 0.6, V 0.3, Al 1.3, Fe bal.
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

L12 ANSWER 9 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2020:1995137 CAPLUS Full-text
DOCUMENT NUMBER: 173:735842
TITLE: Aluminum or aluminum alloy plated steel differential strength welded part and its manufacture
INVENTOR(S): Pan, Hua; Liu, Chengjie; Lei, Ming; Wu, Yue; Sun, Zhongqu; Jiang, Haomin
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: PCT Int. Appl., 27pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020200110	A1	20201008	WO 2020-CN81743	20200327
CN 111215751	A	20200602	CN 2019-10249188	20190329

PRIORITY APPLN. INFO.: CN 2019-10249188 A 20190329

AB The different-strength steel welding component is formed by means of butt welding of a high-strength steel plate and a low-strength steel plate, and each of the high-strength steel plate and the low-strength steel plate comprises a base body and at least one pure aluminum or aluminum-alloy plating on a surface of the base body. The components of the base body of the high-strength steel plate, in percentages by wt., are: 0.08-0.8% of C, 0.05-1.0% of Si, 0.1-5% of Mn, P < 0.3%, S < 0.1%, Al < 0.3%, Ti < 0.5%, 0.0005-0.1% of B, 0.01-3% of Cr, and the remaining components are Fe and inevitable impurities. The components of the base body of the low-strength steel plate, in percentages by wt., are: 0.03-0.1% of C, 0-0.3% of Si, 0.5-2.0% of Mn, P < 0.1%, S < 0.05%, Al < 0.1%, 0-0.1% of Cr, 0-0.05% of Ti, and the remaining components are Fe and inevitable impurities. The tensile strength of a welding seam of the welding component after hot stamping is greater than the tensile strength of a low-strength steel base metal, and the elongation is greater than 4%, such that application requirements of the welding component in the field of automobile hot stamping are met. The present invention also relates to a method for manufg. a different-strength steel welding component with an aluminum or aluminum-alloy plating, a different-strength steel welding component with an aluminum or aluminum-alloy plating that is prepd. by means of the method, and a welding wire used in the method.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ALIPS PHILIPPE	2004			US 20040200813 A1	
BECKER JENS-ULRIK	2017			CN 106794671 A	CAPLUS
GARCIA MICHEL	2015			CN 105163895 A	CAPLUS
GU HONGPING	2017			CN 106687248 A	CAPLUS
LUZIUS SEVERIN	2015			US 20150034615 A1	
PAN HUA	2017			CN 106334875 A	CAPLUS
WANG XIAONAN	2018			CN 108838541 A	CAPLUS

IT 2067242-22-0
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)
RN 2067242-22-0 CAPLUS
CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1	7440-21-3
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B23K0026-26 [I]; B23K0026-322 [I]; B23K0026-12 [I]; C22C0038-38 [I];
C22C0038-32 [I]; C22C0038-28 [I]; C22C0038-06 [I]; C22C0038-04 [I];
C22C0038-02 [I]
IPCR B23K0026-26 [I]; B23K0026-12 [I]; B23K0026-322 [I]; C22C0038-02 [I];
C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-28 [I]; C22C0038-32 [I];
C22C0038-38 [I]
CC 55-9 (Ferrous Metals and Alloys)
ST aluminum alloy plated steel differential strength welded part
IT Laser welding
Plating process
Tensile strength
Welds
(aluminum or aluminum alloy plated steel differential
strength welded part and its manuf.)
IT Welding of metals
(gas metal-arc welding; aluminum or aluminum alloy plated steel
differential strength welded part and its manuf.)
IT 2067242-22-0 2498542-24-6, C 0.03-0.1, Si 0-0.3, Mn 0.5-2, Al
0-0.1, Cr 0-0.1, Fe bal., processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
(Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum or aluminum alloy plated steel differential
strength welded part and its manuf.)
IT 2490151-16-9, processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or
engineered material use); PROC (Process); USES (Uses)
(aluminum or aluminum alloy plated steel differential
strength welded part and its manuf.)
IT 7429-90-5, Aluminum, uses 2087430-39-3, Si 5-11, Fe 0-4, Al bal.
RL: TEM (Technical or engineered material use); USES (Uses)
(aluminum or aluminum alloy plated steel differential
strength welded part and its manuf.)

L12 ANSWER 10 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1945589 CAPLUS Full-text
DOCUMENT NUMBER: 173:612896
TITLE: Production of hot-rolled steel material composite
with various properties, suppressed uncontrolled
deformation, and easier further processing
INVENTOR(S): Wolske, Vanessa; Vetter, Tobias; Fechte-Heinen,
Rainer; Becker, Jens-Ulrik
PATENT ASSIGNEE(S): ThyssenKrupp Steel Europe AG, Germany
SOURCE: PCT Int. Appl., 30pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020193531	A1	20201001	WO 2020-EP58125	20200324

PRIORITY APPLN. INFO.: DE 2019-102019204324 A 20190328
AB This invention discloses a method to produce a hot-rolled steel material
composite with suppressed uncontrolled deformation during hot rolling and
easier further processing.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1980			JP 5570490 A	
BALKENHOL MICHAEL	2016			DE 102014111625 A1	
BENJAMIN LIEBOWITZ	1949			US 2474682 A	CAPLUS
ETZLSTORFER CHRISTOPH	2017			EP 3241675 A1	CAPLUS

IT 2490283-01-2 2490283-02-3
RL: TEM (Technical or engineered material use); USES (Uses)
(prodn. of hot-rolled steel material composite with various
properties, suppressed uncontrolled deformation, and easier further
processing)
RN 2490282-01-2 CAPLUS
CN Iron alloy, base, Fe 92-100,Ni 0-1.8,Mn 0.3-1.5,Cr 0-1,Si 0-0.8,Mo 0-0.5,C

0.1-0.4,Cu 0-0.3,Al 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,As 0-0.1,B 0-0.1,Ca 0-0.1,N 0-0.1,P 0-0.1,S 0-0.1,Sn 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	92 - 100	7439-89-6
Ni	0 - 1.8	7440-02-0
Mn	0.3 - 1.5	7439-96-5
Cr	0 - 1	7440-47-3
Si	0 - 0.8	7440-21-3
Mo	0 - 0.5	7439-98-7
C	0.1 - 0.4	7440-44-0
Cu	0 - 0.3	7440-50-8
Al	0 - 0.2	7429-90-5
Nb	0 - 0.2	7440-03-1
Ti	0 - 0.2	7440-32-6
V	0 - 0.2	7440-62-2
As	0 - 0.1	7440-38-2
B	0 - 0.1	7440-42-8
Ca	0 - 0.1	7440-70-2
N	0 - 0.1	17778-88-0
P	0 - 0.1	7723-14-0
S	0 - 0.1	7704-34-9
Sn	0 - 0.1	7440-31-5

RN 2490282-02-3 CAPLUS
CN Iron alloy, base, Fe 92-99,Cr 0-2,Mn 0.3-1.5,C 0.4-0.9,Si 0-0.8,Ni 0-0.5,V 0-0.5,Cu 0-0.3,Mo 0-0.3,Al 0-0.2,Nb 0-0.2,As 0-0.1,B 0-0.1,Ca 0-0.1,N 0-0.1,P 0-0.1,S 0-0.1,Sn 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	92 - 99	7439-89-6
Cr	0 - 2	7440-47-3
Mn	0.3 - 1.5	7439-96-5
C	0.4 - 0.9	7440-44-0
Si	0 - 0.8	7440-21-3
Ni	0 - 0.5	7440-02-0
V	0 - 0.5	7440-62-2
Cu	0 - 0.3	7440-50-8
Mo	0 - 0.3	7439-98-7
Al	0 - 0.2	7429-90-5
Nb	0 - 0.2	7440-03-1
As	0 - 0.1	7440-38-2
B	0 - 0.1	7440-42-8
Ca	0 - 0.1	7440-70-2
N	0 - 0.1	17778-88-0
P	0 - 0.1	7723-14-0
S	0 - 0.1	7704-34-9
Sn	0 - 0.1	7440-31-5
Ti	0 - 0.1	7440-32-6

IPCI B32B0015-01 [I]; C22C0038-00 [I]; C22C0038-02 [I]; C22C0038-04 [I]; B21D0035-00 [I]; B23K0020-04 [I]; B23K0020-227 [I]; B23K0020-24 [I]; B23K0026-38 [I]; B23K0026-40 [I]; B23K0033-00 [I]; B23K0103-04 [I]; B23K0103-18 [I]; B21B0001-00 [I]
IPCR B32B0015-01 [I]; B21B0001-00 [I]; B21D0035-00 [I]; B23K0020-04 [I]; B23K0020-227 [I]; B23K0020-24 [I]; B23K0026-38 [I]; B23K0026-40 [I]; B23K0033-00 [I]; B23K0103-04 [N]; B23K0103-18 [N]; C22C0038-00 [I]; C22C0038-02 [I]; C22C0038-04 [I]
CC 56-11 (Nonferrous Metals and Alloys)
ST hot rolled steel composite
IT Composites
Heating
Hot rolling
(prodn. of hot-rolled steel material composite with various properties, suppressed uncontrolled deformation, and easier further processing)
IT 12597-69-2, Steel, uses 2490282-01-2 2490282-02-3

RL: TEM (Technical or engineered material use); USES (Uses)
(prodn. of hot-rolled steel material composite with various properties, suppressed uncontrolled deformation, and easier further processing)

L12 ANSWER 11 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1569923 CAPLUS Full-text
DOCUMENT NUMBER: 173:359646
TITLE: Al-Fe-based plated steel sheet for hot press, and method for manufacturing hot press member
INVENTOR(S): Sato, Rinta; Nakajima, Seiji; Ando, Satoru
PATENT ASSIGNEE(S): JFE Steel Corp., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 15pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2020122202	A	20200813	JP 2019-16283	20190131

PRIORITY APPLN. INFO.: JP 2019-16283 20190131

AB The title Al-Fe-based plated steel sheet can obtain a hot press member having excellent corrosion resistance after coating and excellent corrosion resistance at the joint portion while realizing a high temp. rising rate when subjected to heating by a furnace heating method performed before hot pressing. The Al-Fe-based plated steel sheet for hot press comprises a base steel sheet, an Al-Fe alloy plated layer formed on at least one surface of the base steel sheet with an adhesion amt. per one surface of 30-100 g/m2, having a compn. including Fe 25-90% by mass, Si 0-1% by mass and Al and unavoidable impurities as balance, and unalloyed Al attached to the surface of the Al-Fe alloy plated layer with an adhesion amt. per one surface of 0-90 mg/m2.

IT 1356847-15-8
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Al-Fe-based plated steel sheet for hot press, and method for manufg. hot press member)
RN 1356847-15-8 CAPLUS
CN Iron alloy, base, Fe 93-99,Mn 0.5-3,Si 0-2,Cr 0-1,C 0.2-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	93	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Si	0	-	2	7440-21-3
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C23C0002-12 [I]; C23C0002-28 [I]; C22C0021-00 [I]; C22C0038-00 [I]; C22C0021-02 [I]; C22C0038-60 [I]; C21D0009-00 [I]; C21D0001-18 [I]
IPCR C23C0002-12 [I]; C21D0001-18 [I]; C21D0009-00 [I]; C22C0021-00 [I]; C22C0021-02 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C23C0002-28 [I]
CC 56-11 (Nonferrous Metals and Alloys)
ST aluminum iron plating steel sheet hot press
IT Heating
Hot-press molding
(Al-Fe-based plated steel sheet for hot press, and method for manufg. hot press member)
IT 7429-90-5, Aluminum, processes 1356847-15-8 2460706-65-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Al-Fe-based plated steel sheet for hot press, and method for manufg. hot press member)

L12 ANSWER 12 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1063971 CAPLUS Full-text
DOCUMENT NUMBER: 173:85787
TITLE: Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufacturing method
INVENTOR(S): Bi, Wenzhen; Hong, Jiyao; Wang, Li
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: PCT Int. Appl., 23pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020108594	A1	20200604	WO 2019-CN121860	20191129
CN 109371325	A	20190222	CN 2018-11454798	20181130

PRIORITY APPLN. INFO.: CN 2018-11454798 A 20181130

AB Provided are a zinc-based plated hot-formed steel plate or steel strip having excellent cold bending performance, and a manufg. method thereof; said zinc-based plated hot-formed steel plate or steel strip comprises a substrate having a surface decarburized layer thickness of less than 20 um and a zinc-based plated layer having an adhesion amt. of 10 to 100 g/m.cxa. 2; the component wt. percentages of the substrate are: C: 0.1-0.8%, Si: 0.05-2.0%, Mn: 0.5-3.0%, P≤0.1%, S≤0.05%, Al≤0.1%, N≤0.01%; the remainder is Fe and unavoidable impurities; the av. size of original austenite grains of the substrate is less than 15 um. After hot forming of the substrate, the hot-formed steel plate or steel strip has a tensile strength of 1500 MPa and elongation after fracture of 5%, and the coating is continuous and complete, there are no cracks extending to the substrate, and the steel plate has excellent cold bending performance.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
AZUMA MASASHI	2011			JP 2011111675 A	CAPLUS
BI WENZHEN	2017			CN 107127238 A	CAPLUS
BI WENZHEN	2019			CN 109371325 A	CAPLUS
JIN KWANG-KEUN	1996			KR 960005237 B1	
KAWATA HIROYUKI	2014			CN 103874776 A	CAPLUS
TAKEDA GENTARO	2018			WO 2018207560 A1	CAPLUS
TANAKA YUKIMOTO	2012			JP 2012251229 A	CAPLUS
YUANQIANG TU	2010			CN 101880832 A	CAPLUS
ZHOU SHU	2016			CN 106244923 A	CAPLUS
ZHOU SHU	2016			CN 106244923 A	CAPLUS

IT 2293976-55-1D, Aluminum 0-0.1, carbon 0.1-0.8, manganese 0.5-3, phosphorus 0-0.1, silicon 0.05-2, Cr 0-1, Mo 0-1, Ti 0-0.2, Nb 0-0.08, V 0-1, B 0-0.08, iron bal., nitrogen 0-0.01
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
RN 2293976-55-1 CAPLUS
CN Iron alloy, base, Fe 91-99,Mn 0.5-3,Si 0-2,Cr 0-1,Mo 0-1,V 0-1,C 0.1-0.8,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	91 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Si	0 - 2	7440-21-3
Cr	0 - 1	7440-47-3
Mo	0 - 1	7439-98-7
V	0 - 1	7440-62-2
C	0.1 - 0.8	7440-44-0
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8

Nb 0 - 0.1 7440-03-1
P 0 - 0.1 7723-14-0

IPCI C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-60 [I]; C22C0038-06 [I]; C23C0002-40 [I]; C21D0008-02 [I]
IPCR C22C0038-02 [I]; C21D0008-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-60 [I]; C23C0002-40 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST cold bending performance zinc coating steel manuf hot stamping
IT Coating materials
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
IT Galvanized steel
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
IT Metalworking
(stamping, hot; Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
IT 2393976-55-1D, Aluminum 0-0.1, carbon 0.1-0.8, manganese 0.5-3, phosphorus 0-0.1, silicon 0.05-2, Cr 0-1, Mo 0-1, Ti 0-0.2, Nb 0-0.08, V 0-1, B 0-0.08, iron bal., nitrogen 0-0.01
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
IT 7440-66-6, Zinc, processes 98357-26-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)

L12 ANSWER 13 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1063958 CAPLUS Full-text
DOCUMENT NUMBER: 173:85818
TITLE: Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance
INVENTOR(S): Bi, Wenzhen; Hong, Jiyao; Wang, Li
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: PCT Int. Appl., 17pp.; Chemical Indexing Equivalent to 170:379972 (CN)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020108593	A1	20200604	WO 2019-CN121859	20191129
CN 109365606	A	20190222	CN 2018-11453322	20181130
PRIORITY APPLN. INFO.:			CN 2018-11453322 A	20181130

AB A method for forming a zinc-plated steel plate or steel belt having good corrosion resistance, comprising the following steps: 1) conveying the steel plate or steel belt into a heating furnace higher than Ac3, austenitizing the steel plate or steel belt, and keeping the temp. for 1-7 min; 2) before the steel plate or steel belt leaves the heating furnace and enters a forming mold, applying different cooling manners according to different plated thicknesses, wherein when the single-sided wt. of the plating is less than or equal to 50g/m2, only air cooling is required before transferring to the forming mold, when the single-sided wt. of the plating is greater than 50g/m2, aerial fog or water mist precooling is performed before transferring to the forming mold, and the steel plate is cooled to be below 700°C at a cooling sped greater than 30°C/s; and 3) rapidly transferring the steel plate or steel belt to the mold for hot stamping forming, wherein a transferring duration does not exceed 1 min, and the temp. of the hot stamping forming is controlled between 400-800°C. The tensile strength of the steel plate or steel belt after hot stamping is greater than 1,450 MPa, and substrate cracks caused by local press and LME in an element are avoided.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
AKIRA OBAYASHI	2005			CN 1600877 A	CAPLUS
BI WENZHEN	2017			CN 107127238 A	CAPLUS
BI WENZHEN	2017			CN 107127238 A	CAPLUS
BI WENZHEN	2019			CN 109365606 A	CAPLUS
KOJIMA TAKESHI	2017			CN 106756697 A	CAPLUS
SEKIDO YOSHITO	2013			JP 2013227614 A	CAPLUS
TAKEBAYASHI SHIGETO	2009			JP 2009228134 A	CAPLUS
WILHELM WARNECKE	2010			CN 101849029 A	CAPLUS
YI HONGLIANG	2015			CN 104846274 A	CAPLUS

IT 2293976-55-1
RL: MSC (Miscellaneous); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
RN 2293976-55-1 CAPLUS
CN Iron alloy, base, Fe 91-99,Mn 0.5-3,Si 0-2,Cr 0-1,Mo 0-1,V 0-1,C 0.1-0.8,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	91 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Si	0 - 2	7440-21-3
Cr	0 - 1	7440-47-3
Mo	0 - 1	7439-98-7
V	0 - 1	7440-62-2
C	0.1 - 0.8	7440-44-0
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0

IPCI B21D0022-02 [I]; C23C0002-06 [I]; C23C0002-40 [I]; C22C0018-00 [I]; C21D0008-02 [I]
IPCR B21D0022-02 [I]; C21D0008-02 [I]; C22C0018-00 [I]; C23C0002-06 [I]; C23C0002-40 [I]
CC 55-6 (Ferrous Metals and Alloys)
ST corrosion resistance zinc alloy coating steel hot stamping
IT Anticorrosive coating materials
Coating materials
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT Metalworking
(stamping, hot; Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT 2293976-55-1
RL: MSC (Miscellaneous); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT 2226545-76-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)

L12 ANSWER 14 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1041904 CAPLUS Full-text
DOCUMENT NUMBER: 173:612711
TITLE: Aluminum or aluminum alloy plated steel differential strength welded part and its manufacture
INVENTOR(S): Pan, Hua; Liu, Chengjie; Lei, Ming; Wu, Yue; Sun, Zhongqu; Jiang, Haomin
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 12pp.

CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 111215751	A	20200602	CN 2019-10249188	20190329
WO 2020200110	A1	20201008	WO 2020-CN81743	20200327

PRIORITY APPLN. INFO.: CN 2019-10249188 A 20190329

AB The invention discloses a steel differential strength welding part with an aluminum or aluminum alloy coating and a manufg. method thereof, wherein the steel differential strength welding part is formed by butt welding a high-strength steel plate and a low-strength steel plate, and the high-strength steel plate and the low-strength steel plate comprise a substrate and at least one of the surfaces of the substrate and the substrate is a pure aluminum or aluminum alloy coating; the high-strength steel plate matrix comprises the following components in percentage by wt.: c 0.08-0.8%, Si 0.05-1.0%, Mn 0.1-5%, P <0.3%, S <0.1%, Al <0.3%, Ti <0.5%, B 0.0005-0.1%, Cr 0.01-3%, residual Fe and inevitable impurities; the low-strength steel plate matrix comprises the following components in percentage by wt.: c 0.03-0.1%, Si 0-0.1%, Mn 1.0-2.0%, P <0.1%, S <0.05%, Al <0.1%, Cr 0-0.1%, Ti 0-0.05%, balance of Fe and inevitable impurities. The tensile strength of the welded part after hot stamping is greater than that of a low-strength steel base metal, the elongation is greater than 4%, and the application requirements of the welded part in the field of automobile hot stamping are met.

IT 2067242-22-0, C 0.08-0.8, Si 0.05-1, Mn 0.1-5, P 0-0.3, S 0-0.1, Al 0-0.3, Ti 0-0.5, B 0.0005-0.1, Cr 0.01-3, Fe bal.
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)

RN 2067242-22-0 CAPLUS

CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1	7440-21-3
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B23K0026-26; B23K0026-322; B23K0026-12; C22C0038-38; C22C0038-32; C22C0038-28; C22C0038-06; C22C0038-04; C22C0038-02
IPCR B23K0026-26 [I]; B23K0026-12 [I]; B23K0026-322 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-28 [I]; C22C0038-32 [I]; C22C0038-38 [I]
CC 55-9 (Ferrous Metals and Alloys)
ST r aluminum alloy plated steel differential strength welded part
IT Laser welding
Plating process
Tensile strength
Welds
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)
IT Welding of metals
(gas metal-arc welding; aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)
IT 2067242-22-0, C 0.08-0.8, Si 0.05-1, Mn 0.1-5, P 0-0.3, S 0-0.1, Al 0-0.3, Ti 0-0.5, B 0.0005-0.1, Cr 0.01-3, Fe bal. 2490151-15-8, C 0.03-0.1, Si 0-0.1, Mn 0.5-2, Al 0-0.1, Cr 0-0.1, Fe bal., processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)

(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)

IT 2490151-16-9, C 0.1-0.25, Si 0.2-0.4, Mn 1.2-2, Al 0-0.06, Ti 0.02-0.08, Cr 0.05-0.2, Fe bal., processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)

IT 7429-90-5, Aluminum, uses 1273096-81-3, Aluminum alloy
RL: TEM (Technical or engineered material use); USES (Uses)
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)

L12 ANSWER 15 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:185423 CAPLUS Full-text
DOCUMENT NUMBER: 172:169762
TITLE: Manufacture of hardened steel products with aluminum-based coatings
INVENTOR(S): Pohl, Stefan; Danger, Elisabeth; Labudde, Thorsten; Butzkamm, Juergen
PATENT ASSIGNEE(S): Muhr und Bender KG, Germany
SOURCE: PCT Int. Appl., 29pp.; Chemical Indexing Equivalent to 172:169761 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020020644	A1	20200130	WO 2019-EP68581	20190710
DE 102018118015	A1	20200130	DE 2018-102018118015	20180725
PRIORITY APPLN. INFO.:			DE 2018-102018118015 A	20180725

AB A method for producing a hardened steel product, comprises: providing a steel substrate made of a hardenable steel; coating the steel substrate with an aluminum pre-coating, the pre-coating being applied to the steel substrate with a thickness of at least 34μm; flexibly rolling the pre-coated steel substrate in order to produce a variable thickness over the length of the pre-coated steel substrate, the pre-coating being rolled out to a reduced first thickness of less than 33μm in thinner first portions and to a reduced second thickness, which is thicker than the reduced first thickness, in thicker second portions; creating a blank from the flexibly rolled steel substrate; heating the blank to the austenitization temp., diffusion processes between the base material and the pre-coating occurring; and hot-forming the heated blank, the heated blank being formed and being quickly cooled in such a way that a hardened steel product having a coating is produced.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
BATISTA LEONARDO MESQUI	2019			EP 3489386 A1	CAPLUS
Hauger, A	1995	23	40	Fertigung	
KIM HEUNG-YUN	2018			US 20180142337 A1	
MACHADO AMORIM	2017			WO 2017017521 A1	CAPLUS
SCHNEIDER DR CHRISTOPH	2017			EP 3181248 A1	
TANAHASHI HIROYUKI	2014			US 20140044987 A1	
WINKLHOFER KERRY	2008			DE 102007019196 A1	CAPLUS
Windmann, M	2014	246	17	Surface And Coatings	CAPLUS

IT 2408930-78-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrates; manuf. of hardened steel products with aluminum-based coatings)

RN 2408930-78-7 CAPLUS
CN Iron alloy, base, Fe 91-99,Mn 0.5-5,Cr 0-1,Mo 0-1,Si 0.1-0.9,C 0.2-0.5,Ti 0-0.2,V 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Nb 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number

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=========+=============+===============
    Fe     91    -  99        7439-89-6
    Mn      0.5 -   5         7439-96-5
    Cr      0   -   1         7440-47-3
    Mo      0   -   1         7439-98-7
    Si      0.1 -   0.9       7440-21-3
    C       0.2 -   0.5       7440-44-0
    Ti      0   -   0.2       7440-32-6
    V       0   -   0.2       7440-62-2
    Al      0   -   0.1       7429-90-5
    B       0   -   0.1       7440-42-8
    Cu      0   -   0.1       7440-50-8
    Nb      0   -   0.1       7440-03-1
    Ni      0   -   0.1       7440-02-0
    P       0   -   0.1       7723-14-0

IPCI C21D0001-673 [I]; B21B0037-24 [I]; B21B0037-26 [I]; C23C0002-12 [I]
IPCR C21D0001-673 [I]; B21B0037-24 [I]; B21B0037-26 [I]; C23C0002-12 [I]
CC   55-6 (Ferrous Metals and Alloys)
     Section cross-reference(s): 56
ST   hardened steel aluminum alloy coating silicon austenizing rolling
IT   Diffusion
     Heat treatment
     Hot-dip coating process
     Metal forming
     Rolling (metals)
     Thermomechanical metalworking
        (manuf. of hardened steel products with aluminum-based
        coatings)
IT   Oxides (inorganic)
     RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
        (manuf. of hardened steel products with aluminum-based
        coatings)
IT   7429-90-5, Aluminum, processes   77578-10-0
     RL: PEP (Physical, engineering or chemical process); TEM (Technical or
     engineered material use); PROC (Process); USES (Uses)
        (coatings; manuf. of hardened steel products with
        aluminum-based coatings)
IT   12597-69-2, Steel, processes   2408930-78-7
     RL: PEP (Physical, engineering or chemical process); TEM (Technical or
     engineered material use); PROC (Process); USES (Uses)
        (substrates; manuf. of hardened steel products with
        aluminum-based coatings)


L12  ANSWER 16 OF 398  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2020:178086  CAPLUS Full-text
DOCUMENT NUMBER:         172:169761
TITLE:                   Manufacture of hardened steel products with
                         aluminum-based coatings
INVENTOR(S):             Pohl, Stefan; Danger, Elisabeth; Labudde, Thorsten;
                         Butzkamm, Juergen
PATENT ASSIGNEE(S):      Muhr und Bender KG, Germany
SOURCE:                  Ger. Offen., 13pp.; Chemical Indexing Equivalent to
                         172:169762 (WO)
                         CODEN: GWXXBX
DOCUMENT TYPE:           Patent
LANGUAGE:                German
FAMILY ACC. NUM. COUNT:  2
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     DE 102018118015      A1   20200130    DE 2018-102018118015     20180725
     WO 2020020644        A1   20200130    WO 2019-EP68581          20190710
PRIORITY APPLN. INFO.:                    DE 2018-102018118015 A   20180725
AB   A method for producing a hardened steel product, comprises: providing a
     steel substrate made of a hardenable steel; coating the steel
     substrate with an aluminum pre-coating, the pre-coating being applied to
     the steel substrate with a thickness of at least 34μm; flexibly
     rolling the pre-coated steel substrate in order to produce a variable
     thickness over the length of the pre-coated steel substrate, the
     pre-coating being rolled out to a reduced first thickness of less than
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33μm in thinner first portions and to a reduced second thickness, which is thicker than the reduced first thickness, in thicker second portions; creating a blank from the flexibly rolled steel substrate; heating the blank to the austenitization temp., diffusion processes between the base material and the pre-coating occurring; and hot-forming the heated blank, the heated blank being formed and being quickly cooled in such a way that a hardened steel product having a coating is produced.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 102005031461 A1	CAPLUS
Anon				DE 102007013739 B3	CAPLUS
Anon				DE 102007019196 A1	CAPLUS
Anon				DE 102009007909 A1	CAPLUS
Anon	2019			Feuerverzinken In:Wi	
Anon				Salzgitter Flachstah	

IT 2408930-78-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrates; manuf. of hardened steel products with aluminum-based coatings)

RN 2408930-78-7 CAPLUS

CN Iron alloy, base, Fe 91-99,Mn 0.5-5,Cr 0-1,Mo 0-1,Si 0.1-0.9,C 0.2-0.5,Ti 0-0.2,V 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Nb 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	99	7439-89-6
Mn	0.5	-	5	7439-96-5
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
Si	0.1	-	0.9	7440-21-3
C	0.2	-	0.5	7440-44-0
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Cu	0	-	0.1	7440-50-8
Nb	0	-	0.1	7440-03-1
Ni	0	-	0.1	7440-02-0
P	0	-	0.1	7723-14-0

IPCI C23F0017-00 [I]; C23C0002-12 [I]; C22C0038-04 [I]
IPCR C23F0017-00 [I]; C22C0038-04 [I]; C23C0002-12 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST hardened steel aluminum alloy coating silicon austenizing rolling
IT Diffusion
Heat treatment
Hot-dip coating process
Metal forming
Rolling (metals)
Thermomechanical metalworking
(manuf. of hardened steel products with aluminum-based coatings)
IT Oxides (inorganic)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(manuf. of hardened steel products with aluminum-based coatings)
IT 7429-90-5, Aluminum, processes 77578-10-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(coatings; manuf. of hardened steel products with aluminum-based coatings)
IT 12597-69-2, Steel, processes 2408930-78-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrates; manuf. of hardened steel products with aluminum-based coatings)

L12 ANSWER 17 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1450710 CAPLUS Full-text
TITLE: The influence of the heating rate of cemented constructional steels on the growth of austenitic grain in the process of high-temperature holding
AUTHOR(S): Kukareko, V. A.; Valko, A. L.; Chichin, A. N.
CORPORATE SOURCE: Joint Institute of Mechanical Engineering of the National Academy of Sciences of Belarus, Minsk, Belarus
SOURCE: Vestsi Natsyyanal'nai Akademii Navuk Belarusi, Seryya Fizika-Tekhnichnykh Navuk (2018), (4), 399-406
CODEN: VABNFA; ISSN: 1561-8358
DIGITAL OBJECT ID: 10.29235/1561-8358-2018-63-4-399-406
PUBLISHER: Vydavetski Dom "Belaruskaya Navuka"
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB The influence of the heating mode of samples of constructional cemented steels 20KhNZA, 20KhGNR and 15KhGN2TA on the value of austenite grain after high-temp. isothermal aging at 1000 °C is studied. It is shown that the heating of steels at a rate of 1.2-3.0 °C/min in the phase-transformation interval stabilizes the grain structure of the steels and leads to a slowing down of the kinetics of the growth of austenite grains during prolonged high-temp. aging, which makes it possible to increase the temp. of the chem.-thermal treatment of steels. It is concluded that the stabilization of the grain structure of steels is assocd. with the formation of segregation of impurity atoms and particles at grain boundaries with high-angle disorientation during slow heating, which prevents migration of grain boundaries in the process of prolonged high-temp. aging. A high-temp. chem.-thermal treatment of a batch of billets from steel 20KhNZA under exptl. conditions with stepwise heating in the phase-transformation interval provided a qual. fine-grained structure of the cemented layer.
IT INDEXING IN PROGRESS
IT 37312-00-8, 20KhGNR
RL: TEM (Technical or engineered material use); USES (Uses)
(influence of heating rate of cemented constructional steels on growth of austenitic grain in process of high-temp. holding)
RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55 (Ferrous Metals and Alloys)
ST steel austenitic grain growth heating rate holding temp
IT Grain boundaries
Grain size
Heat treatment
Microhardness
Microstructure
Quenching (cooling)
(influence of heating rate of cemented constructional steels on growth of austenitic grain in process of high-temp. holding)

IT 37312-00-8, 20KhGNR 61431-72-9, 15KhGN2TA
RL: TEM (Technical or engineered material use); USES (Uses)
(influence of heating rate of cemented constructional steels on growth of austenitic grain in process of high-temp. holding)

L12 ANSWER 18 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1382711 CAPLUS Full-text
DOCUMENT NUMBER: 171:194698
TITLE: Electric resistance welded steel pipe with excellent fatigue strength and its manufacture for oil wells
INVENTOR(S): Sadasue, Teruki; Handa, Tsunehisa; Ikeda, Michimasa
PATENT ASSIGNEE(S): JFE Steel Corp., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 20pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2019116658	A	20190718	JP 2017-250540	20171227
JP 6760254	B2	20200923		

PRIORITY APPLN. INFO.: JP 2017-250540 20171227

AB The elec. resistance welding steel pipe comprises element in mass%: 0.001-0.50 of carbon (C), 0.001-2.0 of silicon (Si), 0.001-3.0 of manganese (Mn), 0-0.05 of phosphorus (P), 0-0.05 of sulfur (S), 0.010-0.060 of aluminum(Al) and balance of iron (Fe); a ferrite 0-70%, bainite contg. 30-50%, and the total of ferrite and bainite is 90% or more, and further 0-10% a structure consisting of pearlite or martensite; a fine carbides with a particle size of 0-500 nm are dispersed in the described structure, and static yield in the axial direction of the tube is obtained at the thickness center position obtained by the tensile test according to JIS Z 2241; the static yield strength in the axial direction is 360 MPa or more, and the static tensile strength is 520MPa or more; and a cyclic yield strength of 360MPa or more obtained from a cyclic stress distortion line obtained by applying a cyclic stress load of 0.1. According to the present invention, it is possible to provide a elec. resistance welding steel pipe with large thickness of 11.9mm or more, a large diam. of 219.1mm or more, and excellent fatigue strength.

IT 2363036-61-5P, C 0.001-0.50, Si 0.001-2.0, Mn 0.001-3.0, Al 0.010-0.060, Cu 0-5.0, Ni 0-5.0, Cr 0-5.0, Mo 0-5.0, Nb 0-0.5, V 0-0.5, Ti 0-0.5, B 0-0.1, Ca 0-0.1, Mis 0-0.1, Fe bal.
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(elec. resistance welded steel pipe with excellent fatigue strength and its manuf. for oil wells)
RN 2363036-61-5 CAPLUS
CN Iron alloy, base, Fe 73-100,Cr 0-5,Cu 0-5,Mo 0-5,Ni 0-5,Mn 0-3,Si 0-2,C 0-0.5,Nb 0-0.5,Ti 0-0.5,V 0-0.5,Al 0-0.1,B 0-0.1,Ca 0-0.1,misch metal 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	73 - 100	7439-89-6
Cr	0 - 5	7440-47-3
Cu	0 - 5	7440-50-8
Mo	0 - 5	7439-98-7
Ni	0 - 5	7440-02-0
Mn	0 - 3	7439-96-5
Si	0 - 2	7440-21-3
C	0 - 0.5	7440-44-0
Nb	0 - 0.5	7440-03-1
Ti	0 - 0.5	7440-32-6
V	0 - 0.5	7440-62-2
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Ca	0 - 0.1	7440-70-2
Misch metal	0 - 0.1	8049-20-5

IPCI C22C0038-00 [I]; C21D0008-02 [I]; C21D0009-08 [I]; C21D0009-50 [I];

C22C0038-60 [I]; C22C0038-00 [I]; C21D0008-02 [I]; C21D0009-08 [I];
C21D0009-50 [I]; C22C0038-60 [I]
IPCR C22C0038-00 [I]; C21D0008-02 [I]; C21D0009-08 [I]; C21D0009-50 [I];
C22C0038-60 [I]
CC 55-9 (Ferrous Metals and Alloys)
Section cross-reference(s): 51
ST elec resistance welding steel pipe manuf oil well
IT Casting of metals
(continuous; elec. resistance welded steel pipe with
excellent fatigue strength and its manuf. for oil wells)
IT Fatigue, mechanical
Hot rolling
Melting
Microstructure
Oil wells
Pipes and Tubes
Tempering
Tensile strength
Yield strength
(elec. resistance welded steel pipe with excellent fatigue
strength and its manuf. for oil wells)
IT Welding of metals
(resistance welding; elec. resistance welded steel pipe with
excellent fatigue strength and its manuf. for oil wells)
IT 2363036-61-5P, C 0.001-0.50, Si 0.001-2.0, Mn 0.001-3.0, Al
0.010-0.060, Cu 0-5.0, Ni 0-5.0, Cr 0-5.0, Mo 0-5.0, Nb 0-0.5, V 0-0.5, Ti
0-0.5, B 0-0.1, Ca 0-0.1, Mis 0-0.1, Fe bal.
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or
engineered material use); PREP (Preparation); USES (Uses)
(elec. resistance welded steel pipe with excellent fatigue
strength and its manuf. for oil wells)

L12 ANSWER 19 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1379929 CAPLUS Full-text
DOCUMENT NUMBER: 171:194695
TITLE: Large diameter electric resistance welded thick wall steel pipe with excellent fatigue strength and its manufacture for oil wells
INVENTOR(S): Sadasue, Teruki; Handa, Tsunehisa; Ikeda, Michimasa
PATENT ASSIGNEE(S): JFE Steel Corp., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 20pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2019116657	A	20190718	JP 2017-250538	20171227
JP 6773020	B2	20201021		

PRIORITY APPLN. INFO.: JP 2017-250538 20171227
AB The elec. resistance welded steel pipe comprises the following components in mass(%): 0.001-0.50 of carbon (C), 0.001-2.0 of silicon (Si), 0.001-3.0 of manganese (Mn), 0-0.05 of phosphorus, 0-0.05 of sulfur (S), 0.010-0.060 of aluminum (Al), balance of iron (Fe) and unavoidable impurities. The hot-rolled steel strip having a mixed phase composed of ferrite and pearlite as the main phase, and a structure composed of the main phase and the second phase of 0-30% in area ratio, and fine carbides with a particle size of 0-500 nm are dispersed, static yield strength of at least 245 MPa in the axial direction at a thickness center position, static tensile strength of at least 415 MPa, and stress ratio of 0.1 obtained by a tensile test, and cyclic yield strength detd. from a cyclic stress distortion line obtained by applying cyclic stress is at least 245 MPa. The manufg. method of elec. resistance welded steel pipe comprises the following steps: (1) performing hot-rolled steel strip to cold bending in the width direction of the material; (2) abutting against the end portions in the width direction of the open pipe, pressing, and welding to each other to form an elec. resistance welded steel pipe; and (3) performing low-temp. tempering treatment at a tempering temp. of 150 -350°c. According to the present invention, it is possible to provide an excellent elec. resistance welded steel pipe to the fatigue

strength of the pipe outer diam. of at least 219.1mm, and wall thickness is at least 11.9mm.

IT 2363036-61-5P, C 0.001-0.50, Si 0.001-2.0, Mn 0.001-3.0, Al 0.010-0.060, Fe bal., Cu 0-5.0, Ni 0-5.0, Cr 0-5.0, Mo 0-5.0, Nb 0-0.5, V 0-0.5, Ti 0-0.5, B 0-0.1, Ca 0-0.1, Mis 0-0.1
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(large diam. elec. resistance welded thick wall steel pipe with excellent fatigue strength and its manuf. for oil wells)

RN 2363036-61-5 CAPLUS

CN Iron alloy, base, Fe 73-100,Cr 0-5,Cu 0-5,Mo 0-5,Ni 0-5,Mn 0-3,Si 0-2,C 0-0.5,Nb 0-0.5,Ti 0-0.5,V 0-0.5,Al 0-0.1,B 0-0.1,Ca 0-0.1,misch metal 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	73 - 100	7439-89-6
Cr	0 - 5	7440-47-3
Cu	0 - 5	7440-50-8
Mo	0 - 5	7439-98-7
Ni	0 - 5	7440-02-0
Mn	0 - 3	7439-96-5
Si	0 - 2	7440-21-3
C	0 - 0.5	7440-44-0
Nb	0 - 0.5	7440-03-1
Ti	0 - 0.5	7440-32-6
V	0 - 0.5	7440-62-2
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Ca	0 - 0.1	7440-70-2
Misch metal	0 - 0.1	8049-20-5

IPCI C22C0038-00 [I]; C21D0009-08 [I]; C22C0038-60 [I]; C21D0008-02 [I]; C21D0009-50 [I]; C21D0008-10 [I]; C22C0038-00 [I]; C21D0009-08 [I]; C22C0038-60 [I]; C21D0008-02 [I]; C21D0009-50 [I]; C21D0008-10 [I]

IPCR C22C0038-00 [I]; C21D0008-02 [I]; C21D0008-10 [I]; C21D0009-08 [I]; C21D0009-50 [I]; C22C0038-60 [I]

CC 55-9 (Ferrous Metals and Alloys)
Section cross-reference(s): 51

ST elec resistance welded steel pipe manuf oil well

IT Casting of metals
(continuous; large diam. elec. resistance welded thick wall steel pipe with excellent fatigue strength and its manuf. for oil wells)

IT Fatigue, mechanical
Hot rolling
Melting
Metalworking
Microstructure
Oil wells
Pipes and Tubes
Tempering
Tensile strength
Yield strength
(large diam. elec. resistance welded thick wall steel pipe with excellent fatigue strength and its manuf. for oil wells)

IT Carbides
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(large diam. elec. resistance welded thick wall steel pipe with excellent fatigue strength and its manuf. for oil wells)

IT Welding of metals
(resistance welding; large diam. elec. resistance welded thick wall steel pipe with excellent fatigue strength and its manuf. for oil wells)

IT 2363036-61-5P, C 0.001-0.50, Si 0.001-2.0, Mn 0.001-3.0, Al 0.010-0.060, Fe bal., Cu 0-5.0, Ni 0-5.0, Cr 0-5.0, Mo 0-5.0, Nb 0-0.5, V 0-0.5, Ti 0-0.5, B 0-0.1, Ca 0-0.1, Mis 0-0.1
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(large diam. elec. resistance welded thick wall steel pipe with excellent fatigue strength and its manuf. for oil wells)

L12 ANSWER 20 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1378836 CAPLUS Full-text
DOCUMENT NUMBER: 171:194638
TITLE: Large-diameter electric-resistance welded steel pipe having thick wall and excellent fatigue strength and its manufacture for oil wells
INVENTOR(S): Sadasue, Teruki; Handa, Tsunehisa; Ikeda, Michimasa
PATENT ASSIGNEE(S): JFE Steel Corp., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 20pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2019116659	A	20190718	JP 2017-250541	20171227
JP 6773021	B2	20201021		

PRIORITY APPLN. INFO.: JP 2017-250541 20171227

AB The title elec.-resistance welded (ERW) steel pipe is excellent in fatigue strength, has a thickness of 11.9 mm or more and a pipe outer diam. of 219.1 mm or more. The steel pipe is manufd. from (by wt.%) a hot-rolled steel strip composed of C: 0.001-0.50%, Si: 0.001-2.0%, Mn: 0.00-3.0%, P: 0.05% or less, S: 0.05% or less, Al: 0.010-0.060%, Fe and unavoidable impurities as balance, and having an area ratio of 80% or more of bainite and less than 20% (including 0%) of ferrite or martensite, has a cylindrical shape by cold machining. The title method comprises butting the end in the width direction, pressing, elec. resistance welding, and low temp. tempering at 150-350 °C. The steel pipe has static yield strength of 450 MPa or more, static tensile strength of 535 MPa or more. The steel pipe has a cyclic yield strength of 450 MPa or more detd. from a cyclic stress distortion obtained by applying a cyclic stress load of a Charpy absorbed energy of 27 J or more and a stress ratio of 0.1 at a test temp. of 0°C.

IT 2363036-61-5P, Aluminum 0.01-0.06, boron 0-0.1, calcium 0-0.1, carbon 0.001-0.5, chromium 0-5, copper 0-5, iron bal., manganese 0.001-3, molybdenum 0-5, nickel 0-5, niobium 0-0.5, Mis 0-0.1, silicon 0.001-2, titanium 0-0.5, vanadium 0-0.5
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(large-diam. elec.-resistance welded steel pipe having thick wall and excellent fatigue strength and its manuf. for oil wells)

RN 2363036-61-5 CAPLUS
CN Iron alloy, base, Fe 73-100,Cr 0-5,Cu 0-5,Mo 0-5,Ni 0-5,Mn 0-3,Si 0-2,C 0-0.5,Nb 0-0.5,Ti 0-0.5,V 0-0.5,Al 0-0.1,B 0-0.1,Ca 0-0.1,misch metal 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	73 - 100	7439-89-6
Cr	0 - 5	7440-47-3
Cu	0 - 5	7440-50-8
Mo	0 - 5	7439-98-7
Ni	0 - 5	7440-02-0
Mn	0 - 3	7439-96-5
Si	0 - 2	7440-21-3
C	0 - 0.5	7440-44-0
Nb	0 - 0.5	7440-03-1
Ti	0 - 0.5	7440-32-6
V	0 - 0.5	7440-62-2
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Ca	0 - 0.1	7440-70-2
Misch metal	0 - 0.1	8049-20-5

IPCI C22C0038-00 [I]; C21D0008-02 [I]; C22C0038-60 [I]; C21D0009-08 [I]; C21D0009-50 [I]; C21D0008-10 [I]; C22C0038-00 [I]; C21D0008-02 [I]; C22C0038-60 [I]; C21D0009-08 [I]; C21D0009-50 [I]; C21D0008-10 [I]
IPCR C22C0038-00 [I]; C21D0008-02 [I]; C21D0008-10 [I]; C21D0009-08 [I];

C21D0009-50 [I]; C22C0038-60 [I]
CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 51
ST elec resistance welded steel pipe
IT Bending
Compression
Fatigue, mechanical
Microstructure
Oil wells
Pipes and Tubes
Tempering
Tensile strength
Yield strength
(large-diam. elec.-resistance welded steel pipe having thick wall and excellent fatigue strength and its manuf. for oil wells)
IT Welding of metals
(resistance welding; large-diam. elec.-resistance welded steel pipe having thick wall and excellent fatigue strength and its manuf. for oil wells)
IT 2363036-61-5P, Aluminum 0.01-0.06, boron 0-0.1, calcium 0-0.1, carbon 0.001-0.5, chromium 0-5, copper 0-5, iron bal., manganese 0.001-3, molybdenum 0-5, nickel 0-5, niobium 0-0.5, Mis 0-0.1, silicon 0.001-2, titanium 0-0.5, vanadium 0-0.5
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(large-diam. elec.-resistance welded steel pipe having thick wall and excellent fatigue strength and its manuf. for oil wells)

L12 ANSWER 21 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1254928 CAPLUS Full-text
DOCUMENT NUMBER: 171:98349
TITLE: Production of cold-rolled flat steel products having metal anti-corrosion layers
INVENTOR(S): Mraczek, Klemens; Muhr, Andreas; Haneder, Bernhard
PATENT ASSIGNEE(S): Voestalpine Stahl GmbH, Austria
SOURCE: PCT Int. Appl., 38pp.; Chemical Indexing Equivalent to 171:98344 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2019121793	A1	20190627	WO 2018-EP85664	20181218
DE 102017223633	A1	20190627	DE 2017-102017223633	20171221
EP 3728654	A1	20201028	EP 2018-826307	20181218
US 20200325552	A1	20201015	US 2020-16956301	20200619

PRIORITY APPLN. INFO.: DE 2017-102017223633 A 20171221
WO 2018-EP85664 W 20181218
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A cold-rolled flat steel contains, in addn. to iron and unavoidable impurities, (in wt.%): C: 0.01-0.35%, Mn: 1-4%, Si: 0.5-2.5%, Nb: up to 0.1%, Ti: 0.015-0.1%, P: up to 0.1%, Al: up to 0.15%, S: up to 0.01%, N: up to 0.1%, and optionally one or more elements from the group of rare earth metals, Mo, Cr, Zr, V, W, Co, Ni, B, Cu, Ca, with rare earth metals: up to 0.2%, Mo: up to 1%, Cr: up to 3%, Zr: up to 1%, V: up to 1%, W: up to 1%, Co: up to 1%, Ni: up to 2%, B: up to 0.1%, Cu: up to 3%, Ca: up to 0.015%. The flat steel products are manufd. by: melting then casting the steel melt to form a semi-finished product; hot-rolling the semi-finished product at 820-1000°C to form a hot strip; winding the hot strip at a temp. between room temp. and 750°C to form a coil; annealing the hot strip at 530-950°C for 1-50 h; cold-rolling the annealed hot strip to form a cold-rolled flat steel product in one or more stages with a total cold-rolling degree of at least 45%; final annealing of the cold-rolled flat steel product at 650-920°C for 30-1500 s; and applying a zinc-based metal anti-corrosion layer by electrolytic galvanizing or hot dip galvanizing of the cold-rolled and finally-annealed flat steel product. As a result of the final annealing of the cold-rolled flat steel product, an Si enrichment layer is created between a surface and a base material of the cold-rolled and

finally-annealed flat steel product, the max. Si content of which is higher by a factor of 3-8 than the Si content of the base material and which has a depth of 10 nm to 1 μm.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ARLAZAROV ARTEM	2017			EP 3146083 A1	CAPLUS
HAGA JUN	2013			JP 2013032582 A	CAPLUS
NAKAGAITO TATSUYA	2007			JP 2007224416 A	CAPLUS

IT 2351042-49-2P
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(sheets; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)

RN 2351042-49-2 CAPLUS

CN Iron alloy, base, Fe 78-98,Mn 1-4,Cr 0-3,Cu 0-3,Si 0.5-2.5,Ni 0-2,Al 0-1.5,Co 0-1,Mo 0-1,V 0-1,W 0-1,Zr 0-1,C 0-0.4,misch metal 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1,N 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	78 - 98	7439-89-6
Mn	1 - 4	7439-96-5
Cr	0 - 3	7440-47-3
Cu	0 - 3	7440-50-8
Si	0.5 - 2.5	7440-21-3
Ni	0 - 2	7440-02-0
Al	0 - 1.5	7429-90-5
Co	0 - 1	7440-48-4
Mo	0 - 1	7439-98-7
V	0 - 1	7440-62-2
W	0 - 1	7440-33-7
Zr	0 - 1	7440-67-7
C	0 - 0.4	7440-44-0
Misch metal	0 - 0.2	8049-20-5
Nb	0 - 0.2	7440-03-1
Ti	0 - 0.2	7440-32-6
B	0 - 0.1	7440-42-8
N	0 - 0.1	17778-88-0
P	0 - 0.1	7723-14-0

IPCI C21D0006-00 [I]; B21B0001-24 [I]; B21B0001-26 [I]; B21B0001-28 [I]; C21D0007-02 [I]; C21D0007-10 [I]; C21D0008-02 [I]; C21D0008-04 [I]; C23C0002-00 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C21D0001-26 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C25F0001-06 [I]; C23G0001-08 [I]; B21B0001-22 [I]

IPCR C21D0006-00 [I]; B21B0001-22 [I]; B21B0001-24 [I]; B21B0001-26 [I]; B21B0001-28 [I]; C21D0001-26 [I]; C21D0007-02 [I]; C21D0007-10 [I]; C21D0008-02 [I]; C21D0008-04 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C23C0002-00 [I]; C23G0001-08 [I]; C25F0001-06 [I]

CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 56

ST cold rolling annealing flat steel zinc anticorrosion coating

IT Galvanizing
(electrogalvanizing; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)

IT Annealing
Anticorrosive coating materials
Casting of metals
Cold rolling
Hot rolling
Hot-dip galvanizing
(prodn. of cold-rolled flat steel products having metal anti-corrosion layers)

IT 7440-66-6P, Zinc, preparation
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(coatings; prodn. of cold-rolled flat steel products having

metal anti-corrosion layers)
IT 2351042-49-2P
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(sheets; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)

L12 ANSWER 22 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1241982 CAPLUS Full-text
DOCUMENT NUMBER: 171:98344
TITLE: Production of cold-rolled flat steel products having metal anti-corrosion layers
INVENTOR(S): Mraczek, Klemens; Muhr, Andreas; Haneder, Bernhard
PATENT ASSIGNEE(S): Voestalpine Stahl GmbH, Austria
SOURCE: Ger. Offen., 17pp.; Chemical Indexing Equivalent to 171:98349 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102017223633	A1	20190627	DE 2017-102017223633	20171221
WO 2019121793	A1	20190627	WO 2018-EP85664	20181218
EP 3728654	A1	20201028	EP 2018-826307	20181218
US 20200325552	A1	20201015	US 2020-16956301	20200619

PRIORITY APPLN. INFO.: DE 2017-102017223633 A 20171221
WO 2018-EP85664 W 20181218
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A cold-rolled flat steel contains, in addn. to iron and unavoidable impurities, (in wt.%): C: 0.01-0.35%, Mn: 1-4%, Si: 0.5-2.5%, Nb: up to 0.1%, Ti: 0.015-0.1%, P: up to 0.1%, Al: up to 0.15%, S: up to 0.01%, N: up to 0.1%, and optionally one or more elements from the group of rare earth metals, Mo, Cr, Zr, V, W, Co, Ni, B, Cu, Ca, with rare earth metals: up to 0.2%, Mo: up to 1%, Cr: up to 3%, Zr: up to 1%, V: up to 1%, W: up to 1%, Co: up to 1%, Ni: up to 2%, B: up to 0.1%, Cu: up to 3%, Ca: up to 0.015%. The flat steel products are manufd. by: melting then casting the steel melt to form a semi-finished product; hot-rolling the semi-finished product at 820-1000°C to form a hot strip; winding the hot strip at a temp. between room temp. and 750°C to form a coil; annealing the hot strip at 530-950°C for 1-50 h; cold-rolling the annealed hot strip to form a cold-rolled flat steel product in one or more stages with a total cold-rolling degree of at least 45%; final annealing of the cold-rolled flat steel product at 650-920°C for 30-1500 s; and applying a zinc-based metal anti-corrosion layer by electrolytic galvanizing or hot dip galvanizing of the cold-rolled and finally-annealed flat steel product. As a result of the final annealing of the cold-rolled flat steel product, an Si enrichment layer is created between a surface and a base material of the cold-rolled and finally-annealed flat steel product, the max. Si content of which is higher by a factor of 3-8 than the Si content of the base material and which has a depth of 10 nm to 1 μm.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 102012013113 A1	CAPLUS
Anon				DE 102015111866 A1	CAPLUS
Anon				DE 102015112886 A1	CAPLUS
Anon				DE 102015112889 A1	CAPLUS
Anon				EP 2383353 A2	CAPLUS

IT 2351042-49-2P
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(sheets; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)
RN 2351042-49-2 CAPLUS
CN Iron alloy, base, Fe 78-98,Mn 1-4,Cr 0-3,Cu 0-3,Si 0.5-2.5,Ni 0-2,Al

0-1.5,Co 0-1,Mo 0-1,V 0-1,W 0-1,Zr 0-1,C 0-0.4,misch metal 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1,N 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	78 - 98	7439-89-6
Mn	1 - 4	7439-96-5
Cr	0 - 3	7440-47-3
Cu	0 - 3	7440-50-8
Si	0.5 - 2.5	7440-21-3
Ni	0 - 2	7440-02-0
Al	0 - 1.5	7429-90-5
Co	0 - 1	7440-48-4
Mo	0 - 1	7439-98-7
V	0 - 1	7440-62-2
W	0 - 1	7440-33-7
Zr	0 - 1	7440-67-7
C	0 - 0.4	7440-44-0
Misch metal	0 - 0.2	8049-20-5
Nb	0 - 0.2	7440-03-1
Ti	0 - 0.2	7440-32-6
B	0 - 0.1	7440-42-8
N	0 - 0.1	17778-88-0
P	0 - 0.1	7723-14-0

IPCI C22C0038-04 [I]; C22C0038-38 [I]; C22C0038-42 [I]; C22C0038-20 [I]
IPCR C22C0038-04 [I]; C22C0038-20 [I]; C22C0038-38 [I]; C22C0038-42 [I]
CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST cold rolling annealing flat steel zinc anticorrosion coating
IT Galvanizing
(electrogalvanizing; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)
IT Annealing
Anticorrosive coating materials
Casting of metals
Cold rolling
Hot rolling
Hot-dip galvanizing
(prodn. of cold-rolled flat steel products having metal anti-corrosion layers)
IT 7440-66-6P, Zinc, preparation
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(coatings; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)
IT 2351042-49-2P
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(sheets; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)

L12 ANSWER 23 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1102670 CAPLUS Full-text
DOCUMENT NUMBER: 171:64050
TITLE: Manufacture of bainite-martensite-austenite multiphase abrasion-resistant steel
INVENTOR(S): Liu, Xin; Zhu, Ming; Zhang, Chi; Liu, Wenli
PATENT ASSIGNEE(S): Zijing Slurry Pipeline Engineering Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 11pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 109825774	A	20190531	CN 2019-10287951	20190411

CN 109825774 B 20201211
PRIORITY APPLN. INFO.: CN 2019-10287951 20190411
AB The invention discloses a prepn. method of bainite/martensite austenite multiphase abrasion-resistant steel, which adopts mutual restriction of multiple alloy elements and small addn. amt., namely, an upper bainite structure is started to widen and obtain a structure range, a heat treatment mode adopts quick cooling from austenite to BS point, an upper bainite structure and a lower bainite structure are obtained at an intermediate temp. through slow cooling and temp. change, a martensite retained austenite structure is obtained at an isothermal temp. in a low temp. range, and the whole process is continuously and continuously produced. The wear-resistant steel composed of a plurality of composite structures of upper bainite martensite austenite and lower bainite martensite austenite is obtained, and the wear-resistant steel can resist impact and cutting wear and corrosion under various environments. The prodn. process simplifies the process for controlling the cooling speed, and is convenient for large-scale prodn., simple control, good in quality and high in wear resistance.
IT 2345668-52-0P, C 0.2-0.6, Mn 1.5-5, Cr 0.1-3, Al 0.1-3, Si 0.1-3, Mo 0.1-1, Ni 0.1-2, Cu 0.1-1, P 0-0.2, B 0-0.3, V 0-1, W 0-1, Ti 0-0.3, Nb 0-0.3, Re 0-0.3, Ca 0-0.3, Sn 0-0.3, W 0-1, Fe bal.
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(manuf. of bainite-martensite-austenite multiphase abrasion-resistant steel)
RN 2345668-52-0 CAPLUS
CN Iron alloy, base, Fe 77-98,Mn 1.5-5,Al 0.1-3,Cr 0.1-3,Si 0.1-3,Ni 0.1-2,Cu 0.1-1,Mo 0.1-1,V 0-1,W 0-1,C 0.2-0.6,B 0-0.3,Ca 0-0.3,Nb 0-0.3,Re 0-0.3,Sn 0-0.3,Ti 0-0.3,P 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	77	-	98	7439-89-6
Mn	1.5	-	5	7439-96-5
Al	0.1	-	3	7429-90-5
Cr	0.1	-	3	7440-47-3
Si	0.1	-	3	7440-21-3
Ni	0.1	-	2	7440-02-0
Cu	0.1	-	1	7440-50-8
Mo	0.1	-	1	7439-98-7
V	0	-	1	7440-62-2
W	0	-	1	7440-33-7
C	0.2	-	0.6	7440-44-0
B	0	-	0.3	7440-42-8
Ca	0	-	0.3	7440-70-2
Nb	0	-	0.3	7440-03-1
Re	0	-	0.3	7440-15-5
Sn	0	-	0.3	7440-31-5
Ti	0	-	0.3	7440-32-6
P	0	-	0.2	7723-14-0

IPCI C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-42; C22C0038-44; C22C0038-58; C22C0038-54; C22C0038-46; C22C0038-50; C22C0038-48; C21D0008-00; C21D0001-18
IPCR C22C0038-02 [I]; C21D0001-18 [I]; C21D0008-00 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-42 [I]; C22C0038-44 [I]; C22C0038-46 [I]; C22C0038-48 [I]; C22C0038-50 [I]; C22C0038-54 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST bainite martensite austenite multiphase abrasion resistant steel manuf
IT Abrasion-resistant materials
Casting of metals
Forging
Heat treatment
Hot rolling
Melting
Microstructure
(manuf. of bainite-martensite-austenite multiphase abrasion-resistant steel)
IT 2345668-52-0P, C 0.2-0.6, Mn 1.5-5, Cr 0.1-3, Al 0.1-3, Si 0.1-3, Mo 0.1-1, Ni 0.1-2, Cu 0.1-1, P 0-0.2, B 0-0.3, V 0-1, W 0-1, Ti 0-0.3, Nb 0-0.3, Re 0-0.3, Ca 0-0.3, Sn 0-0.3, W 0-1, Fe bal.

RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(manuf. of bainite-martensite-austenite multiphase abrasion-resistant steel)

L12 ANSWER 24 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1019962 CAPLUS Full-text
DOCUMENT NUMBER: 171:30626
TITLE: Ultra-high strength and excellent ductility in multi-layer steel sheet of austenitic hadfield and martensitic hot-press-forming steels
AUTHOR(S): Park, Jaeyeong; Jo, Min Cheol; Song, Taejin; Kim, Hyoung Seop; Sohn, Seok Su; Lee, Sunghak
CORPORATE SOURCE: Center for Advanced Aerospace Materials, Pohang University of Science and Technology, Pohang, 790-784, S. Korea
SOURCE: Materials Science & Engineering, A: Structural Materials: Properties, Microstructure and Processing (2019), 759, 320-328
CODEN: MSAPE3; ISSN: 0921-5093
DIGITAL OBJECT ID: 10.1016/j.msea.2019.05.046
PUBLISHER: Elsevier B.V.
DOCUMENT TYPE: Journal; (online computer file)
LANGUAGE: English
AB An austenitic Hadfield steel sheet shows a relatively low yield strength of 0.4-0.5 GPa and serrated flows in spite of excellent tensile strength and ductility along with highly-sustained strain hardening. In order to overcome the shortcomings, a multi-layer steel (MLS) sheet was fabricated by a roll-bonding with an ultra-high-strength martensitic hot-press-forming (HPF) steel sheet. Near the Hadfield/HPF interface, the carburized and decarburized layers were formed by the carbon diffusion from the Hadfield (1.2% of C) to HPF (0.23% of C) layers, and could generate a kind of very thin multi-layers of 35 μm in thickness. All tensile properties of the Hadfield/HPF MLS sheet (yield strength; 946 MPa, tensile strength; 1291 MPa, elongation; 44.5%) were superior to those of the Hadfield sheet. Interestingly, the persistent elongation up to 44.5%, which is higher than that of the Hadfield steel, in the present MLS sheet is a quite unique and interesting characteristic. The simultaneous enhancement of strength and ductility of the MLS sheet was explained by the contributions of (1) populated twin formation, (2) generation of geometrically necessary dislocations (GNDs), and (3) increase of back stress inside thin interfacial layers.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				K. Sato, Q. Yu, J. H	
Barbier, D	2009	500	196	Mater Sci Eng A	
Bouaziz, O	2016	18	56	Adv Eng Mater	CAPLUS
Calcagnotto, M	2011	59	658	Acta Mater	CAPLUS
Cetin, A	2012	60	2265	Acta Mater	CAPLUS
Chateau, J	2010	240	012023	J Phys Conf Ser	
Chen, L	2007	47	1804	ISIJ Int	CAPLUS
Curtze, S	2010	58	5129	Acta Mater	CAPLUS
Dini, G	2010	64	15	Mater Lett	CAPLUS
Dinsdale, A	1991	15		Calphad	CAPLUS
Dumay, A	2008	483-4	184	Mater Sci Eng A	
Eshelby, J	1951	42	351	Lond Edinb Dublin Ph	
Fan, D	2009	80	241	Steel Res Int	CAPLUS
Frommeyer, G	2003	43	438	ISIJ Int	CAPLUS
Grassel, O	2000	16	1391	Int J Plast	CAPLUS
Gwon, H	2019	25	594	Met Mater Int	CAPLUS
Han, Y	2012	553	192	Mater Sci Eng A	CAPLUS
Hild, F	2006	42	69	Strain	
Hirth, J	1982			Theory of Dislocatio	
Inoue, J	2008	59	1055	Scripta Mater	CAPLUS
Kang, M	2017	700	387	Mater Sci Eng A	CAPLUS
Kang, S	2010	527	745	Mater Sci Eng A	
Kim, J	2019			Met Mater Int	
Koseki, T	2014	55	227	Mater Trans	CAPLUS
Kubin, L	2003	48	119	Scripta Mater	CAPLUS

Kurt, B	2009	60	1035	Mater Char	CAPLUS
Laws, N	1977	7	91	J Elast	
Lebedkina, T	2009	519	147	Mater Sci Eng A	
Lee, D	1988	23	558	J Mater Sci	CAPLUS
Lee, Y	2000	31	355	Metall Mater Trans A	
Li, Y	2018	731	377	Mater Sci Eng A	CAPLUS
Liu, B	2017	679	172	Mater Sci Eng A	CAPLUS
Ma, X	2016	116	43	Acta Mater	CAPLUS
Matlock, D	2012	15	1	JESTECH	
Morito, S	2005	45	91	ISIJ Int	CAPLUS
Nambu, S	2009	69	1936	Compos Sci Technol	CAPLUS
Nambu, S	2009	60	221	Scripta Mater	CAPLUS
Ojima, M	2009	529	16	Mater Sci Eng A	
Ojima, M	2012	66	139	Scripta Mater	CAPLUS
Pan, B	2009	20	1	Meas Sci Technol	
Park, J	2017	7	40231	Sci Rep	CAPLUS
Park, K	2001	7	95	Met Mater Int	CAPLUS
Saleh, A	2011	528	4537	Mater Sci Eng A	
Scott, C	2011	102	538	Int J Mater Res	CAPLUS
Semiatin, S	1979	10	85	Metall Trans A	
Seok, M	2016	121	164	Acta Mater	CAPLUS
Srivastava, A	2008	43	5654	J Mater Sci	CAPLUS
Ueji, R	2012	47	7946	J Mater Sci	CAPLUS
Ueji, R	2008	59	963	Scripta Mater	CAPLUS
Wu, X	2015	112	14501	Proc Natl Acad Sci U	CAPLUS
Xie, G	2011	52	1709	Mater Trans	CAPLUS
Yan, F	2014	81	487	Acta Mater	CAPLUS
Yang, M	2016	4	145	Mater Res Lett	CAPLUS
Yang, W	1990	25	1821	J Mater Sci	CAPLUS
Zuidema, B	1987	18	1629	Metall Trans A	

IT 2334123-60-1, Fe bal., C 0.23, Mn 1.2, Si 0.41, Cr 0.2, Ti 0-0.06, B 0-0.06, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(ultra-high strength and excellent ductility in multi-layer steel sheet of austenitic hadfield and martensitic hot-press-forming steels)
RN 2334123-60-1 CAPLUS
CN Steel, Fe 98,Mn 1.2,Si 0.4,C 0.2,Cr 0.2,B 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	98			7439-89-6
Mn	1.2			7439-96-5
Si	0.4			7440-21-3
C	0.2			7440-44-0
Cr	0.2			7440-47-3
B	0	-	0.1	7440-42-8
Ti	0	-	0.1	7440-32-6

CC 55-12 (Ferrous Metals and Alloys)
ST steel multilayer sheet strength ductility microstructure
IT Elongation, mechanical
Hot-press molding
Microstructure
Multilayers
Sheet materials
Solid-solid interface
Strain hardening
Stress-strain relationship
Tensile strength
Yield strength
(ultra-high strength and excellent ductility in multi-layer steel sheet of austenitic hadfield and martensitic hot-press-forming steels)
IT 2334123-57-6, Fe bal., C 1.2, Mn 13.6, Si 0.2 2334123-60-1, Fe bal., C 0.23, Mn 1.2, Si 0.41, Cr 0.2, Ti 0-0.06, B 0-0.06, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(ultra-high strength and excellent ductility in multi-layer steel sheet of austenitic hadfield and martensitic

hot-press-forming steels)
OS.CITING REF COUNT: 3 THERE ARE 3 CAPLUS RECORDS THAT CITE THIS RECORD
(3 CITINGS)

L12 ANSWER 25 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:949375 CAPLUS Full-text
DOCUMENT NUMBER: 170:609630
TITLE: Al plated steel pipe parts by STAF method
INVENTOR(S): Maki, Jun; Fujita, Soshi; Nakamura, Toyomitsu
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 21pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2019073778	A	20190516	JP 2017-201702	20171018

PRIORITY APPLN. INFO.: JP 2017-201702 20171018

AB The present invention relates to an Al plated steel pipe parts comprising a hollow portion having a predetd. cross-sectional shape; and a flange portion projecting from the outer surface of the hollow portion; wherein the hollow portion and the flange portion are made of the same steel material as a material, and the surface of the hollow portion and the flange portion is coated with a plating layer contg. at least one of an Al-Fe-based alloy and an Al-Fe-Si-based alloy. The Al plated steel pipe parts has thickness of the plating layer is in the range of 5-50 μm, and the surface roughness of the plating layer at the flange portion is in the range of 0.3-1.2 μ m as a center line av. roughness Ra defined by JIS B0610. The Al-plated steel pipe part has excellent spot weldability manufd. by processing an Al-plated steel pipe by the STAF method.

IT 2320493-55-6, Aluminum 0-0.1, boron 0.0001-0.1, carbon 0.15-0.5, chromium 0-1.5, iron bal., manganese 0.6-3, nitrogen 0-0.006, phosphorus 0-0.01, silicon 0.01-2, titanium 0.01-0.1
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum plated steel pipe parts by STAF method)
RN 2320493-55-6 CAPLUS
CN Iron alloy, base, Fe 93-99,Mn 0.6-3,Si 0-2,Cr 0-1.5,C 0.2-0.5,Al 0-0.1,B 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	93	-	99	7439-89-6
Mn	0.6	-	3	7439-96-5
Si	0	-	2	7440-21-3
Cr	0	-	1.5	7440-47-3
C	0.2	-	0.5	7440-44-0
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Ti	0	-	0.1	7440-32-6

IPCI C23C0002-12 [I]; C23C0002-26 [I]; C22C0038-00 [I]; C22C0038-04 [I]; C22C0038-38 [I]; B21D0026-035 [N]; B21D0026-059 [N]; C22C0021-02 [N]; C21D0009-08 [N]
IPCR C23C0002-12 [I]; C22C0038-00 [I]; C22C0038-04 [I]; C22C0038-38 [I]; C23C0002-26 [I]
CC 55-6 (Ferrous Metals and Alloys)
ST aluminum plating steel pipe parts
IT Coating materials
Pipes and Tubes
(aluminum plated steel pipe parts by STAF method)
IT 12043-58-2
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(aluminum plated steel pipe parts by STAF method)
IT 2320493-55-6, Aluminum 0-0.1, boron 0.0001-0.1, carbon 0.15-0.5, chromium 0-1.5, iron bal., manganese 0.6-3, nitrogen 0-0.006, phosphorus 0-0.01, silicon 0.01-2, titanium 0.01-0.1

RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum plated steel pipe parts by STAF method)

IT 1314-13-2, Zinc oxide, uses 7429-90-5, Aluminum, uses 11114-60-6 11116-16-8, Titanium nitride 11122-26-2 12705-37-2, Chromium nitride
RL: TEM (Technical or engineered material use); USES (Uses)
(aluminum plated steel pipe parts by STAF method)

L12 ANSWER 26 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:903363 CAPLUS Full-text
DOCUMENT NUMBER: 170:588989
TITLE: Piercer plug made of seamless steel, and its manufacturing method
INVENTOR(S): Hidaka, Yasuyoshi; Shirasawa, Naoya; Miyai, Tatsuya
PATENT ASSIGNEE(S): Nippon Steel Corporation, Japan
SOURCE: PCT Int. Appl., 27pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.		DATE
WO 2019087510	A1	20190509	WO 2018-JP29879		20180809
CN 111315906	A	20200619	CN 2018-80071094		20180809
BR 112020002943	A2	20200811	BR 2020-112020002943		20180809
EP 3705591	A1	20200909	EP 2018-874192		20180809
US 20200263282	A1	20200820	US 2020-16646739		20200312
PRIORITY APPLN. INFO.:			JP 2017-212753	A	20171102
			WO 2018-JP29879	W	20180809

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The piercer plug comprises the following component in mass (%): 0.15-0.3 of carbon, 0.4-1.2 of silicon, 0.2-1.5 of manganese, 0.1-2 of nickel, 0-4 each of molybdenum and tungsten, 1-4 of chromium, 0-0.2 of boron, 0-1 of niobium , 0-1 of vanadium, 0-1 of titanium, and iron being balance and impurities. The piercer plug further comprises a tip section and a body section made of the same material; wherein the body section includes a cylindrical unit which is a hole for attaching a bar and the tip section is harder than the cylindrical unit. The manufg. method of piercer plug comprises a protective film forming on the surface of the piercer plug to the heating, wherein the protective film is a thermal sprayed coating and a buildup layer. According to the present invention, it is possible to provide a highly recyclable piercer plug.

IT 2315454-12-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(piercer plug made of seamless steel, and its manufg. method)

RN 2315454-12-5 CAPLUS
CN Iron alloy, base, Fe 82-97,Cr 1-4,Mo 0-4,W 0-4,Ni 0.1-2,Mn 0.2-1.5,Si 0.4-1.2,Nb 0-1,Ti 0-1,V 0-1,C 0.2-0.3,B 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	82	-	97	7439-89-6
Cr	1	-	4	7440-47-3
Mo	0	-	4	7439-98-7
W	0	-	4	7440-33-7
Ni	0.1	-	2	7440-02-0
Mn	0.2	-	1.5	7439-96-5
Si	0.4	-	1.2	7440-21-3
Nb	0	-	1	7440-03-1
Ti	0	-	1	7440-32-6
V	0	-	1	7440-62-2
C	0.2	-	0.3	7440-44-0
B	0	-	0.2	7440-42-8

IPCI C22C0038-00 [I]; C21D0009-00 [I]; C22C0038-54 [I]
IPCR C22C0038-00 [I]; C21D0009-00 [I]; C22C0038-54 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST carbon boron seamless steel piercer plug

IT 2315454-12-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(piercer plug made of seamless steel, and its manufg. method)

L12 ANSWER 27 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:807393 CAPLUS Full-text
DOCUMENT NUMBER: 170:538936
TITLE: Manufacture of steel components having a metal coating protecting it against corrosion
INVENTOR(S): Banik, Janko; Koeyer, Maria; Rosenstock, Dirk; Ruthenberg, Manuela
PATENT ASSIGNEE(S): Thyssenkrupp Steel Europe AG, Germany; Thyssenkrupp AG
SOURCE: PCT Int. Appl., 26pp.; Chemical Indexing Equivalent to 170:538935 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2019076720	A1	20190425	WO 2018-EP77692	20181011
DE 102017218704	A1	20190425	DE 2017-102017218704	20171019
CN 110997951	A	20200410	CN 2018-80049166	20181011
EP 3697936	A1	20200826	EP 2018-804228	20181011
US 20200216925	A1	20200709	US 2020-16647894	20200317

PRIORITY APPLN. INFO.: DE 2017-102017218704 A 20171019
WO 2018-EP77692 W 20181011
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A method for producing a steel component comprising a steel substrate and an aluminum alloy-based anti-corrosion coating, is described for use in the automotive sector.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
BANIK JANKO	2016			EP 2993248 A1	CAPLUS
COBO SEBASTIAN	2017			US 20170253941 A1	
KUSUMI K	2007			EP 1767286 A1	CAPLUS
MAKI JUN	2014			EP 2695963 A1	CAPLUS
ROSENSTOCK DIRK	2018			WO 2018234102 A1	CAPLUS

IT 2307271-66-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; manuf. of steel components having a metal coating protecting it against corrosion)
RN 2307271-66-3 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.1 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0

IPCI C21D0001-76 [I]; B21D0022-02 [I]; B21D0022-20 [I]; C21D0007-13 [I]; C23C0002-12 [I]; C23C0002-26 [I]; C23C0002-28 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C21D0001-673 [I]
IPCR C21D0001-76 [I]; B21D0022-02 [I]; B21D0022-20 [I]; C21D0001-673 [I]; C21D0007-13 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C23C0002-12 [I]; C23C0002-26 [I]; C23C0002-28 [I]

CC 55-10 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST steel metal prevention corrosion coating
IT Automobile bodies
(chassis; manuf. of steel components having a metal coating protecting it against corrosion)
IT Anticorrosive coating materials
Automobile bodies
Automotive bumpers
(manuf. of steel components having a metal coating protecting it against corrosion)
IT 1273096-81-3P, Aluminum alloy 2307271-67-4P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(anti-corrosion coatings; manuf. of steel components having a metal coating protecting it against corrosion)
IT 1333-74-0, Hydrogen, uses
RL: MOA (Modifier or additive use); USES (Uses)
(in steel; manuf. of steel components having a metal coating protecting it against corrosion)
IT 12597-69-2P, Steel, preparation 2307271-66-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; manuf. of steel components having a metal coating protecting it against corrosion)

L12 ANSWER 28 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:805627 CAPLUS Full-text
DOCUMENT NUMBER: 170:527030
TITLE: Enamelling of high-strength steels
INVENTOR(S): Myslowicki, Stefan
PATENT ASSIGNEE(S): ThyssenKrupp Steel Europe AG, Germany; ThyssenKrupp AG
SOURCE: PCT Int. Appl., 28pp.; Chemical Indexing Equivalent to 170:527029 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2019076717	A1	20190425	WO 2018-EP77686	20181011
DE 102017218434	A1	20190418	DE 2017-102017218434	20171016
EP 3697545	A1	20200826	EP 2018-786281	20181011
PRIORITY APPLN. INFO.:			DE 2017-102017218434 A	20171016
			WO 2018-EP77686 W	20181011

AB A shaped part having at least two layers, comprises at least one layer made of high-strength steel with a tensile strength ≥500 MPa and a hardness ≥160 HV, and at least one layer made of a steel that has an enamel layer on the outer side. The shaped part are suitable for producing pipelines, pressure vessels, reactors or in app. engineering, in particular for the transport of aq. and/or corrosive media.
IT 2306234-82-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enamelling of high-strength steels)
RN 2306234-82-0 CAPLUS
CN Iron alloy, base, Fe 85-99,Mn 0.5-3,Al 0-3,Si 0.1-2.5,P 0-1.5,Cr 0-1,Mo 0-1,V 0-1,Ti 0-0.8,Nb 0-0.5,C 0-0.4,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	85 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Al	0 - 3	7429-90-5
Si	0.1 - 2.5	7440-21-3
P	0 - 1.5	7723-14-0
Cr	0 - 1	7440-47-3
Mo	0 - 1	7439-98-7
V	0 - 1	7440-62-2

Ti	0	-	0.8	7440-32-6
Nb	0	-	0.5	7440-03-1
C	0	-	0.4	7440-44-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B21B0001-38 [I]; C21D0008-02 [I]; C21D0009-46 [I]; C22C0038-02 [I]; C23D0005-00 [I]
IPCR B21B0001-38 [I]; C21D0008-02 [I]; C21D0009-46 [I]; C22C0038-02 [I]; C23D0005-00 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 57
ST enamel strength steel bilayer
IT Enameling
Enamels (vitreous)
Pipelines
Pressure vessels
Reactors
(enamelling of high-strength steels)
IT 2306234-83-1P, preparation
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enameled; enamelling of high-strength steels)
IT 12597-69-2P, Steel, preparation 59816-66-9P, preparation
2306234-82-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enamelling of high-strength steels)

L12 ANSWER 29 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:802752 CAPLUS Full-text
DOCUMENT NUMBER: 170:538935
TITLE: Manufacture of steel components having a metal coating protecting it against corrosion
INVENTOR(S): Banik, Janko; Koeyer, Maria; Rosenstock, Dirk; Ruthenberg, Manuela
PATENT ASSIGNEE(S): Thyssenkrupp AG, Germany; Thyssenkrupp Steel Europe AG
SOURCE: Ger. Offen., 17pp.; Chemical Indexing Equivalent to 170:538936 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102017218704	A1	20190425	DE 2017-102017218704	20171019
WO 2019076720	A1	20190425	WO 2018-EP77692	20181011
CN 110997951	A	20200410	CN 2018-80049166	20181011
EP 3697936	A1	20200826	EP 2018-804228	20181011
US 20200216925	A1	20200709	US 2020-16647894	20200317
PRIORITY APPLN. INFO.:			DE 2017-102017218704 A	20171019
			WO 2018-EP77692 W	20181011

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A method for producing a steel component comprising a steel substrate and an aluminum alloy-based anti-corrosion coating, is described for use in the automotive sector.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				EP 1767286 A1	CAPLUS
Anon				US 20120085467 A1	CAPLUS
Anon				EP 2377965 A2	CAPLUS
Anon				EP 2993248 A1	CAPLUS

IT 2307271-66-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; manuf. of steel components having a metal coating protecting it against corrosion)
RN 2307271-66-3 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.1 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0

IPCI C22C0038-04 [I]; C23C0002-12 [I]; C23C0002-26 [I]; C21D0001-673 [I]
IPCR C22C0038-04 [I]; C21D0001-673 [I]; C23C0002-12 [I]; C23C0002-26 [I]
CC 55-10 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST steel metal prevention corrosion coating
IT Automobile bodies
(chassis; manuf. of steel components having a metal coating protecting it against corrosion)
IT Anticorrosive coating materials
Automobile bodies
Automotive bumpers
(manuf. of steel components having a metal coating protecting it against corrosion)
IT 1273096-81-3P, Aluminum alloy 2307271-67-4P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(anti-corrosion coatings; manuf. of steel components having a metal coating protecting it against corrosion)
IT 1333-74-0, Hydrogen, uses
RL: MOA (Modifier or additive use); USES (Uses)
(in steel; manuf. of steel components having a metal coating protecting it against corrosion)
IT 12597-69-2P, Steel, preparation 2307271-66-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; manuf. of steel components having a metal coating protecting it against corrosion)

L12 ANSWER 30 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:746016 CAPLUS Full-text
DOCUMENT NUMBER: 170:527029
TITLE: Enamelling of high-strength steels
INVENTOR(S): Myslowicki, Stefan
PATENT ASSIGNEE(S): ThyssenKrupp AG, Germany; ThyssenKrupp Steel Europe AG
SOURCE: Ger. Offen., 20pp.; Chemical Indexing Equivalent to 170:527030 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102017218434	A1	20190418	DE 2017-102017218434	20171016
WO 2019076717	A1	20190425	WO 2018-EP77686	20181011
EP 3697545	A1	20200826	EP 2018-786281	20181011
PRIORITY APPLN. INFO.:			DE 2017-102017218434 A	20171016
			WO 2018-EP77686 W	20181011

AB A shaped part having at least two layers, comprises at least one layer made of high-strength steel with a tensile strength ≥500 MPa and a hardness ≥160 HV, and at least one layer made of a steel that has an enamel layer on the outer side. The shaped part are suitable for producing pipelines, pressure vessels, reactors or in app. engineering, in particular for the transport of aq. and/or corrosive media.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 102008022709 A1	CAPLUS
Anon				DE 1533303 C2	
Anon				EP 2227574 B1	CAPLUS

IT 2306234-82-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enamelling of high-strength steels)
RN 2306234-82-0 CAPLUS
CN Iron alloy, base, Fe 85-99,Mn 0.5-3,Al 0-3,Si 0.1-2.5,P 0-1.5,Cr 0-1,Mo 0-1,V 0-1,Ti 0-0.8,Nb 0-0.5,C 0-0.4,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	85 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Al	0 - 3	7429-90-5
Si	0.1 - 2.5	7440-21-3
P	0 - 1.5	7723-14-0
Cr	0 - 1	7440-47-3
Mo	0 - 1	7439-98-7
V	0 - 1	7440-62-2
Ti	0 - 0.8	7440-32-6
Nb	0 - 0.5	7440-03-1
C	0 - 0.4	7440-44-0
B	0 - 0.1	7440-42-8
S	0 - 0.1	7704-34-9

IPCI C23D0005-00 [I]; B23K0020-04 [I]
IPCR C23D0005-00 [I]; B23K0020-04 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 57
ST enamel strength steel bilayer
IT Enameling
Enamels (vitreous)
Pipelines
Pressure vessels
Reactors
(enamelling of high-strength steels)
IT 2306234-83-1P, preparation
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enameled; enamelling of high-strength steels)
IT 12597-69-2P, Steel, preparation 59816-66-9P, preparation
2306234-82-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enamelling of high-strength steels)

L12 ANSWER 31 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:570060 CAPLUS Full-text
DOCUMENT NUMBER: 170:493791
TITLE: Method for manufacturing hot stamped parts with aluminum-silicon alloy coating and hot stamped parts
INVENTOR(S): Tan, Ning; Fu, Jiang; Hong, Jiyao; Fang, Xuehua
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 13pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 109518114	A	20190326	CN 2018-11035118	20180906
WO 2020030200	A1	20200213	WO 2019-CN104708	20190906
EP 3770295	A1	20210127	EP 2019-847997	20190906

PRIORITY APPLN. INFO.: CN 2018-10896744 A 20180808
CN 2018-11035118 A 20180906
WO 2019-CN104708 W 20190906

AB The title method comprises the following steps of: processing steel plate coated with aluminum-silicon alloy coating to form a blank of a desired shape of the part, heat treating the blank, and hot stamping. The blank heat treatment adopts two-stage or three-stage heating and heat preservation, and the heating and heat preservation are stepwise heating. The steel plate coated with aluminum-silicon alloy coating include a substrate and an aluminum-silicon alloy coating on at least one surface thereof. The method fully considers the characteristics of the aluminum-silicon coating, is able to effectively solve the problem of roll banding of the aluminum-silicon coating, reduces the nodulation probability of the roller of the heat treatment furnace, improves the service life of the roller, and ensures the integrity of the coating of the hot stamped part as well as the mech. property, welding property, coating property and corrosion resisting property of the part.

IT 2305367-85-3P, Aluminum 0-0.3, boron 0-0.1, carbon 0.04-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1.2, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(method for manufg. hot stamped parts with aluminum-silicon alloy coating and hot stamped parts)

RN 2305367-85-3 CAPLUS

CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1.2,C 0-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1.2	7440-21-3
C	0	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI C23C0002-12; C23C0002-40; C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-28; C22C0038-32; C22C0038-38; C21D0001-26; C21D0008-00; B21D0022-02

IPCR C23C0002-12 [I]; B21D0022-02 [I]; C21D0001-26 [I]; C21D0008-00 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-28 [I]; C22C0038-32 [I]; C22C0038-38 [I]; C23C0002-40 [I]

CC 56-11 (Nonferrous Metals and Alloys)

ST hot stamping steel aluminum silicon coating

IT 2305367-85-3P, Aluminum 0-0.3, boron 0-0.1, carbon 0.04-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1.2, sulfur 0-0.1, titanium 0-0.5, iron bal. 2305367-88-6P, Iron 0-4, silicon 4-14, aluminum bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(method for manufg. hot stamped parts with aluminum-silicon alloy coating and hot stamped parts)

L12 ANSWER 32 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:410880 CAPLUS Full-text
DOCUMENT NUMBER: 170:369087
TITLE: Austenitic abrasion resistant steel sheet
INVENTOR(S): Fujioka, Masaaki; Namekawa, Tetsuya; Yoshimura, Masahide; Minagawa, Masaki
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Tokkyo Koho, 22pp.
CODEN: JTXXFF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 6477983	B1	20190306	JP 2018-542295	20180329
WO 2019186906	A1	20191003	WO 2018-JP13281	20180329
KR 2019115094	A	20191010	KR 2019-7027564	20180329
KR 2123604	B1	20200615		
AU 2018412622	A1	20191017	AU 2018-412622	20180329
CN 110546290	A	20191206	CN 2018-80022906	20180329
CN 110546290	B	20200915		
EP 3594374	A1	20200115	EP 2018-909269	20180329
KR 2020029060	A	20200317	KR 2020-7006862	20180329
KR 2206319	B1	20210122		
BR 112019019598	A2	20200414	BR 2019-112019019598	20180329
IN 201917036722	A	20191115	IN 2019-17036722	20190912
PRIORITY APPLN. INFO.:			WO 2018-JP13281 W	20180329
			KR 2019-7027564 A3	20180329

AB The austenite type abrasion-proof steel sheet has specified chem. compn., and the mass% of C and Mn satisfies -13.75×C+16.5≤manganese≤-20×C+30. In the microstructure, the vol. percentage of the austenite is 40-90%, and the mean particle diam. of the austenite is 40-300μm.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	2011			JP 2011219809 A	CAPLUS
Anon	2012			JP 2012107325 A	CAPLUS
Anon	2015			WO 2015147166 A1	CAPLUS
Anon	2016			JP 2016196703 A	CAPLUS
Anon	2016			JP 2016507648 A	

IT 2257425-86-6, Aluminum 0.001-0.3, boron 0-0.3, carbon 0.2-1.6, chromium 0-5, cobalt 0-3, copper 0-3, iron bal., manganese 2.5-30, molybdenum 0-2, nickel 0-3, niobium 0-0.3, nitrogen 0-1, silicon 0.01-2, tantalum 0-0.3, titanium 0-0.3, tungsten 0-2, vanadium 0-0.3, zirconium 0-0.3
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(austenitic abrasion resistant steel sheet)

RN 2257425-86-6 CAPLUS

CN Iron alloy, base, Fe 45-97,Mn 2.5-30,Cr 0-5,Co 0-3,Cu 0-3,Ni 0-3,Mo 0-2,Si 0-2,W 0-2,C 0.2-1.6,N 0-1,Al 0-0.3,B 0-0.3,Nb 0-0.3,Ta 0-0.3,Ti 0-0.3,V 0-0.3,Zr 0-0.3 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	45	-	97	7439-89-6
Mn	2.5	-	30	7439-96-5
Cr	0	-	5	7440-47-3
Co	0	-	3	7440-48-4
Cu	0	-	3	7440-50-8
Ni	0	-	3	7440-02-0
Mo	0	-	2	7439-98-7
Si	0	-	2	7440-21-3
W	0	-	2	7440-33-7
C	0.2	-	1.6	7440-44-0
N	0	-	1	17778-88-0
Al	0	-	0.3	7429-90-5
B	0	-	0.3	7440-42-8
Nb	0	-	0.3	7440-03-1
Ta	0	-	0.3	7440-25-7
Ti	0	-	0.3	7440-32-6
V	0	-	0.3	7440-62-2
Zr	0	-	0.3	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-58 [I]; C21D0008-02 [N]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST austenitic steel sheet abrasion resistance
IT Abrasion resistance
Elongation, mechanical

Microstructure
Sheet materials
Tensile strength
Vickers hardness
Yield strength
(austenitic abrasion resistant steel sheet)

IT 2257425-86-6, Aluminum 0.001-0.3, boron 0-0.3, carbon 0.2-1.6, chromium 0-5, cobalt 0-3, copper 0-3, iron bal., manganese 2.5-30, molybdenum 0-2, nickel 0-3, niobium 0-0.3, nitrogen 0-1, silicon 0.01-2, tantalum 0-0.3, titanium 0-0.3, tungsten 0-2, vanadium 0-0.3, zirconium 0-0.3
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(austenitic abrasion resistant steel sheet)

L12 ANSWER 33 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:340815 CAPLUS Full-text
DOCUMENT NUMBER: 170:379972
TITLE: Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance
INVENTOR(S): Bi, Wenzhen; Hong, Jiyao; Wang, Li
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 7pp.; Chemical Indexing Equivalent to 173:85818 (WO)
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 109365606	A	20190222	CN 2018-11453322	20181130
WO 2020108593	A1	20200604	WO 2019-CN121859	20191129

PRIORITY APPLN. INFO.: CN 2018-11453322 A 20181130

AB The invention discloses a hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance, which improves the corrosion resistance of the steel plate or the steel strip and avoids cracking of the substrate. The above steel plate or steel strip includes the following components in percentage by wt.: C 0.1-0.8%, Si 0.05-2.0%, Mn 0.5-3.0%, P <0.1%, S <0.05%, Al <0.1%, N <0.01%, and balance of Fe and impurities, and also includes at least one of Cr 0.01-1.0%, Mo 0.01-1.0%, Ti <0.2%, Nb 0.01-0.08%, V 0.01-1.0%, and B 0.005-0.08%; the zinc-based coating includes the following components in percentage by wt.: Al 0.15%-6.5%, Mg 0.2-7%, RE <0.2%, Sr 0.002-0.2%, and balance of Zn and impurities, and the coating further includes at least one or more of Mn, Cr, Al, and Mg, and the total amt. thereof is more than 0.1%.

IT 2293976-55-1, Aluminum 0-0.1, boron 0.005-0.1, carbon 0.1-0.8, chromium 0.01-1, iron bal., manganese 0.5-3, molybdenum 0.01-1, niobium 0.01-0.1, phosphorus 0-0.1, silicon 0.05-2, titanium 0-0.2, vanadium 0.01-1
RL: MSC (Miscellaneous); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)

RN 2293976-55-1 CAPLUS
CN Iron alloy, base, Fe 91-99,Mn 0.5-3,Si 0-2,Cr 0-1,Mo 0-1,V 0-1,C 0.1-0.8,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Si	0	-	2	7440-21-3
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
V	0	-	1	7440-62-2
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5

B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0

IPCI B21D0022-02; C23C0002-06; C23C0002-40; C22C0018-00; C21D0008-02
IPCR B21D0022-02 [I]; C21D0008-02 [I]; C22C0018-00 [I]; C23C0002-06 [I]; C23C0002-40 [I]
CC 55-6 (Ferrous Metals and Alloys)
ST corrosion resistance zinc alloy coating steel hot stamping
IT Anticorrosive coating materials
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT Metalworking
(stamping, hot; Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT 2293976-55-1, Aluminum 0-0.1, boron 0.005-0.1, carbon 0.1-0.8, chromium 0.01-1, iron bal., manganese 0.5-3, molybdenum 0.01-1, niobium 0.01-0.1, phosphorus 0-0.1, silicon 0.05-2, titanium 0-0.2, vanadium 0.01-1
RL: MSC (Miscellaneous); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT 2226545-76-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 34 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:269683 CAPLUS Full-text
DOCUMENT NUMBER: 170:345639
TITLE: 20CrNiB steel for carburized gear
INVENTOR(S): Sun, Hongping; Cao, Hongfu; Huang, Zhen; Xu, Xiaohong; Lu, Mingxia; Dou, Shengtao; Yang, Gaocheng; Zhang, Xuecheng
PATENT ASSIGNEE(S): Jiangyin Xingcheng Special Steel Works Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 7pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 109321712	A	20190212	CN 2018-11322890	20181108

PRIORITY APPLN. INFO.: CN 2018-11322890 20181108
AB A 20CrNiB steel for carburized gear has the advantages of high hardenability, high strength and toughness, and stability. The 20CrNiB steel for the carburized gear includes the following raw materials by mass percentages: C: 0.17-0.23%, Si: < 0.35%, Mn: 0.50-0.95%, Cr: 0.85-1.25%, S: 0.015-0.030%, P :≤ 0.025%, Ni: 0.15-0.25%, Nb: 0.015-0.035%, B: 0.0010-0.0030%, Cu: < 0.20%, Al: 0.010-0.050%, Ca: ≤ 0.0005%, and balance of Fe.
IT 12742-15-3, 20CrNiB
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(20CrNiB steel for carburized gear)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0

Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

IPCI C21C0007-06; C21C0007-10; C21D0008-06; C22C0033-04; C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-42; C22C0038-48; C22C0038-54
IPCR C21C0007-06 [I]; C21C0007-10 [I]; C21D0008-06 [I]; C22C0033-04 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-42 [I]; C22C0038-48 [I]; C22C0038-54 [I]
CC 55-7 (Ferrous Metals and Alloys)
ST high hardenability carburization gear 20CrNiB steel
IT Carburizing
Gears
(20CrNiB steel for carburized gear)
IT 12742-15-3, 20CrNiB
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(20CrNiB steel for carburized gear)

L12 ANSWER 35 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:186187 CAPLUS Full-text
DOCUMENT NUMBER: 170:322160
TITLE: Alloy steel material with high-temperature oxidation resistance
INVENTOR(S): Duanmu, Shundi
PATENT ASSIGNEE(S): Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 5pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 109280856	A	20190129	CN 2017-10636887	20170720

PRIORITY APPLN. INFO.: CN 2017-10636887 20170720
AB The title alloy steel material comprises (by wt.%): nickel 0.30-0.50, manganese 0.80-1.40, silicon 0.20-0.34, carbon 0.14-0.18, boron 0.02-0.06, phosphorus 0.01-0.02, sulfur 0.015-0.025, chromium 0.08-0.1, vanadium 0.06-0.2, copper 0.2-0.3, molybdenum 0.02-0.08, titanium 0.08-0.1, niobium 0.02-0.04, rubidium 0.06-0.2, thorium 0.08-0.1, lanthanum and germanium 0.06-0.1, and iron as balance, wherein the content of germanium is 2-4 times of that of lanthanum. The alloy steel material has excellent high-temp. oxidn. resistance, can be used for manufg. workpiece with high high-temp. oxidn. resistance, and the high-temp. oxidn. resistance of the alloy steel material is related to the content ratio of germanium and lanthanum in the alloy steel.
IT 1960401-15-3, Boron 0.02-0.1, carbon 0.1-0.2, chromium 0.1, copper 0.2-0.3, iron bal., lanthanum 0-0.1, germanium 0-0.1, manganese 0.8-1.4, molybdenum 0.02-0.1, nickel 0.3-0.5, rubidium 0.1-0.2, silicon 0.2-0.3, titanium 0.1, thorium 0.1, vanadium 0.1-0.2
RL: TEM (Technical or engineered material use); USES (Uses)
(alloy steel material with high-temp. oxidn. resistance)
RN 1960401-15-3 CAPLUS
CN Iron alloy, base, Fe 96-98,Mn 0.8-1.4,Ni 0.3-0.5,Cu 0.2-0.3,Si 0.2-0.3,C 0.1-0.2,Rb 0.1-0.2,V 0.1-0.2,Cr 0.1,Th 0.1,Ti 0.1,B 0-0.1,Ge 0-0.1,La 0-0.1,Mo 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6

Mn	0.8	-	1.4	7439-96-5
Ni	0.3	-	0.5	7440-02-0
Cu	0.2	-	0.3	7440-50-8
Si	0.2	-	0.3	7440-21-3
C	0.1	-	0.2	7440-44-0
Rb	0.1	-	0.2	7440-17-7
V	0.1	-	0.2	7440-62-2
Cr		0.1		7440-47-3
Th		0.1		7440-29-1
Ti		0.1		7440-32-6
B	0	-	0.1	7440-42-8
Ge	0	-	0.1	7440-56-4
La	0	-	0.1	7439-91-0
Mo	0	-	0.1	7439-98-7

IPCI C22C0038-04; C22C0038-02; C22C0038-54; C22C0038-46; C22C0038-42; C22C0038-44; C22C0038-48; C22C0038-50
IPCR C22C0038-04 [I]; C22C0038-02 [I]; C22C0038-42 [I]; C22C0038-44 [I]; C22C0038-46 [I]; C22C0038-48 [I]; C22C0038-50 [I]; C22C0038-54 [I]
CC 55-12 (Ferrous Metals and Alloys)
ST germanium lanthanum steel oxidn resistance
IT 1960401-15-3, Boron 0.02-0.1, carbon 0.1-0.2, chromium 0.1, copper 0.2-0.3, iron bal., lanthanum 0-0.1, germanium 0-0.1, manganese 0.8-1.4, molybdenum 0.02-0.1, nickel 0.3-0.5, rubidium 0.1-0.2, silicon 0.2-0.3, titanium 0.1, thorium 0.1, vanadium 0.1-0.2
RL: TEM (Technical or engineered material use); USES (Uses)
(alloy steel material with high-temp. oxidn. resistance)

L12 ANSWER 36 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2601319 CAPLUS Full-text
DOCUMENT NUMBER: 170:116258
TITLE: Method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating
INVENTOR(S): Rosenstock, Dirk; Banik, Janko
PATENT ASSIGNEE(S): ThyssenKrupp Steel Europe AG, Germany; ThyssenKrupp AG
SOURCE: PCT Int. Appl., 25pp.; Chemical Indexing Equivalent to 170:116256 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018234102	A1	20181227	WO 2018-EP65498	20180612
DE 102017210201	A1	20181220	DE 2017-102017210201	20170619
EP 3642371	A1	20200429	EP 2018-738199	20180612
PRIORITY APPLN. INFO.:			DE 2017-102017210201 A	20170619
			WO 2018-EP65498 W	20180612

AB A method is described for producing a corrosion-resistant steel automotive component comprising a substrate and an anticorrosive coating.
IT 2254829-63-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
RN 2254829-63-3 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	94	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Si	0.1	-	0.5	7440-21-3
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8

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    Nb      0   -   0.1      7440-03-1
    P       0   -   0.1      7723-14-0

IPCI C21D0008-02 [I]; C23C0002-12 [I]; C21D0009-46 [I]; C21D0001-673 [I];
     B32B0015-01 [I]
IPCR C21D0008-02 [I]; B32B0015-01 [I]; C21D0001-673 [I]; C21D0009-46 [I];
     C23C0002-12 [I]
CC   55-10 (Ferrous Metals and Alloys)
     Section cross-reference(s): 56
ST   steel automobile metal coating corrosion aluminum alloy
IT   Anticorrosive coating materials
        (metallic; method for producing a steel automotive component
        provided with an aluminum alloy anti-corrosion coating)
IT   Automobile bodies
     Automobile doors
     Automobile roofs
     Automotive bumpers
     Heat treatment
        (method for producing a steel automotive component provided
        with an aluminum alloy anti-corrosion coating)
IT   254455-65-7P
     RL: IMF (Industrial manufacture); TEM (Technical or engineered material
     use); PREP (Preparation); USES (Uses)
        (coatings; method for producing a steel automotive component
        provided with an aluminum alloy anti-corrosion coating)
IT   870820-47-6P, 22MnB5   2254829-63-3P
     RL: IMF (Industrial manufacture); TEM (Technical or engineered material
     use); PREP (Preparation); USES (Uses)
        (strips; method for producing a steel automotive component
        provided with an aluminum alloy anti-corrosion coating)
OS.CITING REF COUNT:     1     THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD
                               (1 CITINGS)


L12  ANSWER 37 OF 398  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2018:2596372  CAPLUS Full-text
DOCUMENT NUMBER:         170:106297
TITLE:                   High-strength steel sheet and its manufacture for
                         automobile parts
INVENTOR(S):             Natsumeda, Hirokazu; Murakami, Toshio; Saito, Kenji;
                         Murata, Tadao
PATENT ASSIGNEE(S):      Kobe Steel, Ltd., Japan
SOURCE:                  Jpn. Kokai Tokkyo Koho, 23pp.; Chemical Indexing
                         Equivalent to 170:68139 (WO)
                         CODEN: JKXXAF
DOCUMENT TYPE:           Patent
LANGUAGE:                Japanese
FAMILY ACC. NUM. COUNT:  2
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     JP 2018204058        A    20181227    JP 2017-108340           20170531
     WO 2018221307        A1   20181206    WO 2018-JP19594          20180522
     KR 2020003010        A    20200108    KR 2019-7034838          20180522
     CN 110678569         A    20200110    CN 2018-80035460         20180522
     EP 3636788           A1   20200415    EP 2018-809088           20180522
     IN 201947048601      A    20191206    IN 2019-47048601         20191127
     US 20200190619       A1   20200618    US 2019-16617736         20191127
PRIORITY APPLN. INFO.:                      JP 2017-108340       A  20170531
                                            WO 2018-JP19594      W  20180522
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB   The high-strength steel sheet comprises the following compn. in mass%:
     carbon of 0.15-0.35, silicon of 0.5-3, aluminum of 0.01, nitrogen of
     0-0.01, manganese of 1-4, phosphorus of 0-0.05, sulfur of 0-0.01, and
     remaining made up of iron and unavoidable impurities.  The steel
     structure having a ferrite fraction of 0-5%, the total fraction of
     tempered martensite and bainite is 60% or more, the amt. of retained
     austenite is 10% or more, the av. size of martensite and austenite(MA) is
     0-1 μm and retained austenite is 0-1 μm, wherein the retained
     austenite having a size of 1.5 μm or more is 2% or more of the total
     retained austenite amt., and a solid soln. nitrogen content of 0-0.002
     mass%.
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IT 2253797-76-9P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength steel sheet and its manuf. for automobile parts)
RN 2253797-76-9 CAPLUS
CN Iron alloy, base, Fe 84-99,Mn 1-4,Al 0-3,Si 0-3,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.2-0.4,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zn 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	84	-	99	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	3	7429-90-5
Si	0	-	3	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.2	-	0.4	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zn	0	-	0.2	7440-66-6

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-48 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-48 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST high strength steel sheet manuf automobile part
IT Annealing
Automobile parts
Cold rolling
Elongation, mechanical
Heat treatment
Hot rolling
Microstructure
Sheet materials
Tensile strength
Yield strength
(high-strength steel sheet and its manuf. for automobile parts)
IT 2253797-76-9P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength steel sheet and its manuf. for automobile parts)

L12 ANSWER 38 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2596261 CAPLUS Full-text
DOCUMENT NUMBER: 170:127894
TITLE: Wear-resistant thick steel sheet
INVENTOR(S): Fujioka, Masaaki; Namekawa, Tetsuya; Yoshimura, Masahide; Minagawa, Masaki; Hoshino, Manabu; Sawamura, Mitsuru
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 18pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2018204109	A	20181227	JP 2018-110217	20180608

PRIORITY APPLN. INFO.: JP 2017-113421 A 20170608
AB The title wear-resistant thick steel sheet is excellent in both abrasion

resistance and toughness. The steel sheet comprises (by mass%): carbon 0.2-1.6, silicon 0.01-2, manganese 2.5-30, aluminum 0.001-0.3, phosphorus 0-0.05, sulfur 0-0.05, and iron and impurities as bal., wherein the content (mass%) of carbon and manganese satisfies (-13.75)C + 16.5 ≤ Mn ≤ (-20)C + 35.

IT 2257425-86-6
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(wear-resistant thick steel sheet)

RN 2257425-86-6 CAPLUS

CN Iron alloy, base, Fe 45-97,Mn 2.5-30,Cr 0-5,Co 0-3,Cu 0-3,Ni 0-3,Mo 0-2,Si 0-2,W 0-2,C 0.2-1.6,N 0-1,Al 0-0.3,B 0-0.3,Nb 0-0.3,Ta 0-0.3,Ti 0-0.3,V 0-0.3,Zr 0-0.3 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	45	-	97	7439-89-6
Mn	2.5	-	30	7439-96-5
Cr	0	-	5	7440-47-3
Co	0	-	3	7440-48-4
Cu	0	-	3	7440-50-8
Ni	0	-	3	7440-02-0
Mo	0	-	2	7439-98-7
Si	0	-	2	7440-21-3
W	0	-	2	7440-33-7
C	0.2	-	1.6	7440-44-0
N	0	-	1	17778-88-0
Al	0	-	0.3	7429-90-5
B	0	-	0.3	7440-42-8
Nb	0	-	0.3	7440-03-1
Ta	0	-	0.3	7440-25-7
Ti	0	-	0.3	7440-32-6
V	0	-	0.3	7440-62-2
Zr	0	-	0.3	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-60 [I]; C21D0008-02 [I]
IPCR C22C0038-00 [I]; C21D0008-02 [I]; C22C0038-60 [I]
CC 55-1 (Ferrous Metals and Alloys)
ST wear resistant steel sheet
IT Wear-resistant materials
(wear-resistant thick steel sheet)
IT 12244-31-4, Austenite, formation (nonpreparative)
RL: FMU (Formation, unclassified); OCU (Occurrence, unclassified); FORM (Formation, nonpreparative); OCCU (Occurrence)
(wear-resistant thick steel sheet)
IT 2257425-86-6
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(wear-resistant thick steel sheet)

L12 ANSWER 39 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2544202 CAPLUS Full-text
DOCUMENT NUMBER: 170:116256
TITLE: Method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating
INVENTOR(S): Rosenstock, Dirk; Banik, Janko
PATENT ASSIGNEE(S): ThyssenKrupp AG, Germany; ThyssenKrupp Steel Europe AG
SOURCE: Ger. Offen., 16pp.; Chemical Indexing Equivalent to 170:116258 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102017210201	A1	20181220	DE 2017-102017210201	20170619
CN 109136775	A	20190104	CN 2017-10986828	20171020
WO 2018234102	A1	20181227	WO 2018-EP65498	20180612
EP 3642371	A1	20200429	EP 2018-738199	20180612

PRIORITY APPLN. INFO.: DE 2017-102017210201 A 20170619
WO 2018-EP65498 W 20180612

AB A method is described for producing a corrosion-resistant steel automotive component comprising a substrate and an anticorrosive coating.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 102007061489 A1	CAPLUS
Anon				DE 102009007909 A1	CAPLUS
Anon				WO 2015036151 A1	CAPLUS
Anon				WO 2016034476 A1	CAPLUS

IT 2254829-63-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)

RN 2254829-63-3 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.2 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0

IPCI C22C0038-04 [I]; C21D0008-02 [I]; C23C0002-12 [I]
IPCR C22C0038-04 [I]; C21D0008-02 [I]; C23C0002-12 [I]
CC 55-10 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST steel automobile metal coating corrosion aluminum alloy
IT Anticorrosive coating materials
(metallic; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
IT Automobile bodies
Automobile doors
Automobile roofs
Automotive bumpers
Heat treatment
(method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
IT 254455-65-7P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(coatings; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
IT 870820-47-6P, 22MnB5 2254829-63-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 40 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2476841 CAPLUS Full-text
DOCUMENT NUMBER: 170:49883
TITLE: High-strength steel sheet comprising silicon and manganese, and production method for same
INVENTOR(S): Natsumeda, Hirokazu; Murakami, Toshio; Saito, Kenji; Murata, Tadao
PATENT ASSIGNEE(S): Kobe Steel, Ltd., Japan

SOURCE: Jpn. Kokai Tokkyo Koho, 23pp.; Chemical Indexing Equivalent to 170:35129 (WO)
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2018197380	A	20181213	JP 2017-103024	20170524
WO 2018216522	A1	20181129	WO 2018-JP18489	20180514
KR 2019142354	A	20191226	KR 2019-7033765	20180514
CN 110651062	A	20200103	CN 2018-80033477	20180514
EP 3633058	A1	20200408	EP 2018-806482	20180514
IN 201947047461	A	20191129	IN 2019-47047461	20191121
US 20200071787	A1	20200305	US 2019-16615462	20191121

PRIORITY APPLN. INFO.: JP 2017-103024 A 20170524
WO 2018-JP18489 W 20180514
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The high-strength steel sheet comprises the following compn. by mass %: carbon of 0.15-0.35, silicon of 0.5-3, aluminum of 0.5-3, manganese of 1-4, phosphorus of 0.05, sulfur of 0.01, titanium of 0.01-0.2, with the remainder being made up of iron balance and unavoidable impurities. The steel sheet structure is such that the ferrite fraction does not exceed 5, the total fraction of tempered martensite and tempered bainite is at least 60, the retained austenite fraction is at least 10, the fresh martensite fraction does not exceed 5, the av. particle size of retained austenite does not exceed 0.5 μm, retained austenite having a particle diam. of at least 1.0 μm accounts for at least 2 of total retained austenite content, and prior austenite particle diam. does not exceed 10 μm.
IT 2252460-30-1
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(high-strength steel sheet comprising silicon and manganese, and prodn. method for same)
RN 2252460-30-1 CAPLUS
CN Iron alloy, base, Fe 88-98,Mn 1-4,Al 0-3,Si 0-3,B 0-1,Cr 0-1,Cu 0-1,Ni 0-1,C 0.2-0.4,Hf 0-0.2,Mo 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	88	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	3	7429-90-5
Si	0	-	3	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Ni	0	-	1	7440-02-0
C	0.2	-	0.4	7440-44-0
Hf	0	-	0.2	7440-58-6
Mo	0	-	0.2	7439-98-7
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-14 [I]; C22C0038-58 [I]; C21D0009-46 [I]; C21D0009-48 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C22C0038-14 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST high strength steel sheet
IT Deep drawing of materials
Elongation, mechanical
Grain size
Heat treatment
Impact strength
Microstructure

Rolling (metals)
Tensile strength
Yield strength
(high-strength steel sheet comprising silicon and manganese, and prodn. method for same)

IT 12173-93-2, Martensite, formation (nonpreparative) 12244-31-4, Austenite, formation (nonpreparative) 12427-23-5, Bainite 12427-24-6, Ferrite (ferrous metal component)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(high-strength steel sheet comprising silicon and manganese, and prodn. method for same)

IT 2252460-30-1
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(high-strength steel sheet comprising silicon and manganese, and prodn. method for same)

L12 ANSWER 41 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2421261 CAPLUS Full-text
DOCUMENT NUMBER: 170:106245
TITLE: Ultra-high strength steel having near net shaping for automobile safety components and preparation method thereof
INVENTOR(S): Ju, Jia; Wang, Zhangzhong; Zhang, Sibin; Liu, Zhuang; Zhang, Baosen; Mao, Xiangyang; Ba, Zhixin; Li, Xuan; Li, Huaguan
PATENT ASSIGNEE(S): Nanjing Institute of Technology, Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 9pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 108950411	A	20181207	CN 2018-10840230	20180727
CN 108950411	B	20200519		

PRIORITY APPLN. INFO.: CN 2018-10840230 20180727

AB Raw materials include the following compns. (by wt.%): C 0.15-0.25, Mn 1.3-2.8, P ≤0.006, S ≤0.004, Si 0.25-0.85, B 0.001-0.07, Cr 0.20-0.90, Ti 0.07-0.15, Al 0.005-0.02, Nb 0.65-1.40, and Fe as balance. The prepn. method includes the following steps of S1) formulating; S2) subjecting to vacuum induction melting, casting to form alloy ingot; S3) thermally treating; and S4) pressure processing. The product has the advantages of relatively excellent mech. property and near-net forming.

IT 2254705-29-6P, Boron 0-0.1, Carbon 0.2, chromium 0.2-0.9, iron 94-97, manganese 1.3-2.8, niobium 0.6-1.4, silicon 0.2-0.8, titanium 0.1-0.2
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(ultra-high strength steel having near net shaping for automobile safety components and prepn. method thereof)

RN 2254705-29-6 CAPLUS
CN Iron alloy, base, Fe 94-97,Mn 1.3-2.8,Nb 0.6-1.4,Cr 0.2-0.9,Si 0.2-0.8,C 0.2,Ti 0.1-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 97	7439-89-6
Mn	1.3 - 2.8	7439-96-5
Nb	0.6 - 1.4	7440-03-1
Cr	0.2 - 0.9	7440-47-3
Si	0.2 - 0.8	7440-21-3
C	0.2	7440-44-0
Ti	0.1 - 0.2	7440-32-6
B	0 - 0.1	7440-42-8

IPCI C22C0038-04; C22C0038-02; C22C0038-32; C22C0038-28; C22C0038-26; C22C0038-06; C22C0038-38; C22C0033-04; C21D0008-00

IPCR C22C0038-04 [I]; C21D0008-00 [I]; C22C0033-04 [I]; C22C0038-02 [I];
C22C0038-06 [I]; C22C0038-26 [I]; C22C0038-28 [I]; C22C0038-32 [I];
C22C0038-38 [I]
CC 55-1 (Ferrous Metals and Alloys)
Section cross-reference(s): 47
ST ultrahigh strength steel near net shaping automobile safety component
IT Heat treatment
Magnetic stirring
Melting
Pipes and Tubes
(ultra-high strength steel having near net shaping for
automobile safety components and prepn. method thereof)
IT 2254705-29-6P, Boron 0-0.1, Carbon 0.2, chromium 0.2-0.9, iron
94-97, manganese 1.3-2.8, niobium 0.6-1.4, silicon 0.2-0.8, titanium
0.1-0.2
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical
process); TEM (Technical or engineered material use); PREP (Preparation);
PROC (Process); USES (Uses)
(ultra-high strength steel having near net shaping for
automobile safety components and prepn. method thereof)

L12 ANSWER 42 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2401537 CAPLUS Full-text
DOCUMENT NUMBER: 170:68139
TITLE: High-strength steel sheet and its manufacture for automobile parts
INVENTOR(S): Natsumeda, Hirokazu; Murakami, Toshio; Saito, Kenji; Murata, Tadao
PATENT ASSIGNEE(S): Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.), Japan
SOURCE: PCT Int. Appl., 42pp.; Chemical Indexing Equivalent to 170:106297 (JP)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018221307	A1	20181206	WO 2018-JP19594	20180522
JP 2018204058	A	20181227	JP 2017-108340	20170531
KR 2020003010	A	20200108	KR 2019-7034838	20180522
CN 110678569	A	20200110	CN 2018-80035460	20180522
EP 3636788	A1	20200415	EP 2018-809088	20180522
IN 201947048601	A	20191206	IN 2019-47048601	20191127
US 20200190619	A1	20200618	US 2019-16617736	20191127

PRIORITY APPLN. INFO.: JP 2017-108340 A 20170531
WO 2018-JP19594 W 20180522
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The high-strength steel sheet comprises the following compn. in mass%: carbon of 0.15-0.35, silicon of 0.5-3, aluminum of 0.01, nitrogen of 0-0.01, manganese of 1-4, phosphorus of 0-0.05, sulfur of 0-0.01, and remaining made up of iron and unavoidable impurities. The steel structure having a ferrite fraction of 0-5%, the total fraction of tempered martensite and bainite is 60% or more, the amt. of retained austenite is 10% or more, the av. size of martensite and austenite(MA) is 0-1 μm and retained austenite is 0-1 μm, wherein the retained austenite having a size of 1.5 μm or more is 2% or more of the total retained austenite amt., and a solid soln. nitrogen content of 0-0.002 mass%.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1991			JP 394017 A	
Anon	2015			JP 2015516511 A	
MURAKAMI TOSHIO	2013			JP 2013040383 A	CAPLUS
MURAKAMI TOSHIO	2017			JP 2017214648 A	CAPLUS
MURATA TADAO	2016			JP 2016194138 A	CAPLUS
NAKAGAITO TATSUYA	2009			JP 2009209450 A	CAPLUS

IT 2253797-76-9P, Aluminum 0-3, boron 0-1, carbon 0.15-0.35,

chromium 0-1, copper 0-1, hafnium 0-0.2, iron bal., manganese 1-4, molybdenum 0-1, nickel 0-1, niobium 0-0.2, silicon 0-3, titanium 0-0.2, vanadium 0-0.2, Zn 0-0.2
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength steel sheet and its manuf. for automobile parts)

RN 2253797-76-9 CAPLUS
CN Iron alloy, base, Fe 84-99,Mn 1-4,Al 0-3,Si 0-3,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.2-0.4,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zn 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	84	-	99	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	3	7429-90-5
Si	0	-	3	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.2	-	0.4	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zn	0	-	0.2	7440-66-6

IPCI C22C0038-00 [I]; C21D0009-48 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C21D0009-48 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST high strength steel sheet manuf automobile part
IT Annealing
Automobile parts
Cold rolling
Elongation, mechanical
Heat treatment
Hot rolling
Microstructure
Sheet materials
Tensile strength
Yield strength
(high-strength steel sheet and its manuf. for automobile parts)
IT 2253797-76-9P, Aluminum 0-3, boron 0-1, carbon 0.15-0.35, chromium 0-1, copper 0-1, hafnium 0-0.2, iron bal., manganese 1-4, molybdenum 0-1, nickel 0-1, niobium 0-0.2, silicon 0-3, titanium 0-0.2, vanadium 0-0.2, Zn 0-0.2
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength steel sheet and its manuf. for automobile parts)

L12 ANSWER 43 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2338703 CAPLUS Full-text
DOCUMENT NUMBER: 170:35129
TITLE: High-strength steel sheet comprising silicon and manganese, and production method for same
INVENTOR(S): Natsumeda, Hirokazu; Murakami, Toshio; Saito, Kenji; Murata, Tadao
PATENT ASSIGNEE(S): Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.), Japan
SOURCE: PCT Int. Appl., 41pp.; Chemical Indexing Equivalent to 170:49883 (JP)
CODEN: PIXXD2
DOCUMENT TYPE: Patent

LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018216522	A1	20181129	WO 2018-JP18489	20180514
JP 2018197380	A	20181213	JP 2017-103024	20170524
KR 2019142354	A	20191226	KR 2019-7033765	20180514
CN 110651062	A	20200103	CN 2018-80033477	20180514
EP 3633058	A1	20200408	EP 2018-806482	20180514
IN 201947047461	A	20191129	IN 2019-47047461	20191121
US 20200071787	A1	20200305	US 2019-16615462	20191121

PRIORITY APPLN. INFO.: JP 2017-103024 A 20170524
WO 2018-JP18489 W 20180514
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The high-strength steel sheet comprises the following compn. by mass %: carbon of 0.15-0.35, silicon of 0.5-3, aluminum of 0.5-3, manganese of 1-4, phosphorus of 0.05, sulfur of 0.01, titanium of 0.01-0.2, with the remainder being made up of iron balance and unavoidable impurities. The steel sheet structure is such that the ferrite fraction does not exceed 5, the total fraction of tempered martensite and tempered bainite is at least 60, the retained austenite fraction is at least 10, the fresh martensite fraction does not exceed 5, the av. particle size of retained austenite does not exceed 0.5 μm, retained austenite having a particle diam. of at least 1.0 μm accounts for at least 2 of total retained austenite content, and prior austenite particle diam. does not exceed 10 μm.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
KAWATA HIROYUKI	2017			WO 2017164346 A1	CAPLUS
MURAKAMI TOSHIO	2017			JP 2017214648 A	CAPLUS
SANO KOICHI	2017			JP 2017053001 A	CAPLUS
SHIBATA KOSUKE	2015			JP 2015218365 A	CAPLUS

IT 2252460-30-1, Aluminum 0-3, boron 0-1, calcium 0-0.01, carbon 0.15-0.35, chromium 0-1, copper 0-1, hafnium 0-0.2, iron bal., magnesium 0-0.01, manganese 1-4, molybdenum 0-0.2, nickel 0-1, niobium 0-0.2, phosphorus 0-0.05, mis 0-0.01, silicon 0-3, sulfur 0-0.01, titanium 0.01-0.2, vanadium 0-0.2, zirconium 0-0.2
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(high-strength steel sheet comprising silicon and manganese, and prodn. method for same)
RN 2252460-30-1 CAPLUS
CN Iron alloy, base, Fe 88-98,Mn 1-4,Al 0-3,Si 0-3,B 0-1,Cr 0-1,Cu 0-1,Ni 0-1,C 0.2-0.4,Hf 0-0.2,Mo 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	88	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	3	7429-90-5
Si	0	-	3	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Ni	0	-	1	7440-02-0
C	0.2	-	0.4	7440-44-0
Hf	0	-	0.2	7440-58-6
Mo	0	-	0.2	7439-98-7
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C21D0009-48 [I]; C22C0038-14 [I]; C22C0038-58 [I]
IPCR C22C0038-00 [I]; C21D0009-48 [I]; C22C0038-14 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST high strength steel sheet

IT Deep drawing of materials
Elongation, mechanical
Grain size
Heat treatment
Impact strength
Microstructure
Rolling (metals)
Tensile strength
Yield strength
(high-strength steel sheet comprising silicon and manganese, and prodn. method for same)
IT 12173-93-2, Martensite, formation (nonpreparative) 12244-31-4, Austenite, formation (nonpreparative) 12427-23-5, Bainite 12427-24-6, Ferrite (ferrous metal component)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(high-strength steel sheet comprising silicon and manganese, and prodn. method for same)
IT 2252460-30-1, Aluminum 0-3, boron 0-1, calcium 0-0.01, carbon 0.15-0.35, chromium 0-1, copper 0-1, hafnium 0-0.2, iron bal., magnesium 0-0.01, manganese 1-4, molybdenum 0-0.2, nickel 0-1, niobium 0-0.2, phosphorus 0-0.05, mis 0-0.01, silicon 0-3, sulfur 0-0.01, titanium 0.01-0.2, vanadium 0-0.2, zirconium 0-0.2
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(high-strength steel sheet comprising silicon and manganese, and prodn. method for same)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 44 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2321302 CAPLUS Full-text
DOCUMENT NUMBER: 170:49880
TITLE: Steel-based electromagnetic shield multilayer screen products
INVENTOR(S): Wieschalla, Vanessa; Nierhoff, Daniel; Wolske, Vanessa; Becker, Jens-Ulrik
PATENT ASSIGNEE(S): ThyssenKrupp AG, Germany; ThyssenKrupp Steel Europe AG
SOURCE: Ger., 17pp.
CODEN: GWXXAW
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102017216975	B3	20181129	DE 2017-102017216975	20170925
WO 2019057547	A1	20190328	WO 2018-EP74424	20180911

PRIORITY APPLN. INFO.: DE 2017-102017216975 A 20170925
AB An electromagnetic radiation shielding multilayer material is manufd. for shielding from electromagnetic radiation, static elec. and/or static magnetic fields.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				EP 1426982 A1	CAPLUS
Anon				WO 1991012960 A1	
Anon				DE 3710322 A1	CAPLUS

IT 2253656-70-9P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(layers; steel-based electromagnetic shield multilayer screen products)
RN 2253656-70-9 CAPLUS
CN Iron alloy, base, Fe 94-100,Mn 0.1-3,C 0-0.5,Cr 0-0.5,Cu 0-0.5,Si 0-0.5,Ti 0-0.3,Ni 0-0.2,Al 0-0.1,As 0-0.1,B 0-0.1,Mo 0-0.1,N 0-0.1,Nb 0-0.1,P 0-0.1,S 0-0.1,Sn 0-0.1,V 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number

Fe	94	-	100	7439-89-6
Mn	0.1	-	3	7439-96-5
C	0	-	0.5	7440-44-0
Cr	0	-	0.5	7440-47-3
Cu	0	-	0.5	7440-50-8
Si	0	-	0.5	7440-21-3
Ti	0	-	0.3	7440-32-6
Ni	0	-	0.2	7440-02-0
Al	0	-	0.1	7429-90-5
As	0	-	0.1	7440-38-2
B	0	-	0.1	7440-42-8
Mo	0	-	0.1	7439-98-7
N	0	-	0.1	17778-88-0
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0
S	0	-	0.1	7704-34-9
Sn	0	-	0.1	7440-31-5
V	0	-	0.1	7440-62-2

IPCI C22C0038-02 [I]; H05K0009-00 [I]; C22C0038-04 [I]; C22C0038-18 [I]
IPCR C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-18 [I]; H05K0009-00 [I]
CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 73, 76, 77
ST multilayer screen electromagnetic shield stainless steel alloy
IT Electromagnetic shields
Hot rolling
Multilayers
(steel-based electromagnetic shield multilayer screen products)
IT 2253656-70-9P 2253656-71-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(layers; steel-based electromagnetic shield multilayer screen products)

L12 ANSWER 45 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1991052 CAPLUS Full-text
DOCUMENT NUMBER: 169:495435
TITLE: Preparation method of high-strength steel with fatigue stress amplitude of ≥400mpa
INVENTOR(S): Wang, Shisen; Du, Ming; Xu, Jinqiao; Wang, Rong; Li, Defa; Xiong, Fei; He, Yayuan; Yin, Yunyang
PATENT ASSIGNEE(S): Wuhan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 9pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 108707822	A	20181026	CN 2018-10541993	20180530
CN 108707822	B	20200505		

PRIORITY APPLN. INFO.: CN 2018-10541993 20180530
AB The title steel comprises (by wt%) carbon 0.1-0.2, silicon 0.1-0.4, manganese 1.2-1.6, phosphorus+sulfur 0-0.015, chromium 0.1-0.4, molybdenum 0.4-0.8, nickel 0.05-0.2, niobium +titanium+vanadium+boron 0.045-0.1, iron balance. The steel is prepd. by smelting, continuous casting, hot rolling, quenching at 850-920°C, tempering at 380-420°C, and cooling. The steel has higher strength and elongation.
IT 2248486-84-0P, Carbon 0.1-0.2, boron 0-0.1, chromium 0.1-0.4, manganese 1.2-1.6, molybdenum 0.4-0.8, nickel 0.05-0.2, niobium 0-0.1, silicon 0.1-0.4, titanium 0-0.1, vanadium 0-0.1, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(prepn. method of high-strength steel with fatigue stress amplitude of ≥400mpa)
RN 2248486-84-0 CAPLUS
CN Iron alloy, base, Fe 96-98,Mn 1.2-1.6,Mo 0.4-0.8,Cr 0.1-0.4,Si 0.1-0.4,C 0.1-0.2,Ni 0-0.2,B 0-0.1,Nb 0-0.1,Ti 0-0.1,V 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6
Mn	1.2	-	1.6	7439-96-5
Mo	0.4	-	0.8	7439-98-7
Cr	0.1	-	0.4	7440-47-3
Si	0.1	-	0.4	7440-21-3
C	0.1	-	0.2	7440-44-0
Ni	0	-	0.2	7440-02-0
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
Ti	0	-	0.1	7440-32-6
V	0	-	0.1	7440-62-2

IPCI C22C0038-02; C22C0038-04; C22C0038-44; C22C0038-46; C22C0038-48; C22C0038-50; C22C0038-54; C21D0006-00; C21D0008-02
IPCR C22C0038-02 [I]; C21D0006-00 [I]; C21D0008-02 [I]; C22C0038-04 [I]; C22C0038-44 [I]; C22C0038-46 [I]; C22C0038-48 [I]; C22C0038-50 [I]; C22C0038-54 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST high strength steel strength
IT Casting of metals
(continuous; prepn. method of high-strength steel with fatigue stress amplitude of ≥400mpa)
IT Hot rolling
Quenching (cooling)
Tempering
(prepn. method of high-strength steel with fatigue stress amplitude of ≥400mpa)
IT 2248486-84-0P, Carbon 0.1-0.2, boron 0-0.1, chromium 0.1-0.4, manganese 1.2-1.6, molybdenum 0.4-0.8, nickel 0.05-0.2, niobium 0-0.1, silicon 0.1-0.4, titanium 0-0.1, vanadium 0-0.1, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(prepn. method of high-strength steel with fatigue stress amplitude of ≥400mpa)

L12 ANSWER 46 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1950769 CAPLUS Full-text
DOCUMENT NUMBER: 169:495369
TITLE: Microstructural features and corrosion analysis of A517 steel joint processed by friction stir welding
AUTHOR(S): Ansaripour, Morteza; Soltanipour, Abdol Reza; Dehnavi, Mohamad Reza
CORPORATE SOURCE: Materials Engineering Department, Malek Ashtar University of Technology, Shahin Shahr, Iran
SOURCE: Materials Research Express (2018), 5(6), 066543/1-066543/13
CODEN: MREAC3; ISSN: 2053-1591
DIGITAL OBJECT ID: 10.1088/2053-1591/aacc80
PUBLISHER: IOP Publishing Ltd.
DOCUMENT TYPE: Journal; (online computer file)
LANGUAGE: English
AB Microstructural observations of friction stir welds of A517 (B) steel showed that within the range of welding variables, martensite phase was hindered. Stir zone microstructure displayed coarse-grained upper bainite assocd. with granular bainite. HAZ consisted of decompd. bainite morphol. of lath-like and equiaxed. Electron backscatter diffraction anal. showed a random oriented recrystd. grain. The corrosion behavior in 3.5 wt% NaCl soln. revealed neg. shift of corrosion potential with increasing of traverse speed. However, the effect of welding parameters on cathodic behavior was more predominant than that on anodic behavior; assocd. with the microstructural alterations. Pitting of corrosion rust layer was identified as the main mechanism of corrosion attack in base material and welds. Although, corrosion c.d. of weld in all of the applied welding condition was slightly lower than that in the base material, however, this study provides recommendation for application of A517 steel jointed by friction stir welding in marine environment.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Bhadeshia, H	1999	A273-	58	Mater Sci Eng	CAPLUS
Casalino, G	2012		8239	Proc of SPIE-The Int	
Casalino, G	2014		8963	Proc of SPIE-The Int	
Chen, Y	2005	398	47	Mater Sci Eng A	
Choi, Y	2005	391	162	J Alloys Compd	CAPLUS
Cui, H	2016	681	426	J of Alloys and Comp	CAPLUS
Gao, K	2010	52	3428	Corros Sci	CAPLUS
Ghosh, M	2013	22	3890	J Mater Eng Perform	CAPLUS
Huang, H	1994	36	1027	Corros Sci	CAPLUS
Lee, W	2004	58	1041	Mater Lett	CAPLUS
Li, L	2012	7	3773	Int J Electrochem Sc	CAPLUS
Lu, B	2009	57	41	Acta Mater	CAPLUS
Manvatkar, V	2015	94	36	Scr Mater	CAPLUS
Medina, G	2016	21	146	Soldagem & Inspecao	
Meshram, S	2017	25	94	Journal of Manufactu	
Mishra, R	2005	50	1	Mater Sci Eng R	
Nelson, T	2016	231	66	Mater Process Techno	CAPLUS
Park, H	2004	371A	160	Mater Sci Eng	
Paul, C	2015	10	10246	Int J Electrochem Sc	
Ramirez, A	2013		75	Proc of the 1st Int	
Ren, R	2012	85	283	Electrochemica Acta	CAPLUS
Sato, Y	2005	53	637	Acta Mater	CAPLUS
Sato, Y	2001	32A	3033	Metall Mater Trans	CAPLUS
Sherif, E	2015	10	34	Int J Electrochem Sc	CAPLUS
Sherif, E	2011	129	961	Mater Chem Phy	CAPLUS
Sutton, M	2003	70	2215	Eng Fract Mech	
Sutton, M	2003	354A	6	Mater Sci Eng	
Wang, H	2015	10	5827	Int J Electrochem Sc	CAPLUS
Wang, X	2014	9	4574	Int J Electrochem Sc	
Wang, X	2014	21	474	J Nat Gas Sci Eng	CAPLUS
Wert, J	2003	49	607	Scr Mater	CAPLUS
Yan, J	2005	10	725	Sci Tech Weld Joinin	CAPLUS
Zajac, S	2005		387	Proc of the Int Conf	CAPLUS
Zhang, Q	2002	77	603	Mater Chem Phys	
Zhang, R	2010	41A	1448	Metall Mater Trans	CAPLUS
Zhang, S	2013	75	293	Corros Sci	CAPLUS

IT 52346-86-8, A517B, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(microstructural features and corrosion anal. of A517 steel joint processed by friction stir welding)
RN 52346-86-8 CAPLUS
CN Steel, (UNS K11630) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	0.70	-	1.00	7439-96-5
Cr	0.40	-	0.65	7440-47-3
Si	0.20	-	0.35	7440-21-3
Mo	0.15	-	0.25	7439-98-7
C	0.12	-	0.21	7440-44-0
V	0.03	-	0.08	7440-62-2
S	0	-	0.04	7704-34-9
P	0	-	0.035	7723-14-0
Ti	0.01	-	0.03	7440-32-6
B	0.0005	-	0.005	7440-42-8

CC 55-9 (Ferrous Metals and Alloys)
ST steel joint processed friction stir welding microstructural feature corrosion
IT Corrosion
Corrosion resistance
Current density
Electric current-potential relationship
Friction welding
Friction welds

Grain size
Microstructure
Recrystallization
(microstructural features and corrosion anal. of A517 steel joint processed by friction stir welding)

IT 12173-93-2, Martensite, formation (nonpreparative) 12427-23-5, Bainite
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(microstructural features and corrosion anal. of A517 steel joint processed by friction stir welding)

IT 52346-86-8, A517B, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(microstructural features and corrosion anal. of A517 steel joint processed by friction stir welding)

L12 ANSWER 47 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1916470 CAPLUS Full-text
DOCUMENT NUMBER: 169:454845
TITLE: Aluminum alloy plated electric resistance welded pipe for quenching and method of manufacturing aluminum plated hollow member
INVENTOR(S): Maki, Jun; Fujita, Soshi; Nakamura, Toyomitsu
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Tokkyo Koho, 23pp.
CODEN: JTXXFF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 6406475	B1	20181017	JP 2018-513042	20171120
WO 2019097729	A1	20190523	WO 2017-JP41697	20171120
CN 111247266	A	20200605	CN 2017-80096110	20171120
IN 202017014250	A	20200814	IN 2020-17014250	20200331
US 20200347489	A1	20201105	US 2020-16753961	20200406

PRIORITY APPLN. INFO.: WO 2017-JP41697 W 20171120
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The aluminum alloy plated elec. resistance welded pipe for quenching comprises a base material made of tubular steel plate and an elec. resistance welded part provided in abutting part of steel plate and extending in longitudinal direction. The base material comprises in mass%: carbon 0.06-0.5, silicon 0.01-0.8, manganese 0.6-3, phosphorous 0-0.05, sulfur 0-0.05, aluminum 0-0.1, oxygen 0-0.006, nitrogen 0-0.02, titanium 0.01-0.1, boron 0-0.1, niobium 0-0.1, vanadium 0-0.3, chromium 0-0.5, molybdenum 0-0.5, nickel 0-0.5, copper 0-0.5, calcium 0-0.005, rare earth metal 0-0.005, iron balance and impurities. The base material is positioned on the surface of steel sheet and has an intermetallic compd. layer contg. an aluminum-iron-silicon based intermetallic compd. and an aluminum plating layer located on the surface of the intermetallic compd. layer and contg. aluminum and silicon. The thickness of intermetallic compd. layer is X (μm), the thickness of aluminum layer is Y (μm), and when the thickness of steel pipe is t (mm) and outer diam. of steel pipe is D (mm), the following formula is satisfied: $70 \times X/D \lesssim Y/t \lesssim 30$. The method of manufg. aluminum plated hollow member comprises: positioning the base material on the surface of steel sheet, heating aluminum-plated elec. resistance welded pipe, forming the heated aluminum-plated elec. resistance welded pipe into desired shape, and rapidly cooling the aluminum plating elec. resistance welded pipe. According to the present invention, it is possible to manuf. high strength aluminum plated hollow member by hot working, and it is possible to obtain part that has reduced wt.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1983			JP 58204179 A	CAPLUS
Anon	2008			JP 2008069398 A	CAPLUS
Anon	2009			WO 2009131233 A1	CAPLUS
Anon	2014			JP 2014118628 A	CAPLUS
Anon	2017			JP 2017026147 A	CAPLUS

IT 2247299-93-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum alloy plated elec. resistance welded pipe for quenching and method of manufg. aluminum plated hollow member)
RN 2247299-93-8 CAPLUS
CN Iron alloy, base, Fe 93-99,Mn 0.6-3,Si 0-0.8,C 0.1-0.5,Cr 0-0.5,Cu 0-0.5,Mo 0-0.5,Ni 0-0.5,V 0-0.3,Al 0-0.1,B 0-0.1,Nb 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	93	-	99	7439-89-6
Mn	0.6	-	3	7439-96-5
Si	0	-	0.8	7440-21-3
C	0.1	-	0.5	7440-44-0
Cr	0	-	0.5	7440-47-3
Cu	0	-	0.5	7440-50-8
Mo	0	-	0.5	7439-98-7
Ni	0	-	0.5	7440-02-0
V	0	-	0.3	7440-62-2
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
Ti	0	-	0.1	7440-32-6

IPCI C23C0002-28 [I]; C23C0002-12 [I]; C23C0002-40 [I]; C23C0002-26 [I]; C23C0028-00 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-08 [N]; C21D0001-18 [N]; C21D0009-50 [N]; C22C0021-00 [N]
IPCR C23C0002-28 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C23C0002-12 [I]; C23C0002-26 [I]; C23C0002-40 [I]; C23C0028-00 [I]
CC 56-6 (Nonferrous Metals and Alloys)
IT 2247299-93-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum alloy plated elec. resistance welded pipe for quenching and method of manufg. aluminum plated hollow member)

L12 ANSWER 48 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1651585 CAPLUS Full-text
DOCUMENT NUMBER: 169:330484
TITLE: Method for producing a hot-formed coated steel product
INVENTOR(S): Beentjes, Petrus Cornelis Jozef; Van Schoonevelt, Hugo
PATENT ASSIGNEE(S): Tata Steel IJmuiden B.V., Neth.
SOURCE: PCT Int. Appl., 28pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018158166	A1	20180907	WO 2018-EP54600	20180223
CA 3051002	A1	20180907	CA 2018-3051002	20180223
MX 2019010192	A	20191002	MX 2019-10192	20180223
CN 110352260	A	20191018	CN 2018-80014405	20180223
KR 2019124211	A	20191104	KR 2019-7023413	20180223
EP 3589772	A1	20200108	EP 2018-714700	20180223
JP 2020510755	T	20200409	JP 2019-546825	20180223
BR 112019015673	A2	20200707	BR 2019-112019015673	20180223
US 20200165712	A1	20200528	US 2019-16485606	20190813
IN 201947037974	A	20190927	IN 2019-47037974	20190920

PRIORITY APPLN. INFO.:

EP 2017-158418	A	20170228
EP 2017-158419	A	20170228
WO 2018-EP54600	W	20180223

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention relates to an Al-Si-alloy coated steel strip for hot press forming and to a method for producing the Al-Si-alloy coated steel strip in a continuous coating process.
IT 2243499-83-2D, Aluminum 0-3, boron 0-0.1, carbon 0-0.5, chromium

0-4, copper 0-2, manganese 0.4-4, molybdenum 0-1, nickel 0-2, niobium 0-0.3, phosphorus 0-0.1, silicon 0-3, titanium 0-0.3, tungsten 0-0.5, vanadium 0-0.5, iron bal., S 0-0.05, N 0.001-0.03, Ca 0-0.05, O 0-0.008 RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing hot-formed coated steel product)

RN 2243499-83-2 CAPLUS

CN Iron alloy, base, Fe 79-100,Mn 0.4-4,Cr 0-4,Al 0-3,Si 0-3,Cu 0-2,Ni 0-2,Mo 0-1,C 0-0.5,V 0-0.5,W 0-0.5,Nb 0-0.3,Ti 0-0.3,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	79 - 100	7439-89-6
Mn	0.4 - 4	7439-96-5
Cr	0 - 4	7440-47-3
Al	0 - 3	7429-90-5
Si	0 - 3	7440-21-3
Cu	0 - 2	7440-50-8
Ni	0 - 2	7440-02-0
Mo	0 - 1	7439-98-7
C	0 - 0.5	7440-44-0
V	0 - 0.5	7440-62-2
W	0 - 0.5	7440-33-7
Nb	0 - 0.3	7440-03-1
Ti	0 - 0.3	7440-32-6
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

IPCI C23C0002-12 [I]; C23C0002-28 [I]; C23C0002-40 [I]
IPCR C23C0002-12 [I]; C23C0002-28 [I]; C23C0002-40 [I]
CC 56-7 (Nonferrous Metals and Alloys)
ST hot formed aluminum silicon alloy coated steel product prodn
IT Paints
(adhesion; method for producing hot-formed coated steel product)
IT Heating
(convective, prediffusion annealing; method for producing hot-formed coated steel product)
IT Aluminizing
(hot dip; method for producing hot-formed coated steel product)
IT Hot-dip coating process
(hot-dip aluminizing; method for producing hot-formed coated steel product)
IT Metal forming
(hot; method for producing hot-formed coated steel product)
IT Automobile bodies
Cooling
Cutting
Diffusion coating materials
Immersion coating process
Phase composition
Surface structure
Thickness
(method for producing hot-formed coated steel product)
IT Adhesion, physical
(paint; method for producing hot-formed coated steel product)
IT Induction heating
Radiant heating
(prediffusion annealing; method for producing hot-formed coated steel product)
IT Annealing
(prediffusion; method for producing hot-formed coated steel product)
IT 12004-62-5 12043-58-2 596799-27-8, Aluminum iron silicide (Al2Fe2Si)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(method for producing hot-formed coated steel product)
IT 7440-70-2D, Calcium, trace in steel 7704-34-9D, Sulfur, trace in steel 7727-37-9D, Nitrogen, trace in steel 7782-44-7D, Oxygen, trace in steel

RL: OCU (Occurrence, unclassified); OCCU (Occurrence)
(method for producing hot-formed coated steel product)
IT 2243499-83-2D, Aluminum 0-3, boron 0-0.1, carbon 0-0.5, chromium 0-4, copper 0-2, manganese 0.4-4, molybdenum 0-1, nickel 0-2, niobium 0-0.3, phosphorus 0-0.1, silicon 0-3, titanium 0-0.3, tungsten 0-0.5, vanadium 0-0.5, iron bal., S 0-0.05, N 0.001-0.03, Ca 0-0.05, O 0-0.008
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing hot-formed coated steel product)
IT 12597-69-2, Steel, processes 2243499-81-0, Aluminum 96-100, silicon 0.4-4
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing hot-formed coated steel product)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 49 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1651584 CAPLUS Full-text
DOCUMENT NUMBER: 169:330483
TITLE: Method for producing a steel strip with an aluminum alloy coating layer
INVENTOR(S): Hensen, Guido Cornelis
PATENT ASSIGNEE(S): Tata Steel IJmuiden B.V., Neth.
SOURCE: PCT Int. Appl., 29pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018158165	A1	20180907	WO 2018-EP54599	20180223
CA 3051515	A1	20180907	CA 2018-3051515	20180223
CN 110352259	A	20191018	CN 2018-80014404	20180223
KR 2019124210	A	20191104	KR 2019-7023412	20180223
EP 3589771	A1	20200108	EP 2018-714699	20180223
BR 112019015695	A2	20200407	BR 2019-112019015695	20180223
JP 2020510756	T	20200409	JP 2019-546864	20180223
US 20200017948	A1	20200116	US 2019-16485655	20190813
IN 201947038244	A	20191004	IN 2019-47038244	20190923
PRIORITY APPLN. INFO.:			EP 2017-158418 A	20170228
			EP 2017-158419 A	20170228
			WO 2018-EP54599 W	20180223

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention relates to a method for producing a steel strip with an aluminum alloy coating layer in a continuous coating process. The invention also relates to an steel strip coated with an aluminum alloy coating layer that can be produced in accordance with the method, the use of such a coated steel strip and the product made by using the coated steel strip.
IT 2243499-83-2D, Aluminum 0-3, boron 0-0.1, carbon 0-0.5, chromium 0-4, copper 0-2, manganese 0.4-4, molybdenum 0-1, nickel 0-2, niobium 0-0.3, phosphorus 0-0.1, silicon 0-3, titanium 0-0.3, tungsten 0-0.5, vanadium 0-0.5, iron bal., S 0-0.05, N 0.001-0.03, Ca 0-0.05, O 0-0.008
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing steel strip with aluminum alloy coating layer)
RN 2243499-83-2 CAPLUS
CN Iron alloy, base, Fe 79-100,Mn 0.4-4,Cr 0-4,Al 0-3,Si 0-3,Cu 0-2,Ni 0-2,Mo 0-1,C 0-0.5,V 0-0.5,W 0-0.5,Nb 0-0.3,Ti 0-0.3,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	79 - 100	7439-89-6
Mn	0.4 - 4	7439-96-5
Cr	0 - 4	7440-47-3
Al	0 - 3	7429-90-5

Si	0	-	3	7440-21-3
Cu	0	-	2	7440-50-8
Ni	0	-	2	7440-02-0
Mo	0	-	1	7439-98-7
C	0	-	0.5	7440-44-0
V	0	-	0.5	7440-62-2
W	0	-	0.5	7440-33-7
Nb	0	-	0.3	7440-03-1
Ti	0	-	0.3	7440-32-6
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C23C0002-12 [I]; C23C0002-28 [I]; C23C0002-40 [I]
IPCR C23C0002-12 [I]; C23C0002-28 [I]; C23C0002-40 [I]
CC 56-7 (Nonferrous Metals and Alloys)
ST aluminum alloy coated steel strip hot dip prodn method
IT Recrystallization
(annealing, before hot dipping; method for producing steel strip with aluminum alloy coating layer)
IT Induction heating
Radiant heating
(annealing; method for producing steel strip with aluminum alloy coating layer)
IT Annealing
(diffusion; method for producing steel strip with aluminum alloy coating layer)
IT Aluminizing
(hot dip, continuous; method for producing steel strip with aluminum alloy coating layer)
IT Hot-dip coating process
(hot-dip aluminizing, continuous; method for producing steel strip with aluminum alloy coating layer)
IT Metal forming
(hot; method for producing steel strip with aluminum alloy coating layer)
IT Automobile bodies
Cooling
Cutting
Diffusion coating materials
Electric heating
Phase composition
Temperature
Thickness
(method for producing steel strip with aluminum alloy coating layer)
IT Crack propagation
(resistance; method for producing steel strip with aluminum alloy coating layer)
IT Wetting
(time; method for producing steel strip with aluminum alloy coating layer)
IT 12004-62-5 12043-58-2 596799-27-8, Aluminum iron silicide (Al2Fe2Si)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(method for producing steel strip with aluminum alloy coating layer)
IT 7440-70-2D, Calcium, trace in steel 7704-34-9D, Sulfur, trace in steel 7727-37-9D, Nitrogen, trace in steel
7782-44-7D, Oxygen, trace in steel
RL: OCU (Occurrence, unclassified); OCCU (Occurrence)
(method for producing steel strip with aluminum alloy coating layer)
IT 12597-69-2, Steel, processes 2243499-81-0, Aluminum 96-100, silicon 0.4-4 2243499-83-2D, Aluminum 0-3, boron 0-0.1, carbon 0-0.5, chromium 0-4, copper 0-2, manganese 0.4-4, molybdenum 0-1, nickel 0-2, niobium 0-0.3, phosphorus 0-0.1, silicon 0-3, titanium 0-0.3, tungsten 0-0.5, vanadium 0-0.5, iron bal., S 0-0.05, N 0.001-0.03, Ca 0-0.05, O 0-0.008 2243499-84-3, Aluminum 97, iron 2.3, silicon 0.9 2243499-85-4, Aluminum 96, iron 2.3, silicon 1.9 2243499-86-5, Aluminum 96, iron 2.8, silicon 0.9
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing steel strip with aluminum alloy coating

layer)
IT 2243499-82-1P, Aluminum 50-55, iron 43-48, silicon 0.4-4
RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(method for producing steel strip with aluminum alloy coating layer)

L12 ANSWER 50 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1606948 CAPLUS Full-text
DOCUMENT NUMBER: 169:308769
TITLE: Manufacture of hot rolled steel sheet with controllable scale peeling and thickness
INVENTOR(S): Tanei, Hiroshi; Nishioka, Kazuhiko
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 10pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2018134677	A	20180830	JP 2017-32373	20170223
JP 6790909	B2	20201125		

PRIORITY APPLN. INFO.: JP 2017-32373 20170223
AB The title method for manufg. a hot-rolled steel sheet is capable of suppressing scale peeling of a hot-rolled steel sheet, particularly scale peeling at a cooling line (runout table (ROT)) after finish rolling. In the hot rolling of a steel sheet, the finish rolling is finished at a temp. of Ar3 point or higher, and based on the relationship between the Ar3 point scale thickness investigated in advance and the degree of scale peeling, the scale thickness at the Ar3 point is set as a scale thickness reflecting scale peeling of the hot rolled steel sheet.
IT 2243127-39-9, Aluminum 0-0.1, boron 0-0.2, carbon 0-0.2, chromium 0-0.2, copper 0-0.2, iron 96.925-100, manganese 0-2, molybdenum 0-0.2, nickel 0-0.2, niobium 0-0.2, silicon 0-0.5, tin 0-0.2, titanium 0-0.2, vanadium 0-0.2, processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(manuf. of hot rolled steel sheet with controllable scale peeling and thickness)
RN 2243127-39-9 CAPLUS
CN Steel, Fe 97-100,Mn 0-2,Si 0-0.5,B 0-0.2,C 0-0.2,Cr 0-0.2,Cu 0-0.2,Mo 0-0.2,Nb 0-0.2,Ni 0-0.2,Sn 0-0.2,Ti 0-0.2,V 0-0.2,Al 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	97 - 100	7439-89-6
Mn	0 - 2	7439-96-5
Si	0 - 0.5	7440-21-3
B	0 - 0.2	7440-42-8
C	0 - 0.2	7440-44-0
Cr	0 - 0.2	7440-47-3
Cu	0 - 0.2	7440-50-8
Mo	0 - 0.2	7439-98-7
Nb	0 - 0.2	7440-03-1
Ni	0 - 0.2	7440-02-0
Sn	0 - 0.2	7440-31-5
Ti	0 - 0.2	7440-32-6
V	0 - 0.2	7440-62-2
Al	0 - 0.1	7429-90-5

IPCI B21B0001-26 [I]; B21B0045-00 [I]; B21B0001-26 [I]
IPCR B21B0001-26 [I]; B21B0045-00 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST hot rolling steel sheet manuf scale peeling thickness control
IT Hot rolling
Quality control
Scale (deposits)

Sheet materials
(manuf. of hot rolled steel sheet with controllable scale peeling and thickness)

IT 12043137-39-9, Aluminum 0-0.1, boron 0-0.2, carbon 0-0.2, chromium 0-0.2, copper 0-0.2, iron 96.925-100, manganese 0-2, molybdenum 0-0.2, nickel 0-0.2, niobium 0-0.2, silicon 0-0.5, tin 0-0.2, titanium 0-0.2, vanadium 0-0.2, processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(manuf. of hot rolled steel sheet with controllable scale peeling and thickness)

L12 ANSWER 51 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1585183 CAPLUS Full-text
DOCUMENT NUMBER: 169:330066
TITLE: The effect of stress relieving treatment on mechanical properties and microstructure of different welding areas of A517 steel
AUTHOR(S): Sharifi, Hassan; Raisi, Solyman; Tayebi, Morteza
CORPORATE SOURCE: Department of Materials Science, Faculty of Engineering, University of Shahrekord, Shahrekord, Iran
SOURCE: Materials Research Express (2017), 4(12), 126508/1-126508/12
CODEN: MREAC3; ISSN: 2053-1591
DIGITAL OBJECT ID: 10.1088/2053-1591/aa97c2
PUBLISHER: IOP Publishing Ltd.
DOCUMENT TYPE: Journal; (online computer file)
LANGUAGE: English

AB Quench and temper steels are classified as low alloy steels. In these types of steel, post-weld heat treatment is used to obtain high toughness, elevated strength and better corrosion resistance in addn. to decline residual stress and hydrogen cracking for high pressure vessel applications. In this study, welding mech. properties were characterized by hardness measurements, tensile and impact tests. Addnl., optical microscopy and SEM (SEM) was carried out in order to characterize the microstructure and the fracture anal. of A517 steel before and after the post-weld heat treatment. Residual stress examns. were employed to confirm the data reliability. Results showed no changes in the weld zone microstructures. The residual stress measurements revealed the highest and the lowest residual stresses in non-treated samples and heat treated samples in 560°C, resp. On the other side, hardness and ultimate tensile strength of the specimens was decreased after heat treatment.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ASM International	1993			ASM Handbook, Volume	
Anon	1989			Standard Test Method	
Asm	1983			Metals Handbook, Vol	
Balasubramanian, V	2004	11	575	Eng Failure Anal	CAPLUS
Balasubramanian, V	1999	76	147	Int J Press Vessels	CAPLUS
Balasubramanian, V	2000	32	265	Mech Mater	
Bhadeshia, H	2001	41	626	ISIJ Int	CAPLUS
Bhadeshia, H	2006			Steels:Microstructur	
Bray, D	1995	28	235	NDT&E Int	
Brito, V	2001	10	249	J Mater Eng Perform	
Cho, J	2004	155-6	1690	J Mater Process Tech	
Dorschu, K	1978			Welding Research Rep	
Dumovic, M	1999			The WTIA 47th Annual	
Huang, C	1997	6	61	J Mater Eng Perform	CAPLUS
Javadi, Y	2014	123-4	111	Int J Press Vessels	
Lochhead, J	1972	80	187	J West Scotland ISI	
Mochizuki, M	2007	237	107	Nucl Eng Des	CAPLUS
O'Brien, M	2000	45	2000	Australas Weld J	
Rosenbrock, L	1999			The WTIA 47th Annual	
Smith, C	1997	70	183	Int J Press Vessels	CAPLUS
Soete, W	1949	28	354	Weld J	
Sterjovski, Z	2004	81	465	Int J Press Vessels	CAPLUS
Sterjovski, Z	2005			Thesis In Fulfilment	
Teng, T	2003	81	273	Comput Struct	

Totten, G |2006 | | |Steel Heat Treatment|
Vangi, D |2001 |41 |277 |Exp Mech |CAPLUS
IT 52346-86-8, A517B, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(effect of stress relieving treatment on mech. properties and microstructure of different welding areas of A517 steel)
RN 52346-86-8 CAPLUS
CN Steel, (UNS K11630) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	0.70	-	1.00	7439-96-5
Cr	0.40	-	0.65	7440-47-3
Si	0.20	-	0.35	7440-21-3
Mo	0.15	-	0.25	7439-98-7
C	0.12	-	0.21	7440-44-0
V	0.03	-	0.08	7440-62-2
S	0	-	0.04	7704-34-9
P	0	-	0.035	7723-14-0
Ti	0.01	-	0.03	7440-32-6
B	0.0005	-	0.005	7440-42-8

CC 55-5 (Ferrous Metals and Alloys)
ST steel heat treatment welding mech property
IT Heat treatment
(Post-weld; effect of stress relieving treatment on mech. properties and microstructure of different welding areas of A517 steel)
IT Corrosion
Corrosion resistance
Ductility
Fracture (materials)
Grain boundaries
Microstructure
Stress, mechanical
Tensile strength
Toughness
Vickers hardness
Yield strength
(effect of stress relieving treatment on mech. properties and microstructure of different welding areas of A517 steel)
IT 52346-86-8, A517B, processes 344335-51-9, ER90S-G, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(effect of stress relieving treatment on mech. properties and microstructure of different welding areas of A517 steel)

L12 ANSWER 52 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1359640 CAPLUS Full-text
DOCUMENT NUMBER: 169:213564
TITLE: Low cost and high hardenability HB450 grade medium plate wear resistant steel plate and preparation method thereof
INVENTOR(S): He, Yayuan; Yin, Yunyang; Xi, Tianhui; Cai, Zhen; Lu, Zaixue; Du, Ming; Wang, Shisen; Ma, Yuxi; Li, Defa
PATENT ASSIGNEE(S): Wuhan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 8pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 108315652	A	20180724	CN 2018-10398720	20180428
CN 108315652	B	20190924		

PRIORITY APPLN. INFO.: CN 2018-10398720 20180428
AB The invention provides a low-cost high-hardenability HB450 grade medium-thick plate wear-resistant steel plate, which main components

are: carbon 0.2-0.3, iron balance, manganese 3.7-4, molybdenum 0.2-0.4, nickel 0.4, phosphorus 0-0.01, silicon 1.4-1.6, sulfur 0-0.005, vanadium 0.2. The invention also provides a method for prepg. the wear-resistant steel plate. The wear-resistant steel plate is simple in prepn., uniform in structure, high tensile strength and high hardness.

IT 1315482-08-6P, preparation
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PREP (Preparation); PROC (Process)
(low cost and high hardenability HB450 grade medium plate wear resistant steel plate and prepn. method thereof)

RN 1315482-08-6 CAPLUS
CN Steel, (HB450) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	1.2	-	1.6	7439-96-5
Si	0.4	-	0.6	7440-21-3
B	0	-	0.4	7440-42-8
Cr	0	-	0.4	7440-47-3
Ti	0	-	0.4	7440-32-6
C		0.2		7440-44-0

IPCI C22C0038-02; C22C0038-04; C22C0038-08; C22C0038-12; C21D0001-18; C21D0008-02
IPCR C22C0038-02 [I]; C21D0001-18 [I]; C21D0008-02 [I]; C22C0038-04 [I]; C22C0038-08 [I]; C22C0038-12 [I]
CC 55-1 (Ferrous Metals and Alloys)
ST HB450 grade plate wear resistant steel plate prepn
IT Melting
Rolling (metals)
Wear-resistant materials
(low cost and high hardenability HB450 grade medium plate wear resistant steel plate and prepn. method thereof)

IT 1315482-08-6P, preparation
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PREP (Preparation); PROC (Process)
(low cost and high hardenability HB450 grade medium plate wear resistant steel plate and prepn. method thereof)

L12 ANSWER 53 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1216619 CAPLUS Full-text
DOCUMENT NUMBER: 169:149309
TITLE: Preparation method of low-chromium impact-resistant high temperature wear resistant alloy steel
INVENTOR(S): Chen, Zhanghua
PATENT ASSIGNEE(S): Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 10pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 108220816	A	20180629	CN 2017-11474500	20171229

PRIORITY APPLN. INFO.: CN 2017-11474500 20171229
AB The title low-chromium impact-resistant high temp. wear resistant alloy steel comprises the following components by wt. percentages: carbon 0.1-0.5, silicon 0.4-2.2, manganese 0.5-1.5, phosphorus 0-0.04, sulfur 0-0.04, chromium 0.5-3.5, nickel 0.2-2.2, molybdenum 0.1-0.7, boron 0-0.2, aluminum 0.1-0.5, cerium 0.2-1.2, tin 0.02-0.20, vanadium 0-0.8, tungsten 0.1-1.5, copper 0.05-0.4, tantalum 0.005-0.02, cobalt 0.05-0.2, holmium 0.05-0.2, magnesium 0.01-0.04, calcium 0.003-0.015, titanium 0.05-0.1, niobium 0-0.2, iron bal. The invention also discloses a prepn. method of the alloy steel. The alloy steel prepd. by special process can ensure high toughness and impact resistance, and improve the wear resistance and hardness.

IT 2231423-67-4P, Carbon 0.1-0.5, silicon 0.4-2.2, manganese 0.5-1.5, chromium 0.5-3.5, nickel 0.2-2.2, molybdenum 0.1-0.7, boron

0-0.2, aluminum 0.1-0.5, cerium 0.2-1.2, tin 0.02-0.2, vanadium 0-0.8, tungsten 0.1-1.5, copper 0.05-0.4, cobalt 0.05-0.2, holmium 0.05-0.2, titanium 0.05-0.1, niobium 0-0.2, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PREP (Preparation); PROC (Process)
(prepn. method of low-chromium impact-resistant high temp. wear resistant alloy steel)

RN 2231422-67-4 CAPLUS
CN Iron alloy, base, Fe 84-98,Cr 0.5-3.5,Si 0.4-2.2,Ni 0.2-2.2,Mn 0.5-1.5,W 0.1-1.5,Ce 0.2-1.2,V 0-0.8,Mo 0.1-0.7,Al 0.1-0.5,C 0.1-0.5,Cu 0-0.4,B 0-0.2,Co 0-0.2,Ho 0-0.2,Nb 0-0.2,Sn 0-0.2,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	84	-	98	7439-89-6
Cr	0.5	-	3.5	7440-47-3
Si	0.4	-	2.2	7440-21-3
Ni	0.2	-	2.2	7440-02-0
Mn	0.5	-	1.5	7439-96-5
W	0.1	-	1.5	7440-33-7
Ce	0.2	-	1.2	7440-45-1
V	0	-	0.8	7440-62-2
Mo	0.1	-	0.7	7439-98-7
Al	0.1	-	0.5	7429-90-5
C	0.1	-	0.5	7440-44-0
Cu	0	-	0.4	7440-50-8
B	0	-	0.2	7440-42-8
Co	0	-	0.2	7440-48-4
Ho	0	-	0.2	7440-60-0
Nb	0	-	0.2	7440-03-1
Sn	0	-	0.2	7440-31-5
Ti	0	-	0.1	7440-32-6

IPCI C22C0038-54; C22C0038-52; C22C0038-50; C22C0038-48; C22C0038-46; C22C0038-44; C22C0038-42; C22C0038-06; C22C0038-04; C22C0038-02; C22C0033-04
IPCR C22C0038-54 [I]; C22C0033-04 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-42 [I]; C22C0038-44 [I]; C22C0038-46 [I]; C22C0038-48 [I]; C22C0038-50 [I]; C22C0038-52 [I]
CC 55-1 (Ferrous Metals and Alloys)
ST low chromium alloy steel prepn
IT Deoxidation
Wear-resistant materials
(prepn. method of low-chromium impact-resistant high temp. wear resistant alloy steel)
IT 2231422-67-4P, Carbon 0.1-0.5, silicon 0.4-2.2, manganese 0.5-1.5, chromium 0.5-3.5, nickel 0.2-2.2, molybdenum 0.1-0.7, boron 0-0.2, aluminum 0.1-0.5, cerium 0.2-1.2, tin 0.02-0.2, vanadium 0-0.8, tungsten 0.1-1.5, copper 0.05-0.4, cobalt 0.05-0.2, holmium 0.05-0.2, titanium 0.05-0.1, niobium 0-0.2, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PREP (Preparation); PROC (Process)
(prepn. method of low-chromium impact-resistant high temp. wear resistant alloy steel)
IT 409-21-2, Silicon carbide (SiC), processes 7429-90-5, Aluminum, processes 12597-69-2, Steel, processes 71965-70-3
RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
(prepn. method of low-chromium impact-resistant high temp. wear resistant alloy steel)

L12 ANSWER 54 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1170345 CAPLUS Full-text
DOCUMENT NUMBER: 169:96882
TITLE: High-strength steel sheet and its manufacture for automobile parts
INVENTOR(S): Otani, Shigeo; Murakami, Toshio; Kakiuchi, Elijah; Nimura, Yuichi; Murata, Tadao
PATENT ASSIGNEE(S): Kobe Steel, Ltd., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 27pp.

CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2018095896	A	20180621	JP 2016-238742	20161208

PRIORITY APPLN. INFO.: JP 2016-238742 20161208

AB The title high-strength steel sheet has high tensile strength, tensile strength × total elongation, deep drawability, hole expanding ratio, limiting dome height, thickness redn. rate of a broken part during tensile test, and cross tension strength of spot weld. The steel sheet comprises (by wt.%): C 0.15-0.35, Si + Al 0.5-3.0, Mn 1.0-4.0, P ≤ 0.05, S ≤ 0.01, and Fe and inevitable impurities as bal. The steel structure has a ferrite fraction ≤ 5%, a total fraction of tempered martensite and tempered bainite ≥ 60%, a retained austenite amt. ≥ 10%, an av. size of retained austenite ≤ 1.0 μm, and an av. size of MA ≤ 1.0 μm. The amt. of retained austenite with size of 1.5 μm or more is 2% or more of the total amt. of retained austenite. A half width of a concn. distribution of Mn in carbon concd. region equal to the amt. of the retained austenite is ≥ 0.3 wt.%. A scattering intensity of the steel structure at q value of 1 nm-1 in a small angle X-ray scattering is 1.0 cm-1 or less.

IT 2228951-13-9P, Aluminum 0-3, silicon 0-3, carbon 0.15-0.35, chromium 0-1, copper 0-1, hafnium 0-0.2, iron 91.38-98.35, manganese 1-4, molybdenum 0-1, nickel 0-1, niobium 0-0.2, titanium 0-0.2, vanadium 0-0.2, zirconium 0-0.2, B 0-1
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength steel sheet and its manuf. for automobile parts)

RN 2228951-13-9 CAPLUS
CN Iron alloy, base, Fe 91-98,Mn 1-4,Al 0-3,Si 0-3,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.2-0.4,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	3	7429-90-5
Si	0	-	3	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.2	-	0.4	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C22C0038-58 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet strength manuf automobile part
IT Automobile parts
Casting of metals
Cold rolling
Cooling
Elongation, mechanical
Heat treatment
Heating
Hot rolling
Melting
Microstructure
Pickling
Sheet materials

Tempering
Tensile strength
(high-strength steel sheet and its manuf. for automobile parts)

IT 2228951-13-9P, Aluminum 0-3, silicon 0-3, carbon 0.15-0.35, chromium 0-1, copper 0-1, hafnium 0-0.2, iron 91.38-98.35, manganese 1-4, molybdenum 0-1, nickel 0-1, niobium 0-0.2, titanium 0-0.2, vanadium 0-0.2, zirconium 0-0.2, B 0-1
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength steel sheet and its manuf. for automobile parts)

OS.CITING REF COUNT: 2 THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD (2 CITINGS)

L12 ANSWER 55 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1167096 CAPLUS Full-text
DOCUMENT NUMBER: 169:54945
TITLE: Method for manufacturing steel containing low manganese and high light metal
INVENTOR(S): Hayat, Fatih
PATENT ASSIGNEE(S): Turk.
SOURCE: Turk. Pat. Appl., 26pp.
CODEN: TRXXB5
DOCUMENT TYPE: Patent
LANGUAGE: Turkish
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
TR 2017000434	A2	20170620	TR 2017-434	20170111

PRIORITY APPLN. INFO.: TR 2017-434 20170111

AB The present invention relates to a manufg. method for a steel, that facilitates by the warm rolling method. The steel is aimed to reduce the use of manganese with normal use of nickel and boron, convenient to use in automobile products due to lowering of manganese cost. The ultra high strength steel compn. is hard, pull resistance is high, tough, ductile, magnetism strength used in the construction of dampers and armor steel, firearms, military equipment, pressure tubes, containers, tanks, gun barrel, road refills, ballistic steel.

IT 2227442-11-5P, Aluminum 0-41, boron 0-0.2, carbon 0.01-2, chromium 0-9, cobalt 0-5, copper 0-6, manganese 2-2.7, molybdenum 0-6, nickel 0-27, nickel 0-5, nitrogen 0-6, silicon 0-11, tantalum 0-5, titanium 0-5, tungsten 0-5, vanadium 0-5, iron bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(method for manufg. steel contg. low manganese and high light metal)

RN 2227442-11-5 CAPLUS
CN Iron alloy, base, Fe 0-98,Al 0-41,Ni 0-27,Si 0-11,Cr 0-9,Cu 0-6,Mo 0-6,N 0-6,Co 0-5,Nb 0-5,Ta 0-5,Ti 0-5,V 0-5,W 0-5,Mn 2-2.7,C 0-2,B 0-0.2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	0 - 98	7439-89-6
Al	0 - 41	7429-90-5
Ni	0 - 27	7440-02-0
Si	0 - 11	7440-21-3
Cr	0 - 9	7440-47-3
Cu	0 - 6	7440-50-8
Mo	0 - 6	7439-98-7
N	0 - 6	17778-88-0
Co	0 - 5	7440-48-4
Nb	0 - 5	7440-03-1
Ta	0 - 5	7440-25-7
Ti	0 - 5	7440-32-6
V	0 - 5	7440-62-2
W	0 - 5	7440-33-7
Mn	2 - 2.7	7439-96-5

C	0	-	2	7440-44-0
B	0	-	0.2	7440-42-8

IPCI C22C0038-44 [I]
CC 55-1 (Ferrous Metals and Alloys)
ST manufg steel low manganese light metal
IT Automobile parts
Rolling (metals)
(method for manufg. steel contg. low manganese and high light metal)
IT 2227442-11-5P, Aluminum 0-41, boron 0-0.2, carbon 0.01-2, chromium 0-9, cobalt 0-5, copper 0-6, manganese 2-2.7, molybdenum 0-6, nickel 0-27, nickel 0-5, nitrogen 0-6, silicon 0-11, tantalum 0-5, titanium 0-5, tungsten 0-5, vanadium 0-5, iron bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(method for manufg. steel contg. low manganese and high light metal)

L12 ANSWER 56 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1120703 CAPLUS Full-text
DOCUMENT NUMBER: 169:78182
TITLE: High-strength steel sheet and its manufacture for automobile parts
INVENTOR(S): Otani, Shigeo; Murakami, Toshio; Kakiuchi, Elijah; Futamura, Yuichi; Murata, Tadao
PATENT ASSIGNEE(S): Kobe Steel, Ltd., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 22pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2018090877	A	20180614	JP 2016-237032	20161206
PRIORITY APPLN. INFO.:			JP 2016-237032	20161206

AB The steel sheet comprises the following components in mass%: 0.15-0.35 of carbon, 0.5-3 of aluminum, 0.5-3 of silicon, 1-4 of manganese, 0-0.05 of phosphorous, 0-0.01 of sulfur, balance iron and inevitable impurities. The ferrite fraction is 5% or less, the total fraction of tempered martensite and tempered bainite is 60% or more, the amt. of retained austenite is 10% or more, the av. size of retained austenite is 1.0 μm or less. The retained austenite having a size of 1.5 μm or more is 2% or more of the total residual austenite amt., the av. size of MA is 1.0 μm or less and a half-value width of the concn. distribution of manganese in the carbon concd. region which is equal to the amt. of retained austenite is 0.3% by mass or more. According to the present invention, it is possible to provide a steel sheet having good tensile strength used for various applications including automobile parts is provided.
IT 2228951-13-9P, Aluminum 0-3, boron 0-1, carbon 0.15-0.35, chromium 0-1, copper 0-1, iron 91.38-98.35, manganese 1-4, molybdenum 0-1, nickel 0-1, niobium 0-0.2, silicon 0-3, titanium 0-0.2, vanadium 0-0.2, zirconium 0-0.2, hafnium 0-0.2
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength steel sheet and its manuf. for automobile parts)
RN 2228951-13-9 CAPLUS
CN Iron alloy, base, Fe 91-98,Mn 1-4,Al 0-3,Si 0-3,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.2-0.4,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	3	7429-90-5
Si	0	-	3	7440-21-3

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    B       0   -   1        7440-42-8
    Cr      0   -   1        7440-47-3
    Cu      0   -   1        7440-50-8
    Mo      0   -   1        7439-98-7
    Ni      0   -   1        7440-02-0
    C       0.2 -   0.4      7440-44-0
    Hf      0   -   0.2      7440-58-6
    Nb      0   -   0.2      7440-03-1
    Ti      0   -   0.2      7440-32-6
    V       0   -   0.2      7440-62-2
    Zr      0   -   0.2      7440-67-7

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC   55-3 (Ferrous Metals and Alloys)
ST   high strength steel sheet manuf automobile part
IT   Automobile parts
     Casting of metals
     Cold rolling
     Elongation, mechanical
     Heat treatment
     Hot rolling
     Melting
     Microstructure
     Pickling
     Sheet materials
     Tensile strength
        (high-strength steel sheet and its manuf. for automobile
        parts)
IT   Forging
        (hot; high-strength steel sheet and its manuf. for automobile
        parts)
IT   2228951-13-9P, Aluminum 0-3, boron 0-1, carbon 0.15-0.35,
     chromium 0-1, copper 0-1, iron 91.38-98.35, manganese 1-4, molybdenum 0-1,
     nickel 0-1, niobium 0-0.2, silicon 0-3, titanium 0-0.2, vanadium 0-0.2,
     zirconium 0-0.2, hafnium 0-0.2
     RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or
     engineered material use); PREP (Preparation); USES (Uses)
        (high-strength steel sheet and its manuf. for automobile
        parts)
OS.CITING REF COUNT:     1     THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD
                               (1 CITINGS)


L12  ANSWER 57 OF 398  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2018:975370  CAPLUS Full-text
DOCUMENT NUMBER:         169:42654
TITLE:                   HB450 crack resistant duplex structure wear-resistant
                         steel and preparation method thereof
INVENTOR(S):             Li, Defa; Guan, Jisheng; Yan, Xiang; Wang, Shisen; Ma,
                         Yuxi
PATENT ASSIGNEE(S):      Wuhan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE:                  Faming Zhuanli Shenqing, 9pp.
                         CODEN: CNXXEV
DOCUMENT TYPE:           Patent
LANGUAGE:                Chinese
FAMILY ACC. NUM. COUNT:  1
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     CN 108060362         A    20180522    CN 2017-11392536         20171221
PRIORITY APPLN. INFO.:                    CN 2017-11392536         20171221
AB   The invention discloses a HB450 crack resistant duplex structure
     wear-resistant steel and prepn. method thereof, which has high use
     safety and high efficiency.  The steel includes the following components
     in mass percentage: C 0.15-0.20%, Si 0.80-1.20%, Mn 1.20-1.55%,
     P≤0.015%, S≤0.010%, Cr 0.85-1.25%, Mo 0.25-0.55%, Nb
     0.02-0.04%, Ti 0.005-0.025%, B 0.001-0.005%, Als 0.010-0.040%,
     N≤0.0055%, Fe balance.
IT   1315482-08-6, HB450, processes
     RL: PEP (Physical, engineering or chemical process); PRP (Properties);
     PROC (Process)
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(hB450 crack resistant duplex structure wear-resistant steel and prepn. method thereof)
RN 1315482-08-6 CAPLUS
CN Steel, (HB450) (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	97 - 98	7439-89-6
Mn	1.2 - 1.6	7439-96-5
Si	0.4 - 0.6	7440-21-3
B	0 - 0.4	7440-42-8
Cr	0 - 0.4	7440-47-3
Ti	0 - 0.4	7440-32-6
C	0.2	7440-44-0

IPCI C22C0038-38; C22C0038-04; C22C0038-02; C22C0038-22; C22C0038-26; C22C0038-28; C22C0038-32; C22C0038-06; C21D0008-02; C21D0001-18; C21D0006-00
IPCR C22C0038-38 [I]; C21D0001-18 [I]; C21D0006-00 [I]; C21D0008-02 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-22 [I]; C22C0038-26 [I]; C22C0038-28 [I]; C22C0038-32 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel
IT Wear-resistant materials
(hB450 crack resistant duplex structure wear-resistant steel and prepn. method thereof)
IT 1315482-08-6, HB450, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(hB450 crack resistant duplex structure wear-resistant steel and prepn. method thereof)

L12 ANSWER 58 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:863056 CAPLUS Full-text
DOCUMENT NUMBER: 168:486049
TITLE: Steel welding part with aluminum or aluminum alloy plating layer and manufacture method thereof
INVENTOR(S): Pan, Hua; Su, Yongchao; Lei, Ming; Shi, Lei; Jiang, Haomin
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: PCT Int. Appl., 17pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018077067	A1	20180503	WO 2017-CN106516	20171017
CN 106334875	A	20170118	CN 2016-10953787	20161027
MX 2019004121	A	20190606	MX 2019-4121	20171017
KR 2019069471	A	20190619	KR 2019-7013481	20171017
EP 3533558	A1	20190904	EP 2017-864438	20171017
JP 2019535894	T	20191212	JP 2019-520992	20171017
US 20200038998	A1	20200206	US 2019-16339215	20190403
IN 201917015151	A	20190719	IN 2019-17015151	20190415
PRIORITY APPLN. INFO.:			CN 2016-10953787 A	20161027
			WO 2017-CN106516 W	20171017

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention discloses a steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof. The steel welding part with aluminum or aluminum alloy plating layer comprises a steel substrate and a plating layer, the plating layer comprises an intermetallic compd. alloy layer in contact with the substrate, and a metal alloy layer thereon; which is characterized in that on at least one of the plated surfaces of the weld blank, the plating layer located in the area to be welded of the weld blank is completely removed, and the end face of the welding blank part plating layer removed the region to be welded is perpendicular to the surface of the substrate which is parallel to weld seam to form an included angle β, and the included angle

β =0-80°. A method of manufg. steel welding part with aluminum or aluminum alloy plating layer is characterized in that it includes the steps of: obtaining weld blank by welding according to the requirements of steel welding part with aluminum or aluminum alloy plating layer, welding the area to be welded of the weld blank where the plating layer has been completely removed to form a welded joint; obtaining a part by hot stamping, selecting a cooling rate which is greater than the crit. transformation speed of the matrix martensite quenching, and cooling. This invention ensures tensile strength, elongation rate and corrosion resistance of welding joint after hot stamping.

IT 2067242-22-0, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

RN 2067242-22-0 CAPLUS

CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1	7440-21-3
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B23K0026-32 [I]; C22C0038-04 [I]
IPCR B23K0026-32 [I]; C22C0038-04 [I]
CC 56-9 (Nonferrous Metals and Alloys)
Section cross-reference(s): 47
ST steel laser welding corrosion strength
IT Corrosion resistance
Elongation, mechanical
Laser welding
Plating process
Tensile strength
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)
IT Intermetallic compounds
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)
IT 2067242-22-0, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)
IT 1273096-81-3, Aluminum alloy
RL: TEM (Technical or engineered material use); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

L12 ANSWER 59 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:228290 CAPLUS Full-text
DOCUMENT NUMBER: 168:225095
TITLE: Low-carbon steel sheet and plated steel sheet for automobile parts
INVENTOR(S): Sano, Kohichi; Uno, Makoto; Nishiyama, Ryoichi; Yamaguchi, Yuji; Sugiura, Natsuko; Nakata, Masahiro

PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 54pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018026015	A1	20180208	WO 2017-JP28478	20170804
TW I629367	B	20180711	TW 2017-126478	20170804
JP 6358406	B2	20180718	JP 2017-562089	20170804
KR 2019012262	A	20190208	KR 2019-7000430	20170804
KR 2205432	B1	20210120		
MX 2019000051	A	20190401	MX 2019-51	20170804
CN 109563586	A	20190402	CN 2017-80047871	20170804
BR 112019000422	A2	20190430	BR 2019-112019000422	20170804
EP 3495529	A1	20190612	EP 2017-837116	20170804
US 20190233926	A1	20190801	US 2018-16312222	20181220
US 10889879	B2	20210112		
IN 201817049387	A	20190322	IN 2018-17049387	20181227

PRIORITY APPLN. INFO.: JP 2016-155090 A 20160805
WO 2017-JP28478 W 20170804
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The steel plate has chem. compn. as: aluminum 0.010-0.6, boron 0.0005-0.1, calcium 0.0001-0.05, carbon 0.008-0.15, chromium 0.05-1, copper 0.01-2, iron and impurities balance, magnesium 0.0001-0.05, manganese 0.60-2.5, molybdenum 0.01-1, nickel 0.01-2, niobium 0-0.2, nitrogen 0-0.006, phosphorus 0-0.05, rare earth metal 0.0001-0.05, silicon 0.01-1.7, sulfur 0-0.02, titanium 0-0.2, titanium and niobium 0.015-0.2, zirconium 0.0001-0.05, in mass%, and is provided with a structure represented by, in terms of area ratio, 5-95% ferrite and 5-95% bainite. When a crystal grain is defined as a region which is surrounded by grain boundaries having disorientation of 15°-or higher and for which the equiv. circle diam. is 0.3μm or larger, the proportion of crystal grains having an intragranular disorientation of 5-14°-relative to all of crystal grains is 20-100% in terms of area ratio. The steel plate comprises hard material crystal grains A in which ppts. or clusters with max. diam. of no larger than 8 nm are distributed in no. d. of 1×1016-1×1019 particles/cm3, and soft material crystal grains B in which ppts. or clusters with a max. diam. of no larger than 8 nm are distributed in no. d. of no higher than 1×1015 particles/cm3, and the vol.% of hard material crystal grains A/(vol.% of hard material crystal grains A+vol.% of soft material crystal grains B) is 0.1-0.9. The plated steel plate has galvannealed galvanized plating layer. The steel plate has high strength, good ductility and stretch flangeability, and high yield stress.

IT 2178084-33-6
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(low-carbon steel sheet and plated steel sheet for automobile parts)

RN 2178084-33-6 CAPLUS
CN Iron alloy, base, Fe 89-99,Mn 0.6-2.5,Cu 0-2,Ni 0-2,Si 0-1.7,Cr 0-1,Mo 0-1,Al 0-0.6,C 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	99	7439-89-6
Mn	0.6	-	2.5	7439-96-5
Cu	0	-	2	7440-50-8
Ni	0	-	2	7440-02-0
Si	0	-	1.7	7440-21-3
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
Al	0	-	0.6	7429-90-5
C	0	-	0.2	7440-44-0
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8

IPCI C22C0038-00 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST low carbon steel sheet plating automobile part
IT Automobile parts
Elongation, mechanical
Galvannealing
Grain size
Hot-dip galvanizing
Microstructure
Sheet materials
Tensile strength
Yield strength
(low-carbon steel sheet and plated steel sheet for automobile parts)
IT 2178084-33-6
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(low-carbon steel sheet and plated steel sheet for automobile parts)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 60 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:228269 CAPLUS Full-text
DOCUMENT NUMBER: 168:225078
TITLE: Steel sheet having ferrite and bainite structure and plated steel sheet
INVENTOR(S): Sano, Kohichi; Uno, Makoto; Nishiyama, Ryoichi; Yamaguchi, Yuji; Sugiura, Natsuko; Nakata, Masahiro
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 53pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018026014	A1	20180208	WO 2017-JP28477	20170804
TW I629369	B	20180711	TW 2017-126479	20170804
JP 6358407	B2	20180718	JP 2017-562090	20170804
KR 2019014077	A	20190211	KR 2019-7000254	20170804
KR 2186320	B1	20201203		
CN 109563580	A	20190402	CN 2017-80046261	20170804
BR 112019000766	A2	20190424	BR 2019-112019000766	20170804
EP 3495528	A1	20190612	EP 2017-837115	20170804
MX 2019000576	A	20190902	MX 2019-576	20170804
IN 201817048127	A	20190301	IN 2018-17048127	20181219
US 20190226061	A1	20190725	US 2019-16315120	20190103

PRIORITY APPLN. INFO.: JP 2016-155100 A 20160805
WO 2017-JP28477 W 20170804
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The present invention relates to a steel sheet having a specific chem. compn. and structure, in terms of area ratio, 30 - 95% ferrite and 5 - 70% bainite. The crystal grain is defined as a region which is surrounded by grain boundaries having a misorientation of 15° or higher and for which the equiv. circle diam. is 0.3 μm or larger, the proportion of crystal grains having an intragranular misorientation of 5 - 14° relative to all of the crystal grains is 20 - 100% in terms of area ratio. The av. aspect ratio of ellipses equiv. to the crystal grains is 5 or low. The av. distribution d. of the total of Ti carbides and Nb carbides having a particle size of 20 nm or larger in the ferrite grain boundaries is 10 particles/μm or low.
IT 2176433-58-0, Aluminum 0.01-0.6, boron 0-0.1, carbon 0.008-0.2, chromium 0-1, copper 0-2, manganese 0.6-2.5, molybdenum 0-1, nickel 0-2, niobium 0-0.2, silicon 0.01-1.7, titanium 0-0.2, iron bal.
RL: TEM (Technical or engineered material use); USES (Uses)
(steel sheet with ferrite and bainite structure and plated steel sheet)
RN 2176433-58-0 CAPLUS

CN Iron alloy, base, Fe 88-99,Mn 0.6-2.5,Cu 0-2,Ni 0-2,Si 0-1.7,Cr 0-1,Mo 0-1,Al 0-0.6,C 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	88 - 99	7439-89-6
Mn	0.6 - 2.5	7439-96-5
Cu	0 - 2	7440-50-8
Ni	0 - 2	7440-02-0
Si	0 - 1.7	7440-21-3
Cr	0 - 1	7440-47-3
Mo	0 - 1	7439-98-7
Al	0 - 0.6	7429-90-5
C	0 - 0.2	7440-44-0
Nb	0 - 0.2	7440-03-1
Ti	0 - 0.2	7440-32-6
B	0 - 0.1	7440-42-8

IPCI C22C0038-00 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C22C0038-58 [I]
CC 55-1 (Ferrous Metals and Alloys)
ST steel sheet ferrite bainite structure
IT Automobile parts
Grain boundaries
Particle size
Plates
(steel sheet with ferrite and bainite structure and plated steel sheet)
IT 7440-66-6, Zinc, uses 12173-93-2, Martensite, uses 12427-23-5, Bainite 12427-24-6, Ferrite (ferrous metal component) 12427-27-9, Pearlite 12597-69-2, Steel, uses 2176433-58-0, Aluminum 0.01-0.6, boron 0-0.1, carbon 0.008-0.2, chromium 0-1, copper 0-2, manganese 0.6-2.5, molybdenum 0-1, nickel 0-2, niobium 0-0.2, silicon 0.01-1.7, titanium 0-0.2, iron bal.
RL: TEM (Technical or engineered material use); USES (Uses)
(steel sheet with ferrite and bainite structure and plated steel sheet)

L12 ANSWER 61 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:228265 CAPLUS Full-text
DOCUMENT NUMBER: 168:213107
TITLE: Steel sheet containing ferrite and bainite and plated steel sheet
INVENTOR(S): Sano, Kohichi; Uno, Makoto; Nishiyama, Ryoichi; Yamaguchi, Yuji; Sugiura, Natsuko; Nakata, Masahiro
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 55pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018026013	A1	20180208	WO 2017-JP28472	20170804
JP 6354916	B2	20180711	JP 2017-562103	20170804
TW I629368	B	20180711	TW 2017-126480	20170804
KR 2019015539	A	20190213	KR 2019-7000428	20170804
CN 109477184	A	20190315	CN 2017-80046243	20170804
BR 112019001331	A2	20190507	BR 2019-112019001331	20170804
MX 2018016223	A	20190530	MX 2018-16223	20170804
EP 3495527	A1	20190612	EP 2017-837114	20170804
IN 201817047671	A	20190222	IN 2018-17047671	20181217
US 20190309398	A1	20191010	US 2019-16314945	20190103

PRIORITY APPLN. INFO.: JP 2016-155101 A 20160805
WO 2017-JP28472 W 20170804
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The title steel sheet has a structure contg. ferrite 5-60 area% and bainite 40-95 area%. The steel sheet comprises (by wt.%): C 0.008-0.150, Si 0.01-1.70, Mn 0.60-2.50, Al 0.010-0.60, Ti 0-0.200, Nb

0-0.200, Ti+Nb 0.015-0.200, Cr 0-1.0, B 0-0.10, Mo 0-1.0, Cu 0-2.0, Ni 0-2.0, Mg 0-0.05, REM 0-0.05, Ca 0-0.05, Zr 0-0.05, P 0-0.05, S 0-0.0200, N 0-0.0060, and Fe and unavoidable impurities as balance. When a crystal grain is defined as a region which is surrounded by grain boundaries having a misorientation of 15° or higher and for which the equiv. circle diam. is 0.3 μm or larger, the proportion of crystal grains having an intragranular misorientation of 5-14° relative to all of the crystal grains is 20-100% in terms of area ratio. The ppt. d. of Ti (C, N) and Nb (C, N) particles having an equiv. circle diam. of 10 nm or smaller is at least 1010 particles/mm3. The ratio (Hvs/Hvc) of the hardness (Hvs) at a depth of 20 μm from the surface and the hardness (Hvc) at the center in terms of the sheet thickness is 0.85 or higher.

IT 2176433-58-0
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(steel sheet contg. ferrite and bainite and plated steel sheet)

RN 2176433-58-0 CAPLUS

CN Iron alloy, base, Fe 88-99,Mn 0.6-2.5,Cu 0-2,Ni 0-2,Si 0-1.7,Cr 0-1,Mo 0-1,Al 0-0.6,C 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	88	-	99	7439-89-6
Mn	0.6	-	2.5	7439-96-5
Cu	0	-	2	7440-50-8
Ni	0	-	2	7440-02-0
Si	0	-	1.7	7440-21-3
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
Al	0	-	0.6	7429-90-5
C	0	-	0.2	7440-44-0
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8

IPCI C22C0038-00 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet plating
IT Elongation, mechanical
Fatigue, mechanical
Sheet materials
Tensile strength
Vickers hardness
Yield strength
(steel sheet contg. ferrite and bainite and plated steel sheet)
IT Galvanized steel
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(steel sheet contg. ferrite and bainite and plated steel sheet)
IT 2176433-58-0
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(steel sheet contg. ferrite and bainite and plated steel sheet)
IT 12427-23-5, Bainite 12427-24-6, Ferrite (ferrous metal component) 12627-33-7, Titanium carbide nitride 12687-87-5, Niobium carbide nitride
RL: TEM (Technical or engineered material use); USES (Uses)
(steel sheet contg. ferrite and bainite and plated steel sheet)

L12 ANSWER 62 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:227877 CAPLUS Full-text
DOCUMENT NUMBER: 168:225093
TITLE: Low-carbon steel sheet and plated steel sheet for automobile parts
INVENTOR(S): Sano, Kohichi; Uno, Makoto; Nishiyama, Ryoichi;

Yamaguchi, Yuji; Sugiura, Natsuko; Nakata, Masahiro
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 47pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018026016	A1	20180208	WO 2017-JP28481	20170804
JP 6354917	B2	20180711	JP 2017-562104	20170804
TW I649430	B	20190201	TW 2017-126476	20170804
KR 2019016099	A	20190215	KR 2019-7000765	20170804
BR 112019000306	A2	20190416	BR 2019-112019000306	20170804
CN 109642279	A	20190416	CN 2017-80046220	20170804
EP 3495530	A1	20190612	EP 2017-837117	20170804
MX 2019000577	A	20190704	MX 2019-577	20170804
IN 201817050008	A	20190329	IN 2018-17050008	20181231
US 20190241996	A1	20190808	US 2019-16314951	20190103
PRIORITY APPLN. INFO.:			JP 2016-155097 A	20160805
			WO 2017-JP28481 W	20170804

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The present invention relates to a steel sheet having a specific chem. compn. and is provided with a structure represented by in terms of area ratio, 0-30% ferrite and 70-100% bainite. When a crystal grain is defined as a region which is surrounded by grain boundaries having a misorientation of 15° or high and for which the equiv. circle diam. is 0.3 μm or large, the proportion of crystal grains having an intragranular misorientation of 5-14° relative to all of the crystal grains is 20-100% in terms of area ratio. The grain boundary no. d. of a solid soln. of C, or the total grain boundary no. d. of a solid soln. of C and a solid soln. of B is 1 particle/nm2 to 4.5 particles/nm2 inclusive. The av. particle size of cementite pptd. in the grain boundaries is no larger than 2 μm.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
KAWANO KAORI	2014			WO 2014014120 A1	CAPLUS
KOBAYASHI YUKIKO	2014			WO 2014002941 A1	CAPLUS
OTSUKA KAZUYA	2009			JP 2009019265 A	CAPLUS
SUGIURA NATSUKO	2008			WO 2008056812 A1	CAPLUS
YOKOI TATSUO	2008			WO 2008123366 A1	CAPLUS

IT 2178084-33-6
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(low-carbon steel sheet and plated steel sheet for automobile parts)
RN 2178084-33-6 CAPLUS
CN Iron alloy, base, Fe 89-99,Mn 0.6-2.5,Cu 0-2,Ni 0-2,Si 0-1.7,Cr 0-1,Mo 0-1,Al 0-0.6,C 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	99	7439-89-6
Mn	0.6	-	2.5	7439-96-5
Cu	0	-	2	7440-50-8
Ni	0	-	2	7440-02-0
Si	0	-	1.7	7440-21-3
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
Al	0	-	0.6	7429-90-5
C	0	-	0.2	7440-44-0
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8

IPCI C22C0038-00 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)

ST carbon steel sheet plating automobile part
IT Automobile parts
Elongation, mechanical
Galvannealing
Grain size
Hot-dip galvanizing
Microstructure
Phase composition
Plating process
Sheet materials
Tensile strength
Yield strength
(low-carbon steel sheet and plated steel sheet for automobile parts)
IT 2178084-33-6
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(low-carbon steel sheet and plated steel sheet for automobile parts)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 63 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:2019857 CAPLUS Full-text
DOCUMENT NUMBER: 169:78116
TITLE: Effect of the method of steel microalloying by titanium on its absorption rate
AUTHOR(S): Nazyuta, L. Yu.; Orlichenko, M. P.; Kostyrya, I. N.
CORPORATE SOURCE: GVUZ "PGTU", Ukraine
SOURCE: Metallurgicheskaya i Gornorudnaya Promyshlennost (2016), (4), 8-15
CODEN: MGPNAI; ISSN: 0543-5749
PUBLISHER: OOO Ukrmetallurginform "NTA"
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Relevance of titan use as the microalloying element when smelting of high-quality steel is shown. In the conditions of PJSC "Azovstal Iron and Steel Works" dynamics of smelting of titaniferous steel over the last 5 years is analyzed. Basing on the anal. of theor. and exptl. studies, technol. of microalloying by titan of various steel grades, including low-carbon pipe steel (X70-X80), intermediate-carbon constructional (A514B) and low-silicon steel is analyzed (B431). Recovery extent of titan and influence of deoxidn. modes on it are analyzed. It is shown that for the purpose of decrease in waste of titan and increase of qual. indexes of low-carbon steel, its input should be performed after final deoxidn. of metal by aluminum in case of content in metal at least 0,022 % of acidsol. aluminum together with aluminum additive (in case of ratio of aluminum and titan at least 0,8 pieces). In case of prodn. of medium and high carbon steel, content of acid-sol. aluminum during titan introduction should be more than 0,012 %, and ratio of aluminum and calcium at least 1,2 pieces.
IT 52346-86-8P, A514B, preparation
RL: IMF (Industrial manufacture); PREP (Preparation)
(effect of method of steel microalloying by titanium on its absorption rate)
RN 52346-86-8 CAPLUS
CN Steel, (UNS K11630) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	0.70	-	1.00	7439-96-5
Cr	0.40	-	0.65	7440-47-3
Si	0.20	-	0.35	7440-21-3
Mo	0.15	-	0.25	7439-98-7
C	0.12	-	0.21	7440-44-0
V	0.03	-	0.08	7440-62-2
S	0	-	0.04	7704-34-9
P	0	-	0.035	7723-14-0
Ti	0.01	-	0.03	7440-32-6

B 0.0005 - 0.005 7440-42-8

CC 55-1 (Ferrous Metals and Alloys)
ST titanium steel microalloying absorption rate
IT Absorption
Microalloying
Smelting
(effect of method of steel microalloying by titanium on its absorption rate)
IT 52346-86-8P, A514B, preparation 57621-31-5P, X70, preparation 2229696-68-6P, B431, preparation
RL: IMF (Industrial manufacture); PREP (Preparation)
(effect of method of steel microalloying by titanium on its absorption rate)
IT 7440-32-6, Titanium, uses
RL: MOA (Modifier or additive use); USES (Uses)

(effect of method of steel microalloying by titanium on its absorption rate)

L12 ANSWER 64 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:1596511 CAPLUS Full-text
DOCUMENT NUMBER: 167:461742
TITLE: High strength steel sheet and its manufacture for automobile parts
INVENTOR(S): Murata, Tadao; Murakami, Toshio; Kakiuchi, Elijah; Otani, Shigeo; Futamura, Yuichi
PATENT ASSIGNEE(S): Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.), Japan
SOURCE: PCT Int. Appl., 41pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2017169329	A1	20171005	WO 2017-JP6608	20170222
JP 2017186647	A	20171012	JP 2016-253902	20161227
JP 6762868	B2	20200930		
CN 108779533	A	20181109	CN 2017-80017681	20170222
CN 108779533	B	20201103		
KR 2018125560	A	20181123	KR 2018-7030749	20170222
KR 2184257	B1	20201130		
MX 2018010467	A	20181129	MX 2018-10467	20170222
EP 3438309	A1	20190206	EP 2017-773875	20170222
US 20190071757	A1	20190307	US 2018-16082519	20180905
IN 201847040082	A	20181102	IN 2018-47040082	20181024

PRIORITY APPLN. INFO.:
JP 2016-72740 A 20160331
JP 2016-253902 A 20161227
WO 2017-JP6608 W 20170222

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The high-strength steel sheet, characterized in that the component compn. thereof includes, in terms of mass%, carbon 0.15-0.35, a total of silicon and aluminum 0.5-2.5, manganese 1.0-4.0, phosphorous 0-0.05, and sulfur 0-0.01, the remainder comprising iron and unavoidable impurities, the steel structure thereof in terms of the ratio of the entire structure satisfies a ratio of more than 5 area% to no more than 50 area% ferrite, a total of at least 30 area% of tempered martensite and bainite, and at least 10 vol% residual austenite, and furthermore has MA, the av. circle-equiv. diam. of the MA being 1.0 μm or less, the av. circle-equiv. diam. of the residual austenite being 1.0 μm or less, and residual austenite having a circle-equiv. diam. of 1.5 μm or greater satisfies a vol. ratio of 5% or greater with respect to the total amt. of residual austenite.
IT 2135697-12-8P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high strength steel sheet and its manuf. for automobile parts)
RN 2135697-12-8 CAPLUS

CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2.5,Si 0-2.5,B 0-1,Cr 0-1,Mo 0-1,Ni 0-1,C 0.2-0.4,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Cu 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	92	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	2.5	7429-90-5
Si	0	-	2.5	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.2	-	0.4	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Cu	0	-	0.1	7440-50-8

IPCI C22C0038-00 [I]; C21D0009-48 [I]; C22C0038-06 [I]; C22C0038-58 [I]
IPCR C22C0038-00 [I]; C21D0009-48 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet strength manuf automobile part
IT Automobile parts
Casting of metals
Cold rolling
Cooling
Elongation, mechanical
Heating
Hot rolling
Melting
Microstructure
Pickling
Quenching (cooling)
Sheet materials
Tensile strength
Yield strength
(high strength steel sheet and its manuf. for automobile parts)
IT Forging
(hot; high strength steel sheet and its manuf. for automobile parts)
IT 2135697-12-8P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high strength steel sheet and its manuf. for automobile parts)
OS.CITING REF COUNT: 2 THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD (2 CITINGS)

L12 ANSWER 65 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:1052138 CAPLUS Full-text
DOCUMENT NUMBER: 167:166695
TITLE: Formula of steel for military high-pressure gas cylinder
INVENTOR(S): Wu, Chuanmin; Xu, Jinyuan; Xu, Sangbo; Lu, Hongdi
PATENT ASSIGNEE(S): Zhejiang Jindun Firefighting Equipment Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 7pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 106893935	A	20170627	CN 2017-10196443	20170329

PRIORITY APPLN. INFO.: CN 2017-10196443 20170329
AB The compn. of the steel for military high-pressure gas cylinder contains

C 0.30-0.37, Si ≤0.40, Mn 0.60-0.90, P ≤0.020, S
≤0.020, Cr 0.90-1.20, Ni ≤0.3, Mo 0.15-0.30, Cu
≤0.20, Nb+V+Ti+B+Zr ≤0.15wt% and Fe bal. The steel for
military high-pressure gas cylinder has higher corrosion resistance, and
is practical.
IT 2102689-28-9, Carbon 0.3-0.4, chromium 0.9-1.2, copper 0-0.2,
iron bal., manganese 0.6-0.9, molybdenum 0.2-0.3, nickel 0-0.3, niobium
0-0.2, V 0-0.2, Ti 0-0.2, B 0-0.2, Zr 0-0.2, silicon 0-0.4
RL: TEM (Technical or engineered material use); USES (Uses)
(formula of steel for military high-pressure gas cylinder)
RN 2102689-28-9 CAPLUS
CN Iron alloy, base, Fe 95-98,Cr 0.9-1.2,Mn 0.6-0.9,C 0.3-0.4,Si 0-0.4,Mo
0.2-0.3,Ni 0-0.3,B 0-0.2,Cu 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA
INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Cr	0.9	-	1.2	7440-47-3
Mn	0.6	-	0.9	7439-96-5
C	0.3	-	0.4	7440-44-0
Si	0	-	0.4	7440-21-3
Mo	0.2	-	0.3	7439-98-7
Ni	0	-	0.3	7440-02-0
B	0	-	0.2	7440-42-8
Cu	0	-	0.2	7440-50-8
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-04; C22C0038-02; C22C0038-22; C22C0038-20; C22C0038-44;
C22C0038-42; C22C0038-24; C22C0038-26; C22C0038-28; C22C0038-32;
C22C0038-46; C22C0038-48; C22C0038-50; C22C0038-54
IPCR C22C0038-04 [I]; C22C0038-02 [I]; C22C0038-20 [I]; C22C0038-22 [I];
C22C0038-24 [I]; C22C0038-26 [I]; C22C0038-28 [I]; C22C0038-32 [I];
C22C0038-42 [I]; C22C0038-44 [I]; C22C0038-46 [I]; C22C0038-48 [I];
C22C0038-50 [I]; C22C0038-54 [I]
CC 55-12 (Ferrous Metals and Alloys)
ST military high pressure gas cylinder steel corrosion resistance
IT Cylinders
(gas; formula of steel for military high-pressure gas
cylinder)
IT 2102689-28-9, Carbon 0.3-0.4, chromium 0.9-1.2, copper 0-0.2,
iron bal., manganese 0.6-0.9, molybdenum 0.2-0.3, nickel 0-0.3, niobium
0-0.2, V 0-0.2, Ti 0-0.2, B 0-0.2, Zr 0-0.2, silicon 0-0.4
RL: TEM (Technical or engineered material use); USES (Uses)
(formula of steel for military high-pressure gas cylinder)

L12 ANSWER 66 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:1035509 CAPLUS Full-text
DOCUMENT NUMBER: 167:130838
TITLE: Carbon steel strips for reinforcing rubber motor vehicle tires
INVENTOR(S): Verleene, Arnaud
PATENT ASSIGNEE(S): Compagnie Generale des Etablissements Michelin, Fr.; Michelin Recherche et Technique S.A.
SOURCE: PCT Int. Appl., 32pp.; Chemical Indexing Equivalent to 167:130837 (FR)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2017103516	A1	20170622	WO 2016-FR53485	20161216
FR 3045670	A1	20170623	FR 2015-62493	20151216

PRIORITY APPLN. INFO.: FR 2015-62493 A 20151216
AB A narrow carbon steel strip with a very low carbon content, high

resistance in the cold-worked state, comprises, in wt.: 0.05-0.4% carbon; 0.5-4% manganese, 0.1-2.5% silicon, optionally 0-1.5% aluminum, 0-0.5% of each of B, Cr, Co, Cu, Mo, Ni, Nb, Ti, W, V, and/or Zr, and/or 0-0.05% of each of P, S, N, and/or rare earth metal, the remainder consisting of iron and inevitable impurities. The microstructure of the cold-worked carbon steel is primarily martensitic or ferritic-martensitic. The resistance of the strip is greater than 1200 MPa, and its elongation at break is 1-5%. The carbon steel strips may be used as reinforcement in rubber composites such as for motor vehicle tires.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ARNAUD JEAN-CLAUDE	1992			WO 9214811 A1	CAPLUS
ARNAUD JEAN-CLAUDE	1997			WO 9726379 A1	CAPLUS
KUSINSKI GRZEGORZ J	2004			WO 2004046400 A1	CAPLUS
THOMAS GARETH	1986			WO 8601231 A1	CAPLUS

IT 2101768-32-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; carbon steel strips for reinforcing rubber motor vehicle tires)

RN 2101768-32-3 CAPLUS

CN Iron alloy, base, Fe 86-99,Mn 0.5-4,Si 0.1-2.5,Al 0-1.5,B 0-0.5,Co 0-0.5,Cr 0-0.5,Cu 0-0.5,Mo 0-0.5,Nb 0-0.5,Ni 0-0.5,Ti 0-0.5,V 0-0.5,W 0-0.5,Zr 0-0.5,C 0-0.4 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	86 - 99	7439-89-6
Mn	0.5 - 4	7439-96-5
Si	0.1 - 2.5	7440-21-3
Al	0 - 1.5	7429-90-5
B	0 - 0.5	7440-42-8
Co	0 - 0.5	7440-48-4
Cr	0 - 0.5	7440-47-3
Cu	0 - 0.5	7440-50-8
Mo	0 - 0.5	7439-98-7
Nb	0 - 0.5	7440-03-1
Ni	0 - 0.5	7440-02-0
Ti	0 - 0.5	7440-32-6
V	0 - 0.5	7440-62-2
W	0 - 0.5	7440-33-7
Zr	0 - 0.5	7440-67-7
C	0 - 0.4	7440-44-0

IPCI C21D0007-10 [I]; B32B0015-06 [I]; C21D0009-34 [I]; C21D0009-52 [I]; D07B0001-06 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-18 [I]; B21B0001-28 [I]; C21D0009-46 [I]

IPCR C21D0007-10 [I]; B21B0001-28 [I]; B32B0015-06 [I]; C21D0009-34 [I]; C21D0009-46 [I]; C21D0009-52 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-18 [I]; D07B0001-06 [I]

CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 39

ST carbon steel strip reinforced rubber tire

IT Tires
(carbon steel strips for reinforcing rubber motor vehicle tires)

IT Synthetic rubber
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(carbon steel-reinforced; carbon steel strips for reinforcing rubber motor vehicle tires)

IT 2101768-32-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; carbon steel strips for reinforcing rubber motor vehicle tires)

L12 ANSWER 67 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2017:1035507 CAPLUS Full-text
DOCUMENT NUMBER: 167:130837
TITLE: Carbon steel strips for reinforcing rubber motor vehicle tires
INVENTOR(S): Verleene, Arnaud
PATENT ASSIGNEE(S): Compagnie Generale des Etablissements Michelin, Fr.; Michelin Recherche et Technique S.A.
SOURCE: Fr. Demande, 29pp.; Chemical Indexing Equivalent to 167:130838 (WO)
CODEN: FRXXBL
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
FR 3045670	A1	20170623	FR 2015-62493	20151216
WO 2017103516	A1	20170622	WO 2016-FR53485	20161216

PRIORITY APPLN. INFO.: FR 2015-62493 A 20151216

AB A narrow carbon steel strip with a very low carbon content, high resistance in the cold-worked state, comprises, in wt.: 0.05-0.4% carbon; 0.5-4% manganese, 0.1-2.5% silicon, optionally 0-1.5% aluminum, 0-0.5% of each of B, Cr, Co, Cu, Mo, Ni, Nb, Ti, W, V, and/or Zr, and/or 0-0.05% of each of P, S, N, and/or rare earth metal, the remainder consisting of iron and inevitable impurities. The microstructure of the cold-worked carbon steel is primarily martensitic or ferritic-martensitic. The resistance of the strip is greater than 1200 MPa, and its elongation at break is 1-5%. The carbon steel strips may be used as reinforcement in rubber composites such as for motor vehicle tires.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ARNAUD JEAN-CLAUDE	1992			WO 9214811 A1	CAPLUS
ARNAUD JEAN-CLAUDE	1997			WO 9726379 A1	CAPLUS
KUSINSKI GRZEGORZ J	2004			WO 2004046400 A1	CAPLUS
THOMAS GARETH	1986			WO 8601231 A1	CAPLUS

IT 2101768-32-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; carbon steel strips for reinforcing rubber motor vehicle tires)
RN 2101768-32-3 CAPLUS
CN Iron alloy, base, Fe 86-99,Mn 0.5-4,Si 0.1-2.5,Al 0-1.5,B 0-0.5,Co 0-0.5,Cr 0-0.5,Cu 0-0.5,Mo 0-0.5,Nb 0-0.5,Ni 0-0.5,Ti 0-0.5,V 0-0.5,W 0-0.5,Zr 0-0.5,C 0-0.4 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	86	-	99	7439-89-6
Mn	0.5	-	4	7439-96-5
Si	0.1	-	2.5	7440-21-3
Al	0	-	1.5	7429-90-5
B	0	-	0.5	7440-42-8
Co	0	-	0.5	7440-48-4
Cr	0	-	0.5	7440-47-3
Cu	0	-	0.5	7440-50-8
Mo	0	-	0.5	7439-98-7
Nb	0	-	0.5	7440-03-1
Ni	0	-	0.5	7440-02-0
Ti	0	-	0.5	7440-32-6
V	0	-	0.5	7440-62-2
W	0	-	0.5	7440-33-7
Zr	0	-	0.5	7440-67-7
C	0	-	0.4	7440-44-0

IPCI C22C0038-04 [I]; B32B0025-04 [I]; B60C0009-18 [I]; B60C0001-00 [I]
IPCR C22C0038-04 [I]; B32B0025-04 [I]; B60C0001-00 [I]; B60C0009-18 [I]
CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 39
ST carbon steel strip reinforced rubber tire

IT Tires
(carbon steel strips for reinforcing rubber motor vehicle tires)
IT Synthetic rubber
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(carbon steel-reinforced; carbon steel strips for reinforcing rubber motor vehicle tires)
IT 2101768-32-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; carbon steel strips for reinforcing rubber motor vehicle tires)

L12 ANSWER 68 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:1034863 CAPLUS Full-text
DOCUMENT NUMBER: 167:130836
TITLE: Tire reinforced by a carbon steel strip
INVENTOR(S): Verleene, Arnaud
PATENT ASSIGNEE(S): Compagnie Generale des Etablissements Michelin, Fr.; Michelin Recherche et Technique S.A.
SOURCE: Fr. Demande, 29pp.; Chemical Indexing Equivalent to 167:116100 (WO)
CODEN: FRXXBL
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
FR 3045671	A1	20170623	FR 2015-62495	20151216
FR 3045671	B1	20171208		
WO 2017103515	A1	20170622	WO 2016-FR53484	20161216
EP 3390675	A1	20181024	EP 2016-825529	20161216
US 20200290401	A1	20200917	US 2018-16062765	20180615

PRIORITY APPLN. INFO.: FR 2015-62495 A 20151216
WO 2016-FR53484 W 20161216
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A motor vehicle tire is reinforced by at least one carbon steel strip that has a low carbon content and high resistance in the cold-worked state. The steel comprises (in % by wt.) 0.05-0.4% carbon, 0.5-4% manganese, 0.1-2.5% silicon, optionally 0-1.5% aluminum, 0-0.5% of each of boron, chromium, cobalt, copper, molybdenum, nickel, niobium, titanium, tungsten, vanadium, zirconium, and 0-0.05% of each of phosphorus, sulfur, nitrogen or rare earth metal, the remainder consisting of iron and inevitable impurities resulting from the process. The microstructure of the cold-worked carbon steel is primarily martensitic or ferritic-martensitic; the tensile strength of the strip is >1200 MPa, and its elongation at break is 1-5%.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ARNAUD JEAN-CLAUDE	1992			WO 9214811 A1	CAPLUS
ARNAUD JEAN-CLAUDE	1997			WO 9726379 A1	CAPLUS
KUSINSKI GRZEGORZ J	2004			WO 2004046400 A1	CAPLUS
OBLATH RICHARD MICHAEL	1985			EP 0157716 A1	
THOMAS GARETH	1986			WO 8601231 A1	CAPLUS

IT 2101768-32-3
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(tire reinforced by carbon steel strip)
RN 2101768-32-3 CAPLUS
CN Iron alloy, base, Fe 86-99,Mn 0.5-4,Si 0.1-2.5,Al 0-1.5,B 0-0.5,Co 0-0.5,Cr 0-0.5,Cu 0-0.5,Mo 0-0.5,Nb 0-0.5,Ni 0-0.5,Ti 0-0.5,V 0-0.5,W 0-0.5,Zr 0-0.5,C 0-0.4 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	86 - 99	7439-89-6

Mn	0.5	-	4	7439-96-5
Si	0.1	-	2.5	7440-21-3
Al	0	-	1.5	7429-90-5
B	0	-	0.5	7440-42-8
Co	0	-	0.5	7440-48-4
Cr	0	-	0.5	7440-47-3
Cu	0	-	0.5	7440-50-8
Mo	0	-	0.5	7439-98-7
Nb	0	-	0.5	7440-03-1
Ni	0	-	0.5	7440-02-0
Ti	0	-	0.5	7440-32-6
V	0	-	0.5	7440-62-2
W	0	-	0.5	7440-33-7
Zr	0	-	0.5	7440-67-7
C	0	-	0.4	7440-44-0

IPCI C22C0038-04 [I]; B32B0025-04 [I]; B60C0009-18 [I]; B60C0001-00 [I]
IPCR C22C0038-04 [I]; B32B0025-04 [I]; B60C0001-00 [I]; B60C0009-18 [I]
CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 39
ST tire reinforced carbon steel strip mech property
IT Microstructure
Tire cords
(tire reinforced by carbon steel strip)
IT 2101768-32-3
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(tire reinforced by carbon steel strip)

L12 ANSWER 69 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:1034861 CAPLUS Full-text
DOCUMENT NUMBER: 167:116100
TITLE: Tire reinforced by a carbon steel strip
INVENTOR(S): Verleene, Arnaud
PATENT ASSIGNEE(S): Compagnie Generale des Etablissements Michelin, Fr.; Michelin Recherche et Technique S.A.
SOURCE: PCT Int. Appl., 34pp.; Chemical Indexing Equivalent to 167:130836 (FR)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2017103515	A1	20170622	WO 2016-FR53484	20161216
FR 3045671	A1	20170623	FR 2015-62495	20151216
FR 3045671	B1	20171208		
EP 3390675	A1	20181024	EP 2016-825529	20161216
US 20200290401	A1	20200917	US 2018-16062765	20180615

PRIORITY APPLN. INFO.: FR 2015-62495 A 20151216
WO 2016-FR53484 W 20161216
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB Disclosed is a motor vehicle tire reinforced by at least one carbon steel strip that has a low carbon content and high resistance in the cold-worked state. The steel comprises (in % by wt.) 0.05% to 0.4% carbon, 0.5% to 4% manganese, 0.1% to 2.5% silicon, optionally (i) \<1.5% aluminum, (ii) \<0.5% of each of the metals boron, chromium, cobalt, copper, molybdenum, nickel, niobium, titanium, tungsten, vanadium, zirconium, et (iii) \<0.05% of each of the elements phosphorus, sulfur, nitrogen or rare earth metal, the remainder consisting of iron and inevitable impurities resulting from the process. The microstructure of the cold-worked carbon steel is primarily martensitic or ferritic-martensitic; the tensile strength Rm of the strip is greater than 1200 MPa, and its elongation at break At ranges from 1% to 5%.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ARNAUD JEAN-CLAUDE	1992			WO 9214811 A1	CAPLUS
ARNAUD JEAN-CLAUDE	1997			WO 9726379 A1	CAPLUS

KUSINSKI GRZEGORZ J |2004 | | |WO 2004046400 A1 |CAPLUS
OBLATH RICHARD MICHAEL |1985 | | |EP 0157716 A1 |
THOMAS GARETH |1986 | | |WO 8601231 A1 |CAPLUS

IT 2101768-32-3
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(tire reinforced by carbon steel strip)

RN 2101768-32-3 CAPLUS

CN Iron alloy, base, Fe 86-99,Mn 0.5-4,Si 0.1-2.5,Al 0-1.5,B 0-0.5,Co 0-0.5,Cr 0-0.5,Cu 0-0.5,Mo 0-0.5,Nb 0-0.5,Ni 0-0.5,Ti 0-0.5,V 0-0.5,W 0-0.5,Zr 0-0.5,C 0-0.4 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	86	-	99	7439-89-6
Mn	0.5	-	4	7439-96-5
Si	0.1	-	2.5	7440-21-3
Al	0	-	1.5	7429-90-5
B	0	-	0.5	7440-42-8
Co	0	-	0.5	7440-48-4
Cr	0	-	0.5	7440-47-3
Cu	0	-	0.5	7440-50-8
Mo	0	-	0.5	7439-98-7
Nb	0	-	0.5	7440-03-1
Ni	0	-	0.5	7440-02-0
Ti	0	-	0.5	7440-32-6
V	0	-	0.5	7440-62-2
W	0	-	0.5	7440-33-7
Zr	0	-	0.5	7440-67-7
C	0	-	0.4	7440-44-0

IPCI C21D0007-10 [I]; B60C0009-00 [I]; B21B0001-28 [I]; B32B0015-06 [I]; C21D0009-34 [I]; C21D0009-46 [I]; C21D0009-52 [I]; D07B0001-06 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-18 [I]

IPCR C21D0007-10 [I]; B21B0001-28 [I]; B32B0015-06 [I]; B60C0009-00 [I]; C21D0009-34 [I]; C21D0009-46 [I]; C21D0009-52 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-18 [I]; D07B0001-06 [I]

CC 55-3 (Ferrous Metals and Alloys)

ST tire reinforced carbon steel strip mech property

IT Mechanical properties
Microstructure
Tire cords
(tire reinforced by carbon steel strip)

IT 2101768-32-3
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(tire reinforced by carbon steel strip)

L12 ANSWER 70 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2017:848898 CAPLUS Full-text

TITLE: Contact Fatigue Resistance of Carburized Gears from Chromium-Nickel Steels

AUTHOR(S): Rudenko, S. P.; Val'ko, A. L.

CORPORATE SOURCE: United Institute for Mechanical Engineering, National Academy of Sciences of Belarus, Minsk, Belarus

SOURCE: Metal Science and Heat Treatment (2017), 59(1-2), 60-64
CODEN: MHTRAN; ISSN: 0026-0673

DIGITAL OBJECT ID: 10.1007/s11041-017-0103-3

PUBLISHER: Springer

DOCUMENT TYPE: Journal; (online computer file)

LANGUAGE: English

AB The contact fatigue resistance of carburized gears produced from chromium-nickel steels is studied. The curves of deep contact fatigue of the material of the gears are plotted in terms of the criterion of equality of the characteristics of diffusion layers. An expression for ultimate deep contact fatigue resistance of carburized gears is derived.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File

Anon				A A Susin, Thermoche
Anon				A I Petrusevich, Con
Anon				A N Utkina, Yu Yu Ch
Anon				B A Balashov, R R Ga
Anon				B V Gold, E P Obolen
Anon				E B Vulgakov (ed.),
Anon				E I Tesker, Advanced
Anon				N M Ryzhov, "Technol
Anon				S P Rudenko and A L
Anon				S P Rudenko, "A stud
Anon				S P Rudenko, "Comput
Anon				S P Rudenko, "Fatigu
Anon				S P Rudenko, A L Val
Anon				V E Antonyuk, B V Iv
Anon				Yu S Eliseev, V V Kr

IT INDEXING IN PROGRESS
IT 37312-00-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(contact fatigue resistance of carburized gears from chromium-nickel steels)
RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
ST chromium nickel steel carburized gear contact fatigue resistance
IT Diffusion
Fatigue resistance
Gears
Microhardness
Microstructure
(contact fatigue resistance of carburized gears from chromium-nickel steels)
IT 12681-03-7 12742-08-4 37312-00-8 39411-21-7
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(contact fatigue resistance of carburized gears from chromium-nickel steels)

L12 ANSWER 71 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:342418 CAPLUS Full-text
DOCUMENT NUMBER: 166:297159
TITLE: Method for manufacturing steel plate with aluminum or aluminum alloy coating by hot stamping
INVENTOR(S): Liu, Xin; Hong, Zhenjun; Tan, Ning; Jin, Xinyan; Liu, Junxiang; Hong, Jiyao
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 15pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent

LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 106466697	A	20170301	CN 2016-10664566	20160812
CN 106466697	B	20200131		
PRIORITY APPLN. INFO.:			CN 2016-10664566	20160812

AB The invention discloses a manuf. method of steel plate, which comprises the following steps: blanking the steel plate with aluminum or aluminum alloy coating by blanking or laser cutting, induction heating, hot stamping in die, and cooling. The temp. and time of heating are detd. by the thickness of steel plate. The components of the steel plate is as follows: C 0.08-0.8%, Si 0.05-1.0%, Mn 0.1-5%, P<0.3%, S<0.1%, Al<0.3%, Ti<0.5%, B 0.0005-0.1%, Cr 0.01-3%, and balance of Fe and inevitable impurities. The coating comprises alloy layer, aluminum enriched intermetallic compd. layer, intermediate layer and surface layer. The components of the alloy layer is Si 0-6%, Fe 75-96%, Al 2-12%; the components of the aluminum enriched intermetallic compd. layer is Si 0-2%, Fe 30-50%, Al 40-60%; the components of the intermediate layer is Si 2-6%, Fe 50-65%, Al 20-35%; and the components of the surface layer is Si 2-6%, Fe 50-65%, Al 20-35%. The product has high strength, complex shape, good formability, high precision, and small springback, which can be used for automobile parts such as bumper, pillar reinforced plate, floor inside passage, and stiffening beam, etc..

IT 2067242-22-0P, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

RN 2067242-22-0 CAPLUS

CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1	7440-21-3
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B21D0053-88; C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-32; C22C0038-60; C23C0002-12; C23C0002-40
IPCR B21D0053-88 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-32 [I]; C22C0038-60 [I]; C23C0002-12 [I]; C23C0002-40 [I]
CC 55-1 (Ferrous Metals and Alloys)
ST hot stamping aluminum alloy steel plate coating manuf
IT Coating materials
Cooling
Induction heating
Industrial manufacturing
Laser cutting
Quenching (cooling)
Transmissions (mechanical)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)
IT Metalworking
(stamping, hot; method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)
IT 2067242-22-0P, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal. 2087430-40-6P, Aluminum 2-12, iron

75-96, silicon 0-6 2087430-41-7P, Aluminum 40-60, iron 30-50, silicon 0-2 2087430-42-8P, Aluminum 20-35, iron 50-65, silicon 2-6
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

IT 2087430-39-3, Iron 0-4, silicon 5-11, Aluminum bal.
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

IT 7429-90-5, Aluminum, processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

L12 ANSWER 72 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:227313 CAPLUS Full-text
DOCUMENT NUMBER: 166:249360
TITLE: Hot rolled steel sheet and its manufacture for automobile parts
INVENTOR(S): Sakakibara, Chikami; Sugiura, Natsuko; Tanaka, Yasuaki; Tanei, Hiroshi; Fujii, Takashi; Yokoyama, Takashi
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 16pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2017031454	A	20170209	JP 2015-150831	20150730
JP 6620446	B2	20191218		
WO 2017022025	A1	20170209	WO 2015-JP71845	20150731

PRIORITY APPLN. INFO.: JP 2015-150831 T0 20150730

AB To provide hot-rolled steel plate excellent in pickling property and without an increase in equipment cost, generation of internal oxide layer of a high strength hot rolled steel sheet contg. relatively large amts. of Si and Mn is suppressed, and method for manufg. thereof. Hot-rolled steel plate comprises C: 0.04-0.6%, Si: 0.01-3%, Mn: 0.1-5%, P: 0.04% or less, S: 0.05% or less, Al: 0.001-2%, N: 0.01% or less, O: 0.01% or less, one or more of Sb, Sn and Te: total amt. of 0.01-0.3% and remainder of Fe and unavoidable impurities, and has thickness of the internal oxide layer of 5 μm or less, a concd. layer of Sb, Sn and Te as an upper layer of the internal oxide layer, and has mech. properties with a tensile strength of 590 MPa or more.

IT 2079034-18-5P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high strength hot rolled steel sheet and its manuf. for automobile parts)

RN 2079034-18-5 CAPLUS
CN Iron alloy, base, Fe 80-100,Mn 0.1-5,Si 0-3,Al 0-2,Cr 0-2,Cu 0-2,Ni 0-2,Mo 0-1,C 0-0.6,Nb 0-0.3,Sb 0-0.3,Sn 0-0.3,Te 0-0.3,Ti 0-0.3,V 0-0.3,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	80	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Si	0	-	3	7440-21-3
Al	0	-	2	7429-90-5
Cr	0	-	2	7440-47-3
Cu	0	-	2	7440-50-8
Ni	0	-	2	7440-02-0
Mo	0	-	1	7439-98-7
C	0	-	0.6	7440-44-0

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    Nb      0   -   0.3      7440-03-1
    Sb      0   -   0.3      7440-36-0
    Sn      0   -   0.3      7440-31-5
    Te      0   -   0.3     13494-80-9
    Ti      0   -   0.3      7440-32-6
    V       0   -   0.3      7440-62-2
    B       0   -   0.1      7440-42-8

IPCI C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]; C22C0038-00 [I];
     C22C0038-60 [I]; C21D0009-46 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-60 [I]
CC   55-3 (Ferrous Metals and Alloys)
ST   hot rolled steel sheet manuf automobile part
IT   Automobile parts
     Casting of metals
     Hot rolling
     Melting
     Microstructure
     Pickling
     Sheet materials
     Tensile strength
        (high strength hot rolled steel sheet and its manuf. for
        automobile parts)
IT   2079034-18-5P
     RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or
     engineered material use); PREP (Preparation); USES (Uses)
        (high strength hot rolled steel sheet and its manuf. for
        automobile parts)
OS.CITING REF COUNT:     1     THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD
                               (1 CITINGS)


L12  ANSWER 73 OF 398  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2017:100416  CAPLUS Full-text
DOCUMENT NUMBER:         166:179501
TITLE:                   Steel welding part with aluminum or aluminum alloy
                         plating layer and manufacture method thereof
INVENTOR(S):             Pan, Hua; Su, Yongchao; Lei, Ming; Shi, Lei; Jiang,
                         Haomin
PATENT ASSIGNEE(S):      Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE:                  Faming Zhuanli Shenqing, 8pp.
                         CODEN: CNXXEV
DOCUMENT TYPE:           Patent
LANGUAGE:                Chinese
FAMILY ACC. NUM. COUNT:  2
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     CN 106334875         A    20170118    CN 2016-10953787         20161027
     WO 2018077067        A1   20180503    WO 2017-CN106516         20171017
     MX 2019004121        A    20190606    MX 2019-4121             20171017
     KR 2019069471        A    20190619    KR 2019-7013481          20171017
     EP 3533558           A1   20190904    EP 2017-864438           20171017
     JP 2019535894        T    20191212    JP 2019-520992           20171017
     US 20200038998       A1   20200206    US 2019-16339215         20190403
     IN 201917015151      A    20190719    IN 2019-17015151         20190415
PRIORITY APPLN. INFO.:                      CN 2016-10953787     A   20161027
                                            WO 2017-CN106516     W   20171017
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB   The invention discloses a steel welding part with aluminum or aluminum
     alloy plating layer and manuf. method thereof.  The steel welding part
     with aluminum or aluminum alloy plating layer comprises a steel
     substrate and a plating layer, the plating layer comprises an
     intermetallic compd. alloy layer in contact with the substrate, and a
     metal alloy layer thereon; which is characterized in that on at least one
     of the plated surfaces of the weld blank, the plating layer located in the
     area to be welded of the weld blank is completely removed, and the end
     face of the welding blank part plating layer removed the region to be
     welded is perpendicular to the surface of the substrate which is parallel
     to weld seam to form an included angle β, and the included angle
     β =0-80°.  A method of manufg. steel welding part with
     aluminum or aluminum alloy plating layer is characterized in that it
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includes the steps of: obtaining weld blank by welding according to the requirements of steel welding part with aluminum or aluminum alloy plating layer, welding the area to be welded of the weld blank where the plating layer has been completely removed to form a welded joint; obtaining a part by hot stamping, selecting a cooling rate which is greater than the crit. transformation speed of the matrix martensite quenching, and cooling. This invention ensures tensile strength, elongation rate and corrosion resistance of welding joint after hot stamping.

IT 2067242-22-0, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

RN 2067242-22-0 CAPLUS

CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1	7440-21-3
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B23K0026-32; C22C0038-04; C22C0038-02; C22C0038-06; C22C0038-14; C22C0038-18; C23C0002-12; B23K0103-20

IPCR B23K0026-32 [I]; B23K0103-20 [N]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-14 [I]; C22C0038-18 [I]; C23C0002-12 [I]

CC 56-9 (Nonferrous Metals and Alloys)
Section cross-reference(s): 47

ST steel welding part aluminum alloy plating layer

IT Metalworking
(stamping, hot; steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

IT Corrosion-resistant materials
Industrial manufacturing
Joints, mechanical
Laser ablation
Laser welding
Plating process
Welding apparatus
Welds
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

IT 12003-42-8 12004-62-5 12043-58-2
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

IT 1273096-81-3P, Aluminum alloy
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

IT 2067242-22-0, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

OS.CITING REF COUNT: 2 THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD

(2 CITINGS)

L12 ANSWER 74 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:24305 CAPLUS Full-text
DOCUMENT NUMBER: 166:137133
TITLE: High-strength carbon steel plate having excellent impact resistance and its production for automobile parts
INVENTOR(S): Okamoto, Riki; Toyota, Takeshi; Isogai, Eiji
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 20pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2017002333	A	20170105	JP 2015-114026	20150604
JP 6540245	B2	20190710		

PRIORITY APPLN. INFO.: JP 2015-114026 20150604

AB The invention provides a high-strength steel plate which has tensile strength of 400 N/mm2, excellent shape freezing property, and appropriate yield point elongation, and a method of manufg. thereof. The high-strength steel plate having excellent shape freezing property contains in mass%, C: 0.03-0.35%, Si: 0.01-2.00%, Mn: 0.3-4.0%, P: 0.001-0.100%, S: 0.0005-0.05%, N: 0.0005%-0.010%, Al: 0.01-2.00%, and balance being Fe and inevitable impurities, and includes a metal structure contg. an unrecrystd. ferrite phase at an area ratio of 2-35%. The yield point elongation of the steel plate is 4-10%.

IT 2034133-38-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength carbon steel plate having excellent impact resistance and its prodn. for automobile parts)

RN 2034133-38-3 CAPLUS
CN Iron alloy, base, Fe 80-100,Mn 0.3-4,Cr 0-3,Cu 0-3,Ni 0-3,Al 0-2,Si 0-2,Mo 0-1,V 0-0.5,C 0-0.4,Nb 0-0.3,Ti 0-0.3,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	80	-	100	7439-89-6
Mn	0.3	-	4	7439-96-5
Cr	0	-	3	7440-47-3
Cu	0	-	3	7440-50-8
Ni	0	-	3	7440-02-0
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
Mo	0	-	1	7439-98-7
V	0	-	0.5	7440-62-2
C	0	-	0.4	7440-44-0
Nb	0	-	0.3	7440-03-1
Ti	0	-	0.3	7440-32-6
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST carbon steel plate strength impact resistance prodn automobile part
IT Annealing
Automobile parts
Cold rolling
Cooling
Elongation at break
Heating
Hot rolling
Hot-dip galvanizing
Impact strength

Microstructure
Pickling
Tensile strength
Yield strength
(high-strength carbon steel plate having excellent impact resistance and its prodn. for automobile parts)

IT 2034133-38-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength carbon steel plate having excellent impact resistance and its prodn. for automobile parts)

L12 ANSWER 75 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:24289 CAPLUS Full-text
DOCUMENT NUMBER: 166:148201
TITLE: High-strength carbon steel sheet with excellent processability and its manufacture for automobile parts
INVENTOR(S): Okamoto, Riki; Toyota, Takeshi; Isogai, Eiji
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 19pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2017002332	A	20170105	JP 2015-114025	20150604
JP 6620431	B2	20191218		
PRIORITY APPLN. INFO.:			JP 2015-114025	20150604

AB The high-strength steel sheet with excellent processability, contains in mass%, carbon:0.03-0.35%, silicon:0.01-2.00%, manganese:0.3-4.0%, phosphorus:0.001-0.100%, sulfur:0.0005-0.05%, nitrogen: 0.0005%-0.010%, aluminum: 0.01-2.00%, and balance being iron and inevitable impurities and includes a metal structure contg. an unrecrystd. ferrite phase at an area ratio of 2-20%. The ratio (yield stress (N/mm2)/tensile strength (Nmm2) of the yield stress with respect to the tensile strength is 0.75 or more. The product (yield stress(N/mm2)×elongation (%)) of yield stress and elongation is 12000 or more. The invention provides a high-strength steel sheet which has tensile strength of 400 N/mm<2, excellent processability, high elongation rate and high yield stress.

IT 2034133-38-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength carbon steel sheet with excellent processability and its manuf. for automobile parts)

RN 2034133-38-3 CAPLUS
CN Iron alloy, base, Fe 80-100,Mn 0.3-4,Cr 0-3,Cu 0-3,Ni 0-3,Al 0-2,Si 0-2,Mo 0-1,V 0-0.5,C 0-0.4,Nb 0-0.3,Ti 0-0.3,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	80	-	100	7439-89-6
Mn	0.3	-	4	7439-96-5
Cr	0	-	3	7440-47-3
Cu	0	-	3	7440-50-8
Ni	0	-	3	7440-02-0
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
Mo	0	-	1	7439-98-7
V	0	-	0.5	7440-62-2
C	0	-	0.4	7440-44-0
Nb	0	-	0.3	7440-03-1
Ti	0	-	0.3	7440-32-6
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]

IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-60 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST high strength steel sheet processability manuf automobile part
IT Metalworking
(capability; high-strength carbon steel sheet with excellent processability and its manuf. for automobile parts)
IT Alloying
Annealing
Automobile parts
Casting of metals
Cold rolling
Cooling
Elongation, mechanical
Hot rolling
Hot-dip galvanizing
Microstructure
Phase composition
Pickling
Sheet materials
Tensile strength
Yield strength
(high-strength carbon steel sheet with excellent processability and its manuf. for automobile parts)
IT 2034133-38-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high-strength carbon steel sheet with excellent processability and its manuf. for automobile parts)

L12 ANSWER 76 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:2049760 CAPLUS Full-text
DOCUMENT NUMBER: 167:333389
TITLE: Method for hot forming a coated metal part and formed part
INVENTOR(S): Verloop, Willem Cornelis; Van Genderen, Marc Jacco; Van Tol, Ronald Theodoor; Hensen, Guido Cornelis; Loiseaux, Jenny
PATENT ASSIGNEE(S): Tata Steel IJmuiden B.V., Neth.
SOURCE: U.S., No pp. given
CODEN: USXXAM
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 9127329	B2	20150908	US 2013-13818041	20130220
US 20130153094	A1	20130620		
WO 2012028224	A1	20120308	WO 2011-EP3601	20110719

PRIORITY APPLN. INFO.: EP 2010-9041 A 20100831
WO 2011-EP3601 W 20110719
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A method for manufg. a coated part having very high mech. properties using hot forming techniques. The method includes: -providing an annealed steel strip or blank or pre-shaped part that was coated with a metal or metal alloy before the annealing -if a strip is provided, cutting a blank from the strip before or after the annealing -optionally forming a pre-shaped part from the blank -heating the blank or preshaped part to a temp. of 500° C. at an av. heating rate of 16° C./s or more -further heating the blank or pre-shaped part to a temp. between 700 and 1000° C. -hot forming the blank or preshaped part into a hot formed part -hardening the hot formed part. A method for manufg. a coated steel strip, blank or pre-shaped part, and a coated steel strip, blank or part and a hot formed part.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	2009			DE 102008022400 A1	CAPLUS
Anon	2009			WO 2009021743 A1	CAPLUS
Anon	2009			WO 2009096351 A1	CAPLUS

Anon	2010			WO 2010005121 A1 CAPLUS
Anon	2010			WO 2010069588 A1 CAPLUS
Anon	2010			WO 2010085983 A1 CAPLUS
Anon	2010			EP 2177641 A1 CAPLUS
Anon	2002			"Glossary of Metallu
Anon	2011			International Search
Brandstatter	2011			US 20110045316 A1 CAPLUS
Hensen	2011			US 20110236719 A1 CAPLUS
Maki	2011			US 20110174418 A1 CAPLUS
Mehler	1962			US 3056694 A CAPLUS
Oh	2008			US 20080286603 A1 CAPLUS
Thirion	2012			US 20120085467 A1 CAPLUS
Toki	2011			US 20110048585 A1 CAPLUS
Vlot	2010			US 20100026048 A1 CAPLUS

IT 1360605-36-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manuf. coated steel parts by hot forming)
RN 1360605-36-2 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1,V 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	94	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Cr	0	-	1	7440-47-3
C	0.1	-	0.5	7440-44-0
Si	0.1	-	0.5	7440-21-3
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0
V	0	-	0.1	7440-62-2

IPCI C21D0008-02 [I]; C21D0009-46 [I]; C23C0002-06 [I]; C23C0002-40 [I]; B32B0015-01 [I]; C21D0001-673 [I]; C21D0008-04 [I]; C21D0009-48 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C23C0010-28 [I]; C23C0010-60 [I]; C21D0008-02 [I]; B32B0015-01 [I]
IPCR C21D0008-02 [I]; B32B0015-01 [I]; C21D0001-673 [I]; C21D0008-04 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C23C0002-06 [I]; C23C0002-40 [I]; C23C0010-28 [I]; C23C0010-60 [I]
NCL 001/001.000; 148/533.000; 148/330.000
CC 55-3 (Ferrous Metals and Alloys)
ST steel strip coating hot deformation
IT Plastic deformation
(hot; method for manuf. coated steel parts by hot forming)
IT 1360605-37-3
RL: TEM (Technical or engineered material use); USES (Uses)
(coating; method for manuf. coated steel parts by hot forming)
IT 1360605-36-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manuf. coated steel parts by hot forming)

L12 ANSWER 77 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1997298 CAPLUS Full-text
DOCUMENT NUMBER: 167:180612
TITLE: Coated steel strips, methods of making the same, methods of using the same, stamping blanks prepared from the same, stamped products prepared from the same, and articles of manufacture which contain such a stamped product
INVENTOR(S): Drillet, Pascal; Spehner, Dominique; Kefferstein, Ronald
PATENT ASSIGNEE(S): Arcelormittal France, Fr.
SOURCE: U.S. Pat. Appl. Publ., No pp. given
CODEN: USXXCO

DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 20110165436	A1	20110707	US 2011-447777	20110318
WO 2008053273	A1	20080508	WO 2006-IB4019	20061030
EP 3290199	A1	20180307	EP 2017-192410	20061030
EP 3290199	B1	20190821		
EP 3290200	A1	20180307	EP 2017-192418	20061030
EP 3587104	A1	20200101	EP 2019-185736	20061030
EP 3587105	A1	20200101	EP 2019-185743	20061030
US 20130029172	A1	20130131	US 2012-13621015	20120915
US 9708683	B2	20170718		
US 20170260603	A1	20170914	US 2017-15606770	20170526
US 10550447	B2	20200204		
US 20190271055	A1	20190905	US 2019-16413774	20190516
US 10590507	B2	20200317		
US 20190271056	A1	20190905	US 2019-16413799	20190516
US 20190271057	A1	20190905	US 2019-16413825	20190516
US 20190271058	A1	20190905	US 2019-16414022	20190516
US 10597747	B2	20200324		
US 20190276912	A1	20190912	US 2019-16413729	20190516
US 10577674	B2	20200303		

PRIORITY APPLN. INFO.:

WO 2006-IB4019	W	20061030
EP 2006-842403	A3	20061030
EP 2017-192410	A3	20061030
US 2011-447777	A3	20110318
US 2012-13621015	A1	20120915
US 2017-15606770	A1	20170526

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB Coated steel having a well defined and uniform thickness is useful and advantageous for prepg. products by hot stamping. Products prepd. by hot stamping such a steel are particularly advantageous when subjected to a subsequent spot welding step.

IT 1022915-01-0
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)

RN 1022915-01-0 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.2 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

INCL 428653000; 072342100; 072047000
IPCI B32B0015-01 [I]; B21D0022-00 [I]; C21D0009-46 [I]
IPCR B32B0015-01 [I]; B21D0022-00 [I]; C21D0009-46 [I]
NCL 428/653.000; 072/047.000; 072/342.100
CC 55-11 (Ferrous Metals and Alloys)
ST aluminum coated steel strip stamping article spot welding
IT Metalworking
(stamping; aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)
IT 7429-90-5, Aluminum, uses 952598-91-3, Aluminum 87-90, iron 2-4, silicon 8-11
RL: NUU (Other use, unclassified); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)

IT 1033915-01-0
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)

L12 ANSWER 78 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1976821 CAPLUS Full-text
DOCUMENT NUMBER: 167:35538
TITLE: Low temperature hardenable steels with excellent machinability
INVENTOR(S): Valls, Isaac
PATENT ASSIGNEE(S): Valls Besitz GmbH, Germany
SOURCE: U.S. Pat. Appl. Publ., No pp. given
CODEN: USXXCO
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 3
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 20150118098	A1	20150430	US 2014-14399289	20141106
US 10077490	B2	20180918		
EP 2662462	A1	20131113	EP 2012-166948	20120507
WO 2013167580	A1	20131114	WO 2013-EP59471	20130507
US 20180363110	A1	20181220	US 2018-16052826	20180802

PRIORITY APPLN. INFO.:
EP 2012-166948 A 20120507
WO 2013-EP59471 W 20130507
US 2014-14399289 A1 20141106
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The present invention relates to the application of at least partially bainitic or interstitial martensitic heat treatments on steels, often tool steels or steels that can be used for tools. The first tranche of the heat treatment implying austenitization is applied so that the steel presents a low enough hardness to allow for advantageous shape modification, often trough machining. Thus a steel product is obtained which can be shaped with ease and whose hardness can be raised to a higher working hardness with a simple heat treatment at low temp. (below austenitization temp.).
IT 1478046-17-1 1478046-18-2 1478046-23-9
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(low temp. hardenable tool steels with excellent machinability)
RN 1478046-17-1 CAPLUS
CN Iron alloy, base, Fe 37-100,Mo 0-10,W 0-10,Co 0-6,Ni 0-6,V 0-4,Cr 0-3,Hf 0-3,Mn 0-3,Ta 0-3,Ti 0-3,Zr 0-3,Al 0-2.5,Cu 0-2,Nb 0-1.5,Si 0-1.4,N 0-1,B 0-0.6,C 0.2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	37 - 100	7439-89-6
Mo	0 - 10	7439-98-7
W	0 - 10	7440-33-7
Co	0 - 6	7440-48-4
Ni	0 - 6	7440-02-0
V	0 - 4	7440-62-2
Cr	0 - 3	7440-47-3
Hf	0 - 3	7440-58-6
Mn	0 - 3	7439-96-5
Ta	0 - 3	7440-25-7
Ti	0 - 3	7440-32-6
Zr	0 - 3	7440-67-7
Al	0 - 2.5	7429-90-5
Cu	0 - 2	7440-50-8
Nb	0 - 1.5	7440-03-1
Si	0 - 1.4	7440-21-3
N	0 - 1	17778-88-0
B	0 - 0.6	7440-42-8
C	0.2	7440-44-0

RN 1478046-18-2 CAPLUS
CN Iron alloy, base, Fe 13-100,Mo 0-15,W 0-15,Cr 0-14,V 0-12,Zr 0-12,Co 0-6,Ni 0-6,Hf 0-4,Nb 0-4,Ta 0-4,Ti 0-4,C 0.5-3,Mn 0-3,Al 0-2.5,N 0-2.2,B 0-2,Cu 0-2,Si 0-2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	13 - 100	7439-89-6
Mo	0 - 15	7439-98-7
W	0 - 15	7440-33-7
Cr	0 - 14	7440-47-3
V	0 - 12	7440-62-2
Zr	0 - 12	7440-67-7
Co	0 - 6	7440-48-4
Ni	0 - 6	7440-02-0
Hf	0 - 4	7440-58-6
Nb	0 - 4	7440-03-1
Ta	0 - 4	7440-25-7
Ti	0 - 4	7440-32-6
C	0.5 - 3	7440-44-0
Mn	0 - 3	7439-96-5
Al	0 - 2.5	7429-90-5
N	0 - 2.2	17778-88-0
B	0 - 2	7440-42-8
Cu	0 - 2	7440-50-8
Si	0 - 2	7440-21-3

RN 1478046-23-9 CAPLUS
CN Iron alloy, base, Fe 44-99,W 0-8,Co 0-6,Mo 0-6,Ni 0-6,Cr 0-4,V 0-4,Mn 0.2-3,Si 0.2-2.8,Al 0-2.5,Cu 0-2,Hf 0-2,Nb 0-2,Ta 0-2,Ti 0-2,Zr 0-2,C 0.2-0.9,B 0-0.6,N 0-0.6 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	44 - 99	7439-89-6
W	0 - 8	7440-33-7
Co	0 - 6	7440-48-4
Mo	0 - 6	7439-98-7
Ni	0 - 6	7440-02-0
Cr	0 - 4	7440-47-3
V	0 - 4	7440-62-2
Mn	0.2 - 3	7439-96-5
Si	0.2 - 2.8	7440-21-3
Al	0 - 2.5	7429-90-5
Cu	0 - 2	7440-50-8
Hf	0 - 2	7440-58-6
Nb	0 - 2	7440-03-1
Ta	0 - 2	7440-25-7
Ti	0 - 2	7440-32-6
Zr	0 - 2	7440-67-7
C	0.2 - 0.9	7440-44-0
B	0 - 0.6	7440-42-8
N	0 - 0.6	17778-88-0

INCL 420102000; 420111000; 420110000; 420109000; 420107000; 420106000; 420101000
IPCI C22C0038-58 [I]; C22C0038-50 [I]; C22C0038-52 [I]; C22C0038-38 [I]; C22C0038-32 [I]; C22C0038-02 [I]; C22C0038-28 [I]; C22C0038-26 [I]; C22C0038-24 [I]; C22C0038-22 [I]; C22C0038-04 [I]; C22C0038-44 [I]; C22C0038-30 [I]; C22C0038-12 [I]; C22C0038-22 [I]; C22C0038-44 [I]; C22C0038-58 [I]; C21D0009-00 [I]; C22C0038-18 [I]; C21D0006-00 [I]; C21D0001-30 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-24 [I]; C22C0038-26 [I]; C22C0038-28 [I]; C22C0038-30 [I]; C22C0038-32 [I]; C22C0038-38 [I]; C22C0038-50 [I]; C22C0038-52 [I]; C22C0038-00 [I]; C22C0038-08 [I]; C22C0038-14 [I]
IPCR C22C0038-58 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-22 [I]; C22C0038-24 [I]; C22C0038-26 [I]; C22C0038-28 [I]; C22C0038-30 [I]; C22C0038-32 [I]; C22C0038-38 [I]; C22C0038-44 [I]; C22C0038-50 [I]; C22C0038-52 [I]; C22C0038-12 [I]; C21D0001-30 [I]; C21D0006-00 [I];

C21D0009-00 [I]; C22C0038-00 [I]; C22C0038-08 [I]; C22C0038-14 [I];
C22C0038-18 [I]
NCL 420/102.000; 420/101.000; 420/106.000; 420/107.000; 420/109.000;
420/110.000; 420/111.000
CC 55-3 (Ferrous Metals and Alloys)
ST tool steel heat treatment hardness
IT Dies
Heat treatment
Injection molding apparatus
Tools
(low temp. hardenable tool steels with excellent
machinability)
IT 12173-93-2, Martensite, formation (nonpreparative) 12427-23-5, Bainite
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(low temp. hardenable tool steels with excellent
machinability)
IT 1478046-17-1 1478046-18-2 1478046-23-9
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
(Technical or engineered material use); PROC (Process); USES (Uses)
(low temp. hardenable tool steels with excellent
machinability)

L12 ANSWER 79 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1976461 CAPLUS Full-text
DOCUMENT NUMBER: 167:35564
TITLE: Tough bainitic heat treatments on steels for tooling
INVENTOR(S): Valls Angles, Isaac
PATENT ASSIGNEE(S): Vallsbesitz GmbH, Germany
SOURCE: U.S. Pat. Appl. Publ., No pp. given
CODEN: USXXCO
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 3
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 20150114525	A1	20150430	US 2014-14399239	20141106
EP 2662460	A1	20131113	EP 2012-166949	20120507
WO 2013167628	A1	20131114	WO 2013-EP59542	20130507
PRIORITY APPLN. INFO.:			EP 2012-166949 A	20120507
			WO 2013-EP59542 W	20130507

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention relates to a method that has been developed to obtain good toughness and homogeneous properties through heavy sections in tool steels or likely highly alloyed steels. The microstructure attained is mostly bainitic. The method is esp. good for hot work tool steels in applications demanding heavy sections and very high toughness. The method consists on the application of a low temp. bainitic transformation to tool steels presenting a low enough martensite transformation temp. (Ms). Addnl. or alternatively cementite is replaced from the bainite by other finer carbides, mainly mixed carbides contg. elements with stronger affinity for carbon than iron. The method is esp. simple if applied to steels with high contents of Si or Al (>1.3% and >0.4% resp.) where cementite growth is impaired. The method works also well for low cost plastic injection molding and structural steels. Even some higher alloyed tool steels can benefit from, the present method.
IT 1480228-53-2
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
(Technical or engineered material use); PROC (Process); USES (Uses)
(tough bainitic heat treatment for tool steels)
RN 1480228-53-2 CAPLUS
CN Iron alloy, base, Fe 0-100,Mo 0-15,W 0-15,Cr 0-14,V 0-12,Zr 0-12,Co 0-6,Ni 0-6,Hf 0-4,Nb 0-4,Ta 0-4,Ti 0-4,C 0.5-3,Mn 0-3,Al 0-2.5,N 0-2.2,B 0-2,Cu 0-2,Si 0-2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	0 - 100	7439-89-6
Mo	0 - 15	7439-98-7
W	0 - 15	7440-33-7

Cr	0	-	14	7440-47-3
V	0	-	12	7440-62-2
Zr	0	-	12	7440-67-7
Co	0	-	6	7440-48-4
Ni	0	-	6	7440-02-0
Hf	0	-	4	7440-58-6
Nb	0	-	4	7440-03-1
Ta	0	-	4	7440-25-7
Ti	0	-	4	7440-32-6
C	0.5	-	3	7440-44-0
Mn	0	-	3	7439-96-5
Al	0	-	2.5	7429-90-5
N	0	-	2.2	17778-88-0
B	0	-	2	7440-42-8
Cu	0	-	2	7440-50-8
Si	0	-	2	7440-21-3

INCL 148612000; 148660000; 148663000; 148621000
IPCI C22C0038-58 [I]; C21D0001-00 [I]; C22C0038-54 [I]; C22C0038-50 [I];
C22C0038-48 [I]; C22C0038-46 [I]; C22C0038-44 [I]; C22C0038-38 [I];
C22C0038-28 [I]; C22C0038-26 [I]; C22C0038-24 [I]; C22C0038-22 [I];
C22C0038-04 [I]; C22C0038-02 [I]; C21D0006-00 [I]
IPCR C22C0038-58 [I]; C21D0001-00 [I]; C21D0006-00 [I]; C22C0038-02 [I];
C22C0038-04 [I]; C22C0038-22 [I]; C22C0038-24 [I]; C22C0038-26 [I];
C22C0038-28 [I]; C22C0038-38 [I]; C22C0038-44 [I]; C22C0038-46 [I];
C22C0038-48 [I]; C22C0038-50 [I]; C22C0038-54 [I]
NCL 148/612.000; 148/621.000; 148/660.000; 148/663.000
CC 55-5 (Ferrous Metals and Alloys)
ST tool steel bainite heat treatment hardness
IT Heat treatment
Mechanical hardness
Tools
(tough bainitic heat treatment for tool steels)
IT 12427-23-5, Bainite
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(tough bainitic heat treatment for tool steels)
IT 1480228-53-2
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(tough bainitic heat treatment for tool steels)

L12 ANSWER 80 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1976375 CAPLUS Full-text
DOCUMENT NUMBER: 167:35563
TITLE: High thermal diffusivity, high toughness and low crack risk during heat treatment tool steel
INVENTOR(S): Angles, Isaac Valls
PATENT ASSIGNEE(S): Rovalma, S.A., Spain
SOURCE: U.S. Pat. Appl. Publ., No pp. given
CODEN: USXXCO
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.		DATE
US 20160010168	A1	20160114	US 2015-14771976		20150901
WO 2014131907	A1	20140904	WO 2014-EP54010		20140228
PRIORITY APPLN. INFO.:			EP 2013-382069	A	20130301
			WO 2014-EP54010	W	20140228

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The present invention relates to a tool steel as described in WO2012095532A1 or WO2010112319A1 and its heat treatment where high levels of thermal diffusivity, mech. resistance, wear resistance and/or toughness are attained while having a low cracking risk during the heat treatment. It is achieved by austenitizing at a temp., normally above AC3, cooling to an intermediate temp. below AC1 and above the temp. where bainitic (and alike) transformation occurs and finally quenching with a severe cooling media to a temp. below the bainitic transformation nose. Final microstructure is mainly composed of martensite and/or lower bainite, which will generally be afterwards tempered.

IT 1625647-86-0
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(tool steel; high thermal diffusivity, high toughness and low crack risk during heat treatment tool steel)
RN 1625647-86-0 CAPLUS
CN Iron alloy, base, Fe 36-100,Mo 0-10,W 0-10,Co 0-6,Ni 0-6,V 0-4,Cr 0-3,Hf 0-3,Mn 0-3,Ta 0-3,Zr 0-3,Al 0-2.5,Cu 0-2,Ti 0-2,C 0.2-1.9,Nb 0-1.5,Si 0-1.4,N 0-1,B 0-0.6 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	36 - 100	7439-89-6
Mo	0 - 10	7439-98-7
W	0 - 10	7440-33-7
Co	0 - 6	7440-48-4
Ni	0 - 6	7440-02-0
V	0 - 4	7440-62-2
Cr	0 - 3	7440-47-3
Hf	0 - 3	7440-58-6
Mn	0 - 3	7439-96-5
Ta	0 - 3	7440-25-7
Zr	0 - 3	7440-67-7
Al	0 - 2.5	7429-90-5
Cu	0 - 2	7440-50-8
Ti	0 - 2	7440-32-6
C	0.2 - 1.9	7440-44-0
Nb	0 - 1.5	7440-03-1
Si	0 - 1.4	7440-21-3
N	0 - 1	17778-88-0
B	0 - 0.6	7440-42-8

IPCI C21D0001-84 [I]; C22C0038-46 [I]; C22C0038-44 [I]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-04 [I]; C22C0038-02 [I]; C21D0006-00 [I]; C22C0038-42 [I]
IPCR C21D0001-84 [I]; C21D0006-00 [I]; C22C0038-00 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-42 [I]; C22C0038-44 [I]; C22C0038-46 [I]
CC 55-5 (Ferrous Metals and Alloys)
ST tool steel thermal diffusivity toughness crack heat treatment
IT Structural phase transition
(ferrite-perlite; high thermal diffusivity, high toughness and low crack risk during heat treatment tool steel)
IT Fracture toughness
Heat treatment
Mechanical hardness
Microstructure
Quenching (cooling)
Tempering
Thermal conductivity
Wear resistance
(high thermal diffusivity, high toughness and low crack risk during heat treatment tool steel)
IT 12173-93-2, Martensite, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(high thermal diffusivity, high toughness and low crack risk during heat treatment tool steel)
IT 1625647-86-0
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(tool steel; high thermal diffusivity, high toughness and low crack risk during heat treatment tool steel)

L12 ANSWER 81 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1809235 CAPLUS Full-text
DOCUMENT NUMBER: 165:597854
TITLE: High-strength steel plate and its manufacturing method
INVENTOR(S): Okamoto, Riki; Ishida, Yoshinari; Suwa, Yoshihiro; Yokoyama, Takafumi
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan

SOURCE: PCT Int. Appl., 67pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016178430	A1	20161110	WO 2016-JP63660	20160506
TW I606123	B	20171121	TW 2016-114295	20160506
KR 2017138545	A	20171215	KR 2017-7033656	20160506
KR 1987573	B1	20190610		
CN 107614722	A	20180119	CN 2016-80026467	20160506
CN 107614722	B	20190827		
EP 3293279	A1	20180314	EP 2016-789566	20160506
EP 3293279	B1	20200325		
MX 2017014094	A	20180316	MX 2017-14094	20160506
BR 112017023881	A2	20180717	BR 2017-112017023881	20160506
JP 6471800	B2	20190220	JP 2017-516621	20160506
ES 2784699	T3	20200930	ES 2016-789566	20160506
US 20180148809	A1	20180531	US 2017-15571619	20171103
IN 201717039616	A	20171222	IN 2017-17039616	20171107

PRIORITY APPLN. INFO.:

JP 2015-95157	A	20150507
JP 2015-95158	A	20150507
WO 2016-JP63660	W	20160506

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The present invention relates to a high-strength steel plate that has a predetd. chem. compn. and has a microstructure represented by, in terms of area%, at least 5% martensite, at least 20% ferrite and, 5% or less pearlite. The av. grain diam. of the martensite is an equiv. circle diam. of 4 μm or less. Among multiple martensite grains on grain boundary triple points of a matrix phase, at least one of the grain boundaries that connect adjacent two grain boundary triple points that are structured by the martensite grains and the matrix crystal grains has convex curvature toward the outside with respect to a line segment that connects the two grain boundary triple points. Furthermore, if the martensite grain is referred to as a bulging martensite grain when the martensite grain is on one grain boundary triple point of the matrix phase, the ratio of the no. of bulging martensite grains to the no. of multiple martensite grains on the grain boundary triple points of the matrix phase is at least 70%. The area ratio represented by VM/A0 is at least 1.0, where VM represents the total area of the multiple martensite grains on the grain boundary triple points of the matrix phase, and A0 represents the total area of the polygons structured by line segments connecting any two adjacent grain boundary triple points of multiple martensite grains.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
AKAMIZU HIROSHI	2004			JP 2004308002 A	CAPLUS
IBANO AKIRA	2010			JP 2010285636 A	CAPLUS
MINAMI HIDEKAZU	2015			WO 2015015738 A1	CAPLUS
OKAMOTO TSUTOMU	2014			JP 2014173151 A	CAPLUS
ONO YOSHIHIKO	2010			WO 2010087529 A1	CAPLUS
TAKASHIMA KATSUTOSHI	2015			WO 2015019558 A1	CAPLUS

IT 2034133-38-3
RL: TEM (Technical or engineered material use); USES (Uses)
(high-strength steel plate and its manufg. method)
RN 2034133-38-3 CAPLUS
CN Iron alloy, base, Fe 80-100,Mn 0.3-4,Cr 0-3,Cu 0-3,Ni 0-3,Al 0-2,Si 0-2,Mo 0-1,V 0-0.5,C 0-0.4,Nb 0-0.3,Ti 0-0.3,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	80 - 100	7439-89-6
Mn	0.3 - 4	7439-96-5
Cr	0 - 3	7440-47-3
Cu	0 - 3	7440-50-8
Ni	0 - 3	7440-02-0
Al	0 - 2	7429-90-5
Si	0 - 2	7440-21-3

Mo	0	-	1	7439-98-7
V	0	-	0.5	7440-62-2
C	0	-	0.4	7440-44-0
Nb	0	-	0.3	7440-03-1
Ti	0	-	0.3	7440-32-6
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C22C0038-00 [I]; C21D0009-46 [I]; C22C0018-00 [I]; C22C0038-60 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0018-00 [I]; C22C0038-60 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel plate martensite ferrite pearlite microstructure manufg method
IT Annealing
Automobile parts
Cooling
Elongation at break
Grain boundaries
Heating
Microstructure
Particle size
Rolling (metals)
Tensile strength
(high-strength steel plate and its manufg. method)
IT 15099-26-0, Argon (3+), uses
RL: NUU (Other use, unclassified); USES (Uses)
(high-strength steel plate and its manufg. method)
IT 12173-93-2, Martensite, uses 12427-24-6, Ferrite (ferrous metal component) 12427-27-9, Pearlite 2034133-38-3
RL: TEM (Technical or engineered material use); USES (Uses)
(high-strength steel plate and its manufg. method)

L12 ANSWER 82 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1777903 CAPLUS Full-text
DOCUMENT NUMBER: 165:562899
TITLE: Composition and manufacture of high-strength cold rolled steel plate with excellent workability and weldability
INVENTOR(S): Okamoto, Isamu; Yokoyama, Takashi
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 20pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2016188395	A	20161104	JP 2015-68084	20150330
JP 6492869	B2	20190403		

PRIORITY APPLN. INFO.: JP 2015-68084 20150330
AB The present invention provides a high strength cold rolled steel plate with excellent weldability and workability, and a strength of 400 N/mm2 or more with high processability and yield stress, and its manufg. method. The high strength cold rolled steel plate contains C: 0.03%-0.35%, Si: 0.01%-2.00%, Mn: 0.3%-4.0%, P: 0.001%-0.100%, S: 0.0005%-0.05%, N: 0.0005%-0.010%, Al: 0.01%-2.00%, and the balance being Fe and inevitable impurities. The metal structure contains an unrecrystd. ferrite phase at an area ratio of more than 2% and less than 20%, and martensite phase and tempered martensite phase in an amt. of more than 5% and less than 60% in total. The yield ratio YR that is the ratio of the yield stress to the tensile strength is 0.7 or more, and the product of the yield stress and the elongation is 13000 or more.
IT 2034133-38-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(compn. and manuf. of high-strength cold rolled steel plate with excellent workability and weldability)
RN 2034133-38-3 CAPLUS
CN Iron alloy, base, Fe 80-100,Mn 0.3-4,Cr 0-3,Cu 0-3,Ni 0-3,Al 0-2,Si 0-2,Mo 0-1,V 0-0.5,C 0-0.4,Nb 0-0.3,Ti 0-0.3,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	80 - 100	7439-89-6
Mn	0.3 - 4	7439-96-5
Cr	0 - 3	7440-47-3
Cu	0 - 3	7440-50-8
Ni	0 - 3	7440-02-0
Al	0 - 2	7429-90-5
Si	0 - 2	7440-21-3
Mo	0 - 1	7439-98-7
V	0 - 0.5	7440-62-2
C	0 - 0.4	7440-44-0
Nb	0 - 0.3	7440-03-1
Ti	0 - 0.3	7440-32-6
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

IPCI C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-60 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST cold rolled steel plate manuf strength workability weldability
IT Metalworking
(capability; compn. and manuf. of high-strength cold rolled steel plate with excellent workability and weldability)
IT Alloying
Annealing
Casting of metals
Cooling
Elongation at break
Hot rolling
Hot-dip galvanizing
Microstructure
Pickling
Recrystallization
Tensile strength
Weldability
Yield strength
(compn. and manuf. of high-strength cold rolled steel plate with excellent workability and weldability)
IT 2034133-38-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(compn. and manuf. of high-strength cold rolled steel plate with excellent workability and weldability)

L12 ANSWER 83 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1770673 CAPLUS Full-text
DOCUMENT NUMBER: 165:549448
TITLE: Production of hot or cold strips from steel having high copper content
INVENTOR(S): Redenius, Alexander; Evertz, Thomas; Palzer, Peter
PATENT ASSIGNEE(S): Salzgitter Flachstahl GmbH, Germany
SOURCE: PCT Int. Appl., 23pp.; Chemical Indexing Equivalent to 165:549447 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016174020	A1	20161103	WO 2016-EP59266	20160426
DE 102015106780	A1	20161103	DE 2015-102015106780	20150430

PRIORITY APPLN. INFO.: DE 2015-102015106780 A 20150430
AB A hot or cold strip of steel with high copper content, is manufd. by: melting a steel melt contg. (in wt.%) 0-0.4% C, 0-3% Mn, 0-2% Al, 0-2% Si, more than 0.8% Cu, 0-0.2% P, 0-0.05% S, and 0-0.3% N, with optional addn. of Sn, Ni, Cr, V, Nb, Ti, Mo, W, B, Co, Sb and/or Zr, the remainder being iron and unavoidable impurities; casting the melt under an atm.

having an oxygen content <10 vol.%, by a near-net-shape casting method, in particular horizontal strip casting or vertical casting according to the two-roll method, into a pre-strip having a thickness in of 1-30 mm; cooling the cast pre-strip at a cooling rate ≥100 K/s at the actively cooled strip surface until forming a rigid boundary layer.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
FANG YUAN	2014			US 20140366602 A1	
GUELTON NICOLAS PATRICE	2004			EP 1466024 A1	CAPLUS
IKI HIROSHI	2000			JP 2000045045 A	CAPLUS
IUNG THIERRY	2001			EP 1072689 A1	CAPLUS
MARUYAMA NAOKI	2005			JP 2005036271 A	CAPLUS
MIZOGUCHI TOSHIAKI NIPP	1995			EP 0641867 A1	CAPLUS
UENISHI AKIHIRO	2000			EP 0969112 A1	CAPLUS
YAMAKAWA TSUNAHIRO	1992			US 5098489 A	CAPLUS

IT 2031158-69-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; prodn. of hot or cold strips from steel having high copper content)

RN 2031158-69-5 CAPLUS

CN Iron alloy, base, Fe 68-99,Cu 0.8-5,Cr 0-4,Co 0-3,Mn 0-3,Mo 0-3,W 0-3,Al 0-2,Ni 0-2,Si 0-2,Nb 0-0.9,Ti 0-0.9,V 0-0.9,Sn 0-0.5,Zr 0-0.5,C 0-0.4,B 0-0.3,N 0-0.3,P 0-0.2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	68 - 99	7439-89-6
Cu	0.8 - 5	7440-50-8
Cr	0 - 4	7440-47-3
Co	0 - 3	7440-48-4
Mn	0 - 3	7439-96-5
Mo	0 - 3	7439-98-7
W	0 - 3	7440-33-7
Al	0 - 2	7429-90-5
Ni	0 - 2	7440-02-0
Si	0 - 2	7440-21-3
Nb	0 - 0.9	7440-03-1
Ti	0 - 0.9	7440-32-6
V	0 - 0.9	7440-62-2
Sn	0 - 0.5	7440-31-5
Zr	0 - 0.5	7440-67-7
C	0 - 0.4	7440-44-0
B	0 - 0.3	7440-42-8
N	0 - 0.3	17778-88-0
P	0 - 0.2	7723-14-0

IPCI C22C0038-00 [I]; B22D0011-00 [I]; B22D0011-06 [I]; B22D0011-106 [I]; B22D0011-124 [I]; B22D0011-14 [I]; B22D0011-22 [I]; B22D0015-00 [I]; B22D0037-00 [I]; C21D0006-00 [I]; C21D0008-02 [I]; C21D0001-26 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-16 [I]; B22D0011-112 [I]; C21D0006-02 [I]

IPCR C22C0038-00 [I]; B22D0011-00 [I]; B22D0011-06 [I]; B22D0011-106 [I]; B22D0011-112 [I]; B22D0011-124 [I]; B22D0011-14 [I]; B22D0011-22 [I]; B22D0015-00 [I]; B22D0037-00 [I]; C21D0001-26 [I]; C21D0006-00 [I]; C21D0006-02 [I]; C21D0008-02 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-16 [I]

CC 55-3 (Ferrous Metals and Alloys)

ST hot cold strip steel copper casting cooling

IT Annealing
Casting of metals
Cooling
Hot rolling
(prodn. of hot or cold strips from steel having high copper content)

IT 124-38-9, Carbon dioxide, uses 630-08-0, Carbon monoxide, uses 7440-37-1, Argon, uses 7727-37-9, Nitrogen, uses 7782-44-7, Oxygen, uses
RL: NUU (Other use, unclassified); USES (Uses)

(casting atm.; prodn. of hot or cold strips from steel having high copper content)
IT 2031158-68-4P 2031158-69-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; prodn. of hot or cold strips from steel having high copper content)

L12 ANSWER 84 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1770568 CAPLUS Full-text
DOCUMENT NUMBER: 165:549447
TITLE: Production of hot or cold strips from steel having high copper content
INVENTOR(S): Redenius, Alexander; Evertz, Thomas; Palzer, Peter
PATENT ASSIGNEE(S): Salzgitter Flachstahl GmbH, Germany
SOURCE: Ger. Offen., 9pp.; Chemical Indexing Equivalent to 165:549448 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102015106780	A1	20161103	DE 2015-102015106780	20150430
WO 2016174020	A1	20161103	WO 2016-EP59266	20160426

PRIORITY APPLN. INFO.: DE 2015-102015106780 A 20150430
AB A hot or cold strip of steel with high copper content, is manufd. by: melting a steel melt contg. (in wt.%) 0-0.4% C, 0-3% Mn, 0-2% Al, 0-2% Si, more than 0.8% Cu, 0-0.2% P, 0-0.05% S, and 0-0.3% N, with optional addn. of Sn, Ni, Cr, V, Nb, Ti, Mo, W, B, Co, Sb and/or Zr, the remainder being iron and unavoidable impurities; casting the melt under an atm. having an oxygen content <10 vol.%, by a near-net-shape casting method, in particular horizontal strip casting or vertical casting according to the two-roll method, into a pre-strip having a thickness in of 1-30 mm; cooling the cast pre-strip at a cooling rate ≥100 K/s at the actively cooled strip surface until forming a rigid boundary layer.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 112013001434 T5	CAPLUS
Anon				WO 2015003755 A1	CAPLUS
Anon				EP 2546368 A1	CAPLUS
Anon				DE 60306365 T2	
Anon	2013			M Bausch et al:Ultra	

IT 2031158-69-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; prodn. of hot or cold strips from steel having high copper content)
RN 2031158-69-5 CAPLUS
CN Iron alloy, base, Fe 68-99,Cu 0.8-5,Cr 0-4,Co 0-3,Mn 0-3,Mo 0-3,W 0-3,Al 0-2,Ni 0-2,Si 0-2,Nb 0-0.9,Ti 0-0.9,V 0-0.9,Sn 0-0.5,Zr 0-0.5,C 0-0.4,B 0-0.3,N 0-0.3,P 0-0.2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	68 - 99	7439-89-6
Cu	0.8 - 5	7440-50-8
Cr	0 - 4	7440-47-3
Co	0 - 3	7440-48-4
Mn	0 - 3	7439-96-5
Mo	0 - 3	7439-98-7
W	0 - 3	7440-33-7
Al	0 - 2	7429-90-5
Ni	0 - 2	7440-02-0
Si	0 - 2	7440-21-3
Nb	0 - 0.9	7440-03-1
Ti	0 - 0.9	7440-32-6

V	0	-	0.9	7440-62-2
Sn	0	-	0.5	7440-31-5
Zr	0	-	0.5	7440-67-7
C	0	-	0.4	7440-44-0
B	0	-	0.3	7440-42-8
N	0	-	0.3	17778-88-0
P	0	-	0.2	7723-14-0

IPCI C22C0038-04 [I]; C22C0038-16 [I]; C21D0008-00 [I]; B22D0011-06 [I]; B22D0011-116 [I]; B22D0011-12 [I]; C22C0111-00 [I]
IPCR C22C0038-04 [I]; B22D0011-06 [I]; B22D0011-116 [I]; B22D0011-12 [I]; C21D0008-00 [I]; C22C0038-16 [I]; C22C0111-00 [N]
CC 55-3 (Ferrous Metals and Alloys)
ST hot cold strip steel copper casting cooling
IT Annealing
Casting of metals
Cooling
Hot rolling
(prodn. of hot or cold strips from steel having high copper content)
IT 124-38-9, Carbon dioxide, uses 630-08-0, Carbon monoxide, uses 7440-37-1, Argon, uses 7727-37-9, Nitrogen, uses 7782-44-7, Oxygen, uses
RL: NUU (Other use, unclassified); USES (Uses)
(casting atm.; prodn. of hot or cold strips from steel having high copper content)
IT 2031158-68-4P 2031158-69-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; prodn. of hot or cold strips from steel having high copper content)

L12 ANSWER 85 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1617614 CAPLUS Full-text
DOCUMENT NUMBER: 165:466273
TITLE: Composition and manufacture of carbon steel sheet suitable for hot stamping, and hot stamping molded parts
INVENTOR(S): Azuma, Masafumi; Suwa, Yoshihiro; Kondo, Yusuke; Sato, Koichi
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 49pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016158961	A1	20161006	WO 2016-JP60145	20160329
CA 2979978	A1	20161006	CA 2016-2979978	20160329
KR 2017122823	A	20171106	KR 2017-7027982	20160329
KR 2000863	B1	20190716		
CN 107427889	A	20171201	CN 2016-80017529	20160329
CN 107427889	B	20191025		
MX 2017012377	A	20171214	MX 2017-12377	20160329
EP 3278895	A1	20180207	EP 2016-772842	20160329
EP 3278895	B1	20200311		
BR 112017020165	A2	20180605	BR 2017-112017020165	20160329
RU 2683397	C1	20190328	RU 2017-135379	20160329
JP 6515356	B2	20190522	JP 2017-510030	20160329
ES 2781465	T3	20200902	ES 2016-772842	20160329
TW I597370	B	20170901	TW 2016-110064	20160330
US 20180044754	A1	20180215	US 2017-15559731	20170919
IN 201717033300	A	20171201	IN 2017-17033300	20170920

PRIORITY APPLN. INFO.: JP 2015-72280 A 20150331
WO 2016-JP60145 W 20160329
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A steel sheet for hot stamping contains, in percentage by wt., C: 0.100%-0.600%, Si: 0.50%-3.00%, Mn: 1.20%-4.00%, Ti: 0.005%-0.100%, B: 0.0005%-0.100%, P: 0.100% or less, S: 0.0001%-0.0100%, Al: 0.005%-1.000%,

and N: 0.100% or less, with the remainder comprising Fe and impurities. The steel sheet surface roughness is such that Rz > 2.5 μm, and the surface is coated with 50 mg/m2-1,500 mg/m2 of oil coated thereon.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1997			JP 976004 A	
HAYASHI KUNIO	2012			WO 2012053636 A1	CAPLUS
KAWASAKI KAORU	2011			WO 2011158818 A1	CAPLUS
KOJIMA TAKESHI	2014			JP 2014159624 A	CAPLUS
KUSUMI KAZUHISA	2008			JP 2008240046 A	CAPLUS
SETO KAZUHIRO	2010			JP 2010174302 A	CAPLUS

IT 2015959-64-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(compn. and manuf. of carbon steel sheet suitable for hot stamping, and hot stamping molded parts)

RN 2015959-64-3 CAPLUS

CN Iron alloy, base, Fe 83-98,Mn 1.2-4,Si 0.5-3,Cr 0-2,Cu 0-2,Mo 0-2,Ni 0-2,Al 0-1,C 0.1-0.6,B 0-0.1,Nb 0-0.1,P 0-0.1,Ti 0-0.1,V 0-0.1,W 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	83	-	98	7439-89-6
Mn	1.2	-	4	7439-96-5
Si	0.5	-	3	7440-21-3
Cr	0	-	2	7440-47-3
Cu	0	-	2	7440-50-8
Mo	0	-	2	7439-98-7
Ni	0	-	2	7440-02-0
Al	0	-	1	7429-90-5
C	0.1	-	0.6	7440-44-0
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0
Ti	0	-	0.1	7440-32-6
V	0	-	0.1	7440-62-2
W	0	-	0.1	7440-33-7

IPCI B21D0022-20 [I]; B21D0024-00 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-14 [I]; C22C0038-58 [I]; C23F0011-00 [I]; C23G0001-08 [I]

IPCR B21D0022-20 [I]; B21D0024-00 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-14 [I]; C22C0038-58 [I]; C23F0011-00 [I]; C23G0001-08 [I]

CC 55-3 (Ferrous Metals and Alloys)

ST carbon steel sheet manuf hot stamping molded part

IT Adhesion, physical
Annealing
Casting of metals
Cold rolling
Hot rolling
Lubrication
Pickling
Scale (deposits)
Sheet materials
Surface roughness
Tensile strength
(compn. and manuf. of carbon steel sheet suitable for hot stamping, and hot stamping molded parts)

IT Metalworking
(stamping, hot; compn. and manuf. of carbon steel sheet suitable for hot stamping, and hot stamping molded parts)

IT 2015959-64-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(compn. and manuf. of carbon steel sheet suitable for hot stamping, and hot stamping molded parts)

OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 86 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1459241 CAPLUS Full-text
DOCUMENT NUMBER: 165:355921
TITLE: High-strength high-ductility steel sheet for automobile body
INVENTOR(S): Otani, Shigeo; Murakami, Toshio
PATENT ASSIGNEE(S): Kobe Steel, Ltd., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 16pp.; Chemical Indexing Equivalent to 165:355914 (WO)
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2016160467	A	20160905	JP 2015-38856	20150227
JP 6348435	B2	20180627		
WO 2016136625	A1	20160901	WO 2016-JP54887	20160219

PRIORITY APPLN. INFO.: JP 2015-38856 A 20150227

AB The steel comprises C: 0.40 - 0.60%, Si+Al: 0.5 - 2.0%, Mn: 1.0 - 4.0%, P: 0 - 0.05%, S: As with 0 - 0.01%, the remainder consists of the iron and the inevitable impurity, steel organization, in the area ratio for all organization, retained austenite 20 - 40%, ferrite with 2 - 20%, the remainder consists of above 1 or 2 kinds of the bainite, the martensite, the tempering bainite, and the tempering martensite, in regard to the carbon concn. in the aforementioned retained austenite, that av. carbon concn. 0.9 - 1.2 mass %, std. deviation of the carbon concn. distribution 0.29 mass % above, that carbon concn. 1.5 mass % the high strength high ductility which in the area ratio the territory above for all organization is 3.0% or more.

IT 1995867-40-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel sheet for automobile body)
RN 1995867-40-7 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2,Si 0-2,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.4-0.6,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	92	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.4	-	0.6	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet strength ductility automobile body
IT Automobile bodies
Elongation at break
Microstructure
Phase composition
Sheet materials
Tensile strength

Yield strength
(high-strength high-ductility steel sheet for automobile body)
IT 1995867-40-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel sheet for automobile body)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 87 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1459216 CAPLUS Full-text
DOCUMENT NUMBER: 165:355920
TITLE: High-strength high-ductility steel sheet for automobile body
INVENTOR(S): Otani, Shigeo; Murakami, Toshio
PATENT ASSIGNEE(S): Kobe Steel, Ltd., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 16pp.; Chemical Indexing Equivalent to 165:355916 (WO)
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2016160468	A	20160905	JP 2015-38857	20150227
JP 6348436	B2	20180627		
WO 2016136627	A1	20160901	WO 2016-JP54890	20160219

PRIORITY APPLN. INFO.: JP 2015-38857 A 20150227

AB The present invention relates to a high-strength and highly-ductile steel sheet comprises: a compn. contg. C, (Si+Al), Mn, P, and S in specific amts., with the remainder comprising iron and unavoidable impurities; and a structure contg. residual austenite in a specific area ratio, with the remainder comprising at least one of bainite, martensite, tempered bainite, and tempered martensite. The carbon is present in the residual austenite at a specific concn. and concn. distribution, and regions having a carbon concn. of at least 1.5 mass% constitute at least 2.0% of the total structure.

IT 1995867-40-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel sheet for automobile body)
RN 1995867-40-7 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2,Si 0-2,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.4-0.6,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	92	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.4	-	0.6	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]

IPCR C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet strength ductility automobile body
IT Automobile bodies
Elongation at break
Microstructure
Sheet materials
Tensile strength
(high-strength high-ductility steel sheet for automobile body)
IT 1995867-40-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel sheet for automobile body)

L12 ANSWER 88 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1441448 CAPLUS Full-text
DOCUMENT NUMBER: 165:355916
TITLE: High-strength high-ductility steel sheet for automobile body
INVENTOR(S): Otani, Shigeo; Murakami, Toshio
PATENT ASSIGNEE(S): Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.), Japan
SOURCE: PCT Int. Appl., 28pp.; Chemical Indexing Equivalent to 165:355920 (JP)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016136627	A1	20160901	WO 2016-JP54890	20160219
JP 2016160468	A	20160905	JP 2015-38857	20150227
JP 6348436	B2	20180627		

PRIORITY APPLN. INFO.: JP 2015-38857 A 20150227
AB The present invention relates to a high-strength and highly-ductile steel sheet comprises: a compn. contg. C, (Si+Al), Mn, P, and S in specific amts., with the remainder comprising iron and unavoidable impurities; and a structure contg. residual austenite in a specific area ratio, with the remainder comprising at least one of bainite, martensite, tempered bainite, and tempered martensite. The carbon is present in the residual austenite at a specific concn. and concn. distribution, and regions having a carbon concn. of at least 1.5 mass% constitute at least 2.0% of the total structure.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
AKAMIZU HIROSHI	2005			JP 2005336526 A	CAPLUS
Anon	1996			JP 83720 A	
HAYASHI KOTARO	2014			JP 2014025091 A	CAPLUS
KINO NOBUO	2001			JP 2001330101 A	CAPLUS
KUROKAWA SHINPEI	2013			JP 2013159802 A	CAPLUS
SHIBAIRI KOSUKE	2013			JP 2013204093 A	CAPLUS
SUZUKI TAKESHI	2010			JP 2010222671 A	CAPLUS
SUZUKI TAKESHI	2013			JP 2013036087 A	CAPLUS

IT 1995867-40-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel sheet for automobile body)
RN 1995867-40-7 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2,Si 0-2,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.4-0.6,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number

Fe	92	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.4	-	0.6	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet strength ductility automobile body
IT Automobile bodies
Elongation at break
Microstructure
Sheet materials
Tensile strength
(high-strength high-ductility steel sheet for automobile body)
IT 1995867-40-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel sheet for automobile body)

L12 ANSWER 89 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1441302 CAPLUS Full-text
DOCUMENT NUMBER: 165:355914
TITLE: High-strength high-ductility steel sheet for automobile body
INVENTOR(S): Otani, Shigeo; Murakami, Toshio
PATENT ASSIGNEE(S): Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.), Japan
SOURCE: PCT Int. Appl., 27pp.; Chemical Indexing Equivalent to 165:355921 (JP)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016136625	A1	20160901	WO 2016-JP54887	20160219
JP 2016160467	A	20160905	JP 2015-38856	20150227
JP 6348435	B2	20180627		

PRIORITY APPLN. INFO.: JP 2015-38856 A 20150227
AB The steel sheet comprising a compn. contg. C, (Si+Al), Mn, P, and S in specific amts., with the remainder comprising iron and unavoidable impurities; and a structure contg. residual austenite and ferrite in a specific area ratio. Carbon is present in the residual austenite at a specific concn. and concn. distribution, and regions having a carbon concn. of at least 1.5 mass% constitute at least 3.0% of the total structure.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
HATAKE HIDEO	2011			JP 2011219859 A	CAPLUS
HATAKE HIDEO	2012			JP 2012240095 A	CAPLUS
KAKIUCHI ELIJAH	2013			JP 2013181184 A	CAPLUS
MURAKAMI TOSHIO	2012			JP 2012122130 A	CAPLUS
SATO KOICHI	2013			WO 2013047808 A1	CAPLUS
WAKITA MASAYUKI	2007			JP 2007023339 A	CAPLUS

YOSHIDA MITSURU |2012 | | |JP 2012251201 A |CAPLUS
IT 1995867-40-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel sheet for automobile body)
RN 1995867-40-7 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2,Si 0-2,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.4-0.6,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	92	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.4	-	0.6	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet strength ductility automobile body
IT Automobile bodies
Elongation at break
Microstructure
Phase composition
Sheet materials
Tensile strength
Yield strength
(high-strength high-ductility steel sheet for automobile body)
IT 1995867-40-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel sheet for automobile body)

L12 ANSWER 90 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1420548 CAPLUS Full-text
DOCUMENT NUMBER: 165:369451
TITLE: Anti-bacterial stainless steel
INVENTOR(S): Zhu, Hongyan
PATENT ASSIGNEE(S): Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 5pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 105908085	A	20160831	CN 2016-10462806	20160622

PRIORITY APPLN. INFO.: CN 2016-10462806 20160622
AB The present invention discloses an anti-bacterial stainless steel, comprising the following chem. compns.: nickel 0.30-0.50wt%, manganese 0.80-1.40wt%, silicon 0.20-0.34wt%, carbon 0.14-0.18wt%, boron 0.02-0.06wt%, phosphorus 0.01-0.02wt%, sulfur 0.015-0.025wt%, erbium 0.08-0.1wt%, vanadium 0.06-0.2wt% , thulium 0.2-0.3wt%, molybdenum 0.02-0.08wt%, titanium 0.08-0.1wt%, niobium 0.02-0.04wt%, rubidium

0.06~0.2wt%, thorium 0.08-0.1wt%, chromium and copper 0.06-0.08wt%, and iron as balance, wherein, the chromium content is 5~7 times of copper content. The anti-bacteria stainless steel provided by the present invention has excellent anti-bacterial property. The anti-bacterial effect of antibacterial stainless steel is relevant with the ratio of chromium and copper content, and when chromium content is 5-7 times of copper content, the antibacterial effect reaches the best.

IT 1998722-49-8, Ni 0.3-0.5, Mn 0.8-1.4, Si 0.2-0.3, C 0.1-0.2, B 0-0.1, Er 0.1, V 0.1-0.2, Tm 0.2-0.3, Mo 0-0.1, Ti 0.1, Rb 0.1-0.2, Th 0.1, Cr 0-0.1, Cu 0-0.1, Fe bal.
RL: TEM (Technical or engineered material use); THU (Therapeutic use); BIOL (Biological study); USES (Uses)
(anti-bacterial stainless steel)

RN 1998722-49-8 CAPLUS

CN Iron alloy, base, Fe 96-98,Mn 0.8-1.4,Ni 0.3-0.5,Si 0.2-0.3,Tm 0.2-0.3,C 0.1-0.2,Rb 0.1-0.2,V 0.1-0.2,Er 0.1,Th 0.1,Ti 0.1,B 0-0.1,Cr 0-0.1,Cu 0-0.1,Mo 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6
Mn	0.8	-	1.4	7439-96-5
Ni	0.3	-	0.5	7440-02-0
Si	0.2	-	0.3	7440-21-3
Tm	0.2	-	0.3	7440-30-4
C	0.1	-	0.2	7440-44-0
Rb	0.1	-	0.2	7440-17-7
V	0.1	-	0.2	7440-62-2
Er		0.1		7440-52-0
Th		0.1		7440-29-1
Ti		0.1		7440-32-6
B	0	-	0.1	7440-42-8
Cr	0	-	0.1	7440-47-3
Cu	0	-	0.1	7440-50-8
Mo	0	-	0.1	7439-98-7

IPCI C22C0038-04; C22C0038-02; C22C0038-08; C22C0038-12; C22C0038-14; C22C0038-18; C22C0038-16

IPCR C22C0038-04 [I]; C22C0038-02 [I]; C22C0038-08 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C22C0038-16 [I]; C22C0038-18 [I]

CC 55-12 (Ferrous Metals and Alloys)

ST antibacterial stainless steel

IT Antibacterial agents
Candida albicans
Clostridium tetani
Escherichia coli
Staphylococcus aureus
(anti-bacterial stainless steel)

IT 1998722-49-8, Ni 0.3-0.5, Mn 0.8-1.4, Si 0.2-0.3, C 0.1-0.2, B 0-0.1, Er 0.1, V 0.1-0.2, Tm 0.2-0.3, Mo 0-0.1, Ti 0.1, Rb 0.1-0.2, Th 0.1, Cr 0-0.1, Cu 0-0.1, Fe bal.
RL: TEM (Technical or engineered material use); THU (Therapeutic use); BIOL (Biological study); USES (Uses)
(anti-bacterial stainless steel)

L12 ANSWER 91 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2016:1363138 CAPLUS Full-text

DOCUMENT NUMBER: 165:320572

TITLE: Alloy steel with high strength and high toughness

INVENTOR(S): He, Huaqiong

PATENT ASSIGNEE(S): Peop. Rep. China

SOURCE: Faming Zhuanli Shenqing, 5pp.
CODEN: CNXXEV

DOCUMENT TYPE: Patent

LANGUAGE: Chinese

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 105861921	A	20160817	CN 2016-10264079	20160423

PRIORITY APPLN. INFO.: CN 2016-10264079 20160423

AB The title alloy steel comprises boron 0.02-0.1 wt%, carbon 0.1-0.2 wt%, chromium 0.1 wt%, cobalt and zirconium (at a ratio of 4-6:1) 0.05-0.1 wt%, copper 0.2-0.3 wt%, manganese 0.8-1.2 wt%, molybdenum 0.04-0.1 wt%, nickel 0.3-0.5 wt%, niobium 0.02-0.04 wt%, phosphorus 0.01-0.03 wt%, rubidium 0.2 wt%, silicon 0.2-0.3 wt%, sulfur 0.015-0.025 wt%, thorium 0.1 wt%, titanium 0.1 wt%, vanadium 0.1 wt%, iron bal. The alloy steel of the present invention has ultra-high strength and toughness, and can be used for producing workpieces with relatively high requirements on strength and toughness. The strength and toughness of the alloy steel are related to the content ratio of cobalt to zirconium in the alloy, and little change of the ratio greatly affects the strength and toughness.

IT 1988674-60-7, Boron 0-0.1, carbon 0.1-0.2, chromium 0.1, cobalt 0-0.1, copper 0.2-0.3, manganese 0.8-1.2, molybdenum 0-0.1, nickel 0.3-0.5, rubidium 0.2, silicon 0.2-0.3, thorium 0.1, titanium 0.1, vanadium 0.1, zirconium 0-0.1, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(alloy steel with high strength and high toughness)

RN 1988674-60-7 CAPLUS

CN Iron alloy, base, Fe 96-98,Mn 0.8-1.2,Ni 0.3-0.5,Cu 0.2-0.3,Si 0.2-0.3,Rb 0.2,C 0.1-0.2,Cr 0.1,Th 0.1,Ti 0.1,V 0.1,B 0-0.1,Co 0-0.1,Mo 0-0.1,Zr 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6
Mn	0.8	-	1.2	7439-96-5
Ni	0.3	-	0.5	7440-02-0
Cu	0.2	-	0.3	7440-50-8
Si	0.2	-	0.3	7440-21-3
Rb		0.2		7440-17-7
C	0.1	-	0.2	7440-44-0
Cr		0.1		7440-47-3
Th		0.1		7440-29-1
Ti		0.1		7440-32-6
V		0.1		7440-62-2
B	0	-	0.1	7440-42-8
Co	0	-	0.1	7440-48-4
Mo	0	-	0.1	7439-98-7
Zr	0	-	0.1	7440-67-7

IPCI C22C0038-02; C22C0038-32; C22C0038-04; C22C0038-18; C22C0038-12; C22C0038-10; C22C0038-08; C22C0038-16; C22C0038-14

IPCR C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-08 [I]; C22C0038-10 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C22C0038-16 [I]; C22C0038-18 [I]; C22C0038-32 [I]

CC 55-1 (Ferrous Metals and Alloys)

ST alloy steel tensile yield strength toughness

IT Impact strength
Tensile strength
Yield strength
(alloy steel with high strength and high toughness)

IT 1988674-60-7, Boron 0-0.1, carbon 0.1-0.2, chromium 0.1, cobalt 0-0.1, copper 0.2-0.3, manganese 0.8-1.2, molybdenum 0-0.1, nickel 0.3-0.5, rubidium 0.2, silicon 0.2-0.3, thorium 0.1, titanium 0.1, vanadium 0.1, zirconium 0-0.1, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(alloy steel with high strength and high toughness)

L12 ANSWER 92 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2016:1336365 CAPLUS Full-text

DOCUMENT NUMBER: 165:309752

TITLE: Abrasion-resistant steel plate with thickness of 4-8 mm for HB450-grade engineering machinery and manufacturing method thereof

INVENTOR(S): Hou, Dengyi; Feng, Yong; Sun, Genling; Wang, Nanhui; Cong, Liang; Su, Xiumei; Yang, Ruixia

PATENT ASSIGNEE(S): Shandong Iron & Steel Co., Ltd., Peop. Rep. China

SOURCE: Faming Zhuanli Shenqing, 11pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 105861928	A	20160817	CN 2016-10440247	20160617
PRIORITY APPLN. INFO.:			CN 2016-10440247	20160617

AB The present invention belongs to the tech. field of prodn. of steel plates for engineering machinery and particularly relates to an abrasion-resistant steel plate with thickness of 4-8 mm for HB450-grade engineering machinery and a manufg. method thereof. The abrasion-resistant steel plate with thickness of 4-8 mm for HB450-grade engineering machinery comprises the following molten chem. components in percentage by wt.: C 0.16-0.18%, Si 0.05-0.20%, Mn, 0.50-0.70%, P less than or equal to 0.010%, S less than or equal to 0.003%, Alt 0.020-0.030%, Cr 0.35-0.45%, Mo 0.10-0.15%, B 0.0008-0.0015%, Ti 0.015-0.025%, O less than or equal to 10 ppm, N less than or equal to 15 ppm, H less than or equal to 3 ppm, and the balance of Fe and inevitable impurities. The manuf. method comprises KR iron melt pre-treatment, converter smelting, deoxidn. alloying, CAS refining, LF refining, RH vacuum degassing, electromagnetic stirring and continuously casting to gain blanks, cold stacking the blanks, heating the blanks, high pressure water descaling, four-roll rough rolling, four-roll finish rolling, thermal straightening, water cooling and quenching, thermal straightening, distressing and annealing, thermal straightening, and length-fixing cutting. The steel plate belongs to thin-size high-grade high-strength abrasion-resistant steel, has excellent mech. property, high purity and good plate shape, and is easy to weld.

IT 1315482-08-6P, HB450, preparation
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(abrasion-resistant steel plate with thickness of 4-8 mm for HB450-grade engineering machinery and manufg. method thereof)

RN 1315482-08-6 CAPLUS
CN Steel, (HB450) (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	97 - 98	7439-89-6
Mn	1.2 - 1.6	7439-96-5
Si	0.4 - 0.6	7440-21-3
B	0 - 0.4	7440-42-8
Cr	0 - 0.4	7440-47-3
Ti	0 - 0.4	7440-32-6
C	0.2	7440-44-0

IPCI C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-18; C22C0038-12; C22C0038-32; C22C0038-14; C22C0033-04; C21D0001-30; C21D0001-18; C21D0008-02
IPCR C22C0038-02 [I]; C21D0001-18 [I]; C21D0001-30 [I]; C21D0008-02 [I]; C22C0033-04 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C22C0038-18 [I]; C22C0038-32 [I]
CC 55-1 (Ferrous Metals and Alloys)
ST steel plate thickness engineering machinery manufg rolling quenching annealing
IT Apparatus
(Engineering; abrasion-resistant steel plate with thickness of 4-8 mm for HB450-grade engineering machinery and manufg. method thereof)
IT Annealing
Finishing
Industrial manufacturing
Plates
Quenching (cooling)
Rolling (metals)
(abrasion-resistant steel plate with thickness of 4-8 mm for HB450-grade engineering machinery and manufg. method thereof)

IT 1315482-08-6P, HB450, preparation
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(abrasion-resistant steel plate with thickness of 4-8 mm for HB450-grade engineering machinery and manufg. method thereof)

L12 ANSWER 93 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1336280 CAPLUS Full-text
DOCUMENT NUMBER: 165:320587
TITLE: Long-service-life steel ball for shot blasting surface treatment, and its preparation method
INVENTOR(S): Hu, Yinji
PATENT ASSIGNEE(S): Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 16pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 105861922	A	20160817	CN 2016-10272692	20160428
CN 105861922	B	20170929		

PRIORITY APPLN. INFO.: CN 2016-10272692 20160428

AB The inventive long-service-life steel ball for shot blasting surface treatment comprises (by wt%) aluminum 0.001-0.05, carbon 0.1-0.4, chromium 0.3-1.5, copper 0.05-0.2, manganese 0.4-1.5, molybdenum 0.001-0.05, nickel 0.001-0.1, niobium 0.001-0.2, phosphorus 0-0.05, silicon 0.1-1.0, sulfur 0-0.05, titanium 0.001-0.1, tungsten 0.001-0.1, vanadium 0.001-0.2, zinc 0.001-0.1, boron, magnesium, cerium and/or lanthanum 0.0001-0.1, iron balance. The steel ball has metallog. structure of lath martensite-bainite duplex structure, or lath martensite-plate martensite duplex structure. The prepn. method includes smelting, deoxidizing with aluminum, performing centrifugal granulation, cooling with water to form as-cast steel balls, drying, sieving, heating at 860-930°C for 30-40 min, quenching in water, and tempering by heating at 150-480°C for 30-60 min. The steel ball has good wear resistance, long service life, high surface hardness, and breaking resistance.

IT 1988677-28-6P, Carbon 0.1-0.4, chromium 0.3-1.5, copper 0.05-0.2, manganese 0.4-1.5, nickel 0.001-0.1, niobium 0.001-0.2, silicon 0.1-1.0, titanium 0.001-0.1, tungsten 0.001-0.1, vanadium 0.001-0.2, zinc 0.001-0.1, boron 0-0.1, magnesium 0-0.1, cerium 0-0.1, lanthanum 0.0001-0.1, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(long-service-life steel ball for shot blasting surface treatment, and its prepn. method)
RN 1988677-28-6 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.4-1.5,Cr 0.3-1.5,Si 0.1-1,C 0.1-0.4,Cu 0-0.2,Nb 0-0.2,V 0-0.2,B 0-0.1,Ce 0-0.1,La 0-0.1,Mg 0-0.1,Ni 0-0.1,Ti 0-0.1,W 0-0.1,Zn 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	94	-	99	7439-89-6
Mn	0.4	-	1.5	7439-96-5
Cr	0.3	-	1.5	7440-47-3
Si	0.1	-	1	7440-21-3
C	0.1	-	0.4	7440-44-0
Cu	0	-	0.2	7440-50-8
Nb	0	-	0.2	7440-03-1
V	0	-	0.2	7440-62-2
B	0	-	0.1	7440-42-8
Ce	0	-	0.1	7440-45-1
La	0	-	0.1	7439-91-0
Mg	0	-	0.1	7439-95-4
Ni	0	-	0.1	7440-02-0

Ti 0 - 0.1 7440-32-6
W 0 - 0.1 7440-33-7
Zn 0 - 0.1 7440-66-6

IPCI C22C0038-02; C22C0038-04; C22C0038-60; C22C0038-18; C22C0038-12; C22C0038-14; C22C0038-08; C22C0038-16; C22C0038-06; C22C0038-32; C21D0006-00; C21D0009-36; C21D0001-18; B22F0009-10
IPCR C22C0038-02 [I]; B22F0009-10 [I]; C21D0001-18 [I]; C21D0006-00 [I]; C21D0009-36 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-08 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C22C0038-16 [I]; C22C0038-18 [I]; C22C0038-32 [I]; C22C0038-60 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel ball shot blasting surface treatment long service life
IT Deoxidation
Granulation
Quenching (cooling)
Shotblasting
Sieving
Smelting
Spheres
Tempering
Wear-resistant materials
(long-service-life steel ball for shot blasting surface treatment, and its prepn. method)
IT 1988677-28-6P, Carbon 0.1-0.4, chromium 0.3-1.5, copper 0.05-0.2, manganese 0.4-1.5, nickel 0.001-0.1, niobium 0.001-0.2, silicon 0.1-1.0, titanium 0.001-0.1, tungsten 0.001-0.1, vanadium 0.001-0.2, zinc 0.001-0.1, boron 0-0.1, magnesium 0-0.1, cerium 0-0.1, lanthanum 0.0001-0.1, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(long-service-life steel ball for shot blasting surface treatment, and its prepn. method)
IT 7429-90-5, Aluminum, processes
RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)
(long-service-life steel ball for shot blasting surface treatment, and its prepn. method)

L12 ANSWER 94 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1287935 CAPLUS Full-text
DOCUMENT NUMBER: 165:278246
TITLE: Steel sheet blank having laser cut end surfaces, steel sheet for laser cutting, and manufacture thereof
INVENTOR(S): Fujinaka, Shingo
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 17pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2016141816	A	20160808	JP 2015-15695	20150129
JP 6417977	B2	20181107		

PRIORITY APPLN. INFO.: JP 2015-15695 20150129
AB The title steel sheet blank is characterized by a compn. contg. C 0.02-0.16, Si 0.04-2, Mn 0.4-3, P ≤0.05, S ≤0.02, sol.Al 0.01-2, and balance Fe, a microstructure having martensite and bainite for total area ratio ≥70% at cut end surfaces with 40 μm width to inside, and having ferrite area ratio 10-90%, retained austenite area ratio ≥1%, and balance martensite and bainite at mother material parts except the cut end surfaces, and tensile strength ≥440 MPa and <780 MPa. Optionally, the compn. contains (1) Ti ≤0.2, Nb ≤0.2, and/or V ≤0.2, (2) Cu ≤1, Ni ≤1, Cr ≤1, Mo ≤1, and/or B ≤0.1, and/or (3) REM ≤0.1, Mg ≤0.01, Ca ≤0.01, and/or Bi ≤0.1 mass%. The title steel sheet is manufd. by the steps comprising: hot rolling a steel slab at 1100-1300°, finishing the hot rolling at 850-950°,

and then coiling at ≤650°; (B) pickling and cold rolling the hot rolled sheet; and then (C) continuous annealing by heating at ≥[(Ac1 + Ac3)/2] and ≤(Ac3 + 50°), retaining at the temp. region for 240 s, and then cooling at av. cooling rate 2-50°/s to 250-500°. The manuf. process provides the high-strength steel sheet having excellent elongation and stretch flangeability to give the steel sheet blank.

IT 1980840-39-8D, Mg,Ca microalloy
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(manuf. of steel sheet for laser cutting and microstructure of steel sheet blank)

RN 1980840-39-8 CAPLUS

CN Iron alloy, base, Fe 88-100,Mn 0.4-3,Al 0-2,Si 0-2,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,B 0-0.1,Bi 0-0.1,misch metal 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	88 - 100	7439-89-6
Mn	0.4 - 3	7439-96-5
Al	0 - 2	7429-90-5
Si	0 - 2	7440-21-3
Cr	0 - 1	7440-47-3
Cu	0 - 1	7440-50-8
Mo	0 - 1	7439-98-7
Ni	0 - 1	7440-02-0
C	0 - 0.2	7440-44-0
Nb	0 - 0.2	7440-03-1
Ti	0 - 0.2	7440-32-6
V	0 - 0.2	7440-62-2
B	0 - 0.1	7440-42-8
Bi	0 - 0.1	7440-69-9
Misch metal	0 - 0.1	8049-20-5

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-5 (Ferrous Metals and Alloys)
ST laser cutting steel sheet blank microstructure; annealing steel sheet laser cutting
IT Annealing
Hot rolling
Laser cutting
Microstructure
(manuf. of steel sheet for laser cutting and microstructure of steel sheet blank)
IT 1980840-37-6 1980840-39-8D, Mg,Ca microalloy
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(manuf. of steel sheet for laser cutting and microstructure of steel sheet blank)
IT 12173-93-2, Martensite, uses 12427-23-5, Bainite 12427-24-6, Ferrite (ferrous metal component)
RL: TEM (Technical or engineered material use); USES (Uses)
(manuf. of steel sheet for laser cutting and microstructure of steel sheet blank)
IT 7439-95-4D, Magnesium, trace in steel 7440-70-2D, Calcium, trace in steel
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(microalloy; manuf. of steel sheet for laser cutting and microstructure of steel sheet blank)
IT 12244-31-4, Austenite, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(retained; manuf. of steel sheet for laser cutting and microstructure of steel sheet blank)

L12 ANSWER 95 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1097932 CAPLUS Full-text

DOCUMENT NUMBER: 165:167420
TITLE: An alloy steel new material with resistance to high temperature oxidation
INVENTOR(S): Guo, Jiachuan
PATENT ASSIGNEE(S): Wenling Chuangjia Information Technology Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 5pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 105734420	A	20160706	CN 2016-10154150	20160317

PRIORITY APPLN. INFO.: CN 2016-10154150 20160317

AB The present invention discloses an alloy steel new material with resistance to high temp. oxidn., comprising 0.30~0.50wt% of nickel, 0.80%~1.40wt% of manganese, 0.20~0.34wt% of silicon, 0.14~0.18wt% of carbon, 0.02~0.06wt% of boron, 0.01~0.02wt% of phosphorus, 0.015~0.025wt% of sulfur, 0.08~0.1wt% of chromium, 0.06~0.2wt% of vanadium, 0.2~0.3wt% of copper, 0.02~0.08wt% of molybdenum, 0.08~0.1wt% of titanium, 0.02~0.04wt% of niobium, 0.06~0.2wt% of rubidium, 0.08~0.1wt% of thorium, 0.06~0.1wt% of lanthanum and germanium, and balance iron; wherein the germanium content is 2~4 times of the lanthanum content. The alloy steel new material provided by the present invention has excellent high temp. oxidn. resistance, and could be used for manufg. the workpiece with high temp. oxidn. resistance. The high temp. oxidn. resistance of the alloy steel new material is related with the content proportion of the lanthanum and germanium in the alloy steel.

IT 1960401-15-3, Ni 0.3-0.5, Mn 0.8-1.4, Si 0.2-0.3, C 0.1-0.2, B 0-0.1, Cr 0.1, V 0.1-0.2, Cu 0.2-0.3, Mo 0-0.1, Ti 0.1, Rb 0.1-0.2, Th 0.1, La 0-0.1, Ge 0-0.1, Fe bal.
RL: TEM (Technical or engineered material use); USES (Uses)
(alloy steel new material with resistance to high temp. oxidn.)
RN 1960401-15-3 CAPLUS
CN Iron alloy, base, Fe 96-98,Mn 0.8-1.4,Ni 0.3-0.5,Cu 0.2-0.3,Si 0.2-0.3,C 0.1-0.2,Rb 0.1-0.2,V 0.1-0.2,Cr 0.1,Th 0.1,Ti 0.1,B 0-0.1,Ge 0-0.1,La 0-0.1,Mo 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	96 - 98	7439-89-6
Mn	0.8 - 1.4	7439-96-5
Ni	0.3 - 0.5	7440-02-0
Cu	0.2 - 0.3	7440-50-8
Si	0.2 - 0.3	7440-21-3
C	0.1 - 0.2	7440-44-0
Rb	0.1 - 0.2	7440-17-7
V	0.1 - 0.2	7440-62-2
Cr	0.1	7440-47-3
Th	0.1	7440-29-1
Ti	0.1	7440-32-6
B	0 - 0.1	7440-42-8
Ge	0 - 0.1	7440-56-4
La	0 - 0.1	7439-91-0
Mo	0 - 0.1	7439-98-7

IPCI C22C0038-04; C22C0038-08; C22C0038-02; C22C0038-18; C22C0038-12; C22C0038-16; C22C0038-14
IPCR C22C0038-04 [I]; C22C0038-02 [I]; C22C0038-08 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C22C0038-16 [I]; C22C0038-18 [I]
CC 55-12 (Ferrous Metals and Alloys)
ST alloy steel material high temp oxidn resistance
IT Furnaces
(alloy steel new material with resistance to high temp. oxidn.)
IT 1960401-15-3, Ni 0.3-0.5, Mn 0.8-1.4, Si 0.2-0.3, C 0.1-0.2, B

0-0.1, Cr 0.1, V 0.1-0.2, Cu 0.2-0.3, Mo 0-0.1, Ti 0.1, Rb 0.1-0.2, Th 0.1, La 0-0.1, Ge 0-0.1, Fe bal.
RL: TEM (Technical or engineered material use); USES (Uses)
(alloy steel new material with resistance to high temp. oxidn.)

L12 ANSWER 96 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1011326 CAPLUS Full-text
DOCUMENT NUMBER: 165:117791
TITLE: High temperature resistant alloy steel and preparation method thereof
INVENTOR(S): Xu, Ting
PATENT ASSIGNEE(S): Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 5pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 105695866	A	20160622	CN 2016-10264926	20160423

PRIORITY APPLN. INFO.: CN 2016-10264926 20160423

AB The present invention discloses a high temp. resistant alloy steel and prepn. method thereof, comprising 0.30-0.50wt% of nickel, 0.80%-1.40wt% of manganese, 0.20-0.34wt% of silicon, 0.14-0.18wt% of carbon, 0.02-0.06wt% of boron, 0.01-0.02wt% of phosphorus, 0.015-0.025wt% of sulfur, 0.08-0.1wt% of chromium, 0.06-0.2wt% of vanadium, 0.2-0.3wt% of copper, 0.02-0.08wt% of molybdenum, 0.08-0.1wt% of titanium, 0.02-0.04wt% of niobium, 0.06-0.2wt% of rubidium, 0.08-0.1wt% of thorium, 0.06-0.1wt% of erbium and thulium, the residue is iron; wherein, the content of described thulium is 2-4 times of the content of erbium. The alloy steel novel material provided by the present invention has excellent high temp. oxidn. resistance, it is possible to prep. the workpiece that the high temp. oxidn. resistance is high. The high temp. oxidn. resistance of this alloy steel novel material is relevant with the content ratio of thulium and erbium in this steel alloy.

IT 1949764-15-1, Ni 0.3-0.5, Mn 0.8-1.4, Si 0.2-0.3, C 0.1-0.2, B 0-0.1, Cr 0.1, V 0.1-0.2, Cu 0.2-0.3, Mo 0-0.1, Ti 0.1, Rb 0.1-0.2, Th 0.1, Er 0-0.1, Tm 0-0.1, Fe bal.
RL: TEM (Technical or engineered material use); USES (Uses)
(high temp. resistant alloy steel and prepn. method thereof)
RN 1949764-15-1 CAPLUS
CN Iron alloy, base, Fe 96-98,Mn 0.8-1.4,Ni 0.3-0.5,Cu 0.2-0.3,Si 0.2-0.3,C 0.1-0.2,Rb 0.1-0.2,V 0.1-0.2,Cr 0.1,Th 0.1,Ti 0.1,B 0-0.1,Er 0-0.1,Mo 0-0.1,Tm 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	96 - 98	7439-89-6
Mn	0.8 - 1.4	7439-96-5
Ni	0.3 - 0.5	7440-02-0
Cu	0.2 - 0.3	7440-50-8
Si	0.2 - 0.3	7440-21-3
C	0.1 - 0.2	7440-44-0
Rb	0.1 - 0.2	7440-17-7
V	0.1 - 0.2	7440-62-2
Cr	0.1	7440-47-3
Th	0.1	7440-29-1
Ti	0.1	7440-32-6
B	0 - 0.1	7440-42-8
Er	0 - 0.1	7440-52-0
Mo	0 - 0.1	7439-98-7
Tm	0 - 0.1	7440-30-4

IPCI C22C0038-08; C22C0038-04; C22C0038-02; C22C0038-32; C22C0038-18; C22C0038-12; C22C0038-16; C22C0038-14
IPCR C22C0038-08 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C22C0038-16 [I]; C22C0038-18 [I]; C22C0038-32 [I]
CC 55-12 (Ferrous Metals and Alloys)

ST high temp resistant alloy steel
IT Heat-resistant materials
(high temp. resistant alloy steel and prepn. method thereof)
IT 1949764-15-1, Ni 0.3-0.5, Mn 0.8-1.4, Si 0.2-0.3, C 0.1-0.2, B 0-0.1, Cr 0.1, V 0.1-0.2, Cu 0.2-0.3, Mo 0-0.1, Ti 0.1, Rb 0.1-0.2, Th 0.1, Er 0-0.1, Tm 0-0.1, Fe bal.
RL: TEM (Technical or engineered material use); USES (Uses)
(high temp. resistant alloy steel and prepn. method thereof)

L12 ANSWER 97 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:894459 CAPLUS Full-text
DOCUMENT NUMBER: 165:46380
TITLE: A high-strength high-toughness alloy steel
INVENTOR(S): Song, Xiaoling
PATENT ASSIGNEE(S): Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 5pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 105624555	A	20160601	CN 2016-10038427	20160120

PRIORITY APPLN. INFO.: CN 2016-10038427 20160120
AB The present invention discloses a high-strength high-toughness alloy steel. The alloy steel includes carbon 0.14-0.18, Si 0.20-0.34, boron 0.02-0.06, Mn 0.80-1.40, phosphorus 0.01-0.02, sulfur 0.015-0.025, chromium 0.08-0.1, vanadium 0.06-0.2, nickel 0.30-0.50, Cu 0.2-0.3, molybdenum 0.02-0.08, titanium 0.08-0.1, niobium 0.02-0.04, rubidium 0.06-0.2, indium 0.01-0.02, europium 0.02-0.08, thorium 0.08-0.1, the balance iron; wherein the content of europium is 2 to 4 times of indium content. Alloy steel of the present invention has ultra-high strength and toughness, can be used in manuf. of workpiece with high requirement to strength and toughness. The strength and toughness of the steel alloy is relative to content ratio of europium and indium in alloy steel, and small changes of the content ratio has large influence on the strength and toughness.
IT 1935673-46-3, Boron 0.02-0.06, carbon 0.14-0.18, copper 0.2-0.3, chromium 0.1, europium 0.02-0.08, iron 71.28-97.88, manganese 0.80-1.40, molybdenum 0.02-0.08, nickel 0.30-0.50, rubidium 0.06-0.2, silicon 0.20-0.34, titanium 0.1, thorium 0.1, vanadium 0.06-0.2
RL: TEM (Technical or engineered material use); USES (Uses)
(high-strength high-toughness alloy steel)
RN 1935673-46-3 CAPLUS
CN Iron alloy, base, Fe 71-98,Mn 0.8-1.4,Ni 0.3-0.5,Cu 0.2-0.3,Si 0.2-0.3,C 0.1-0.2,Rb 0.1-0.2,V 0.1-0.2,Cr 0.1,Th 0.1,Ti 0.1,B 0-0.1,Eu 0-0.1,Mo 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	71 - 98	7439-89-6
Mn	0.8 - 1.4	7439-96-5
Ni	0.3 - 0.5	7440-02-0
Cu	0.2 - 0.3	7440-50-8
Si	0.2 - 0.3	7440-21-3
C	0.1 - 0.2	7440-44-0
Rb	0.1 - 0.2	7440-17-7
V	0.1 - 0.2	7440-62-2
Cr	0.1	7440-47-3
Th	0.1	7440-29-1
Ti	0.1	7440-32-6
B	0 - 0.1	7440-42-8
Eu	0 - 0.1	7440-53-1
Mo	0 - 0.1	7439-98-7

IPCI C22C0038-04; C22C0038-02; C22C0038-18; C22C0038-12; C22C0038-08; C22C0038-16; C22C0038-14
IPCR C22C0038-04 [I]; C22C0038-02 [I]; C22C0038-08 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C22C0038-16 [I]; C22C0038-18 [I]

CC 55-12 (Ferrous Metals and Alloys)
ST high strength toughness alloy steel
IT 1935673-46-3, Boron 0.02-0.06, carbon 0.14-0.18, copper 0.2-0.3, chromium 0.1, europium 0.02-0.08, iron 71.28-97.88, manganese 0.80-1.40, molybdenum 0.02-0.08, nickel 0.30-0.50, rubidium 0.06-0.2, silicon 0.20-0.34, titanium 0.1, thorium 0.1, vanadium 0.06-0.2
RL: TEM (Technical or engineered material use); USES (Uses)
(high-strength high-toughness alloy steel)

L12 ANSWER 98 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:892009 CAPLUS Full-text
DOCUMENT NUMBER: 165:46330
TITLE: High-strength high-ductility steel plate for automobile body
INVENTOR(S): Murakami, Toshio; Otani, Shigeo
PATENT ASSIGNEE(S): Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.), Japan
SOURCE: PCT Int. Appl., 27pp.; Chemical Indexing Equivalent to 165:46317 (JP)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016084847	A1	20160602	WO 2015-JP83078	20151125
JP 2016098427	A	20160530	JP 2014-238710	20141126
JP 6282577	B2	20180221		
KR 2017070230	A	20170621	KR 2017-7013590	20151125
KR 2111921	B1	20200518		
CN 107002192	A	20170801	CN 2015-80061877	20151125
CN 107002192	B	20190308		
EP 3225708	A1	20171004	EP 2015-862199	20151125
US 20170268077	A1	20170921	US 2017-15528675	20170522

PRIORITY APPLN. INFO.: JP 2014-238710 A 20141126
WO 2015-JP83078 W 20151125
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention provides a high-strength high-ductility steel plate excellent in strength-ductility balance which can secure tensile strength (TS) × elongation (EL) × elongation flange ability (λ) of more than 1000000MPa·%·%, and yield ratio (YR) of 0.7 or more. The high-strength high-ductility steel plate contains (by wt.%) C 0.10-0.35, Si+Al 0.5-2.0, Mn 1.0-4.0, P 0-0.05, S 0-0.01, and iron and inevitable impurities as balance. As for steel texture, retained austenite is 8% or more at the area rate with respect to all the texture, and the remainder consists of one or two of bainite, martensite, tempered bainite, and tempered martensite. As for the carbon concn. in the retained austenite, the mean carbon concn. is 0.9-1.2 mass%, and the std. deviation of the carbon concn. distribution is more than 0.35 mass%. The region with carbon concn. of more than 1.5 mass% is 1.0% or more at the area rate to all the texture.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
AKAMIZU HIROSHI	2005			JP 2005336526 A	CAPLUS
FUTAMURA YUICHI	2011			JP 2011157583 A	CAPLUS
MATSUDA HIROSHI	2010			JP 2010065273 A	CAPLUS
NOMURA MASAHIRO	2005			JP 2005179703 A	CAPLUS
OKAMOTO RIKI	2011			WO 2011093490 A1	CAPLUS
SPEER JOHN G	2006			US 20060011274 A1	CAPLUS

IT 1935673-79-2
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel plate for automobile body)
RN 1935673-79-2 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2,Si 0-2,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.1-0.4,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	92 - 98	7439-89-6
Mn	1 - 4	7439-96-5
Al	0 - 2	7429-90-5
Si	0 - 2	7440-21-3
B	0 - 1	7440-42-8
Cr	0 - 1	7440-47-3
Cu	0 - 1	7440-50-8
Mo	0 - 1	7439-98-7
Ni	0 - 1	7440-02-0
C	0.1 - 0.4	7440-44-0
Hf	0 - 0.2	7440-58-6
Nb	0 - 0.2	7440-03-1
Ti	0 - 0.2	7440-32-6
V	0 - 0.2	7440-62-2
Zr	0 - 0.2	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel plate strength ductility microstructure automobile body
IT Automobile bodies
Elongation, mechanical
Phase composition
Tensile strength
Yield strength
(high-strength high-ductility steel plate)
IT Microstructure
(high-strength high-ductility steel plate for automobile body)
IT 7440-44-0, Carbon, properties
RL: MOA (Modifier or additive use); PRP (Properties); USES (Uses)
(alloy element, high-strength high-ductility steel plate)
IT 1935673-79-2
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel plate for automobile body)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 99 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:871152 CAPLUS Full-text
DOCUMENT NUMBER: 165:46317
TITLE: High-strength high-ductility steel plate for automobile body
INVENTOR(S): Murakami, Toshio; Otani, Shigeo
PATENT ASSIGNEE(S): Kobe Steel, Ltd., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 16pp.; Chemical Indexing Equivalent to 165:46330 (WO)
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2016098427	A	20160530	JP 2014-238710	20141126
JP 6282577	B2	20180221		
WO 2016084847	A1	20160602	WO 2015-JP83078	20151125
KR 2017070230	A	20170621	KR 2017-7013590	20151125
KR 2111921	B1	20200518		
CN 107002192	A	20170801	CN 2015-80061877	20151125
CN 107002192	B	20190308		
EP 3225708	A1	20171004	EP 2015-862199	20151125
US 20170268077	A1	20170921	US 2017-15528675	20170522

PRIORITY APPLN. INFO.: JP 2014-238710 A 20141126
WO 2015-JP83078 W 20151125

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention provides a high-strength high-ductility steel plate excellent in strength-ductility balance which can secure tensile strength (TS) × elongation (EL) × elongation flange ability (λ) of more than 1000000MPa·%·%, and yield ratio (YR) of 0.7 or more. The high-strength high-ductility steel plate contains (by wt.%) C 0.10-0.35, Si+Al 0.5-2.0, Mn 1.0-4.0, P 0-0.05, S 0-0.01, and iron and inevitable impurities as balance. As for steel texture, retained austenite is 8% or more at the area rate with respect to all the texture, and the remainder consists of one or two of bainite, martensite, tempered bainite, and tempered martensite. As for the carbon concn. in the retained austenite, the mean carbon concn. is 0.9-1.2 mass%, and the std. deviation of the carbon concn. distribution is more than 0.35 mass%. The region with carbon concn. of more than 1.5 mass% is 1.0% or more at the area rate to all the texture.
IT 1935673-79-2
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel plate for automobile body)
RN 1935673-79-2 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2,Si 0-2,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.1-0.4,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	92	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.1	-	0.4	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel plate strength ductility microstructure automobile body
IT Automobile bodies
Elongation, mechanical
Phase composition
Tensile strength
Yield strength
(high-strength high-ductility steel plate)
IT Microstructure
(high-strength high-ductility steel plate for automobile body)
IT 7440-44-0, Carbon, properties
RL: MOA (Modifier or additive use); PRP (Properties); USES (Uses)
(alloy element, high-strength high-ductility steel plate)
IT 1935673-79-2
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high-strength high-ductility steel plate for automobile body)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L12 ANSWER 100 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:871099 CAPLUS Full-text

DOCUMENT NUMBER: 165:35141
TITLE: High strength high ductility steel plate for automobile body
INVENTOR(S): Murakami, Toshio; Otani, Shigeo
PATENT ASSIGNEE(S): Kobe Steel, Ltd., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 16pp.; Chemical Indexing Equivalent to 165:35129 (WO)
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2016098413	A	20160530	JP 2014-236928	20141121
JP 6282576	B2	20180221		
WO 2016080534	A1	20160526	WO 2015-JP82758	20151120
KR 2017070168	A	20170621	KR 2017-7013013	20151120
KR 2111923	B1	20200518		
CN 107109557	A	20170829	CN 2015-80061931	20151120
EP 3222741	A1	20170927	EP 2015-860677	20151120
US 20170335423	A1	20171123	US 2017-15527814	20170518

PRIORITY APPLN. INFO.: JP 2014-236928 A 20141121
WO 2015-JP82758 W 20151120
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB To provide a superior high strength and high ductility steel sheet strength over ductility balance, a tensile strength (TS) is above 980MPa, tensile strength (TS) × elongation (EL) can be kept more than 25000MPa·%. High strength and high ductility steel sheet component compn., in mass%, C: 0.10-0.30%, Si + Al: 0.5-2.0%, Mn: 1.0-4.0%, P: 0-0.05%, S: at 0-0.01 %, balance of iron and unavoidable impurities, steel organizations has the area ratio for the entire organization, residual austenite is 8% or more, ferrite is less than or equal to 5% greater than 50%, balance bainite, martensite, tempered bainite, and together consist of one or more tempered martensite it relates carbon concn. of the residual austenite, the av. carbon concn. is 0.8-1.1% by mass, the std. deviation of the carbon concn. distribution is 0.25 mass% or more, the carbon concn. for the entire organization is 1.3 mass% or more of the area, it is 1.0% or more in the area ratio.
IT 1933489-48-5
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high strength high ductility steel plate for automobile body)
RN 1933489-48-5 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2,Si 0-2,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.1-0.3,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	92	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.1	-	0.3	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [I]; C21D0001-19 [N]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C22C0038-58 [I]

CC 55-3 (Ferrous Metals and Alloys)
ST steel plate strength ductility microstructure automobile body
IT Automobile bodies
Elongation at break
Microstructure
Tensile strength
Yield strength
(high strength high ductility steel plate for automobile body)
IT 7440-44-0, Carbon, properties
RL: PRP (Properties)
(concn. distribution in steel; high strength high ductility steel plate for automobile body)
IT 1933489-48-5
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high strength high ductility steel plate for automobile body)
IT 12173-93-2, Martensite, processes 12244-31-4, Austenite, processes 12427-23-5, Bainite
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(phase; high strength high ductility steel plate for automobile body)

L12 ANSWER 101 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:848429 CAPLUS Full-text
DOCUMENT NUMBER: 165:35129
TITLE: High strength high ductility steel plate for automobile body
INVENTOR(S): Murakami, Toshio; Otani, Shigeo
PATENT ASSIGNEE(S): Kabushiki Kaisha Kobe Seiko Sho (Kobe Steel, Ltd.), Japan
SOURCE: PCT Int. Appl., 27pp.; Chemical Indexing Equivalent to 165:35141 (JP)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016080534	A1	20160526	WO 2015-JP82758	20151120
JP 2016098413	A	20160530	JP 2014-236928	20141121
JP 6282576	B2	20180221		
KR 2017070168	A	20170621	KR 2017-7013013	20151120
KR 2111923	B1	20200518		
CN 107109557	A	20170829	CN 2015-80061931	20151120
EP 3222741	A1	20170927	EP 2015-860677	20151120
US 20170335423	A1	20171123	US 2017-15527814	20170518

PRIORITY APPLN. INFO.: JP 2014-236928 A 20141121
WO 2015-JP82758 W 20151120
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB In the present invention, a steel plate contains specific alloy components, has a steel structure that contains specific proportions of retained austenite and ferrite, with the remainder comprising one or more types selected from among bainite, martensite, tempered bainite and tempered martensite, and has a specific av. carbon concn. and carbon concn. distribution in the retained austenite. The steel plate is composed of a mass percentage of carbon 0.10 to 0.30, silicon and aluminum 0.5 to 2.0, manganese 1.0-4.0, phosphorus 0.0 to 0.5, sulfur 0.0 to 0.1, and the balance iron and unavoidable impurities.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ENNIS BERNARD LEO	2014			WO 2014139625 A1	CAPLUS
KOBE STEEL LTD	2012			JP 2012180570 A	CAPLUS
KOBE STEEL LTD	2012			JP 2012214869 A	CAPLUS
NIPPON STEEL CORP	2012			JP 2012041573 A	CAPLUS
NIPPON STEEL & SUMITOMO	2013			JP 2013032581 A	CAPLUS

OKAMOTO TSUTOMU |2011 | | |JP 2011195956 A |CAPLUS
IT 1933489-48-5
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high strength high ductility steel plate for automobile body)
RN 1933489-48-5 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-4,Al 0-2,Si 0-2,B 0-1,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,C 0.1-0.3,Hf 0-0.2,Nb 0-0.2,Ti 0-0.2,V 0-0.2,Zr 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	92	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Al	0	-	2	7429-90-5
Si	0	-	2	7440-21-3
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
C	0.1	-	0.3	7440-44-0
Hf	0	-	0.2	7440-58-6
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Zr	0	-	0.2	7440-67-7

IPCI C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C22C0038-58 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C22C0038-58 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel plate strength ductility microstructure automobile body
IT Automobile bodies
Elongation at break
Microstructure
Tensile strength
Yield strength
(high strength high ductility steel plate for automobile body)
IT 7440-44-0, Carbon, properties
RL: PRP (Properties)
(concn. distribution in steel; high strength high ductility steel plate for automobile body)
IT 1933489-48-5
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(high strength high ductility steel plate for automobile body)
IT 12173-93-2, Martensite, processes 12244-31-4, Austenite, processes 12427-23-5, Bainite
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(phase; high strength high ductility steel plate for automobile body)

L12 ANSWER 102 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:387717 CAPLUS Full-text
DOCUMENT NUMBER: 164:385854
TITLE: Manufacture method of high-strength high-toughness alloy steel
INVENTOR(S): Tao, Jun; Dong, Banglin; Sheng, Xiang
PATENT ASSIGNEE(S): Anhui Chujiang Special Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 8pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 105385939	A	20160309	CN 2015-10928577	20151215

PRIORITY APPLN. INFO.: CN 2015-10928577 20151215

AB The chem. compn. of the alloy steel contains carbon 0.3-0.58, silicon 0.25-1.38, manganese 0.55-1.55, phosphorus ≤0.025%, sulfur 0.02-0.025, chromium 0.09-1.32, nickel 0.28-0.62, molybdenum 0.02-0.035, titanium 0.18-0.20, vanadium 0.2-0.5, tungsten 0.4-0.9, niobium 0.3-0.6, cobalt 0.11-0.15, copper 0.2-0.8, aluminum ≤0.2, boron ≤0.15%, nitrogen ≤0.3% and inevitable impurities bal. The manuf. method comprises the steps of (1) smelting raw materials in smelting furnace to obtain alloy steel billet, (2) annealing the alloy steel billet, then forging to obtain alloy steel crude product, (3) carrying out heat treatment on the alloy steel crude product, then carrying out primary hot-rolling and fine hot-rolling operations in sequence to obtain alloy steel finished product, and (4) carrying out annealing heat treatment on the alloy steel finished product, cooling to room temp., inspecting and packaging. The alloy steel has low cost, high tensile strength, yield strength and hardness, good uniformity of structure and uniformity of mech. properties, and broad application prospects.

IT 1884454-35-6P, Aluminum 0-0.2, boron 0-0.2, carbon 0.3-0.6, chromium 0.1-1.32, cobalt 0.1-0.2, copper 0.2-0.8, manganese 0.55-1.55, nickel 0.28-0.62, niobium 0.3-0.6, nitrogen 0-0.3, silicon 0.25-1.38, titanium 0.2, tungsten 0.4-0.9, vanadium 0.2-0.5, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(manuf. method of alloy steel having high strength and toughness)

RN 1884454-35-6 CAPLUS

CN Iron alloy, base, Fe 91-97,Mn 0.6-1.6,Si 0.2-1.4,Cr 0.1-1.3,W 0.4-0.9,Cu 0.2-0.8,C 0.3-0.6,Nb 0.3-0.6,Ni 0.3-0.6,V 0.2-0.5,N 0-0.3,Ti 0.2,Co 0.1-0.2,Al 0-0.2,B 0-0.2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	91 - 97	7439-89-6
Mn	0.6 - 1.6	7439-96-5
Si	0.2 - 1.4	7440-21-3
Cr	0.1 - 1.3	7440-47-3
W	0.4 - 0.9	7440-33-7
Cu	0.2 - 0.8	7440-50-8
C	0.3 - 0.6	7440-44-0
Nb	0.3 - 0.6	7440-03-1
Ni	0.3 - 0.6	7440-02-0
V	0.2 - 0.5	7440-62-2
N	0 - 0.3	17778-88-0
Ti	0.2	7440-32-6
Co	0.1 - 0.2	7440-48-4
Al	0 - 0.2	7429-90-5
B	0 - 0.2	7440-42-8

IPCI C22C0038-02; C22C0038-04; C22C0038-12; C22C0038-14; C22C0038-16; C22C0038-18; C22C0038-08; C22C0033-04; C21D0008-02; C21D0001-26

IPCR C22C0038-02 [I]; C21D0001-26 [I]; C21D0008-02 [I]; C22C0033-04 [I]; C22C0038-04 [I]; C22C0038-08 [I]; C22C0038-12 [I]; C22C0038-14 [I]; C22C0038-16 [I]; C22C0038-18 [I]

CC 55-1 (Ferrous Metals and Alloys)

ST alloy steel smelting forging rolling heat treatment strength toughness

IT Annealing
Forging
Hot rolling
Industrial manufacturing
Smelting
(manuf. method of alloy steel having high strength and toughness)

IT 1884454-35-6P, Aluminum 0-0.2, boron 0-0.2, carbon 0.3-0.6, chromium 0.1-1.32, cobalt 0.1-0.2, copper 0.2-0.8, manganese 0.55-1.55, nickel 0.28-0.62, niobium 0.3-0.6, nitrogen 0-0.3, silicon 0.25-1.38, titanium 0.2, tungsten 0.4-0.9, vanadium 0.2-0.5, iron bal.

RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(manuf. method of alloy steel having high strength and toughness)

L12 ANSWER 103 OF 398 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2015:1942164 CAPLUS Full-text
DOCUMENT NUMBER: 164:40753
TITLE: Steel sheet provided with a sacrificial cathodically protected coating comprising lanthanum
INVENTOR(S): Allely, Christian; Petitjean, Jacques
PATENT ASSIGNEE(S): ArcelorMittal Investigacion y Desarrollo, S.L., Spain
SOURCE: PCT Int. Appl., 20pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2015181581	A1	20151203	WO 2014-IB61788	20140528
CA 2950476	A1	20151203	CA 2015-2950476	20150528
WO 2015181318	A1	20151203	WO 2015-EP61891	20150528
KR 2017010773	A	20170201	KR 2016-7032934	20150528
CN 106460138	A	20170222	CN 2015-80027730	20150528
EP 3149217	A1	20170405	EP 2015-724718	20150528
EP 3149217	B1	20180711		
JP 2017524806	T	20170831	JP 2016-569819	20150528
JP 6762879	B2	20200930		
ES 2689039	T3	20181108	ES 2015-724718	20150528
RU 2689979	C2	20190530	RU 2016-146657	20150528
ZA 2016007435	A	20171220	ZA 2016-7435	20161027
IN 201617039713	A	20170310	IN 2016-17039713	20161121
IN 343260	B	20200804		
MX 2016015550	A	20170425	MX 2016-15550	20161125
US 20170198374	A1	20170713	US 2016-15314457	20161128
US 10676804	B2	20200609		

PRIORITY APPLN. INFO.: WO 2014-IB61788 A 20140528
WO 2015-EP61891 W 20150528
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention relates to a steel sheet provided with a sacrificial cathodically protected coating comprising between 1 and 40 % by wt. zinc, between 0.01 and 0.4 % by wt. lanthanum, and optionally up to 10 % by wt. magnesium, optionally up to 15 % by wt. silicon, and optionally up to 0.3 % by wt., in cumulative amts., of addnl. components, the remainder consisting of aluminum and unavoidable impurities or residual elements. The invention also relates to a method of producing parts by hot or cold swaging and the parts which can be obtained in this way.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
LIXIN FENG	2010			CN 101736217 A	CAPLUS
MORIMOTO YASUHIDE	2009			JP 2009120942 A	CAPLUS
NOSE KOICHI	2008			EP 1997927 A1	CAPLUS
ZHAO YUNJIE	2013			CN 103045980 A	CAPLUS

IT 1173986-65-6
RL: NUU (Other use, unclassified); USES (Uses)
(steel sheet provided with sacrificial cathodically protected coating comprising lanthanum)
RN 1173986-65-6 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3

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    C       0.2 -   0.5      7440-44-0
    Si      0.1 -   0.5      7440-21-3
    Ti      0   -   0.2      7440-32-6
    Al      0   -   0.1      7429-90-5
    B       0   -   0.1      7440-42-8
    Cu      0   -   0.1      7440-50-8
    Ni      0   -   0.1      7440-02-0
    P       0   -   0.1      7723-14-0

IPCI C23C0002-12 [I]; C22C0021-10 [I]
IPCR C23C0002-12 [I]; C22C0021-10 [I]
CC   56-3 (Nonferrous Metals and Alloys)
ST   steel sheet sacrificial cathodically protected coating lanthanum swaging
IT   Anticorrosive coating materials
     Coating process
     Swaging
        (steel sheet provided with sacrificial cathodically protected
        coating comprising lanthanum)
IT   7439-91-0, Lanthanum, uses
     RL: MOA (Modifier or additive use); USES (Uses)
        (steel sheet provided with sacrificial cathodically protected
        coating comprising lanthanum)
IT   12597-69-2, Steel, uses   1173986-65-6
     RL: NUU (Other use, unclassified); USES (Uses)
        (steel sheet provided with sacrificial cathodically protected
        coating comprising lanthanum)
IT   1832643-11-4
     RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
     (Technical or engineered material use); PROC (Process); USES (Uses)
        (steel sheet provided with sacrificial cathodically protected
        coating comprising lanthanum)



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L13  ANSWER 1 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2020:2713368  CAPLUS Full-text
DOCUMENT NUMBER:         174:278826
TITLE:                   Steel sheet comprising carbon, silicon and titanium
                         with high strength and excellent collision resistance
INVENTOR(S):             Nakano, Katsuya; Takeda, Kengo; Kawata, Hiroyuki;
                         Uenishi, Akihiro; Suzuki, Yuya
PATENT ASSIGNEE(S):      Nippon Steel Corporation, Japan
SOURCE:                  PCT Int. Appl., 58pp.
                         CODEN: PIXXD2
DOCUMENT TYPE:           Patent
LANGUAGE:                Japanese
FAMILY ACC. NUM. COUNT:  1
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     WO 2020262651        A1   20201230    WO 2020-JP25352          20200626
PRIORITY APPLN. INFO.:                     JP 2019-121092       A   20190628
                                           JP 2019-121093       A   20190628
AB   A steel sheet which has a metal structure that contains, in terms of
     vol. fraction, 95% or more of tempered martensite and a total of 5% or
     less of one or more structures selected from among ferrite, pearlite,
     bainite, as-quenched martensite and residual austenite.  This steel
     sheet has a tensile strength of 1,100 MPa or more; the std. deviation of
     the Vickers hardness is 30 or less as measured under a load of 9.8 N at 30
     points in a 300μm square area that is centered at the position of t/2,
     where t is the sheet thickness, in a cross-section of the steel sheet
     10, said cross-section being parallel to the sheet thickness direction;
     and if nanohardness is measured under a max. load of 1 mN at 100 points in
     a 100μm square area that is centered at the position of t/2, the ratio
     of the measurement points that have a nanohardness difference of 3 GPa or
     more from 8 adjacent measurement points is 10% or less.
IT   2572991-88-7
     RL: PRP (Properties); TEM (Technical or engineered material use); USES
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(Uses)
(steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
RN 2572991-88-7 CAPLUS
CN Iron alloy, base, Fe 85-99,Mn 0.6-5,Si 0-2.5,Cr 0-2,Al 0-1,Co 0-1,Ni 0-1,Cu 0-0.5,Mo 0-0.5,V 0-0.5,C 0.2-0.4,B 0-0.1,Nb 0-0.1,Ta 0-0.1,Ti 0-0.1,W 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	85	-	99	7439-89-6
Mn	0.6	-	5	7439-96-5
Si	0	-	2.5	7440-21-3
Cr	0	-	2	7440-47-3
Al	0	-	1	7429-90-5
Co	0	-	1	7440-48-4
Ni	0	-	1	7440-02-0
Cu	0	-	0.5	7440-50-8
Mo	0	-	0.5	7439-98-7
V	0	-	0.5	7440-62-2
C	0.2	-	0.4	7440-44-0
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
Ta	0	-	0.1	7440-25-7
Ti	0	-	0.1	7440-32-6
W	0	-	0.1	7440-33-7

IPCI C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-60 [I]
IPCR C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-60 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST carbon silicon titanium steel sheet
IT Galvanizing
(electrogalvanizing, layer; steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT Hot-dip galvanizing
(layer; steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT Collisions
(resistance; steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT Microhardness
Tensile strength
Vickers hardness
(steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT 12597-69-2, Steel, properties
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(sheet; steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)
IT 2572991-88-7
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(steel sheet comprising carbon, silicon and titanium with high strength and excellent collision resistance)

L13 ANSWER 2 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:2054532 CAPLUS Full-text
DOCUMENT NUMBER: 173:899795
TITLE: Strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets
AUTHOR(S): Jo, Min Cheol; Jo, Min Chul; Yoo, Jisung; Song, Taejin; Kim, Sang-Heon; Sohn, Seok Su; Lee, Sunghak
CORPORATE SOURCE: Center for Advanced Aerospace Materials, Pohang University of Science and Technology, Pohang, 37673, S. Korea
SOURCE: Materials Science & Engineering, A: Structural Materials: Properties, Microstructure and Processing

(2021), 800, 140319
CODEN: MSAPE3; ISSN: 0921-5093
DIGITAL OBJECT ID: 10.1016/j.msea.2020.140319
PUBLISHER: Elsevier B.V.
DOCUMENT TYPE: Journal; (online computer file)
LANGUAGE: English

AB Layered architectures have been applied to twinning-induced plasticity (TWIP) steel in terms of configuring multi-layered TWIP and martensitic steel (MLS) sheets to overcome the limitation of low yield strength. However, hydrogen embrittlement (HE) inevitably appears in materials used for high-strength purposes, with the interfacial layers presenting localization sites of hydrogen, thereby limiting the materials' broad structural applications. Here, we present a novel design for MLS sheets that exhibit both strong resistance to HE and a good strength-ductility balance via surface shielding. Our hydrogen penetration data demonstrates that the proposed austenitic shielding structure effectively acts as a barrier to hydrogen due to the reduced hydrogen diffusivity, compared with existing MLS sheets. We propose the optimal surface thickness required to play the role of shielding layer based on the quantified diffusivity and the rule of mixts. of the layer fractions, which presents a plausible novel design for layered architectures that exhibit strong resistance to HE and possess tunable mech. properties.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1991		261	Electron Probe Quant	
Anon	2004			ISO 17081 Method of	
Ashby, M	2003	51	5801	Acta Mater	CAPLUS
Ashby, M	2013	68	4	Scripta Mater	CAPLUS
Barabash, R	2014	45	98	Metall Mater Trans	CAPLUS
Beachem, C	1972	3	441	Metall Mater Trans B	
Bouaziz, O	2008	10	24	Adv Eng Mater	CAPLUS
Bouaziz, O	2016	18	56	Adv Eng Mater	CAPLUS
Cetin, A	2012	60	2265	Acta Mater	CAPLUS
Chin, K	2018	24	489	Met Mater Int	CAPLUS
Cho, L	2018	734	416	Mater Sci Eng, A	CAPLUS
Cho, L	2018	735	448	Mater Sci Eng, A	CAPLUS
De Cooman, B	2011			New Trends and Devel	
Devanathan, M	1962	270	90	Proc R Soc A	CAPLUS
Dunne, D	2012	706	1568	Mater Sci Forum	
Dwivedi, S	2018	43	21603	Int J Hydrogen Energ	CAPLUS
Enomoto, M	2012	43	572	Metall Mater Trans	CAPLUS
Fang, T	2011	331	1587	Science	CAPLUS
Grassel, O	2000	16	1391	Int J Plast	CAPLUS
Gutierrez-Urrutia, I	2010	527	3552	Mater Sci Eng, A	
Gwon, H	2017	696	416	Mater Sci Eng, A	CAPLUS
Han, D	2015	99	45	Scripta Mater	CAPLUS
He, J	2018	726	288	Mater Sci Eng, A	CAPLUS
Huang, M	2018	153	235	Acta Mater	CAPLUS
Ichimura, M	1991	32	1109	Mater Trans, JIM	CAPLUS
Inoue, J	2008	59	1055	Scripta Mater	CAPLUS
Jin, J	2012	60	1680	Acta Mater	CAPLUS
Jo, M	2019	50	4085	Metall Mater Trans	CAPLUS
Jo, S	2015	627	374	J Alloys Compd	CAPLUS
Kim, J	2018	147	304	Acta Mater	CAPLUS
Kim, J	2009	505	105	Mater Sci Eng, A	
Kim, J	2017	682	164	Mater Sci Eng, A	CAPLUS
Kim, J	2019	25	912	Met Mater Int	CAPLUS
Kim, J	2019	9	6829	Sci Rep	
Koseki, T	2014	55	227	Mater Trans	CAPLUS
Koyama, M	2013	61	4607	Acta Mater	CAPLUS
Koyama, M	2017	355	1055	Science	CAPLUS
Kubin, L	2003	48	119	Scripta Mater	CAPLUS
Kwon, Y	2018	43	10129	Int J Hydrogen Energ	CAPLUS
Lee, J	2019	9	5219	Sci Rep	
Li, Y	2013	61	2588	J Mech Phys Solid	CAPLUS
Mohtadi-Bonab, M	2019	25	1109	Met Mater Int	CAPLUS
Oh, S	2020	188	366	Acta Mater	CAPLUS
Park, C	2019	25	584	Met Mater Int	CAPLUS
Park, I	2015	93	63	Corrosion Sci	CAPLUS
Park, J	2017	686	160	Mater Sci Eng, A	CAPLUS

Park, J	2019	759	320	Mater Sci Eng, A	CAPLUS
Ritchie, R	2011	10	817	Nat Mater	CAPLUS
Seok, M	2016	121	164	Acta Mater	CAPLUS
Song, E	2014	87	9	Scripta Mater	CAPLUS
Takai, K	2003	43	520	ISIJ Int	CAPLUS
Wang, M	2005	398	37	Mater Sci Eng, A	
Wang, Y	2002	419	912	Nature	CAPLUS
Wang, Y	2018	150	22	Scripta Mater	CAPLUS
Wei, Y	2014	5	3580	Nat Commun	
Wu, X	2014	2	185	Mater Res Lett	CAPLUS
Yanagimoto, J	2010	59	287	CIRP Ann - Manuf Tec	
Yokota, T	2003	43	534	ISIJ Int	CAPLUS
Yu, W	2018	727	70	Mater Sci Eng, A	CAPLUS
Zhang, Y	2019	165	15	Scripta Mater	CAPLUS

IT 2522569-69-1, C 0.35, Mn 1.3, Si 0.15, Mo 0.1, Cr 0.2, Ti 0-0.06, B 0-0.06, Fe bal., processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

RN 2522569-69-1 CAPLUS

CN Steel, Fe 98,Mn 1.3,C 0.4,Cr 0.2,Si 0.2,Mo 0.1,B 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	98			7439-89-6
Mn	1.3			7439-96-5
C	0.4			7440-44-0
Cr	0.2			7440-47-3
Si	0.2			7440-21-3
Mo	0.1			7439-98-7
B	0	-	0.1	7440-42-8
Ti	0	-	0.1	7440-32-6

CC 55-8 (Ferrous Metals and Alloys)

ST TWIP steel multilayer austenite martensite shielding hydrogen embrittlement resistance

IT Diffusion
Elongation, mechanical
Fracture surface morphology
Hydrogen embrittlement
Interface
Microstructure
Multilayers
Sheet materials
Shields
Stress-strain relationship
Tensile strength
Yield strength
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

IT 1333-74-0, Hydrogen, processes
RL: OCU (Occurrence, unclassified); PEP (Physical, engineering or chemical process); OCCU (Occurrence); PROC (Process)
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

IT 12173-93-2, Martensite, processes 12244-31-4, Austenite, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

IT 2362540-95-0, C 1.2, Mn 13, Si 0.2, Fe bal. 2522569-69-1, C 0.35, Mn 1.3, Si 0.15, Mo 0.1, Cr 0.2, Ti 0-0.06, B 0-0.06, Fe bal., processes 2522569-74-8, C 0.7, Mn 17, Si 0.6, V 0.3, Al 1.3, Fe bal.
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(strong resistance to hydrogen embrittlement via surface shielding in multi-layered austenite/martensite steel sheets)

L13 ANSWER 3 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1569923 CAPLUS Full-text
DOCUMENT NUMBER: 173:359646
TITLE: Al-Fe-based plated steel sheet for hot press, and method for manufacturing hot press member
INVENTOR(S): Sato, Rinta; Nakajima, Seiji; Ando, Satoru
PATENT ASSIGNEE(S): JFE Steel Corp., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 15pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2020122202	A	20200813	JP 2019-16283	20190131

PRIORITY APPLN. INFO.: JP 2019-16283 20190131

AB The title Al-Fe-based plated steel sheet can obtain a hot press member having excellent corrosion resistance after coating and excellent corrosion resistance at the joint portion while realizing a high temp. rising rate when subjected to heating by a furnace heating method performed before hot pressing. The Al-Fe-based plated steel sheet for hot press comprises a base steel sheet, an Al-Fe alloy plated layer formed on at least one surface of the base steel sheet with an adhesion amt. per one surface of 30-100 g/m2, having a compn. including Fe 25-90% by mass, Si 0-1% by mass and Al and unavoidable impurities as balance, and unalloyed Al attached to the surface of the Al-Fe alloy plated layer with an adhesion amt. per one surface of 0-90 mg/m2.

IT 1356847-15-8
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Al-Fe-based plated steel sheet for hot press, and method for manufg. hot press member)

RN 1356847-15-8 CAPLUS
CN Iron alloy, base, Fe 93-99,Mn 0.5-3,Si 0-2,Cr 0-1,C 0.2-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	93	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Si	0	-	2	7440-21-3
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C23C0002-12 [I]; C23C0002-28 [I]; C22C0021-00 [I]; C22C0038-00 [I]; C22C0021-02 [I]; C22C0038-60 [I]; C21D0009-00 [I]; C21D0001-18 [I]
IPCR C23C0002-12 [I]; C21D0001-18 [I]; C21D0009-00 [I]; C22C0021-00 [I]; C22C0021-02 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C23C0002-28 [I]
CC 56-11 (Nonferrous Metals and Alloys)
ST aluminum iron plating steel sheet hot press
IT Heating
Hot-press molding
(Al-Fe-based plated steel sheet for hot press, and method for manufg. hot press member)
IT 7429-90-5, Aluminum, processes 1356847-15-8 2460706-65-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Al-Fe-based plated steel sheet for hot press, and method for manufg. hot press member)

L13 ANSWER 4 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1063971 CAPLUS Full-text
DOCUMENT NUMBER: 173:85787
TITLE: Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its

manufacturing method
INVENTOR(S): Bi, Wenzhen; Hong, Jiyao; Wang, Li
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: PCT Int. Appl., 23pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020108594	A1	20200604	WO 2019-CN121860	20191129
CN 109371325	A	20190222	CN 2018-11454798	20181130

PRIORITY APPLN. INFO.: CN 2018-11454798 A 20181130

AB Provided are a zinc-based plated hot-formed steel plate or steel strip having excellent cold bending performance, and a manufg. method thereof; said zinc-based plated hot-formed steel plate or steel strip comprises a substrate having a surface decarburized layer thickness of less than 20 um and a zinc-based plated layer having an adhesion amt. of 10 to 100 g/m.cxa. 2; the component wt. percentages of the substrate are: C: 0.1-0.8%, Si: 0.05-2.0%, Mn: 0.5-3.0%, P≤0.1%, S≤0.05%, Al≤0.1%, N≤0.01%; the remainder is Fe and unavoidable impurities; the av. size of original austenite grains of the substrate is less than 15 um. After hot forming of the substrate, the hot-formed steel plate or steel strip has a tensile strength of 1500 MPa and elongation after fracture of 5%, and the coating is continuous and complete, there are no cracks extending to the substrate, and the steel plate has excellent cold bending performance.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
AZUMA MASASHI	2011			JP 2011111675 A	CAPLUS
BI WENZHEN	2017			CN 107127238 A	CAPLUS
BI WENZHEN	2019			CN 109371325 A	CAPLUS
JIN KWANG-KEUN	1996			KR 960005237 B1	
KAWATA HIROYUKI	2014			CN 103874776 A	CAPLUS
TAKEDA GENTARO	2018			WO 2018207560 A1	CAPLUS
TANAKA YUKIMOTO	2012			JP 2012251229 A	CAPLUS
YUANQIANG TU	2010			CN 101880832 A	CAPLUS
ZHOU SHU	2016			CN 106244923 A	CAPLUS
ZHOU SHU	2016			CN 106244923 A	CAPLUS

IT 2293976-55-1D, Aluminum 0-0.1, carbon 0.1-0.8, manganese 0.5-3, phosphorus 0-0.1, silicon 0.05-2, Cr 0-1, Mo 0-1, Ti 0-0.2, Nb 0-0.08, V 0-1, B 0-0.08, iron bal., nitrogen 0-0.01
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)

RN 2293976-55-1 CAPLUS
CN Iron alloy, base, Fe 91-99,Mn 0.5-3,Si 0-2,Cr 0-1,Mo 0-1,V 0-1,C 0.1-0.8,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Si	0	-	2	7440-21-3
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
V	0	-	1	7440-62-2
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0

IPCI C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-60 [I]; C22C0038-06 [I]; C23C0002-40 [I]; C21D0008-02 [I]
IPCR C22C0038-02 [I]; C21D0008-02 [I]; C22C0038-04 [I]; C22C0038-06 [I];

C22C0038-60 [I]; C23C0002-40 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST cold bending performance zinc coating steel manuf hot stamping
IT Coating materials
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
IT Galvanized steel
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
IT Metalworking
(stamping, hot; Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
IT 2293976-55-1D, Aluminum 0-0.1, carbon 0.1-0.8, manganese 0.5-3, phosphorus 0-0.1, silicon 0.05-2, Cr 0-1, Mo 0-1, Ti 0-0.2, Nb 0-0.08, V 0-1, B 0-0.08, iron bal., nitrogen 0-0.01
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)
IT 7440-66-6, Zinc, processes 98357-26-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Zinc-coated hot-stamped steel plate or strip with excellent cold bending performance and its manufg. method)

L13 ANSWER 5 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1063958 CAPLUS Full-text
DOCUMENT NUMBER: 173:85818
TITLE: Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance
INVENTOR(S): Bi, Wenzhen; Hong, Jiyao; Wang, Li
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: PCT Int. Appl., 17pp.; Chemical Indexing Equivalent to 170:379972 (CN)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020108593	A1	20200604	WO 2019-CN121859	20191129
CN 109365606	A	20190222	CN 2018-11453322	20181130
PRIORITY APPLN. INFO.:			CN 2018-11453322 A	20181130

AB A method for forming a zinc-plated steel plate or steel belt having good corrosion resistance, comprising the following steps: 1) conveying the steel plate or steel belt into a heating furnace higher than Ac3, austenitizing the steel plate or steel belt, and keeping the temp. for 1-7 min; 2) before the steel plate or steel belt leaves the heating furnace and enters a forming mold, applying different cooling manners according to different plated thicknesses, wherein when the single-sided wt. of the plating is less than or equal to 50g/m2, only air cooling is required before transferring to the forming mold, when the single-sided wt. of the plating is greater than 50g/m2, aerial fog or water mist precooling is performed before transferring to the forming mold, and the steel plate is cooled to be below 700°C at a cooling sped greater than 30°C/s; and 3) rapidly transferring the steel plate or steel belt to the mold for hot stamping forming, wherein a transferring duration does not exceed 1 min, and the temp. of the hot stamping forming is controlled between 400-800°C. The tensile strength of the steel plate or steel belt after hot stamping is greater than 1,450 MPa, and substrate cracks caused by local press and LME in an element are avoided.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File

AKIRA OBAYASHI |2005 | | |CN 1600877 A |CAPLUS
BI WENZHEN |2017 | | |CN 107127238 A |CAPLUS
BI WENZHEN |2017 | | |CN 107127238 A |CAPLUS
BI WENZHEN |2019 | | |CN 109365606 A |CAPLUS
KOJIMA TAKESHI |2017 | | |CN 106756697 A |CAPLUS
SEKIDO YOSHITO |2013 | | |JP 2013227614 A |CAPLUS
TAKEBAYASHI SHIGETO |2009 | | |JP 2009228134 A |CAPLUS
WILHELM WARNECKE |2010 | | |CN 101849029 A |CAPLUS
YI HONGLIANG |2015 | | |CN 104846274 A |CAPLUS

IT 2293976-55-1
RL: MSC (Miscellaneous); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)

RN 2293976-55-1 CAPLUS

CN Iron alloy, base, Fe 91-99,Mn 0.5-3,Si 0-2,Cr 0-1,Mo 0-1,V 0-1,C 0.1-0.8,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Si	0	-	2	7440-21-3
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
V	0	-	1	7440-62-2
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0

IPCI B21D0022-02 [I]; C23C0002-06 [I]; C23C0002-40 [I]; C22C0018-00 [I]; C21D0008-02 [I]
IPCR B21D0022-02 [I]; C21D0008-02 [I]; C22C0018-00 [I]; C23C0002-06 [I]; C23C0002-40 [I]
CC 55-6 (Ferrous Metals and Alloys)
ST corrosion resistance zinc alloy coating steel hot stamping
IT Anticorrosive coating materials
Coating materials
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT Metalworking
(stamping, hot; Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT 2293976-55-1
RL: MSC (Miscellaneous); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT 2226545-76-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)

L13 ANSWER 6 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:1041904 CAPLUS Full-text
DOCUMENT NUMBER: 173:612711
TITLE: Aluminum or aluminum alloy plated steel differential strength welded part and its manufacture
INVENTOR(S): Pan, Hua; Liu, Chengjie; Lei, Ming; Wu, Yue; Sun, Zhongqu; Jiang, Haomin
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 12pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese

FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 111215751	A	20200602	CN 2019-10249188	20190329
WO 2020200110	A1	20201008	WO 2020-CN81743	20200327

PRIORITY APPLN. INFO.: CN 2019-10249188 A 20190329

AB The invention discloses a steel differential strength welding part with an aluminum or aluminum alloy coating and a manufg. method thereof, wherein the steel differential strength welding part is formed by butt welding a high-strength steel plate and a low-strength steel plate, and the high-strength steel plate and the low-strength steel plate comprise a substrate and at least one of the surfaces of the substrate and the substrate is a pure aluminum or aluminum alloy coating; the high-strength steel plate matrix comprises the following components in percentage by wt.: c 0.08-0.8%, Si 0.05-1.0%, Mn 0.1-5%, P <0.3%, S <0.1%, Al <0.3%, Ti <0.5%, B 0.0005-0.1%, Cr 0.01-3%, residual Fe and inevitable impurities; the low-strength steel plate matrix comprises the following components in percentage by wt.: c 0.03-0.1%, Si 0-0.1%, Mn 1.0-2.0%, P <0.1%, S <0.05%, Al <0.1%, Cr 0-0.1%, Ti 0-0.05%, balance of Fe and inevitable impurities. The tensile strength of the welded part after hot stamping is greater than that of a low-strength steel base metal, the elongation is greater than 4%, and the application requirements of the welded part in the field of automobile hot stamping are met.

IT 2067242-22-0, C 0.08-0.8, Si 0.05-1, Mn 0.1-5, P 0-0.3, S 0-0.1, Al 0-0.3, Ti 0-0.5, B 0.0005-0.1, Cr 0.01-3, Fe bal.
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)

RN 2067242-22-0 CAPLUS

CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1	7440-21-3
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B23K0026-26; B23K0026-322; B23K0026-12; C22C0038-38; C22C0038-32; C22C0038-28; C22C0038-06; C22C0038-04; C22C0038-02
IPCR B23K0026-26 [I]; B23K0026-12 [I]; B23K0026-322 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-28 [I]; C22C0038-32 [I]; C22C0038-38 [I]
CC 55-9 (Ferrous Metals and Alloys)
ST r aluminum alloy plated steel differential strength welded part
IT Laser welding
Plating process
Tensile strength
Welds
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)
IT Welding of metals
(gas metal-arc welding; aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)
IT 2067242-22-0, C 0.08-0.8, Si 0.05-1, Mn 0.1-5, P 0-0.3, S 0-0.1, Al 0-0.3, Ti 0-0.5, B 0.0005-0.1, Cr 0.01-3, Fe bal. 2490151-15-8, C 0.03-0.1, Si 0-0.1, Mn 0.5-2, Al 0-0.1, Cr 0-0.1, Fe bal., processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)
IT 2490151-16-9, C 0.1-0.25, Si 0.2-0.4, Mn 1.2-2, Al 0-0.06, Ti 0.02-0.08,

Cr 0.05-0.2, Fe bal., processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)
IT 7429-90-5, Aluminum, uses 1273096-81-3, Aluminum alloy
RL: TEM (Technical or engineered material use); USES (Uses)
(aluminum or aluminum alloy plated steel differential strength welded part and its manuf.)

L13 ANSWER 7 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:185423 CAPLUS Full-text
DOCUMENT NUMBER: 172:169762
TITLE: Manufacture of hardened steel products with aluminum-based coatings
INVENTOR(S): Pohl, Stefan; Danger, Elisabeth; Labudde, Thorsten; Butzkamm, Juergen
PATENT ASSIGNEE(S): Muhr und Bender KG, Germany
SOURCE: PCT Int. Appl., 29pp.; Chemical Indexing Equivalent to 172:169761 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2020020644	A1	20200130	WO 2019-EP68581	20190710
DE 102018118015	A1	20200130	DE 2018-102018118015	20180725

PRIORITY APPLN. INFO.: DE 2018-102018118015 A 20180725
AB A method for producing a hardened steel product, comprises: providing a steel substrate made of a hardenable steel; coating the steel substrate with an aluminum pre-coating, the pre-coating being applied to the steel substrate with a thickness of at least 34μm; flexibly rolling the pre-coated steel substrate in order to produce a variable thickness over the length of the pre-coated steel substrate, the pre-coating being rolled out to a reduced first thickness of less than 33μm in thinner first portions and to a reduced second thickness, which is thicker than the reduced first thickness, in thicker second portions; creating a blank from the flexibly rolled steel substrate; heating the blank to the austenitization temp., diffusion processes between the base material and the pre-coating occurring; and hot-forming the heated blank, the heated blank being formed and being quickly cooled in such a way that a hardened steel product having a coating is produced.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
BATISTA LEONARDO MESQUI	2019			EP 3489386 A1	CAPLUS
Hauger, A	1995	23	40	Fertigung	
KIM HEUNG-YUN	2018			US 20180142337 A1	
MACHADO AMORIM	2017			WO 2017017521 A1	CAPLUS
SCHNEIDER DR CHRISTOPH	2017			EP 3181248 A1	
TANAHASHI HIROYUKI	2014			US 20140044987 A1	
WINKLHOFER KERRY	2008			DE 102007019196 A1	CAPLUS
Windmann, M	2014	246	17	Surface And Coatings	CAPLUS

IT 2408930-78-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrates; manuf. of hardened steel products with aluminum-based coatings)
RN 2408930-78-7 CAPLUS
CN Iron alloy, base, Fe 91-99,Mn 0.5-5,Cr 0-1,Mo 0-1,Si 0.1-0.9,C 0.2-0.5,Ti 0-0.2,V 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Nb 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	91 - 99	7439-89-6
Mn	0.5 - 5	7439-96-5

Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
Si	0.1	-	0.9	7440-21-3
C	0.2	-	0.5	7440-44-0
Ti	0	-	0.2	7440-32-6
V	0	-	0.2	7440-62-2
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Cu	0	-	0.1	7440-50-8
Nb	0	-	0.1	7440-03-1
Ni	0	-	0.1	7440-02-0
P	0	-	0.1	7723-14-0

IPCI C21D0001-673 [I]; B21B0037-24 [I]; B21B0037-26 [I]; C23C0002-12 [I]
IPCR C21D0001-673 [I]; B21B0037-24 [I]; B21B0037-26 [I]; C23C0002-12 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST hardened steel aluminum alloy coating silicon austenizing rolling
IT Diffusion
Heat treatment
Hot-dip coating process
Metal forming
Rolling (metals)
Thermomechanical metalworking
(manuf. of hardened steel products with aluminum-based coatings)
IT Oxides (inorganic)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(manuf. of hardened steel products with aluminum-based coatings)
IT 7429-90-5, Aluminum, processes 77578-10-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(coatings; manuf. of hardened steel products with aluminum-based coatings)
IT 12597-69-2, Steel, processes 2408930-78-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrates; manuf. of hardened steel products with aluminum-based coatings)

L13 ANSWER 8 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2020:178086 CAPLUS Full-text
DOCUMENT NUMBER: 172:169761
TITLE: Manufacture of hardened steel products with aluminum-based coatings
INVENTOR(S): Pohl, Stefan; Danger, Elisabeth; Labudde, Thorsten; Butzkamm, Juergen
PATENT ASSIGNEE(S): Muhr und Bender KG, Germany
SOURCE: Ger. Offen., 13pp.; Chemical Indexing Equivalent to 172:169762 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102018118015	A1	20200130	DE 2018-102018118015	20180725
WO 2020020644	A1	20200130	WO 2019-EP68581	20190710

PRIORITY APPLN. INFO.: DE 2018-102018118015 A 20180725
AB A method for producing a hardened steel product, comprises: providing a steel substrate made of a hardenable steel; coating the steel substrate with an aluminum pre-coating, the pre-coating being applied to the steel substrate with a thickness of at least 34μm; flexibly rolling the pre-coated steel substrate in order to produce a variable thickness over the length of the pre-coated steel substrate, the pre-coating being rolled out to a reduced first thickness of less than 33μm in thinner first portions and to a reduced second thickness, which is thicker than the reduced first thickness, in thicker second portions; creating a blank from the flexibly rolled steel substrate; heating the

blank to the austenitization temp., diffusion processes between the base material and the pre-coating occurring; and hot-forming the heated blank, the heated blank being formed and being quickly cooled in such a way that a hardened steel product having a coating is produced.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 102005031461 A1	CAPLUS
Anon				DE 102007013739 B3	CAPLUS
Anon				DE 102007019196 A1	CAPLUS
Anon				DE 102009007909 A1	CAPLUS
Anon	2019			Feuerverzinken In:Wi	
Anon				Salzgitter Flachstah	

IT 2408930-78-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrates; manuf. of hardened steel products with aluminum-based coatings)

RN 2408930-78-7 CAPLUS

CN Iron alloy, base, Fe 91-99,Mn 0.5-5,Cr 0-1,Mo 0-1,Si 0.1-0.9,C 0.2-0.5,Ti 0-0.2,V 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Nb 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	91 - 99	7439-89-6
Mn	0.5 - 5	7439-96-5
Cr	0 - 1	7440-47-3
Mo	0 - 1	7439-98-7
Si	0.1 - 0.9	7440-21-3
C	0.2 - 0.5	7440-44-0
Ti	0 - 0.2	7440-32-6
V	0 - 0.2	7440-62-2
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Cu	0 - 0.1	7440-50-8
Nb	0 - 0.1	7440-03-1
Ni	0 - 0.1	7440-02-0
P	0 - 0.1	7723-14-0

IPCI C23F0017-00 [I]; C23C0002-12 [I]; C22C0038-04 [I]
IPCR C23F0017-00 [I]; C22C0038-04 [I]; C23C0002-12 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST hardened steel aluminum alloy coating silicon austenizing rolling
IT Diffusion
Heat treatment
Hot-dip coating process
Metal forming
Rolling (metals)
Thermomechanical metalworking
(manuf. of hardened steel products with aluminum-based coatings)
IT Oxides (inorganic)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(manuf. of hardened steel products with aluminum-based coatings)
IT 7429-90-5, Aluminum, processes 77578-10-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(coatings; manuf. of hardened steel products with aluminum-based coatings)
IT 12597-69-2, Steel, processes 2408930-78-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrates; manuf. of hardened steel products with aluminum-based coatings)

L13 ANSWER 9 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2019:1450710 CAPLUS Full-text
TITLE: The influence of the heating rate of cemented constructional steels on the growth of austenitic grain in the process of high-temperature holding
AUTHOR(S): Kukareko, V. A.; Valko, A. L.; Chichin, A. N.
CORPORATE SOURCE: Joint Institute of Mechanical Engineering of the National Academy of Sciences of Belarus, Minsk, Belarus
SOURCE: Vestsi Natsyyanal'nai Akademii Navuk Belarusi, Seryya Fizika-Tekhnichnykh Navuk (2018), (4), 399-406
CODEN: VABNFA; ISSN: 1561-8358
DIGITAL OBJECT ID: 10.29235/1561-8358-2018-63-4-399-406
PUBLISHER: Vydavetski Dom "Belaruskaya Navuka"
DOCUMENT TYPE: Journal
LANGUAGE: Russian

AB The influence of the heating mode of samples of constructional cemented steels 20KhNZA, 20KhGNR and 15KhGN2TA on the value of austenite grain after high-temp. isothermal aging at 1000 °C is studied. It is shown that the heating of steels at a rate of 1.2-3.0 °C/min in the phase-transformation interval stabilizes the grain structure of the steels and leads to a slowing down of the kinetics of the growth of austenite grains during prolonged high-temp. aging, which makes it possible to increase the temp. of the chem.-thermal treatment of steels. It is concluded that the stabilization of the grain structure of steels is assocd. with the formation of segregation of impurity atoms and particles at grain boundaries with high-angle disorientation during slow heating, which prevents migration of grain boundaries in the process of prolonged high-temp. aging. A high-temp. chem.-thermal treatment of a batch of billets from steel 20KhNZA under exptl. conditions with stepwise heating in the phase-transformation interval provided a qual. fine-grained structure of the cemented layer.

IT INDEXING IN PROGRESS
IT 37312-00-8, 20KhGNR
RL: TEM (Technical or engineered material use); USES (Uses)
(influence of heating rate of cemented constructional steels on growth of austenitic grain in process of high-temp. holding)
RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55 (Ferrous Metals and Alloys)
ST steel austenitic grain growth heating rate holding temp
IT Grain boundaries
Grain size
Heat treatment
Microhardness
Microstructure
Quenching (cooling)
(influence of heating rate of cemented constructional steels on growth of austenitic grain in process of high-temp. holding)
IT 37312-00-8, 20KhGNR 61431-72-9, 15KhGN2TA
RL: TEM (Technical or engineered material use); USES (Uses)
(influence of heating rate of cemented constructional steels

on growth of austenitic grain in process of high-temp. holding)

L13 ANSWER 10 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1254928 CAPLUS Full-text
DOCUMENT NUMBER: 171:98349
TITLE: Production of cold-rolled flat steel products having metal anti-corrosion layers
INVENTOR(S): Mraczek, Klemens; Muhr, Andreas; Haneder, Bernhard
PATENT ASSIGNEE(S): Voestalpine Stahl GmbH, Austria
SOURCE: PCT Int. Appl., 38pp.; Chemical Indexing Equivalent to 171:98344 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2019121793	A1	20190627	WO 2018-EP85664	20181218
DE 102017223633	A1	20190627	DE 2017-102017223633	20171221
EP 3728654	A1	20201028	EP 2018-826307	20181218
US 20200325552	A1	20201015	US 2020-16956301	20200619

PRIORITY APPLN. INFO.: DE 2017-102017223633 A 20171221
WO 2018-EP85664 W 20181218
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A cold-rolled flat steel contains, in addn. to iron and unavoidable impurities, (in wt.%): C: 0.01-0.35%, Mn: 1-4%, Si: 0.5-2.5%, Nb: up to 0.1%, Ti: 0.015-0.1%, P: up to 0.1%, Al: up to 0.15%, S: up to 0.01%, N: up to 0.1%, and optionally one or more elements from the group of rare earth metals, Mo, Cr, Zr, V, W, Co, Ni, B, Cu, Ca, with rare earth metals: up to 0.2%, Mo: up to 1%, Cr: up to 3%, Zr: up to 1%, V: up to 1%, W: up to 1%, Co: up to 1%, Ni: up to 2%, B: up to 0.1%, Cu: up to 3%, Ca: up to 0.015%. The flat steel products are manufd. by: melting then casting the steel melt to form a semi-finished product; hot-rolling the semi-finished product at 820-1000°C to form a hot strip; winding the hot strip at a temp. between room temp. and 750°C to form a coil; annealing the hot strip at 530-950°C for 1-50 h; cold-rolling the annealed hot strip to form a cold-rolled flat steel product in one or more stages with a total cold-rolling degree of at least 45%; final annealing of the cold-rolled flat steel product at 650-920°C for 30-1500 s; and applying a zinc-based metal anti-corrosion layer by electrolytic galvanizing or hot dip galvanizing of the cold-rolled and finally-annealed flat steel product. As a result of the final annealing of the cold-rolled flat steel product, an Si enrichment layer is created between a surface and a base material of the cold-rolled and finally-annealed flat steel product, the max. Si content of which is higher by a factor of 3-8 than the Si content of the base material and which has a depth of 10 nm to 1 μm.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ARLAZAROV ARTEM	2017			EP 3146083 A1	CAPLUS
HAGA JUN	2013			JP 2013032582 A	CAPLUS
NAKAGAITO TATSUYA	2007			JP 2007224416 A	CAPLUS

IT 2351042-49-2P
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(sheets; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)
RN 2351042-49-2 CAPLUS
CN Iron alloy, base, Fe 78-98,Mn 1-4,Cr 0-3,Cu 0-3,Si 0.5-2.5,Ni 0-2,Al 0-1.5,Co 0-1,Mo 0-1,V 0-1,W 0-1,Zr 0-1,C 0-0.4,misch metal 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1,N 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	78 - 98	7439-89-6
Mn	1 - 4	7439-96-5

Cr	0	-	3	7440-47-3
Cu	0	-	3	7440-50-8
Si	0.5	-	2.5	7440-21-3
Ni	0	-	2	7440-02-0
Al	0	-	1.5	7429-90-5
Co	0	-	1	7440-48-4
Mo	0	-	1	7439-98-7
V	0	-	1	7440-62-2
W	0	-	1	7440-33-7
Zr	0	-	1	7440-67-7
C	0	-	0.4	7440-44-0
Misch metal	0	-	0.2	8049-20-5
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8
N	0	-	0.1	17778-88-0
P	0	-	0.1	7723-14-0

IPCI C21D0006-00 [I]; B21B0001-24 [I]; B21B0001-26 [I]; B21B0001-28 [I];
C21D0007-02 [I]; C21D0007-10 [I]; C21D0008-02 [I]; C21D0008-04 [I];
C23C0002-00 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C21D0001-26 [I];
C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-12 [I]; C22C0038-14 [I];
C25F0001-06 [I]; C23G0001-08 [I]; B21B0001-22 [I]
IPCR C21D0006-00 [I]; B21B0001-22 [I]; B21B0001-24 [I]; B21B0001-26 [I];
B21B0001-28 [I]; C21D0001-26 [I]; C21D0007-02 [I]; C21D0007-10 [I];
C21D0008-02 [I]; C21D0008-04 [I]; C21D0009-46 [I]; C21D0009-48 [I];
C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-12 [I]; C22C0038-14 [I];
C23C0002-00 [I]; C23G0001-08 [I]; C25F0001-06 [I]
CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST cold rolling annealing flat steel zinc anticorrosion coating
IT Galvanizing
(electrogalvanizing; prodn. of cold-rolled flat steel
products having metal anti-corrosion layers)
IT Annealing
Anticorrosive coating materials
Casting of metals
Cold rolling
Hot rolling
Hot-dip galvanizing
(prodn. of cold-rolled flat steel products having metal
anti-corrosion layers)
IT 7440-66-6P, Zinc, preparation
RL: IMF (Industrial manufacture); TEM (Technical or engineered material
use); PREP (Preparation); USES (Uses)
(coatings; prodn. of cold-rolled flat steel
products having metal anti-corrosion layers)
IT 2351042-49-2P
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical
process); TEM (Technical or engineered material use); PREP (Preparation);
PROC (Process); USES (Uses)
(sheets; prodn. of cold-rolled flat steel products having
metal anti-corrosion layers)

L13 ANSWER 11 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1241982 CAPLUS Full-text
DOCUMENT NUMBER: 171:98344
TITLE: Production of cold-rolled flat steel products having metal anti-corrosion layers
INVENTOR(S): Mraczek, Klemens; Muhr, Andreas; Haneder, Bernhard
PATENT ASSIGNEE(S): Voestalpine Stahl GmbH, Austria
SOURCE: Ger. Offen., 17pp.; Chemical Indexing Equivalent to 171:98349 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102017223633	A1	20190627	DE 2017-102017223633	20171221

WO 2019121793	A1	20190627	WO 2018-EP85664		20181218
EP 3728654	A1	20201028	EP 2018-826307		20181218
US 20200325552	A1	20201015	US 2020-16956301		20200619
PRIORITY APPLN. INFO.:			DE 2017-102017223633	A	20171221
			WO 2018-EP85664	W	20181218

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB A cold-rolled flat steel contains, in addn. to iron and unavoidable impurities, (in wt.%): C: 0.01-0.35%, Mn: 1-4%, Si: 0.5-2.5%, Nb: up to 0.1%, Ti: 0.015-0.1%, P: up to 0.1%, Al: up to 0.15%, S: up to 0.01%, N: up to 0.1%, and optionally one or more elements from the group of rare earth metals, Mo, Cr, Zr, V, W, Co, Ni, B, Cu, Ca, with rare earth metals: up to 0.2%, Mo: up to 1%, Cr: up to 3%, Zr: up to 1%, V: up to 1%, W: up to 1%, Co: up to 1%, Ni: up to 2%, B: up to 0.1%, Cu: up to 3%, Ca: up to 0.015%. The flat steel products are manufd. by: melting then casting the steel melt to form a semi-finished product; hot-rolling the semi-finished product at 820-1000°C to form a hot strip; winding the hot strip at a temp. between room temp. and 750°C to form a coil; annealing the hot strip at 530-950°C for 1-50 h; cold-rolling the annealed hot strip to form a cold-rolled flat steel product in one or more stages with a total cold-rolling degree of at least 45%; final annealing of the cold-rolled flat steel product at 650-920°C for 30-1500 s; and applying a zinc-based metal anti-corrosion layer by electrolytic galvanizing or hot dip galvanizing of the cold-rolled and finally-annealed flat steel product. As a result of the final annealing of the cold-rolled flat steel product, an Si enrichment layer is created between a surface and a base material of the cold-rolled and finally-annealed flat steel product, the max. Si content of which is higher by a factor of 3-8 than the Si content of the base material and which has a depth of 10 nm to 1 μm.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 102012013113 A1	CAPLUS
Anon				DE 102015111866 A1	CAPLUS
Anon				DE 102015112886 A1	CAPLUS
Anon				DE 102015112889 A1	CAPLUS
Anon				EP 2383353 A2	CAPLUS

IT 2351042-49-2P
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(sheets; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)

RN 2351042-49-2 CAPLUS

CN Iron alloy, base, Fe 78-98,Mn 1-4,Cr 0-3,Cu 0-3,Si 0.5-2.5,Ni 0-2,Al 0-1.5,Co 0-1,Mo 0-1,V 0-1,W 0-1,Zr 0-1,C 0-0.4,misch metal 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1,N 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	78	-	98	7439-89-6
Mn	1	-	4	7439-96-5
Cr	0	-	3	7440-47-3
Cu	0	-	3	7440-50-8
Si	0.5	-	2.5	7440-21-3
Ni	0	-	2	7440-02-0
Al	0	-	1.5	7429-90-5
Co	0	-	1	7440-48-4
Mo	0	-	1	7439-98-7
V	0	-	1	7440-62-2
W	0	-	1	7440-33-7
Zr	0	-	1	7440-67-7
C	0	-	0.4	7440-44-0
Misch metal	0	-	0.2	8049-20-5
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8
N	0	-	0.1	17778-88-0
P	0	-	0.1	7723-14-0

IPCI C22C0038-04 [I]; C22C0038-38 [I]; C22C0038-42 [I]; C22C0038-20 [I]
IPCR C22C0038-04 [I]; C22C0038-20 [I]; C22C0038-38 [I]; C22C0038-42 [I]
CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST cold rolling annealing flat steel zinc anticorrosion coating
IT Galvanizing
(electrogalvanizing; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)
IT Annealing
Anticorrosive coating materials
Casting of metals
Cold rolling
Hot rolling
Hot-dip galvanizing
(prodn. of cold-rolled flat steel products having metal anti-corrosion layers)
IT 7440-66-6P, Zinc, preparation
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(coatings; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)
IT 2351042-49-2P
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(sheets; prodn. of cold-rolled flat steel products having metal anti-corrosion layers)

L13 ANSWER 12 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:1019962 CAPLUS Full-text
DOCUMENT NUMBER: 171:30626
TITLE: Ultra-high strength and excellent ductility in multi-layer steel sheet of austenitic hadfield and martensitic hot-press-forming steels
AUTHOR(S): Park, Jaeyeong; Jo, Min Cheol; Song, Taejin; Kim, Hyoung Seop; Sohn, Seok Su; Lee, Sunghak
CORPORATE SOURCE: Center for Advanced Aerospace Materials, Pohang University of Science and Technology, Pohang, 790-784, S. Korea
SOURCE: Materials Science & Engineering, A: Structural Materials: Properties, Microstructure and Processing (2019), 759, 320-328
CODEN: MSAPE3; ISSN: 0921-5093
DIGITAL OBJECT ID: 10.1016/j.msea.2019.05.046
PUBLISHER: Elsevier B.V.
DOCUMENT TYPE: Journal; (online computer file)
LANGUAGE: English
AB An austenitic Hadfield steel sheet shows a relatively low yield strength of 0.4-0.5 GPa and serrated flows in spite of excellent tensile strength and ductility along with highly-sustained strain hardening. In order to overcome the shortcomings, a multi-layer steel (MLS) sheet was fabricated by a roll-bonding with an ultra-high-strength martensitic hot-press-forming (HPF) steel sheet. Near the Hadfield/HPF interface, the carburized and decarburized layers were formed by the carbon diffusion from the Hadfield (1.2% of C) to HPF (0.23% of C) layers, and could generate a kind of very thin multi-layers of 35 μm in thickness. All tensile properties of the Hadfield/HPF MLS sheet (yield strength; 946 MPa, tensile strength; 1291 MPa, elongation; 44.5%) were superior to those of the Hadfield sheet. Interestingly, the persistent elongation up to 44.5%, which is higher than that of the Hadfield steel, in the present MLS sheet is a quite unique and interesting characteristic. The simultaneous enhancement of strength and ductility of the MLS sheet was explained by the contributions of (1) populated twin formation, (2) generation of geometrically necessary dislocations (GNDs), and (3) increase of back stress inside thin interfacial layers.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				K. Sato, Q. Yu, J. H	
Barbier, D	2009	500	196	Mater Sci Eng A	

Bouaziz, O	2016	18	56	Adv Eng Mater	CAPLUS
Calcagnotto, M	2011	59	658	Acta Mater	CAPLUS
Cetin, A	2012	60	2265	Acta Mater	CAPLUS
Chateau, J	2010	240	012023	J Phys Conf Ser	
Chen, L	2007	47	1804	ISIJ Int	CAPLUS
Curtze, S	2010	58	5129	Acta Mater	CAPLUS
Dini, G	2010	64	15	Mater Lett	CAPLUS
Dinsdale, A	1991	15		Calphad	CAPLUS
Dumay, A	2008	483-4	184	Mater Sci Eng A	
Eshelby, J	1951	42	351	Lond Edinb Dublin Ph	
Fan, D	2009	80	241	Steel Res Int	CAPLUS
Frommeyer, G	2003	43	438	ISIJ Int	CAPLUS
Grassel, O	2000	16	1391	Int J Plast	CAPLUS
Gwon, H	2019	25	594	Met Mater Int	CAPLUS
Han, Y	2012	553	192	Mater Sci Eng A	CAPLUS
Hild, F	2006	42	69	Strain	
Hirth, J	1982			Theory of Dislocatio	
Inoue, J	2008	59	1055	Scripta Mater	CAPLUS
Kang, M	2017	700	387	Mater Sci Eng A	CAPLUS
Kang, S	2010	527	745	Mater Sci Eng A	
Kim, J	2019			Met Mater Int	
Koseki, T	2014	55	227	Mater Trans	CAPLUS
Kubin, L	2003	48	119	Scripta Mater	CAPLUS
Kurt, B	2009	60	1035	Mater Char	CAPLUS
Laws, N	1977	7	91	J Elast	
Lebedkina, T	2009	519	147	Mater Sci Eng A	
Lee, D	1988	23	558	J Mater Sci	CAPLUS
Lee, Y	2000	31	355	Metall Mater Trans A	
Li, Y	2018	731	377	Mater Sci Eng A	CAPLUS
Liu, B	2017	679	172	Mater Sci Eng A	CAPLUS
Ma, X	2016	116	43	Acta Mater	CAPLUS
Matlock, D	2012	15	1	JESTECH	
Morito, S	2005	45	91	ISIJ Int	CAPLUS
Nambu, S	2009	69	1936	Compos Sci Technol	CAPLUS
Nambu, S	2009	60	221	Scripta Mater	CAPLUS
Ojima, M	2009	529	16	Mater Sci Eng A	
Ojima, M	2012	66	139	Scripta Mater	CAPLUS
Pan, B	2009	20	1	Meas Sci Technol	
Park, J	2017	7	40231	Sci Rep	CAPLUS
Park, K	2001	7	95	Met Mater Int	CAPLUS
Saleh, A	2011	528	4537	Mater Sci Eng A	
Scott, C	2011	102	538	Int J Mater Res	CAPLUS
Semiatin, S	1979	10	85	Metall Trans A	
Seok, M	2016	121	164	Acta Mater	CAPLUS
Srivastava, A	2008	43	5654	J Mater Sci	CAPLUS
Ueji, R	2012	47	7946	J Mater Sci	CAPLUS
Ueji, R	2008	59	963	Scripta Mater	CAPLUS
Wu, X	2015	112	14501	Proc Natl Acad Sci U	CAPLUS
Xie, G	2011	52	1709	Mater Trans	CAPLUS
Yan, F	2014	81	487	Acta Mater	CAPLUS
Yang, M	2016	4	145	Mater Res Lett	CAPLUS
Yang, W	1990	25	1821	J Mater Sci	CAPLUS
Zuidema, B	1987	18	1629	Metall Trans A	

IT 2334123-60-1, Fe bal., C 0.23, Mn 1.2, Si 0.41, Cr 0.2, Ti 0-0.06, B 0-0.06, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(ultra-high strength and excellent ductility in multi-layer steel sheet of austenitic hadfield and martensitic hot-press-forming steels)
RN 2334123-60-1 CAPLUS
CN Steel, Fe 98,Mn 1.2,Si 0.4,C 0.2,Cr 0.2,B 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	98	7439-89-6
Mn	1.2	7439-96-5
Si	0.4	7440-21-3
C	0.2	7440-44-0
Cr	0.2	7440-47-3
B	0 - 0.1	7440-42-8

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    Ti       0  -   0.1      7440-32-6

CC   55-12 (Ferrous Metals and Alloys)
ST   steel multilayer sheet strength ductility microstructure
IT   Elongation, mechanical
     Hot-press molding
     Microstructure
     Multilayers
     Sheet materials
     Solid-solid interface
     Strain hardening
     Stress-strain relationship
     Tensile strength
     Yield strength
        (ultra-high strength and excellent ductility in multi-layer
        steel sheet of austenitic hadfield and martensitic
        hot-press-forming steels)
IT   2334123-57-6, Fe bal., C 1.2, Mn 13.6, Si 0.2   2334123-60-1, Fe
     bal., C 0.23, Mn 1.2, Si 0.41, Cr 0.2, Ti 0-0.06, B 0-0.06, processes
     RL: PEP (Physical, engineering or chemical process); PRP (Properties);
     PROC (Process)
        (ultra-high strength and excellent ductility in multi-layer
        steel sheet of austenitic hadfield and martensitic
        hot-press-forming steels)
OS.CITING REF COUNT:     3     THERE ARE 3 CAPLUS RECORDS THAT CITE THIS RECORD
                               (3 CITINGS)


L13  ANSWER 13 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2019:949375  CAPLUS Full-text
DOCUMENT NUMBER:         170:609630
TITLE:                   Al plated steel pipe parts by STAF method
INVENTOR(S):             Maki, Jun; Fujita, Soshi; Nakamura, Toyomitsu
PATENT ASSIGNEE(S):      Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE:                  Jpn. Kokai Tokkyo Koho, 21pp.
                         CODEN: JKXXAF
DOCUMENT TYPE:           Patent
LANGUAGE:                Japanese
FAMILY ACC. NUM. COUNT:  1
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     JP 2019073778        A    20190516    JP 2017-201702           20171018
PRIORITY APPLN. INFO.:                     JP 2017-201702           20171018
AB   The present invention relates to an Al plated steel pipe parts
     comprising a hollow portion having a predetd. cross-sectional shape; and a
     flange portion projecting from the outer surface of the hollow portion;
     wherein the hollow portion and the flange portion are made of the same
     steel material as a material, and the surface of the hollow portion and
     the flange portion is coated with a plating layer contg. at least one
     of an Al-Fe-based alloy and an Al-Fe-Si-based alloy.  The Al plated
     steel pipe parts has thickness of the plating layer is in the range of
     5-50 μm, and the surface roughness of the plating layer at the flange
     portion is in the range of 0.3-1.2 μ m as a center line av. roughness
     Ra defined by JIS B0610.  The Al-plated steel pipe part has excellent
     spot weldability manufd. by processing an Al-plated steel pipe by the
     STAF method.
IT   2320493-55-6, Aluminum 0-0.1, boron 0.0001-0.1, carbon 0.15-0.5,
     chromium 0-1.5, iron bal., manganese 0.6-3, nitrogen 0-0.006, phosphorus
     0-0.01, silicon 0.01-2, titanium 0.01-0.1
     RL: PEP (Physical, engineering or chemical process); TEM (Technical or
     engineered material use); PROC (Process); USES (Uses)
        (aluminum plated steel pipe parts by STAF method)
RN   2320493-55-6  CAPLUS
CN   Iron alloy, base, Fe 93-99,Mn 0.6-3,Si 0-2,Cr 0-1.5,C 0.2-0.5,Al 0-0.1,B
     0-0.1,Ti 0-0.1  (CA INDEX NAME)

Component   Component      Component
             Percent    Registry Number
=========+=============+===============
    Fe     93   -  99        7439-89-6
    Mn      0.6 -   3        7439-96-5
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Si	0	-	2	7440-21-3
Cr	0	-	1.5	7440-47-3
C	0.2	-	0.5	7440-44-0
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Ti	0	-	0.1	7440-32-6

IPCI C23C0002-12 [I]; C23C0002-26 [I]; C22C0038-00 [I]; C22C0038-04 [I]; C22C0038-38 [I]; B21D0026-035 [N]; B21D0026-059 [N]; C22C0021-02 [N]; C21D0009-08 [N]
IPCR C23C0002-12 [I]; C22C0038-00 [I]; C22C0038-04 [I]; C22C0038-38 [I]; C23C0002-26 [I]
CC 55-6 (Ferrous Metals and Alloys)
ST aluminum plating steel pipe parts
IT Coating materials
Pipes and Tubes
(aluminum plated steel pipe parts by STAF method)
IT 12043-58-2
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(aluminum plated steel pipe parts by STAF method)
IT 2330493-55-6, Aluminum 0-0.1, boron 0.0001-0.1, carbon 0.15-0.5, chromium 0-1.5, iron bal., manganese 0.6-3, nitrogen 0-0.006, phosphorus 0-0.01, silicon 0.01-2, titanium 0.01-0.1
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum plated steel pipe parts by STAF method)
IT 1314-13-2, Zinc oxide, uses 7429-90-5, Aluminum, uses 11114-60-6 11116-16-8, Titanium nitride 11122-26-2 12705-37-2, Chromium nitride
RL: TEM (Technical or engineered material use); USES (Uses)
(aluminum plated steel pipe parts by STAF method)

L13 ANSWER 14 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:903363 CAPLUS Full-text
DOCUMENT NUMBER: 170:588989
TITLE: Piercer plug made of seamless steel, and its manufacturing method
INVENTOR(S): Hidaka, Yasuyoshi; Shirasawa, Naoya; Miyai, Tatsuya
PATENT ASSIGNEE(S): Nippon Steel Corporation, Japan
SOURCE: PCT Int. Appl., 27pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2019087510	A1	20190509	WO 2018-JP29879	20180809
CN 111315906	A	20200619	CN 2018-80071094	20180809
BR 112020002943	A2	20200811	BR 2020-112020002943	20180809
EP 3705591	A1	20200909	EP 2018-874192	20180809
US 20200263282	A1	20200820	US 2020-16646739	20200312
PRIORITY APPLN. INFO.:			JP 2017-212753 A	20171102
			WO 2018-JP29879 W	20180809

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The piercer plug comprises the following component in mass (%): 0.15-0.3 of carbon, 0.4-1.2 of silicon, 0.2-1.5 of manganese, 0.1-2 of nickel, 0-4 each of molybdenum and tungsten, 1-4 of chromium, 0-0.2 of boron, 0-1 of niobium , 0-1 of vanadium, 0-1 of titanium, and iron being balance and impurities. The piercer plug further comprises a tip section and a body section made of the same material; wherein the body section includes a cylindrical unit which is a hole for attaching a bar and the tip section is harder than the cylindrical unit. The manufg. method of piercer plug comprises a protective film forming on the surface of the piercer plug to the heating, wherein the protective film is a thermal sprayed coating and a buildup layer. According to the present invention, it is possible to provide a highly recyclable piercer plug.
IT 2315454-12-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(piercer plug made of seamless steel, and its manufg. method)
RN 2315454-12-5 CAPLUS

CN Iron alloy, base, Fe 82-97,Cr 1-4,Mo 0-4,W 0-4,Ni 0.1-2,Mn 0.2-1.5,Si 0.4-1.2,Nb 0-1,Ti 0-1,V 0-1,C 0.2-0.3,B 0-0.2 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	82 - 97	7439-89-6
Cr	1 - 4	7440-47-3
Mo	0 - 4	7439-98-7
W	0 - 4	7440-33-7
Ni	0.1 - 2	7440-02-0
Mn	0.2 - 1.5	7439-96-5
Si	0.4 - 1.2	7440-21-3
Nb	0 - 1	7440-03-1
Ti	0 - 1	7440-32-6
V	0 - 1	7440-62-2
C	0.2 - 0.3	7440-44-0
B	0 - 0.2	7440-42-8

IPCI C22C0038-00 [I]; C21D0009-00 [I]; C22C0038-54 [I]
IPCR C22C0038-00 [I]; C21D0009-00 [I]; C22C0038-54 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST carbon boron seamless steel piercer plug
IT 2315454-12-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(piercer plug made of seamless steel, and its manufg. method)

L13 ANSWER 15 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:807393 CAPLUS Full-text
DOCUMENT NUMBER: 170:538936
TITLE: Manufacture of steel components having a metal coating protecting it against corrosion
INVENTOR(S): Banik, Janko; Koeyer, Maria; Rosenstock, Dirk; Ruthenberg, Manuela
PATENT ASSIGNEE(S): Thyssenkrupp Steel Europe AG, Germany; Thyssenkrupp AG
SOURCE: PCT Int. Appl., 26pp.; Chemical Indexing Equivalent to 170:538935 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2019076720	A1	20190425	WO 2018-EP77692	20181011
DE 102017218704	A1	20190425	DE 2017-102017218704	20171019
CN 110997951	A	20200410	CN 2018-80049166	20181011
EP 3697936	A1	20200826	EP 2018-804228	20181011
US 20200216925	A1	20200709	US 2020-16647894	20200317
PRIORITY APPLN. INFO.:			DE 2017-102017218704 A	20171019
			WO 2018-EP77692 W	20181011

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A method for producing a steel component comprising a steel substrate and an aluminum alloy-based anti-corrosion coating, is described for use in the automotive sector.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
BANIK JANKO	2016			EP 2993248 A1	CAPLUS
COBO SEBASTIAN	2017			US 20170253941 A1	
KUSUMI K	2007			EP 1767286 A1	CAPLUS
MAKI JUN	2014			EP 2695963 A1	CAPLUS
ROSENSTOCK DIRK	2018			WO 2018234102 A1	CAPLUS

IT 2307271-66-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; manuf. of steel components having a metal coating protecting it against corrosion)
RN 2307271-66-3 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	94	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Cr	0	-	1	7440-47-3
C	0.1	-	0.5	7440-44-0
Si	0.1	-	0.5	7440-21-3
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0

IPCI C21D0001-76 [I]; B21D0022-02 [I]; B21D0022-20 [I]; C21D0007-13 [I]; C23C0002-12 [I]; C23C0002-26 [I]; C23C0002-28 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C21D0001-673 [I]
IPCR C21D0001-76 [I]; B21D0022-02 [I]; B21D0022-20 [I]; C21D0001-673 [I]; C21D0007-13 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C23C0002-12 [I]; C23C0002-26 [I]; C23C0002-28 [I]
CC 55-10 (Ferrous Metals and Alloys)
    Section cross-reference(s): 56
ST steel metal prevention corrosion coating
IT Automobile bodies
      (chassis; manuf. of steel components having a metal coating protecting it against corrosion)
IT Anticorrosive coating materials
    Automobile bodies
    Automotive bumpers
      (manuf. of steel components having a metal coating protecting it against corrosion)
IT 1273096-81-3P, Aluminum alloy 2307271-67-4P
    RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
      (anti-corrosion coatings; manuf. of steel components having a metal coating protecting it against corrosion)
IT 1333-74-0, Hydrogen, uses
    RL: MOA (Modifier or additive use); USES (Uses)
      (in steel; manuf. of steel components having a metal coating protecting it against corrosion)
IT 12597-69-2P, Steel, preparation 2307271-66-3P
    RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
      (strips; manuf. of steel components having a metal coating protecting it against corrosion)

L13 ANSWER 16 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:805627 CAPLUS Full-text
DOCUMENT NUMBER: 170:527030
TITLE: Enamelling of high-strength steels
INVENTOR(S): Myslowicki, Stefan
PATENT ASSIGNEE(S): ThyssenKrupp Steel Europe AG, Germany; ThyssenKrupp AG
SOURCE: PCT Int. Appl., 28pp.; Chemical Indexing Equivalent to 170:527029 (DE)
    CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2019076717	A1	20190425	WO 2018-EP77686	20181011
DE 102017218434	A1	20190418	DE 2017-102017218434	20171016
EP 3697545	A1	20200826	EP 2018-786281	20181011
PRIORITY APPLN. INFO.:			DE 2017-102017218434 A	20171016
			WO 2018-EP77686 W	20181011

AB A shaped part having at least two layers, comprises at least one layer

made of high-strength steel with a tensile strength ≥500 MPa and a hardness ≥160 HV, and at least one layer made of a steel that has an enamel layer on the outer side. The shaped part are suitable for producing pipelines, pressure vessels, reactors or in app. engineering, in particular for the transport of aq. and/or corrosive media.

IT 2306234-82-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enamelling of high-strength steels)

RN 2306234-82-0 CAPLUS

CN Iron alloy, base, Fe 85-99,Mn 0.5-3,Al 0-3,Si 0.1-2.5,P 0-1.5,Cr 0-1,Mo 0-1,V 0-1,Ti 0-0.8,Nb 0-0.5,C 0-0.4,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	85	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Al	0	-	3	7429-90-5
Si	0.1	-	2.5	7440-21-3
P	0	-	1.5	7723-14-0
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
V	0	-	1	7440-62-2
Ti	0	-	0.8	7440-32-6
Nb	0	-	0.5	7440-03-1
C	0	-	0.4	7440-44-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B21B0001-38 [I]; C21D0008-02 [I]; C21D0009-46 [I]; C22C0038-02 [I]; C23D0005-00 [I]

IPCR B21B0001-38 [I]; C21D0008-02 [I]; C21D0009-46 [I]; C22C0038-02 [I]; C23D0005-00 [I]

CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 57

ST enamel strength steel bilayer

IT Enameling
Enamels (vitreous)
Pipelines
Pressure vessels
Reactors
(enamelling of high-strength steels)

IT 2306234-83-1P, preparation
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enameled; enamelling of high-strength steels)

IT 12597-69-2P, Steel, preparation 59816-66-9P, preparation
2306234-82-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enamelling of high-strength steels)

L13 ANSWER 17 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2019:802752 CAPLUS Full-text

DOCUMENT NUMBER: 170:538935

TITLE: Manufacture of steel components having a metal coating protecting it against corrosion

INVENTOR(S): Banik, Janko; Koeyer, Maria; Rosenstock, Dirk; Ruthenberg, Manuela

PATENT ASSIGNEE(S): Thyssenkrupp AG, Germany; Thyssenkrupp Steel Europe AG

SOURCE: Ger. Offen., 17pp.; Chemical Indexing Equivalent to 170:538936 (WO)
CODEN: GWXXBX

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 2

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102017218704	A1	20190425	DE 2017-102017218704	20171019

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     WO 2019076720         A1   20190425    WO 2018-EP77692          20181011
     CN 110997951          A    20200410    CN 2018-80049166         20181011
     EP 3697936            A1   20200826    EP 2018-804228           20181011
     US 20200216925        A1   20200709    US 2020-16647894         20200317
PRIORITY APPLN. INFO.:                      DE 2017-102017218704 A   20171019
                                            WO 2018-EP77692      W   20181011
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB   A method for producing a steel component comprising a steel substrate
     and an aluminum alloy-based anti-corrosion coating, is described for use
     in the automotive sector.
RETABLE
   Referenced Author   |Year | VOL | PG   | Referenced Work    | Referenced
         (RAU)         |(RPY)|(RVL)|(RPG) |      (RWK)         | File
=======================+=====+=====+======+====================+===========
Anon                   |     |     |      |EP 1767286 A1       |CAPLUS
Anon                   |     |     |      |US 20120085467 A1   |CAPLUS
Anon                   |     |     |      |EP 2377965 A2       |CAPLUS
Anon                   |     |     |      |EP 2993248 A1       |CAPLUS
IT   2307271-66-3P
     RL: IMF (Industrial manufacture); TEM (Technical or engineered material
     use); PREP (Preparation); USES (Uses)
        (strips; manuf. of steel components having a metal
        coating protecting it against corrosion)
RN   2307271-66-3  CAPLUS
CN   Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Ti
     0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1  (CA INDEX NAME)

Component   Component      Component
             Percent    Registry Number
=========+============+===============
    Fe     94   -  99        7439-89-6
    Mn      0.5 -   3        7439-96-5
    Cr      0   -   1        7440-47-3
    C       0.1 -   0.5      7440-44-0
    Si      0.1 -   0.5      7440-21-3
    Ti      0   -   0.2      7440-32-6
    Al      0   -   0.1      7429-90-5
    B       0   -   0.1      7440-42-8
    Nb      0   -   0.1      7440-03-1
    P       0   -   0.1      7723-14-0

IPCI C22C0038-04 [I]; C23C0002-12 [I]; C23C0002-26 [I]; C21D0001-673 [I]
IPCR C22C0038-04 [I]; C21D0001-673 [I]; C23C0002-12 [I]; C23C0002-26 [I]
CC   55-10 (Ferrous Metals and Alloys)
     Section cross-reference(s): 56
ST   steel metal prevention corrosion coating
IT   Automobile bodies
        (chassis; manuf. of steel components having a metal
        coating protecting it against corrosion)
IT   Anticorrosive coating materials
     Automobile bodies
     Automotive bumpers
        (manuf. of steel components having a metal coating
        protecting it against corrosion)
IT   1273096-81-3P, Aluminum alloy   2307271-67-4P
     RL: IMF (Industrial manufacture); TEM (Technical or engineered material
     use); PREP (Preparation); USES (Uses)
        (anti-corrosion coatings; manuf. of steel
        components having a metal coating protecting it against
        corrosion)
IT   1333-74-0, Hydrogen, uses
     RL: MOA (Modifier or additive use); USES (Uses)
        (in steel; manuf. of steel components having a
        metal coating protecting it against corrosion)
IT   12597-69-2P, Steel, preparation   2307271-66-3P
     RL: IMF (Industrial manufacture); TEM (Technical or engineered material
     use); PREP (Preparation); USES (Uses)
        (strips; manuf. of steel components having a metal
        coating protecting it against corrosion)


L13  ANSWER 18 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
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ACCESSION NUMBER: 2019:746016 CAPLUS Full-text
DOCUMENT NUMBER: 170:527029
TITLE: Enamelling of high-strength steels
INVENTOR(S): Myslowicki, Stefan
PATENT ASSIGNEE(S): ThyssenKrupp AG, Germany; ThyssenKrupp Steel Europe AG
SOURCE: Ger. Offen., 20pp.; Chemical Indexing Equivalent to 170:527030 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102017218434	A1	20190418	DE 2017-102017218434	20171016
WO 2019076717	A1	20190425	WO 2018-EP77686	20181011
EP 3697545	A1	20200826	EP 2018-786281	20181011
PRIORITY APPLN. INFO.:			DE 2017-102017218434 A	20171016
			WO 2018-EP77686 W	20181011

AB A shaped part having at least two layers, comprises at least one layer made of high-strength steel with a tensile strength ≥500 MPa and a hardness ≥160 HV, and at least one layer made of a steel that has an enamel layer on the outer side. The shaped part are suitable for producing pipelines, pressure vessels, reactors or in app. engineering, in particular for the transport of aq. and/or corrosive media.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 102008022709 A1	CAPLUS
Anon				DE 1533303 C2	
Anon				EP 2227574 B1	CAPLUS

IT 2306234-82-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enamelling of high-strength steels)
RN 2306234-82-0 CAPLUS
CN Iron alloy, base, Fe 85-99,Mn 0.5-3,Al 0-3,Si 0.1-2.5,P 0-1.5,Cr 0-1,Mo 0-1,V 0-1,Ti 0-0.8,Nb 0-0.5,C 0-0.4,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	85	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Al	0	-	3	7429-90-5
Si	0.1	-	2.5	7440-21-3
P	0	-	1.5	7723-14-0
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
V	0	-	1	7440-62-2
Ti	0	-	0.8	7440-32-6
Nb	0	-	0.5	7440-03-1
C	0	-	0.4	7440-44-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI C23D0005-00 [I]; B23K0020-04 [I]
IPCR C23D0005-00 [I]; B23K0020-04 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 57
ST enamel strength steel bilayer
IT Enameling
Enamels (vitreous)
Pipelines
Pressure vessels
Reactors
(enamelling of high-strength steels)
IT 2306234-83-1P, preparation
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enameled; enamelling of high-strength steels)

IT 12597-69-2P, Steel, preparation 59816-66-9P, preparation
2306234-82-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(enamelling of high-strength steels)

L13 ANSWER 19 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:570060 CAPLUS Full-text
DOCUMENT NUMBER: 170:493791
TITLE: Method for manufacturing hot stamped parts with aluminum-silicon alloy coating and hot stamped parts
INVENTOR(S): Tan, Ning; Fu, Jiang; Hong, Jiyao; Fang, Xuehua
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 13pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 109518114	A	20190326	CN 2018-11035118	20180906
WO 2020030200	A1	20200213	WO 2019-CN104708	20190906
EP 3770295	A1	20210127	EP 2019-847997	20190906
PRIORITY APPLN. INFO.:			CN 2018-10896744 A	20180808
			CN 2018-11035118 A	20180906
			WO 2019-CN104708 W	20190906

AB The title method comprises the following steps of: processing steel plate coated with aluminum-silicon alloy coating to form a blank of a desired shape of the part, heat treating the blank, and hot stamping. The blank heat treatment adopts two-stage or three-stage heating and heat preservation, and the heating and heat preservation are stepwise heating. The steel plate coated with aluminum-silicon alloy coating include a substrate and an aluminum-silicon alloy coating on at least one surface thereof. The method fully considers the characteristics of the aluminum-silicon coating, is able to effectively solve the problem of roll banding of the aluminum-silicon coating, reduces the nodulation probability of the roller of the heat treatment furnace, improves the service life of the roller, and ensures the integrity of the coating of the hot stamped part as well as the mech. property, welding property, coating property and corrosion resisting property of the part.
IT 2305367-85-3P, Aluminum 0-0.3, boron 0-0.1, carbon 0.04-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1.2, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(method for manufg. hot stamped parts with aluminum-silicon alloy coating and hot stamped parts)
RN 2305367-85-3 CAPLUS
CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1.2,C 0-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1.2	7440-21-3
C	0	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI C23C0002-12; C23C0002-40; C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-28; C22C0038-32; C22C0038-38; C21D0001-26; C21D0008-00; B21D0022-02
IPCR C23C0002-12 [I]; B21D0022-02 [I]; C21D0001-26 [I]; C21D0008-00 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-28 [I];

C22C0038-32 [I]; C22C0038-38 [I]; C23C0002-40 [I]
CC 56-11 (Nonferrous Metals and Alloys)
ST hot stamping steel aluminum silicon coating
IT Cooling
Heat treatment
(method for manufg. hot stamped parts with aluminum-silicon alloy coating and hot stamped parts)
IT Metalworking
(stamping; method for manufg. hot stamped parts with aluminum-silicon alloy coating and hot stamped parts)
IT 2305367-85-3P, Aluminum 0-0.3, boron 0-0.1, carbon 0.04-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1.2, sulfur 0-0.1, titanium 0-0.5, iron bal. 2305367-88-6P, Iron 0-4, silicon 4-14, aluminum bal.
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(method for manufg. hot stamped parts with aluminum-silicon alloy coating and hot stamped parts)

L13 ANSWER 20 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2019:340815 CAPLUS Full-text
DOCUMENT NUMBER: 170:379972
TITLE: Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance
INVENTOR(S): Bi, Wenzhen; Hong, Jiyao; Wang, Li
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 7pp.; Chemical Indexing Equivalent to 173:85818 (WO)
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 109365606	A	20190222	CN 2018-11453322	20181130
WO 2020108593	A1	20200604	WO 2019-CN121859	20191129

PRIORITY APPLN. INFO.: CN 2018-11453322 A 20181130
AB The invention discloses a hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance, which improves the corrosion resistance of the steel plate or the steel strip and avoids cracking of the substrate. The above steel plate or steel strip includes the following components in percentage by wt.: C 0.1-0.8%, Si 0.05-2.0%, Mn 0.5-3.0%, P <0.1%, S <0.05%, Al <0.1%, N <0.01%, and balance of Fe and impurities, and also includes at least one of Cr 0.01-1.0%, Mo 0.01-1.0%, Ti <0.2%, Nb 0.01-0.08%, V 0.01-1.0%, and B 0.005-0.08%; the zinc-based coating includes the following components in percentage by wt.: Al 0.15%-6.5%, Mg 0.2-7%, RE <0.2%, Sr 0.002-0.2%, and balance of Zn and impurities, and the coating further includes at least one or more of Mn, Cr, Al, and Mg, and the total amt. thereof is more than 0.1%.
IT 2293976-55-1, Aluminum 0-0.1, boron 0.005-0.1, carbon 0.1-0.8, chromium 0.01-1, iron bal., manganese 0.5-3, molybdenum 0.01-1, niobium 0.01-0.1, phosphorus 0-0.1, silicon 0.05-2, titanium 0-0.2, vanadium 0.01-1
RL: MSC (Miscellaneous); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
RN 2293976-55-1 CAPLUS
CN Iron alloy, base, Fe 91-99,Mn 0.5-3,Si 0-2,Cr 0-1,Mo 0-1,V 0-1,C 0.1-0.8,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	91 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Si	0 - 2	7440-21-3
Cr	0 - 1	7440-47-3

Mo	0	-	1	7439-98-7
V	0	-	1	7440-62-2
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0

IPCI B21D0022-02; C23C0002-06; C23C0002-40; C22C0018-00; C21D0008-02
IPCR B21D0022-02 [I]; C21D0008-02 [I]; C22C0018-00 [I]; C23C0002-06 [I]; C23C0002-40 [I]
CC 55-6 (Ferrous Metals and Alloys)
ST corrosion resistance zinc alloy coating steel hot stamping
IT Anticorrosive coating materials
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT Metalworking
(stamping, hot; Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT 2293976-55-1, Aluminum 0-0.1, boron 0.005-0.1, carbon 0.1-0.8, chromium 0.01-1, iron bal., manganese 0.5-3, molybdenum 0.01-1, niobium 0.01-0.1, phosphorus 0-0.1, silicon 0.05-2, titanium 0-0.2, vanadium 0.01-1
RL: MSC (Miscellaneous); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
IT 2226545-76-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(Hot stamping method of zinc-based coated steel plate or steel strip with excellent corrosion resistance)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 21 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2601319 CAPLUS Full-text
DOCUMENT NUMBER: 170:116258
TITLE: Method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating
INVENTOR(S): Rosenstock, Dirk; Banik, Janko
PATENT ASSIGNEE(S): ThyssenKrupp Steel Europe AG, Germany; ThyssenKrupp AG
SOURCE: PCT Int. Appl., 25pp.; Chemical Indexing Equivalent to 170:116256 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018234102	A1	20181227	WO 2018-EP65498	20180612
DE 102017210201	A1	20181220	DE 2017-102017210201	20170619
EP 3642371	A1	20200429	EP 2018-738199	20180612
PRIORITY APPLN. INFO.:			DE 2017-102017210201 A	20170619
			WO 2018-EP65498 W	20180612

AB A method is described for producing a corrosion-resistant steel automotive component comprising a substrate and an anticorrosive coating.
IT 2254829-63-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
RN 2254829-63-3 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number

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=========+=============+===============
    Fe     94    -  99        7439-89-6
    Mn      0.5 -   3        7439-96-5
    Cr      0   -   1        7440-47-3
    C       0.2 -   0.5      7440-44-0
    Si      0.1 -   0.5      7440-21-3
    Ti      0   -   0.2      7440-32-6
    Al      0   -   0.1      7429-90-5
    B       0   -   0.1      7440-42-8
    Nb      0   -   0.1      7440-03-1
    P       0   -   0.1      7723-14-0

IPCI C21D0008-02 [I]; C23C0002-12 [I]; C21D0009-46 [I]; C21D0001-673 [I];
     B32B0015-01 [I]
IPCR C21D0008-02 [I]; B32B0015-01 [I]; C21D0001-673 [I]; C21D0009-46 [I];
     C23C0002-12 [I]
CC   55-10 (Ferrous Metals and Alloys)
     Section cross-reference(s): 56
ST   steel automobile metal coating corrosion aluminum alloy
IT   Anticorrosive coating materials
        (metallic; method for producing a steel automotive component
        provided with an aluminum alloy anti-corrosion coating)
IT   Automobile bodies
     Automobile doors
     Automobile roofs
     Automotive bumpers
     Heat treatment
        (method for producing a steel automotive component provided
        with an aluminum alloy anti-corrosion coating)
IT   254455-65-7P
     RL: IMF (Industrial manufacture); TEM (Technical or engineered material
     use); PREP (Preparation); USES (Uses)
        (coatings; method for producing a steel automotive
        component provided with an aluminum alloy anti-corrosion
        coating)
IT   870820-47-6P, 22MnB5   2254829-63-3P
     RL: IMF (Industrial manufacture); TEM (Technical or engineered material
     use); PREP (Preparation); USES (Uses)
        (strips; method for producing a steel automotive component
        provided with an aluminum alloy anti-corrosion coating)
OS.CITING REF COUNT:     1     THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD
                               (1 CITINGS)


L13  ANSWER 22 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:         2018:2544202  CAPLUS Full-text
DOCUMENT NUMBER:          170:116256
TITLE:                    Method for producing a steel automotive component
                          provided with an aluminum alloy anti-corrosion coating
INVENTOR(S):              Rosenstock, Dirk; Banik, Janko
PATENT ASSIGNEE(S):       ThyssenKrupp AG, Germany; ThyssenKrupp Steel Europe AG
SOURCE:                   Ger. Offen., 16pp.; Chemical Indexing Equivalent to
                          170:116258 (WO)
                          CODEN: GWXXBX
DOCUMENT TYPE:            Patent
LANGUAGE:                 German
FAMILY ACC. NUM. COUNT:   2
PATENT INFORMATION:
     PATENT NO.           KIND  DATE        APPLICATION NO.          DATE
     ---------------      ----  --------    ----------------------   --------
     DE 102017210201       A1   20181220    DE 2017-102017210201     20170619
     CN 109136775          A    20190104    CN 2017-10986828         20171020
     WO 2018234102         A1   20181227    WO 2018-EP65498          20180612
     EP 3642371            A1   20200429    EP 2018-738199           20180612
PRIORITY APPLN. INFO.:                      DE 2017-102017210201 A   20170619
                                            WO 2018-EP65498      W   20180612
AB   A method is described for producing a corrosion-resistant steel
     automotive component comprising a substrate and an anticorrosive coating.
RETABLE
   Referenced Author   |Year | VOL | PG   | Referenced Work    | Referenced
         (RAU)         |(RPY)|(RVL)|(RPG) |      (RWK)         | File
=======================+=====+=====+======+====================+===========
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Anon | | | |DE 102007061489 A1 |CAPLUS
Anon | | | |DE 102009007909 A1 |CAPLUS
Anon | | | |WO 2015036151 A1 |CAPLUS
Anon | | | |WO 2016034476 A1 |CAPLUS

IT 2254829-63-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)

RN 2254829-63-3 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	94	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Si	0.1	-	0.5	7440-21-3
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0

IPCI C22C0038-04 [I]; C21D0008-02 [I]; C23C0002-12 [I]
IPCR C22C0038-04 [I]; C21D0008-02 [I]; C23C0002-12 [I]
CC 55-10 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST steel automobile metal coating corrosion aluminum alloy
IT Anticorrosive coating materials
(metallic; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
IT Automobile bodies
Automobile doors
Automobile roofs
Automotive bumpers
Heat treatment
(method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
IT 254455-65-7P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(coatings; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
IT 870820-47-6P, 22MnB5 2254829-63-3P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; method for producing a steel automotive component provided with an aluminum alloy anti-corrosion coating)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 23 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:2321302 CAPLUS Full-text
DOCUMENT NUMBER: 170:49880
TITLE: Steel-based electromagnetic shield multilayer screen products
INVENTOR(S): Wieschalla, Vanessa; Nierhoff, Daniel; Wolske, Vanessa; Becker, Jens-Ulrik
PATENT ASSIGNEE(S): ThyssenKrupp AG, Germany; ThyssenKrupp Steel Europe AG
SOURCE: Ger., 17pp.
CODEN: GWXXAW
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:
PATENT NO. KIND DATE APPLICATION NO. DATE

DE 102017216975	B3	20181129	DE 2017-102017216975	20170925
WO 2019057547	A1	20190328	WO 2018-EP74424	20180911

PRIORITY APPLN. INFO.: DE 2017-102017216975 A 20170925

AB An electromagnetic radiation shielding multilayer material is manufd. for shielding from electromagnetic radiation, static elec. and/or static magnetic fields.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				EP 1426982 A1	CAPLUS
Anon				WO 1991012960 A1	
Anon				DE 3710322 A1	CAPLUS

IT 2253656-70-9P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(layers; steel-based electromagnetic shield multilayer screen products)

RN 2253656-70-9 CAPLUS

CN Iron alloy, base, Fe 94-100,Mn 0.1-3,C 0-0.5,Cr 0-0.5,Cu 0-0.5,Si 0-0.5,Ti 0-0.3,Ni 0-0.2,Al 0-0.1,As 0-0.1,B 0-0.1,Mo 0-0.1,N 0-0.1,Nb 0-0.1,P 0-0.1,S 0-0.1,Sn 0-0.1,V 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 100	7439-89-6
Mn	0.1 - 3	7439-96-5
C	0 - 0.5	7440-44-0
Cr	0 - 0.5	7440-47-3
Cu	0 - 0.5	7440-50-8
Si	0 - 0.5	7440-21-3
Ti	0 - 0.3	7440-32-6
Ni	0 - 0.2	7440-02-0
Al	0 - 0.1	7429-90-5
As	0 - 0.1	7440-38-2
B	0 - 0.1	7440-42-8
Mo	0 - 0.1	7439-98-7
N	0 - 0.1	17778-88-0
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0
S	0 - 0.1	7704-34-9
Sn	0 - 0.1	7440-31-5
V	0 - 0.1	7440-62-2

IPCI C22C0038-02 [I]; H05K0009-00 [I]; C22C0038-04 [I]; C22C0038-18 [I]
IPCR C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-18 [I]; H05K0009-00 [I]
CC 55-3 (Ferrous Metals and Alloys)
Section cross-reference(s): 73, 76, 77
ST multilayer screen electromagnetic shield stainless steel alloy
IT Electromagnetic shields
Hot rolling
Multilayers
(steel-based electromagnetic shield multilayer screen products)
IT 2253656-70-9P 2253656-71-0P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(layers; steel-based electromagnetic shield multilayer screen products)

L13 ANSWER 24 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1950769 CAPLUS Full-text
DOCUMENT NUMBER: 169:495369
TITLE: Microstructural features and corrosion analysis of A517 steel joint processed by friction stir welding
AUTHOR(S): Ansaripour, Morteza; Soltanipour, Abdol Reza; Dehnavi, Mohamad Reza
CORPORATE SOURCE: Materials Engineering Department, Malek Ashtar University of Technology, Shahin Shahr, Iran

SOURCE: Materials Research Express (2018), 5(6), 066543/1-066543/13
CODEN: MREAC3; ISSN: 2053-1591
DIGITAL OBJECT ID: 10.1088/2053-1591/aacc80
PUBLISHER: IOP Publishing Ltd.
DOCUMENT TYPE: Journal; (online computer file)
LANGUAGE: English

AB Microstructural observations of friction stir welds of A517 (B) steel showed that within the range of welding variables, martensite phase was hindered. Stir zone microstructure displayed coarse-grained upper bainite assocd. with granular bainite. HAZ consisted of decompd. bainite morphol. of lath-like and equiaxed. Electron backscatter diffraction anal. showed a random oriented recrystd. grain. The corrosion behavior in 3.5 wt% NaCl soln. revealed neg. shift of corrosion potential with increasing of traverse speed. However, the effect of welding parameters on cathodic behavior was more predominant than that on anodic behavior; assocd. with the microstructural alterations. Pitting of corrosion rust layer was identified as the main mechanism of corrosion attack in base material and welds. Although, corrosion c.d. of weld in all of the applied welding condition was slightly lower than that in the base material, however, this study provides recommendation for application of A517 steel jointed by friction stir welding in marine environment.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Bhadeshia, H	1999	A273-	58	Mater Sci Eng	CAPLUS
Casalino, G	2012		8239	Proc of SPIE-The Int	
Casalino, G	2014		8963	Proc of SPIE-The Int	
Chen, Y	2005	398	47	Mater Sci Eng A	
Choi, Y	2005	391	162	J Alloys Compd	CAPLUS
Cui, H	2016	681	426	J of Alloys and Comp	CAPLUS
Gao, K	2010	52	3428	Corros Sci	CAPLUS
Ghosh, M	2013	22	3890	J Mater Eng Perform	CAPLUS
Huang, H	1994	36	1027	Corros Sci	CAPLUS
Lee, W	2004	58	1041	Mater Lett	CAPLUS
Li, L	2012	7	3773	Int J Electrochem Sc	CAPLUS
Lu, B	2009	57	41	Acta Mater	CAPLUS
Manvatkar, V	2015	94	36	Scr Mater	CAPLUS
Medina, G	2016	21	146	Soldagem & Inspecao	
Meshram, S	2017	25	94	Journal of Manufactu	
Mishra, R	2005	50	1	Mater Sci Eng R	
Nelson, T	2016	231	66	Mater Process Techno	CAPLUS
Park, H	2004	371A	160	Mater Sci Eng	
Paul, C	2015	10	10246	Int J Electrochem Sc	
Ramirez, A	2013		75	Proc of the 1st Int	
Ren, R	2012	85	283	Electrochemica Acta	CAPLUS
Sato, Y	2005	53	637	Acta Mater	CAPLUS
Sato, Y	2001	32A	3033	Metall Mater Trans	CAPLUS
Sherif, E	2015	10	34	Int J Electrochem Sc	CAPLUS
Sherif, E	2011	129	961	Mater Chem Phy	CAPLUS
Sutton, M	2003	70	2215	Eng Fract Mech	
Sutton, M	2003	354A	6	Mater Sci Eng	
Wang, H	2015	10	5827	Int J Electrochem Sc	CAPLUS
Wang, X	2014	9	4574	Int J Electrochem Sc	
Wang, X	2014	21	474	J Nat Gas Sci Eng	CAPLUS
Wert, J	2003	49	607	Scr Mater	CAPLUS
Yan, J	2005	10	725	Sci Tech Weld Joinin	CAPLUS
Zajac, S	2005		387	Proc of the Int Conf	CAPLUS
Zhang, Q	2002	77	603	Mater Chem Phys	
Zhang, R	2010	41A	1448	Metall Mater Trans	CAPLUS
Zhang, S	2013	75	293	Corros Sci	CAPLUS

IT 52346-86-8, A517B, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(microstructural features and corrosion anal. of A517 steel joint processed by friction stir welding)
RN 52346-86-8 CAPLUS
CN Steel, (UNS K11630) (CA INDEX NAME)

Component	Component Percent	Component Registry Number

Fe	97	-	98	7439-89-6
Mn	0.70	-	1.00	7439-96-5
Cr	0.40	-	0.65	7440-47-3
Si	0.20	-	0.35	7440-21-3
Mo	0.15	-	0.25	7439-98-7
C	0.12	-	0.21	7440-44-0
V	0.03	-	0.08	7440-62-2
S	0	-	0.04	7704-34-9
P	0	-	0.035	7723-14-0
Ti	0.01	-	0.03	7440-32-6
B	0.0005	-	0.005	7440-42-8

CC 55-9 (Ferrous Metals and Alloys)
ST steel joint processed friction stir welding microstructural feature corrosion
IT Corrosion
Corrosion resistance
Current density
Electric current-potential relationship
Friction welding
Friction welds
Grain size
Microstructure
Recrystallization
(microstructural features and corrosion anal. of A517 steel joint processed by friction stir welding)
IT 12173-93-2, Martensite, formation (nonpreparative) 12427-23-5, Bainite
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(microstructural features and corrosion anal. of A517 steel joint processed by friction stir welding)
IT 52346-86-8, A517B, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(microstructural features and corrosion anal. of A517 steel joint processed by friction stir welding)

L13 ANSWER 25 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1916470 CAPLUS Full-text
DOCUMENT NUMBER: 169:454845
TITLE: Aluminum alloy plated electric resistance welded pipe for quenching and method of manufacturing aluminum plated hollow member
INVENTOR(S): Maki, Jun; Fujita, Soshi; Nakamura, Toyomitsu
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Tokkyo Koho, 23pp.
CODEN: JTXXFF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 6406475	B1	20181017	JP 2018-513042	20171120
WO 2019097729	A1	20190523	WO 2017-JP41697	20171120
CN 111247266	A	20200605	CN 2017-80096110	20171120
IN 202017014250	A	20200814	IN 2020-17014250	20200331
US 20200347489	A1	20201105	US 2020-16753961	20200406

PRIORITY APPLN. INFO.: WO 2017-JP41697 W 20171120
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The aluminum alloy plated elec. resistance welded pipe for quenching comprises a base material made of tubular steel plate and an elec. resistance welded part provided in abutting part of steel plate and extending in longitudinal direction. The base material comprises in mass%: carbon 0.06-0.5, silicon 0.01-0.8, manganese 0.6-3, phosphorous 0-0.05, sulfur 0-0.05, aluminum 0-0.1, oxygen 0-0.006, nitrogen 0-0.02, titanium 0.01-0.1, boron 0-0.1, niobium 0-0.1, vanadium 0-0.3, chromium 0-0.5, molybdenum 0-0.5, nickel 0-0.5, copper 0-0.5, calcium 0-0.005, rare earth metal 0-0.005, iron balance and impurities. The base material is positioned on the surface of steel sheet and has an intermetallic compd. layer contg. an aluminum-iron-silicon based intermetallic compd. and an

aluminum plating layer located on the surface of the intermetallic compd. layer and contg. aluminum and silicon. The thickness of intermetallic compd. layer is X (μm), the thickness of aluminum layer is Y (μm), and when the thickness of steel pipe is t (mm) and outer diam. of steel pipe is D (mm), the following formula is satisfied: $70 \times X/D \lesssim Y/t \lesssim 30$. The method of manufg. aluminum plated hollow member comprises: positioning the base material on the surface of steel sheet, heating aluminum-plated elec. resistance welded pipe, forming the heated aluminum-plated elec. resistance welded pipe into desired shape, and rapidly cooling the aluminum plating elec. resistance welded pipe. According to the present invention, it is possible to manuf. high strength aluminum plated hollow member by hot working, and it is possible to obtain part that has reduced wt.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1983			JP 58204179 A	CAPLUS
Anon	2008			JP 2008069398 A	CAPLUS
Anon	2009			WO 2009131233 A1	CAPLUS
Anon	2014			JP 2014118628 A	CAPLUS
Anon	2017			JP 2017026147 A	CAPLUS

IT 2247299-93-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum alloy plated elec. resistance welded pipe for quenching and method of manufg. aluminum plated hollow member)

RN 2247299-93-8 CAPLUS

CN Iron alloy, base, Fe 93-99,Mn 0.6-3,Si 0-0.8,C 0.1-0.5,Cr 0-0.5,Cu 0-0.5,Mo 0-0.5,Ni 0-0.5,V 0-0.3,Al 0-0.1,B 0-0.1,Nb 0-0.1,Ti 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	93	-	99	7439-89-6
Mn	0.6	-	3	7439-96-5
Si	0	-	0.8	7440-21-3
C	0.1	-	0.5	7440-44-0
Cr	0	-	0.5	7440-47-3
Cu	0	-	0.5	7440-50-8
Mo	0	-	0.5	7439-98-7
Ni	0	-	0.5	7440-02-0
V	0	-	0.3	7440-62-2
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
Ti	0	-	0.1	7440-32-6

IPCI C23C0002-28 [I]; C23C0002-12 [I]; C23C0002-40 [I]; C23C0002-26 [I]; C23C0028-00 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-08 [N]; C21D0001-18 [N]; C21D0009-50 [N]; C22C0021-00 [N]

IPCR C23C0002-28 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C23C0002-12 [I]; C23C0002-26 [I]; C23C0002-40 [I]; C23C0028-00 [I]

CC 56-6 (Nonferrous Metals and Alloys)

IT 2247299-93-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum alloy plated elec. resistance welded pipe for quenching and method of manufg. aluminum plated hollow member)

L13 ANSWER 26 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2018:1651585 CAPLUS Full-text

DOCUMENT NUMBER: 169:330484

TITLE: Method for producing a hot-formed coated steel product

INVENTOR(S): Beentjes, Petrus Cornelis Jozef; Van Schoonevelt, Hugo

PATENT ASSIGNEE(S): Tata Steel IJmuiden B.V., Neth.

SOURCE: PCT Int. Appl., 28pp.
CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: English

FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018158166	A1	20180907	WO 2018-EP54600	20180223
CA 3051002	A1	20180907	CA 2018-3051002	20180223
MX 2019010192	A	20191002	MX 2019-10192	20180223
CN 110352260	A	20191018	CN 2018-80014405	20180223
KR 2019124211	A	20191104	KR 2019-7023413	20180223
EP 3589772	A1	20200108	EP 2018-714700	20180223
JP 2020510755	T	20200409	JP 2019-546825	20180223
BR 112019015673	A2	20200707	BR 2019-112019015673	20180223
US 20200165712	A1	20200528	US 2019-16485606	20190813
IN 201947037974	A	20190927	IN 2019-47037974	20190920

PRIORITY APPLN. INFO.:

EP 2017-158418	A	20170228
EP 2017-158419	A	20170228
WO 2018-EP54600	W	20180223

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The invention relates to an Al-Si-alloy coated steel strip for hot press forming and to a method for producing the Al-Si-alloy coated steel strip in a continuous coating process.

IT 2243499-83-2D, Aluminum 0-3, boron 0-0.1, carbon 0-0.5, chromium 0-4, copper 0-2, manganese 0.4-4, molybdenum 0-1, nickel 0-2, niobium 0-0.3, phosphorus 0-0.1, silicon 0-3, titanium 0-0.3, tungsten 0-0.5, vanadium 0-0.5, iron bal., S 0-0.05, N 0.001-0.03, Ca 0-0.05, O 0-0.008
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing hot-formed coated steel product)

RN 2243499-83-2 CAPLUS

CN Iron alloy, base, Fe 79-100,Mn 0.4-4,Cr 0-4,Al 0-3,Si 0-3,Cu 0-2,Ni 0-2,Mo 0-1,C 0-0.5,V 0-0.5,W 0-0.5,Nb 0-0.3,Ti 0-0.3,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	79 - 100	7439-89-6
Mn	0.4 - 4	7439-96-5
Cr	0 - 4	7440-47-3
Al	0 - 3	7429-90-5
Si	0 - 3	7440-21-3
Cu	0 - 2	7440-50-8
Ni	0 - 2	7440-02-0
Mo	0 - 1	7439-98-7
C	0 - 0.5	7440-44-0
V	0 - 0.5	7440-62-2
W	0 - 0.5	7440-33-7
Nb	0 - 0.3	7440-03-1
Ti	0 - 0.3	7440-32-6
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

IPCI C23C0002-12 [I]; C23C0002-28 [I]; C23C0002-40 [I]
IPCR C23C0002-12 [I]; C23C0002-28 [I]; C23C0002-40 [I]
CC 56-7 (Nonferrous Metals and Alloys)
ST hot formed aluminum silicon alloy coated steel product prodn
IT Paints
(adhesion; method for producing hot-formed coated steel product)
IT Heating
(convective, prediffusion annealing; method for producing hot-formed coated steel product)
IT Aluminizing
(hot dip; method for producing hot-formed coated steel product)
IT Hot-dip coating process
(hot-dip aluminizing; method for producing hot-formed coated steel product)
IT Metal forming
(hot; method for producing hot-formed coated steel product)

IT Automobile bodies
Cooling
Cutting
Diffusion coating materials
Immersion coating process
Phase composition
Surface structure
Thickness
(method for producing hot-formed coated steel product)
IT Adhesion, physical
(paint; method for producing hot-formed coated steel product)
IT Induction heating
Radiant heating
(prediffusion annealing; method for producing hot-formed coated steel product)
IT Annealing
(prediffusion; method for producing hot-formed coated steel product)
IT 12004-62-5 12043-58-2 596799-27-8, Aluminum iron silicide (Al2Fe2Si)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(method for producing hot-formed coated steel product)
IT 7440-70-2D, Calcium, trace in steel 7704-34-9D, Sulfur, trace in steel 7727-37-9D, Nitrogen, trace in steel
7782-44-7D, Oxygen, trace in steel
RL: OCU (Occurrence, unclassified); OCCU (Occurrence)
(method for producing hot-formed coated steel product)
IT 2243499-83-2D, Aluminum 0-3, boron 0-0.1, carbon 0-0.5, chromium 0-4, copper 0-2, manganese 0.4-4, molybdenum 0-1, nickel 0-2, niobium 0-0.3, phosphorus 0-0.1, silicon 0-3, titanium 0-0.3, tungsten 0-0.5, vanadium 0-0.5, iron bal., S 0-0.05, N 0.001-0.03, Ca 0-0.05, O 0-0.008
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing hot-formed coated steel product)
IT 12597-69-2, Steel, processes 2243499-81-0, Aluminum 96-100, silicon 0.4-4
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing hot-formed coated steel product)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 27 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:1651584 CAPLUS Full-text
DOCUMENT NUMBER: 169:330483
TITLE: Method for producing a steel strip with an aluminum alloy coating layer
INVENTOR(S): Hensen, Guido Cornelis
PATENT ASSIGNEE(S): Tata Steel IJmuiden B.V., Neth.
SOURCE: PCT Int. Appl., 29pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018158165	A1	20180907	WO 2018-EP54599	20180223
CA 3051515	A1	20180907	CA 2018-3051515	20180223
CN 110352259	A	20191018	CN 2018-80014404	20180223
KR 2019124210	A	20191104	KR 2019-7023412	20180223
EP 3589771	A1	20200108	EP 2018-714699	20180223
BR 112019015695	A2	20200407	BR 2019-112019015695	20180223
JP 2020510756	T	20200409	JP 2019-546864	20180223
US 20200017948	A1	20200116	US 2019-16485655	20190813
IN 201947038244	A	20191004	IN 2019-47038244	20190923

PRIORITY APPLN. INFO.: EP 2017-158418 A 20170228
EP 2017-158419 A 20170228
WO 2018-EP54599 W 20180223
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention relates to a method for producing a steel strip with an aluminum alloy coating layer in a continuous coating process. The invention also relates to an steel strip coated with an aluminum alloy coating layer that can be produced in accordance with the method, the use of such a coated steel strip and the product made by using the coated steel strip.
IT 2243499-83-2D, Aluminum 0-3, boron 0-0.1, carbon 0-0.5, chromium 0-4, copper 0-2, manganese 0.4-4, molybdenum 0-1, nickel 0-2, niobium 0-0.3, phosphorus 0-0.1, silicon 0-3, titanium 0-0.3, tungsten 0-0.5, vanadium 0-0.5, iron bal., S 0-0.05, N 0.001-0.03, Ca 0-0.05, O 0-0.008
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing steel strip with aluminum alloy coating layer)
RN 2243499-83-2 CAPLUS
CN Iron alloy, base, Fe 79-100,Mn 0.4-4,Cr 0-4,Al 0-3,Si 0-3,Cu 0-2,Ni 0-2,Mo 0-1,C 0-0.5,V 0-0.5,W 0-0.5,Nb 0-0.3,Ti 0-0.3,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	79	-	100	7439-89-6
Mn	0.4	-	4	7439-96-5
Cr	0	-	4	7440-47-3
Al	0	-	3	7429-90-5
Si	0	-	3	7440-21-3
Cu	0	-	2	7440-50-8
Ni	0	-	2	7440-02-0
Mo	0	-	1	7439-98-7
C	0	-	0.5	7440-44-0
V	0	-	0.5	7440-62-2
W	0	-	0.5	7440-33-7
Nb	0	-	0.3	7440-03-1
Ti	0	-	0.3	7440-32-6
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C23C0002-12 [I]; C23C0002-28 [I]; C23C0002-40 [I]
IPCR C23C0002-12 [I]; C23C0002-28 [I]; C23C0002-40 [I]
CC 56-7 (Nonferrous Metals and Alloys)
ST aluminum alloy coated steel strip hot dip prodn method
IT Recrystallization
(annealing, before hot dipping; method for producing steel strip with aluminum alloy coating layer)
IT Induction heating
Radiant heating
(annealing; method for producing steel strip with aluminum alloy coating layer)
IT Annealing
(diffusion; method for producing steel strip with aluminum alloy coating layer)
IT Aluminizing
(hot dip, continuous; method for producing steel strip with aluminum alloy coating layer)
IT Hot-dip coating process
(hot-dip aluminizing, continuous; method for producing steel strip with aluminum alloy coating layer)
IT Metal forming
(hot; method for producing steel strip with aluminum alloy coating layer)
IT Automobile bodies
Cooling
Cutting
Diffusion coating materials
Electric heating
Phase composition
Temperature

Thickness
(method for producing steel strip with aluminum alloy coating layer)

IT Crack propagation
(resistance; method for producing steel strip with aluminum alloy coating layer)

IT Wetting
(time; method for producing steel strip with aluminum alloy coating layer)

IT 12004-62-5 12043-58-2 596799-27-8, Aluminum iron silicide (Al2Fe2Si)
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(method for producing steel strip with aluminum alloy coating layer)

IT 7440-70-2D, Calcium, trace in steel 7704-34-9D, Sulfur, trace in steel 7727-37-9D, Nitrogen, trace in steel 7782-44-7D, Oxygen, trace in steel
RL: OCU (Occurrence, unclassified); OCCU (Occurrence)
(method for producing steel strip with aluminum alloy coating layer)

IT 12597-69-2, Steel, processes 2243499-81-0, Aluminum 96-100, silicon 0.4-4 2243499-83-2D, Aluminum 0-3, boron 0-0.1, carbon 0-0.5, chromium 0-4, copper 0-2, manganese 0.4-4, molybdenum 0-1, nickel 0-2, niobium 0-0.3, phosphorus 0-0.1, silicon 0-3, titanium 0-0.3, tungsten 0-0.5, vanadium 0-0.5, iron bal., S 0-0.05, N 0.001-0.03, Ca 0-0.05, O 0-0.008 2243499-84-3, Aluminum 97, iron 2.3, silicon 0.9 2243499-85-4, Aluminum 96, iron 2.3, silicon 1.9 2243499-86-5, Aluminum 96, iron 2.8, silicon 0.9
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for producing steel strip with aluminum alloy coating layer)

IT 2243499-82-1P, Aluminum 50-55, iron 43-48, silicon 0.4-4
RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(method for producing steel strip with aluminum alloy coating layer)

L13 ANSWER 28 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:863056 CAPLUS Full-text
DOCUMENT NUMBER: 168:486049
TITLE: Steel welding part with aluminum or aluminum alloy plating layer and manufacture method thereof
INVENTOR(S): Pan, Hua; Su, Yongchao; Lei, Ming; Shi, Lei; Jiang, Haomin
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: PCT Int. Appl., 17pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018077067	A1	20180503	WO 2017-CN106516	20171017
CN 106334875	A	20170118	CN 2016-10953787	20161027
MX 2019004121	A	20190606	MX 2019-4121	20171017
KR 2019069471	A	20190619	KR 2019-7013481	20171017
EP 3533558	A1	20190904	EP 2017-864438	20171017
JP 2019535894	T	20191212	JP 2019-520992	20171017
US 20200038998	A1	20200206	US 2019-16339215	20190403
IN 201917015151	A	20190719	IN 2019-17015151	20190415
PRIORITY APPLN. INFO.:			CN 2016-10953787 A	20161027
			WO 2017-CN106516 W	20171017

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention discloses a steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof. The steel welding part with aluminum or aluminum alloy plating layer comprises a steel substrate and a plating layer, the plating layer comprises an intermetallic compd. alloy layer in contact with the substrate, and a metal alloy layer thereon; which is characterized in that on at least one of the plated surfaces of the weld blank, the plating layer located

in the area to be welded of the weld blank is completely removed, and the end face of the welding blank part plating layer removed the region to be welded is perpendicular to the surface of the substrate which is parallel to weld seam to form an included angle β, and the included angle β =0-80°. A method of manufg. steel welding part with aluminum or aluminum alloy plating layer is characterized in that it includes the steps of: obtaining weld blank by welding according to the requirements of steel welding part with aluminum or aluminum alloy plating layer, welding the area to be welded of the weld blank where the plating layer has been completely removed to form a welded joint; obtaining a part by hot stamping, selecting a cooling rate which is greater than the crit. transformation speed of the matrix martensite quenching, and cooling. This invention ensures tensile strength, elongation rate and corrosion resistance of welding joint after hot stamping.

IT 2067242-22-0, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

RN 2067242-22-0 CAPLUS

CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1	7440-21-3
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B23K0026-32 [I]; C22C0038-04 [I]
IPCR B23K0026-32 [I]; C22C0038-04 [I]
CC 56-9 (Nonferrous Metals and Alloys)
Section cross-reference(s): 47
ST steel laser welding corrosion strength
IT Corrosion resistance
Elongation, mechanical
Laser welding
Plating process
Tensile strength
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)
IT Intermetallic compounds
RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)
IT 2067242-22-0, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)
IT 1273096-81-3, Aluminum alloy
RL: TEM (Technical or engineered material use); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)

L13 ANSWER 29 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2018:228290 CAPLUS Full-text
DOCUMENT NUMBER: 168:225095

TITLE: Low-carbon steel sheet and plated steel sheet for automobile parts
INVENTOR(S): Sano, Kohichi; Uno, Makoto; Nishiyama, Ryoichi; Yamaguchi, Yuji; Sugiura, Natsuko; Nakata, Masahiro
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 54pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2018026015	A1	20180208	WO 2017-JP28478	20170804
TW I629367	B	20180711	TW 2017-126478	20170804
JP 6358406	B2	20180718	JP 2017-562089	20170804
KR 2019012262	A	20190208	KR 2019-7000430	20170804
KR 2205432	B1	20210120		
MX 2019000051	A	20190401	MX 2019-51	20170804
CN 109563586	A	20190402	CN 2017-80047871	20170804
BR 112019000422	A2	20190430	BR 2019-112019000422	20170804
EP 3495529	A1	20190612	EP 2017-837116	20170804
US 20190233926	A1	20190801	US 2018-16312222	20181220
US 10889879	B2	20210112		
IN 201817049387	A	20190322	IN 2018-17049387	20181227

PRIORITY APPLN. INFO.: JP 2016-155090 A 20160805
WO 2017-JP28478 W 20170804
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The steel plate has chem. compn. as: aluminum 0.010-0.6, boron 0.0005-0.1, calcium 0.0001-0.05, carbon 0.008-0.15, chromium 0.05-1, copper 0.01-2, iron and impurities balance, magnesium 0.0001-0.05, manganese 0.60-2.5, molybdenum 0.01-1, nickel 0.01-2, niobium 0-0.2, nitrogen 0-0.006, phosphorus 0-0.05, rare earth metal 0.0001-0.05, silicon 0.01-1.7, sulfur 0-0.02, titanium 0-0.2, titanium and niobium 0.015-0.2, zirconium 0.0001-0.05, in mass%, and is provided with a structure represented by, in terms of area ratio, 5-95% ferrite and 5-95% bainite. When a crystal grain is defined as a region which is surrounded by grain boundaries having disorientation of 15°-or higher and for which the equiv. circle diam. is 0.3μm or larger, the proportion of crystal grains having an intragranular disorientation of 5-14°-relative to all of crystal grains is 20-100% in terms of area ratio. The steel plate comprises hard material crystal grains A in which ppts. or clusters with max. diam. of no larger than 8 nm are distributed in no. d. of 1×1016-1×1019 particles/cm3, and soft material crystal grains B in which ppts. or clusters with a max. diam. of no larger than 8 nm are distributed in no. d. of no higher than 1×1015 particles/cm3, and the vol.% of hard material crystal grains A/(vol.% of hard material crystal grains A+vol.% of soft material crystal grains B) is 0.1-0.9. The plated steel plate has galvannealed galvanized plating layer. The steel plate has high strength, good ductility and stretch flangeability, and high yield stress.
IT 2178084-33-6
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)
(low-carbon steel sheet and plated steel sheet for automobile parts)
RN 2178084-33-6 CAPLUS
CN Iron alloy, base, Fe 89-99,Mn 0.6-2.5,Cu 0-2,Ni 0-2,Si 0-1.7,Cr 0-1,Mo 0-1,Al 0-0.6,C 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	89 - 99	7439-89-6
Mn	0.6 - 2.5	7439-96-5
Cu	0 - 2	7440-50-8
Ni	0 - 2	7440-02-0
Si	0 - 1.7	7440-21-3
Cr	0 - 1	7440-47-3
Mo	0 - 1	7439-98-7
Al	0 - 0.6	7429-90-5
C	0 - 0.2	7440-44-0

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    Nb      0   -   0.2      7440-03-1
    Ti      0   -   0.2      7440-32-6
    B       0   -   0.1      7440-42-8

IPCI C22C0038-00 [I]; C22C0038-58 [I]; C21D0009-46 [N]
IPCR C22C0038-00 [I]; C21D0009-46 [N]; C22C0038-58 [I]
CC   55-3 (Ferrous Metals and Alloys)
ST   low carbon steel sheet plating automobile part
IT   Automobile parts
     Elongation, mechanical
     Galvannealing
     Grain size
     Hot-dip galvanizing
     Microstructure
     Sheet materials
     Tensile strength
     Yield strength
        (low-carbon steel sheet and plated steel sheet for
        automobile parts)
IT   2178084-33-6
     RL: PRP (Properties); TEM (Technical or engineered material use); USES
     (Uses)
        (low-carbon steel sheet and plated steel sheet for
        automobile parts)
OS.CITING REF COUNT:     1     THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD
                               (1 CITINGS)


L13  ANSWER 30 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2017:848898  CAPLUS Full-text
TITLE:                   Contact Fatigue Resistance of Carburized Gears from
                         Chromium-Nickel Steels
AUTHOR(S):               Rudenko, S. P.; Val'ko, A. L.
CORPORATE SOURCE:        United Institute for Mechanical Engineering, National
                         Academy of Sciences of Belarus, Minsk, Belarus
SOURCE:                  Metal Science and Heat Treatment (2017), 59(1-2),
                         60-64
                         CODEN: MHTRAN; ISSN: 0026-0673
DIGITAL OBJECT ID:       10.1007/s11041-017-0103-3
PUBLISHER:               Springer
DOCUMENT TYPE:           Journal; (online computer file)
LANGUAGE:                English
AB   The contact fatigue resistance of carburized gears produced from
     chromium-nickel steels is studied. The curves of deep contact fatigue of
     the material of the gears are plotted in terms of the criterion of
     equality of the characteristics of diffusion layers. An expression for
     ultimate deep contact fatigue resistance of carburized gears is derived.
RETABLE
   Referenced Author    |Year | VOL | PG   | Referenced Work    | Referenced
         (RAU)          |(RPY)|(RVL)|(RPG) |      (RWK)         | File
========================+=====+=====+======+====================+===========
Anon                    |     |     |      |A A Susin, Thermoche|
Anon                    |     |     |      |A I Petrusevich, Con|
Anon                    |     |     |      |A N Utkina, Yu Yu Ch|
Anon                    |     |     |      |B A Balashov, R R Ga|
Anon                    |     |     |      |B V Gold, E P Obolen|
Anon                    |     |     |      |E B Vulgakov (ed.), |
Anon                    |     |     |      |E I Tesker, Advanced|
Anon                    |     |     |      |N M Ryzhov, "Technol|
Anon                    |     |     |      |S P Rudenko and A L |
Anon                    |     |     |      |S P Rudenko, "A stud|
Anon                    |     |     |      |S P Rudenko, "Comput|
Anon                    |     |     |      |S P Rudenko, "Fatigu|
Anon                    |     |     |      |S P Rudenko, A L Val|
Anon                    |     |     |      |V E Antonyuk, B V Iv|
Anon                    |     |     |      |Yu S Eliseev, V V Kr|
IT   INDEXING IN PROGRESS
IT   37312-00-8
     RL: PEP (Physical, engineering or chemical process); PRP (Properties);
     PROC (Process)
        (contact fatigue resistance of carburized gears from chromium-nickel
        steels)
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RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
ST chromium nickel steel carburized gear contact fatigue resistance
IT Diffusion
Fatigue resistance
Gears
Microhardness
Microstructure
(contact fatigue resistance of carburized gears from chromium-nickel steels)
IT 12681-03-7 12742-08-4 37312-00-8 39411-21-7
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(contact fatigue resistance of carburized gears from chromium-nickel steels)

L13 ANSWER 31 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:342418 CAPLUS Full-text
DOCUMENT NUMBER: 166:297159
TITLE: Method for manufacturing steel plate with aluminum or aluminum alloy coating by hot stamping
INVENTOR(S): Liu, Xin; Hong, Zhenjun; Tan, Ning; Jin, Xinyan; Liu, Junxiang; Hong, Jiyao
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 15pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 106466697	A	20170301	CN 2016-10664566	20160812
CN 106466697	B	20200131		

PRIORITY APPLN. INFO.: CN 2016-10664566 20160812
AB The invention discloses a manuf. method of steel plate, which comprises the following steps: blanking the steel plate with aluminum or aluminum alloy coating by blanking or laser cutting, induction heating, hot stamping in die, and cooling. The temp. and time of heating are detd. by the thickness of steel plate. The components of the steel plate is as follows: C 0.08-0.8%, Si 0.05-1.0%, Mn 0.1-5%, P<0.3%, S<0.1%, Al<0.3%, Ti<0.5%, B 0.0005-0.1%, Cr 0.01-3%, and balance of Fe and inevitable impurities. The coating comprises alloy layer, aluminum enriched intermetallic compd. layer, intermediate layer and surface layer. The components of the alloy layer is Si 0-6%, Fe 75-96%, Al 2-12%; the components of the aluminum enriched intermetallic compd. layer is Si 0-2%, Fe 30-50%, Al 40-60%; the components of the intermediate layer is Si 2-6%, Fe 50-65%, Al 20-35%; and the components of the surface layer is Si 2-6%, Fe 50-65%, Al 20-35%. The product has high strength, complex

shape, good formability, high precision, and small springback, which can be used for automobile parts such as bumper, pillar reinforced plate, floor inside passage, and stiffening beam, etc..

IT 2067242-22-0P, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

RN 2067242-22-0 CAPLUS

CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	89	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Cr	0	-	3	7440-47-3
Si	0	-	1	7440-21-3
C	0.1	-	0.8	7440-44-0
Ti	0	-	0.5	7440-32-6
Al	0	-	0.3	7429-90-5
P	0	-	0.3	7723-14-0
B	0	-	0.1	7440-42-8
S	0	-	0.1	7704-34-9

IPCI B21D0053-88; C22C0038-02; C22C0038-04; C22C0038-06; C22C0038-32; C22C0038-60; C23C0002-12; C23C0002-40
IPCR B21D0053-88 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-32 [I]; C22C0038-60 [I]; C23C0002-12 [I]; C23C0002-40 [I]
CC 55-1 (Ferrous Metals and Alloys)
ST hot stamping aluminum alloy steel plate coating manuf
IT Coating materials
Cooling
Induction heating
Industrial manufacturing
Laser cutting
Quenching (cooling)
Transmissions (mechanical)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

IT Metalworking
(stamping, hot; method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

IT 2067242-22-0P, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal. 2087430-40-6P, Aluminum 2-12, iron 75-96, silicon 0-6 2087430-41-7P, Aluminum 40-60, iron 30-50, silicon 0-2 2087430-42-8P, Aluminum 20-35, iron 50-65, silicon 2-6
RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

IT 2087430-39-3, Iron 0-4, silicon 5-11, Aluminum bal.
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

IT 7429-90-5, Aluminum, processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manufg. steel plate with aluminum or aluminum alloy coating by hot stamping)

L13 ANSWER 32 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:227313 CAPLUS Full-text
DOCUMENT NUMBER: 166:249360
TITLE: Hot rolled steel sheet and its manufacture for

automobile parts
INVENTOR(S): Sakakibara, Chikami; Sugiura, Natsuko; Tanaka, Yasuaki; Tanei, Hiroshi; Fujii, Takashi; Yokoyama, Takashi
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 16pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2017031454	A	20170209	JP 2015-150831	20150730
JP 6620446	B2	20191218		
WO 2017022025	A1	20170209	WO 2015-JP71845	20150731

PRIORITY APPLN. INFO.: JP 2015-150831 T0 20150730

AB To provide hot-rolled steel plate excellent in pickling property and without an increase in equipment cost, generation of internal oxide layer of a high strength hot rolled steel sheet contg. relatively large amts. of Si and Mn is suppressed, and method for manufg. thereof. Hot-rolled steel plate comprises C: 0.04-0.6%, Si: 0.01-3%, Mn: 0.1-5%, P: 0.04% or less, S: 0.05% or less, Al: 0.001-2%, N: 0.01% or less, O: 0.01% or less, one or more of Sb, Sn and Te: total amt. of 0.01-0.3% and remainder of Fe and unavoidable impurities, and has thickness of the internal oxide layer of 5 μm or less, a concd. layer of Sb, Sn and Te as an upper layer of the internal oxide layer, and has mech. properties with a tensile strength of 590 MPa or more.

IT 2079034-18-5P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high strength hot rolled steel sheet and its manuf. for automobile parts)
RN 2079034-18-5 CAPLUS
CN Iron alloy, base, Fe 80-100,Mn 0.1-5,Si 0-3,Al 0-2,Cr 0-2,Cu 0-2,Ni 0-2,Mo 0-1,C 0-0.6,Nb 0-0.3,Sb 0-0.3,Sn 0-0.3,Te 0-0.3,Ti 0-0.3,V 0-0.3,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	80	-	100	7439-89-6
Mn	0.1	-	5	7439-96-5
Si	0	-	3	7440-21-3
Al	0	-	2	7429-90-5
Cr	0	-	2	7440-47-3
Cu	0	-	2	7440-50-8
Ni	0	-	2	7440-02-0
Mo	0	-	1	7439-98-7
C	0	-	0.6	7440-44-0
Nb	0	-	0.3	7440-03-1
Sb	0	-	0.3	7440-36-0
Sn	0	-	0.3	7440-31-5
Te	0	-	0.3	13494-80-9
Ti	0	-	0.3	7440-32-6
V	0	-	0.3	7440-62-2
B	0	-	0.1	7440-42-8

IPCI C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]
IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-60 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST hot rolled steel sheet manuf automobile part
IT Automobile parts
Casting of metals
Hot rolling
Melting
Microstructure
Pickling
Sheet materials
Tensile strength
(high strength hot rolled steel sheet and its manuf. for

automobile parts)
IT 2079034-18-5P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(high strength hot rolled steel sheet and its manuf. for automobile parts)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 33 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2017:100416 CAPLUS Full-text
DOCUMENT NUMBER: 166:179501
TITLE: Steel welding part with aluminum or aluminum alloy plating layer and manufacture method thereof
INVENTOR(S): Pan, Hua; Su, Yongchao; Lei, Ming; Shi, Lei; Jiang, Haomin
PATENT ASSIGNEE(S): Baoshan Iron & Steel Co., Ltd., Peop. Rep. China
SOURCE: Faming Zhuanli Shenqing, 8pp.
CODEN: CNXXEV
DOCUMENT TYPE: Patent
LANGUAGE: Chinese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 106334875	A	20170118	CN 2016-10953787	20161027
WO 2018077067	A1	20180503	WO 2017-CN106516	20171017
MX 2019004121	A	20190606	MX 2019-4121	20171017
KR 2019069471	A	20190619	KR 2019-7013481	20171017
EP 3533558	A1	20190904	EP 2017-864438	20171017
JP 2019535894	T	20191212	JP 2019-520992	20171017
US 20200038998	A1	20200206	US 2019-16339215	20190403
IN 201917015151	A	20190719	IN 2019-17015151	20190415
PRIORITY APPLN. INFO.:			CN 2016-10953787 A	20161027
			WO 2017-CN106516 W	20171017

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention discloses a steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof. The steel welding part with aluminum or aluminum alloy plating layer comprises a steel substrate and a plating layer, the plating layer comprises an intermetallic compd. alloy layer in contact with the substrate, and a metal alloy layer thereon; which is characterized in that on at least one of the plated surfaces of the weld blank, the plating layer located in the area to be welded of the weld blank is completely removed, and the end face of the welding blank part plating layer removed the region to be welded is perpendicular to the surface of the substrate which is parallel to weld seam to form an included angle β, and the included angle β =0-80°. A method of manufg. steel welding part with aluminum or aluminum alloy plating layer is characterized in that it includes the steps of: obtaining weld blank by welding according to the requirements of steel welding part with aluminum or aluminum alloy plating layer, welding the area to be welded of the weld blank where the plating layer has been completely removed to form a welded joint; obtaining a part by hot stamping, selecting a cooling rate which is greater than the crit. transformation speed of the matrix martensite quenching, and cooling. This invention ensures tensile strength, elongation rate and corrosion resistance of welding joint after hot stamping.
IT 2067242-22-0, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8, chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur 0-0.1, titanium 0-0.5, iron bal.
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel welding part with aluminum or aluminum alloy plating layer and manuf. method thereof)
RN 2067242-22-0 CAPLUS
CN Iron alloy, base, Fe 89-100,Mn 0.1-5,Cr 0-3,Si 0-1,C 0.1-0.8,Ti 0-0.5,Al 0-0.3,P 0-0.3,B 0-0.1,S 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number

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=========+=============+===============
    Fe     89   - 100        7439-89-6
    Mn      0.1 -   5        7439-96-5
    Cr      0   -   3        7440-47-3
    Si      0   -   1        7440-21-3
    C       0.1 -   0.8      7440-44-0
    Ti      0   -   0.5      7440-32-6
    Al      0   -   0.3      7429-90-5
    P       0   -   0.3      7723-14-0
    B       0   -   0.1      7440-42-8
    S       0   -   0.1      7704-34-9

IPCI B23K0026-32; C22C0038-04; C22C0038-02; C22C0038-06; C22C0038-14;
     C22C0038-18; C23C0002-12; B23K0103-20
IPCR B23K0026-32 [I]; B23K0103-20 [N]; C22C0038-02 [I]; C22C0038-04 [I];
     C22C0038-06 [I]; C22C0038-14 [I]; C22C0038-18 [I]; C23C0002-12 [I]
CC   56-9 (Nonferrous Metals and Alloys)
     Section cross-reference(s): 47
ST   steel welding part aluminum alloy plating layer
IT   Metalworking
        (stamping, hot; steel welding part with aluminum or aluminum
        alloy plating layer and manuf. method thereof)
IT   Corrosion-resistant materials
     Industrial manufacturing
     Joints, mechanical
     Laser ablation
     Laser welding
     Plating process
     Welding apparatus
     Welds
        (steel welding part with aluminum or aluminum alloy plating
        layer and manuf. method thereof)
IT   12003-42-8   12004-62-5   12043-58-2
     RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)
        (steel welding part with aluminum or aluminum alloy plating
        layer and manuf. method thereof)
IT   1273096-81-3P, Aluminum alloy
     RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical
     process); TEM (Technical or engineered material use); PREP (Preparation);
     PROC (Process); USES (Uses)
        (steel welding part with aluminum or aluminum alloy plating
        layer and manuf. method thereof)
IT   2067242-22-0, Aluminum 0-0.3, boron 0-0.1, carbon 0.1-0.8,
     chromium 0-3, manganese 0.1-5, phosphorus 0-0.3, silicon 0-1, sulfur
     0-0.1, titanium 0-0.5, iron bal.
     RL: PEP (Physical, engineering or chemical process); TEM (Technical or
     engineered material use); PROC (Process); USES (Uses)
        (steel welding part with aluminum or aluminum alloy plating
        layer and manuf. method thereof)
OS.CITING REF COUNT:     2     THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD
                               (2 CITINGS)


L13  ANSWER 34 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2016:2049760  CAPLUS Full-text
DOCUMENT NUMBER:         167:333389
TITLE:                   Method for hot forming a coated metal part and
                         formed part
INVENTOR(S):             Verloop, Willem Cornelis; Van Genderen, Marc Jacco;
                         Van Tol, Ronald Theodoor; Hensen, Guido Cornelis;
                         Loiseaux, Jenny
PATENT ASSIGNEE(S):      Tata Steel IJmuiden B.V., Neth.
SOURCE:                  U.S., No pp. given
                         CODEN: USXXAM
DOCUMENT TYPE:           Patent
LANGUAGE:                English
FAMILY ACC. NUM. COUNT:  2
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.         DATE
     ---------------     ----  --------    ----------------------  --------
     US 9127329           B2   20150908    US 2013-13818041        20130220
     US 20130153094       A1   20130620
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WO 2012028224 A1 20120308 WO 2011-EP3601 20110719
PRIORITY APPLN. INFO.: EP 2010-9041 A 20100831
WO 2011-EP3601 W 20110719
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A method for manufg. a coated part having very high mech. properties using hot forming techniques. The method includes: -providing an annealed steel strip or blank or pre-shaped part that was coated with a metal or metal alloy before the annealing -if a strip is provided, cutting a blank from the strip before or after the annealing -optionally forming a pre-shaped part from the blank -heating the blank or preshaped part to a temp. of 500° C. at an av. heating rate of 16° C./s or more -further heating the blank or pre-shaped part to a temp. between 700 and 1000° C. -hot forming the blank or preshaped part into a hot formed part -hardening the hot formed part. A method for manufg. a coated steel strip, blank or pre-shaped part, and a coated steel strip, blank or part and a hot formed part.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	2009			DE 102008022400 A1	CAPLUS
Anon	2009			WO 2009021743 A1	CAPLUS
Anon	2009			WO 2009096351 A1	CAPLUS
Anon	2010			WO 2010005121 A1	CAPLUS
Anon	2010			WO 2010069588 A1	CAPLUS
Anon	2010			WO 2010085983 A1	CAPLUS
Anon	2010			EP 2177641 A1	CAPLUS
Anon	2002			"Glossary of Metallu	
Anon	2011			International Search	
Brandstatter	2011			US 20110045316 A1	CAPLUS
Hensen	2011			US 20110236719 A1	CAPLUS
Maki	2011			US 20110174418 A1	CAPLUS
Mehler	1962			US 3056694 A	CAPLUS
Oh	2008			US 20080286603 A1	CAPLUS
Thirion	2012			US 20120085467 A1	CAPLUS
Toki	2011			US 20110048585 A1	CAPLUS
Vlot	2010			US 20100026048 A1	CAPLUS

IT 1360605-36-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manuf. coated steel parts by hot forming)
RN 1360605-36-2 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1,V 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.1 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0
V	0 - 0.1	7440-62-2

IPCI C21D0008-02 [I]; C21D0009-46 [I]; C23C0002-06 [I]; C23C0002-40 [I]; B32B0015-01 [I]; C21D0001-673 [I]; C21D0008-04 [I]; C21D0009-48 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C23C0010-28 [I]; C23C0010-60 [I]; C21D0008-02 [I]; B32B0015-01 [I]
IPCR C21D0008-02 [I]; B32B0015-01 [I]; C21D0001-673 [I]; C21D0008-04 [I]; C21D0009-46 [I]; C21D0009-48 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C23C0002-06 [I]; C23C0002-40 [I]; C23C0010-28 [I]; C23C0010-60 [I]
NCL 001/001.000; 148/533.000; 148/330.000
CC 55-3 (Ferrous Metals and Alloys)
ST steel strip coating hot deformation
IT Plastic deformation

(hot; method for manuf. coated steel parts by hot forming)

IT 1360605-37-3
RL: TEM (Technical or engineered material use); USES (Uses)
(coating; method for manuf. coated steel parts by hot forming)

IT 1360605-36-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manuf. coated steel parts by hot forming)

L13 ANSWER 35 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1997298 CAPLUS Full-text
DOCUMENT NUMBER: 167:180612
TITLE: Coated steel strips, methods of making the same, methods of using the same, stamping blanks prepared from the same, stamped products prepared from the same, and articles of manufacture which contain such a stamped product
INVENTOR(S): Drillet, Pascal; Spehner, Dominique; Kefferstein, Ronald
PATENT ASSIGNEE(S): Arcelormittal France, Fr.
SOURCE: U.S. Pat. Appl. Publ., No pp. given
CODEN: USXXCO
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 20110165436	A1	20110707	US 2011-447777	20110318
WO 2008053273	A1	20080508	WO 2006-IB4019	20061030
EP 3290199	A1	20180307	EP 2017-192410	20061030
EP 3290199	B1	20190821		
EP 3290200	A1	20180307	EP 2017-192418	20061030
EP 3587104	A1	20200101	EP 2019-185736	20061030
EP 3587105	A1	20200101	EP 2019-185743	20061030
US 20130029172	A1	20130131	US 2012-13621015	20120915
US 9708683	B2	20170718		
US 20170260603	A1	20170914	US 2017-15606770	20170526
US 10550447	B2	20200204		
US 20190271055	A1	20190905	US 2019-16413774	20190516
US 10590507	B2	20200317		
US 20190271056	A1	20190905	US 2019-16413799	20190516
US 20190271057	A1	20190905	US 2019-16413825	20190516
US 20190271058	A1	20190905	US 2019-16414022	20190516
US 10597747	B2	20200324		
US 20190276912	A1	20190912	US 2019-16413729	20190516
US 10577674	B2	20200303		

PRIORITY APPLN. INFO.:

WO 2006-IB4019	W	20061030
EP 2006-842403	A3	20061030
EP 2017-192410	A3	20061030
US 2011-447777	A3	20110318
US 2012-13621015	A1	20120915
US 2017-15606770	A1	20170526

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB Coated steel having a well defined and uniform thickness is useful and advantageous for prepg. products by hot stamping. Products prepd. by hot stamping such a steel are particularly advantageous when subjected to a subsequent spot welding step.
IT 1022915-01-0
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)
RN 1022915-01-0 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component Component Component

	Percent	Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.2 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

INCL 428653000; 072342100; 072047000
IPCI B32B0015-01 [I]; B21D0022-00 [I]; C21D0009-46 [I]
IPCR B32B0015-01 [I]; B21D0022-00 [I]; C21D0009-46 [I]
NCL 428/653.000; 072/047.000; 072/342.100
CC 55-11 (Ferrous Metals and Alloys)
ST aluminum coated steel strip stamping article spot welding
IT Metalworking
(stamping; aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)
IT 7429-90-5, Aluminum, uses 952598-91-3, Aluminum 87-90, iron 2-4, silicon 8-11
RL: NUU (Other use, unclassified); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)
IT 1022915-01-0
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)

L13 ANSWER 36 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1770673 CAPLUS Full-text
DOCUMENT NUMBER: 165:549448
TITLE: Production of hot or cold strips from steel having high copper content
INVENTOR(S): Redenius, Alexander; Evertz, Thomas; Palzer, Peter
PATENT ASSIGNEE(S): Salzgitter Flachstahl GmbH, Germany
SOURCE: PCT Int. Appl., 23pp.; Chemical Indexing Equivalent to 165:549447 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016174020	A1	20161103	WO 2016-EP59266	20160426
DE 102015106780	A1	20161103	DE 2015-102015106780	20150430
PRIORITY APPLN. INFO.:			DE 2015-102015106780 A	20150430

AB A hot or cold strip of steel with high copper content, is manufd. by: melting a steel melt contg. (in wt.%) 0-0.4% C, 0-3% Mn, 0-2% Al, 0-2% Si, more than 0.8% Cu, 0-0.2% P, 0-0.05% S, and 0-0.3% N, with optional addn. of Sn, Ni, Cr, V, Nb, Ti, Mo, W, B, Co, Sb and/or Zr, the remainder being iron and unavoidable impurities; casting the melt under an atm. having an oxygen content <10 vol.%, by a near-net-shape casting method, in particular horizontal strip casting or vertical casting according to the two-roll method, into a pre-strip having a thickness in of 1-30 mm; cooling the cast pre-strip at a cooling rate ≥100 K/s at the actively cooled strip surface until forming a rigid boundary layer.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
FANG YUAN	2014			US 20140366602 A1	
GUELTON NICOLAS PATRICE	2004			EP 1466024 A1	CAPLUS
IKI HIROSHI	2000			JP 2000045045 A	CAPLUS
IUNG THIERRY	2001			EP 1072689 A1	CAPLUS
MARUYAMA NAOKI	2005			JP 2005036271 A	CAPLUS
MIZOGUCHI TOSHIAKI NIPP	1995			EP 0641867 A1	CAPLUS

UENISHI AKIHIRO |2000 | | |EP 0969112 A1 |CAPLUS
YAMAKAWA TSUNAHIRO |1992 | | |US 5098489 A |CAPLUS

IT 2031158-69-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; prodn. of hot or cold strips from steel having high copper content)

RN 2031158-69-5 CAPLUS

CN Iron alloy, base, Fe 68-99,Cu 0.8-5,Cr 0-4,Co 0-3,Mn 0-3,Mo 0-3,W 0-3,Al 0-2,Ni 0-2,Si 0-2,Nb 0-0.9,Ti 0-0.9,V 0-0.9,Sn 0-0.5,Zr 0-0.5,C 0-0.4,B 0-0.3,N 0-0.3,P 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	68	-	99	7439-89-6
Cu	0.8	-	5	7440-50-8
Cr	0	-	4	7440-47-3
Co	0	-	3	7440-48-4
Mn	0	-	3	7439-96-5
Mo	0	-	3	7439-98-7
W	0	-	3	7440-33-7
Al	0	-	2	7429-90-5
Ni	0	-	2	7440-02-0
Si	0	-	2	7440-21-3
Nb	0	-	0.9	7440-03-1
Ti	0	-	0.9	7440-32-6
V	0	-	0.9	7440-62-2
Sn	0	-	0.5	7440-31-5
Zr	0	-	0.5	7440-67-7
C	0	-	0.4	7440-44-0
B	0	-	0.3	7440-42-8
N	0	-	0.3	17778-88-0
P	0	-	0.2	7723-14-0

IPCI C22C0038-00 [I]; B22D0011-00 [I]; B22D0011-06 [I]; B22D0011-106 [I]; B22D0011-124 [I]; B22D0011-14 [I]; B22D0011-22 [I]; B22D0015-00 [I]; B22D0037-00 [I]; C21D0006-00 [I]; C21D0008-02 [I]; C21D0001-26 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-16 [I]; B22D0011-112 [I]; C21D0006-02 [I]

IPCR C22C0038-00 [I]; B22D0011-00 [I]; B22D0011-06 [I]; B22D0011-106 [I]; B22D0011-112 [I]; B22D0011-124 [I]; B22D0011-14 [I]; B22D0011-22 [I]; B22D0015-00 [I]; B22D0037-00 [I]; C21D0001-26 [I]; C21D0006-00 [I]; C21D0006-02 [I]; C21D0008-02 [I]; C22C0038-02 [I]; C22C0038-04 [I]; C22C0038-06 [I]; C22C0038-16 [I]

CC 55-3 (Ferrous Metals and Alloys)

ST hot cold strip steel copper casting cooling

IT Annealing
Casting of metals
Cooling
Hot rolling
(prodn. of hot or cold strips from steel having high copper content)

IT 124-38-9, Carbon dioxide, uses 630-08-0, Carbon monoxide, uses 7440-37-1, Argon, uses 7727-37-9, Nitrogen, uses 7782-44-7, Oxygen, uses
RL: NUU (Other use, unclassified); USES (Uses)
(casting atm.; prodn. of hot or cold strips from steel having high copper content)

IT 2031158-68-4P 2031158-69-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; prodn. of hot or cold strips from steel having high copper content)

L13 ANSWER 37 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1770568 CAPLUS Full-text
DOCUMENT NUMBER: 165:549447
TITLE: Production of hot or cold strips from steel having high copper content
INVENTOR(S): Redenius, Alexander; Evertz, Thomas; Palzer, Peter

PATENT ASSIGNEE(S): Salzgitter Flachstahl GmbH, Germany
SOURCE: Ger. Offen., 9pp.; Chemical Indexing Equivalent to 165:549448 (WO)
CODEN: GWXXBX
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 102015106780	A1	20161103	DE 2015-102015106780	20150430
WO 2016174020	A1	20161103	WO 2016-EP59266	20160426

PRIORITY APPLN. INFO.: DE 2015-102015106780 A 20150430

AB A hot or cold strip of steel with high copper content, is manufd. by: melting a steel melt contg. (in wt.%) 0-0.4% C, 0-3% Mn, 0-2% Al, 0-2% Si, more than 0.8% Cu, 0-0.2% P, 0-0.05% S, and 0-0.3% N, with optional addn. of Sn, Ni, Cr, V, Nb, Ti, Mo, W, B, Co, Sb and/or Zr, the remainder being iron and unavoidable impurities; casting the melt under an atm. having an oxygen content <10 vol.%, by a near-net-shape casting method, in particular horizontal strip casting or vertical casting according to the two-roll method, into a pre-strip having a thickness in of 1-30 mm; cooling the cast pre-strip at a cooling rate ≥100 K/s at the actively cooled strip surface until forming a rigid boundary layer.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon				DE 112013001434 T5	CAPLUS
Anon				WO 2015003755 A1	CAPLUS
Anon				EP 2546368 A1	CAPLUS
Anon				DE 60306365 T2	
Anon	2013			M Bausch et al:Ultra	

IT 2031158-69-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; prodn. of hot or cold strips from steel having high copper content)

RN 2031158-69-5 CAPLUS
CN Iron alloy, base, Fe 68-99,Cu 0.8-5,Cr 0-4,Co 0-3,Mn 0-3,Mo 0-3,W 0-3,Al 0-2,Ni 0-2,Si 0-2,Nb 0-0.9,Ti 0-0.9,V 0-0.9,Sn 0-0.5,Zr 0-0.5,C 0-0.4,B 0-0.3,N 0-0.3,P 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	68	-	99	7439-89-6
Cu	0.8	-	5	7440-50-8
Cr	0	-	4	7440-47-3
Co	0	-	3	7440-48-4
Mn	0	-	3	7439-96-5
Mo	0	-	3	7439-98-7
W	0	-	3	7440-33-7
Al	0	-	2	7429-90-5
Ni	0	-	2	7440-02-0
Si	0	-	2	7440-21-3
Nb	0	-	0.9	7440-03-1
Ti	0	-	0.9	7440-32-6
V	0	-	0.9	7440-62-2
Sn	0	-	0.5	7440-31-5
Zr	0	-	0.5	7440-67-7
C	0	-	0.4	7440-44-0
B	0	-	0.3	7440-42-8
N	0	-	0.3	17778-88-0
P	0	-	0.2	7723-14-0

IPCI C22C0038-04 [I]; C22C0038-16 [I]; C21D0008-00 [I]; B22D0011-06 [I]; B22D0011-116 [I]; B22D0011-12 [I]; C22C0111-00 [I]
IPCR C22C0038-04 [I]; B22D0011-06 [I]; B22D0011-116 [I]; B22D0011-12 [I]; C21D0008-00 [I]; C22C0038-16 [I]; C22C0111-00 [N]
CC 55-3 (Ferrous Metals and Alloys)
ST hot cold strip steel copper casting cooling
IT Annealing

Casting of metals
Cooling
Hot rolling
(prodn. of hot or cold strips from steel having high copper content)

IT 124-38-9, Carbon dioxide, uses 630-08-0, Carbon monoxide, uses 7440-37-1, Argon, uses 7727-37-9, Nitrogen, uses 7782-44-7, Oxygen, uses
RL: NUU (Other use, unclassified); USES (Uses)
(casting atm.; prodn. of hot or cold strips from steel having high copper content)

IT 2031158-68-4P 2031158-69-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(strips; prodn. of hot or cold strips from steel having high copper content)

L13 ANSWER 38 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2016:1617614 CAPLUS Full-text
DOCUMENT NUMBER: 165:466273
TITLE: Composition and manufacture of carbon steel sheet suitable for hot stamping, and hot stamping molded parts
INVENTOR(S): Azuma, Masafumi; Suwa, Yoshihiro; Kondo, Yusuke; Sato, Koichi
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 49pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2016158961	A1	20161006	WO 2016-JP60145	20160329
CA 2979978	A1	20161006	CA 2016-2979978	20160329
KR 2017122823	A	20171106	KR 2017-7027982	20160329
KR 2000863	B1	20190716		
CN 107427889	A	20171201	CN 2016-80017529	20160329
CN 107427889	B	20191025		
MX 2017012377	A	20171214	MX 2017-12377	20160329
EP 3278895	A1	20180207	EP 2016-772842	20160329
EP 3278895	B1	20200311		
BR 112017020165	A2	20180605	BR 2017-112017020165	20160329
RU 2683397	C1	20190328	RU 2017-135379	20160329
JP 6515356	B2	20190522	JP 2017-510030	20160329
ES 2781465	T3	20200902	ES 2016-772842	20160329
TW I597370	B	20170901	TW 2016-110064	20160330
US 20180044754	A1	20180215	US 2017-15559731	20170919
IN 201717033300	A	20171201	IN 2017-17033300	20170920

PRIORITY APPLN. INFO.: JP 2015-72280 A 20150331
WO 2016-JP60145 W 20160329
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A steel sheet for hot stamping contains, in percentage by wt., C: 0.100%-0.600%, Si: 0.50%-3.00%, Mn: 1.20%-4.00%, Ti: 0.005%-0.100%, B: 0.0005%-0.100%, P: 0.100% or less, S: 0.0001%-0.0100%, Al: 0.005%-1.000%, and N: 0.100% or less, with the remainder comprising Fe and impurities. The steel sheet surface roughness is such that Rz > 2.5 μm, and the surface is coated with 50 mg/m2-1,500 mg/m2 of oil coated thereon.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1997			JP 976004 A	
HAYASHI KUNIO	2012			WO 2012053636 A1	CAPLUS
KAWASAKI KAORU	2011			WO 2011158818 A1	CAPLUS
KOJIMA TAKESHI	2014			JP 2014159624 A	CAPLUS
KUSUMI KAZUHISA	2008			JP 2008240046 A	CAPLUS
SETO KAZUHIRO	2010			JP 2010174302 A	CAPLUS

IT 2015959-64-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or

engineered material use); PREP (Preparation); USES (Uses)
(compn. and manuf. of carbon steel sheet suitable for hot stamping, and hot stamping molded parts)
RN 2015959-64-3 CAPLUS
CN Iron alloy, base, Fe 83-98,Mn 1.2-4,Si 0.5-3,Cr 0-2,Cu 0-2,Mo 0-2,Ni 0-2,Al 0-1,C 0.1-0.6,B 0-0.1,Nb 0-0.1,P 0-0.1,Ti 0-0.1,V 0-0.1,W 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	83 - 98	7439-89-6
Mn	1.2 - 4	7439-96-5
Si	0.5 - 3	7440-21-3
Cr	0 - 2	7440-47-3
Cu	0 - 2	7440-50-8
Mo	0 - 2	7439-98-7
Ni	0 - 2	7440-02-0
Al	0 - 1	7429-90-5
C	0.1 - 0.6	7440-44-0
B	0 - 0.1	7440-42-8
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0
Ti	0 - 0.1	7440-32-6
V	0 - 0.1	7440-62-2
W	0 - 0.1	7440-33-7

IPCI B21D0022-20 [I]; B21D0024-00 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-14 [I]; C22C0038-58 [I]; C23F0011-00 [I]; C23G0001-08 [I]
IPCR B21D0022-20 [I]; B21D0024-00 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-14 [I]; C22C0038-58 [I]; C23F0011-00 [I]; C23G0001-08 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST carbon steel sheet manuf hot stamping molded part
IT Adhesion, physical
Annealing
Casting of metals
Cold rolling
Hot rolling
Lubrication
Pickling
Scale (deposits)
Sheet materials
Surface roughness
Tensile strength
(compn. and manuf. of carbon steel sheet suitable for hot stamping, and hot stamping molded parts)
IT Metalworking
(stamping, hot; compn. and manuf. of carbon steel sheet suitable for hot stamping, and hot stamping molded parts)
IT 2015959-64-3P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(compn. and manuf. of carbon steel sheet suitable for hot stamping, and hot stamping molded parts)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 39 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2015:1942164 CAPLUS Full-text
DOCUMENT NUMBER: 164:40753
TITLE: Steel sheet provided with a sacrificial cathodically protected coating comprising lanthanum
INVENTOR(S): Allely, Christian; Petitjean, Jacques
PATENT ASSIGNEE(S): ArcelorMittal Investigacion y Desarrollo, S.L., Spain
SOURCE: PCT Int. Appl., 20pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:
PATENT NO. KIND DATE APPLICATION NO. DATE

WO 2015181581	A1	20151203	WO 2014-IB61788	20140528
CA 2950476	A1	20151203	CA 2015-2950476	20150528
WO 2015181318	A1	20151203	WO 2015-EP61891	20150528
KR 2017010773	A	20170201	KR 2016-7032934	20150528
CN 106460138	A	20170222	CN 2015-80027730	20150528
EP 3149217	A1	20170405	EP 2015-724718	20150528
EP 3149217	B1	20180711		
JP 2017524806	T	20170831	JP 2016-569819	20150528
JP 6762879	B2	20200930		
ES 2689039	T3	20181108	ES 2015-724718	20150528
RU 2689979	C2	20190530	RU 2016-146657	20150528
ZA 2016007435	A	20171220	ZA 2016-7435	20161027
IN 201617039713	A	20170310	IN 2016-17039713	20161121
IN 343260	B	20200804		
MX 2016015550	A	20170425	MX 2016-15550	20161125
US 20170198374	A1	20170713	US 2016-15314457	20161128
US 10676804	B2	20200609		

PRIORITY APPLN. INFO.: WO 2014-IB61788 A 20140528
WO 2015-EP61891 W 20150528

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The invention relates to a steel sheet provided with a sacrificial cathodically protected coating comprising between 1 and 40 % by wt. zinc, between 0.01 and 0.4 % by wt. lanthanum, and optionally up to 10 % by wt. magnesium, optionally up to 15 % by wt. silicon, and optionally up to 0.3 % by wt., in cumulative amts., of addnl. components, the remainder consisting of aluminum and unavoidable impurities or residual elements. The invention also relates to a method of producing parts by hot or cold swaging and the parts which can be obtained in this way.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
LIXIN FENG	2010			CN 101736217 A	CAPLUS
MORIMOTO YASUHIDE	2009			JP 2009120942 A	CAPLUS
NOSE KOICHI	2008			EP 1997927 A1	CAPLUS
ZHAO YUNJIE	2013			CN 103045980 A	CAPLUS

IT 1173986-65-6
RL: NUU (Other use, unclassified); USES (Uses)
(steel sheet provided with sacrificial cathodically protected coating comprising lanthanum)

RN 1173986-65-6 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	94	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Si	0.1	-	0.5	7440-21-3
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Cu	0	-	0.1	7440-50-8
Ni	0	-	0.1	7440-02-0
P	0	-	0.1	7723-14-0

IPCI C23C0002-12 [I]; C22C0021-10 [I]
IPCR C23C0002-12 [I]; C22C0021-10 [I]
CC 56-3 (Nonferrous Metals and Alloys)
ST steel sheet sacrificial cathodically protected coating lanthanum swaging
IT Anticorrosive coating materials
Coating process
Swaging
(steel sheet provided with sacrificial cathodically protected coating comprising lanthanum)
IT 7439-91-0, Lanthanum, uses
RL: MOA (Modifier or additive use); USES (Uses)
(steel sheet provided with sacrificial cathodically protected

coating comprising lanthanum)
IT 12597-69-2, Steel, uses 1173986-65-6
RL: NUU (Other use, unclassified); USES (Uses)
(steel sheet provided with sacrificial cathodically protected coating comprising lanthanum)
IT 1832643-11-4
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel sheet provided with sacrificial cathodically protected coating comprising lanthanum)

L13 ANSWER 40 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2015:1942163 CAPLUS Full-text
DOCUMENT NUMBER: 164:40752
TITLE: Steel sheet provided with a sacrificial cathodically protected coating comprising lanthanum
INVENTOR(S): Allely, Christian; Petitjean, Jacques
PATENT ASSIGNEE(S): ArcelorMittal, Luxembourg
SOURCE: PCT Int. Appl., 21pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2015181318	A1	20151203	WO 2015-EP61891	20150528
WO 2015181581	A1	20151203	WO 2014-IB61788	20140528
CA 2950476	A1	20151203	CA 2015-2950476	20150528
KR 2017010773	A	20170201	KR 2016-7032934	20150528
CN 106460138	A	20170222	CN 2015-80027730	20150528
EP 3149217	A1	20170405	EP 2015-724718	20150528
EP 3149217	B1	20180711		
JP 2017524806	T	20170831	JP 2016-569819	20150528
JP 6762879	B2	20200930		
ES 2689039	T3	20181108	ES 2015-724718	20150528
RU 2689979	C2	20190530	RU 2016-146657	20150528
IN 201617039713	A	20170310	IN 2016-17039713	20161121
IN 343260	B	20200804		
MX 2016015550	A	20170425	MX 2016-15550	20161125
US 20170198374	A1	20170713	US 2016-15314457	20161128
US 10676804	B2	20200609		

PRIORITY APPLN. INFO.: WO 2014-IB61788 A 20140528
WO 2015-EP61891 W 20150528
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The invention relates to a steel sheet provided with a sacrificial cathodically protected coating comprising between 1 and 40 % by wt. zinc, between 0.01 and 0.4 % by wt. lanthanum, and optionally up to 10 % by wt. magnesium, optionally up to 15 % by wt. silicon, and optionally up to 0.3 % by wt., in cumulative amts., of addnl. components, the remainder consisting of aluminum and unavoidable impurities or residual elements. The invention also relates to a method of producing parts by hot or cold swaging and the parts which can be obtained in this way.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
LIXIN FENG	2010			CN 101736217 A	CAPLUS
MORIMOTO YASUHIDE	2009			JP 2009120942 A	CAPLUS
NOSE KOICHI	2008			EP 1997927 A1	CAPLUS
ZHAO YUNJIE	2013			CN 103045980 A	CAPLUS

IT 1173986-65-6
RL: NUU (Other use, unclassified); USES (Uses)
(steel sheet provided with sacrificial cathodically protected coating comprising lanthanum)
RN 1173986-65-6 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number

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=========+=============+===============
    Fe     94    -  99        7439-89-6
    Mn      0.5 -   3        7439-96-5
    Cr      0   -   1        7440-47-3
    C       0.2 -   0.5      7440-44-0
    Si      0.1 -   0.5      7440-21-3
    Ti      0   -   0.2      7440-32-6
    Al      0   -   0.1      7429-90-5
    B       0   -   0.1      7440-42-8
    Cu      0   -   0.1      7440-50-8
    Ni      0   -   0.1      7440-02-0
    P       0   -   0.1      7723-14-0

IPCI C23C0002-12 [I]; C22C0021-10 [I]
IPCR C23C0002-12 [I]; C22C0021-10 [I]
CC   56-3 (Nonferrous Metals and Alloys)
ST   steel sheet sacrificial cathodically protected coating swaging
IT   Anticorrosive coating materials
       Coating process
        (steel sheet provided with sacrificial cathodically protected
        coating comprising lanthanum)
IT   12597-69-2, Steel, uses   1173986-65-6
     RL: NUU (Other use, unclassified); USES (Uses)
        (steel sheet provided with sacrificial cathodically protected
        coating comprising lanthanum)
IT   1832625-87-2
     RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
     (Technical or engineered material use); PROC (Process); USES (Uses)
        (steel sheet provided with sacrificial cathodically protected
        coating comprising lanthanum)


L13  ANSWER 41 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2015:512917  CAPLUS Full-text
DOCUMENT NUMBER:         162:428426
TITLE:                   Metal powder for powder-based production processes and
                         method for production of a metallic component from
                         metal powder
INVENTOR(S):             Fechte-Heinen, Rainer; Mayer, Stefan; Offergeld,
                         Andreas; Patberg, Lothar; Cott, Andreas
PATENT ASSIGNEE(S):      ThyssenKrupp Steel Europe AG, Germany
SOURCE:                  Ger. Offen., 7pp.; Chemical Indexing Equivalent to
                         162:428425 (WO)
                         CODEN: GWXXBX
DOCUMENT TYPE:           Patent
LANGUAGE:                German
FAMILY ACC. NUM. COUNT:  2
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     DE 102013110417      A1   20150326    DE 2013-102013110417     20130920
     WO 2015039986        A2   20150326    WO 2014-EP69603          20140915
     WO 2015039986        A3   20150827
     EP 3046704           A2   20160727    EP 2014-771830           20140915
PRIORITY APPLN. INFO.:                     DE 2013-102013110417 A   20130920
                                           WO 2014-EP69603      W   20140915
AB   The invention relates to metal powder for powder-based prodn. processes
     wherein a component is structured in layers or as a compact green body
     from metal powder and is strengthened by welding or sintering.  In order
     that such a metal powder is easily weldable and can be cost-effectively
     produced, and is thus in particular suitable for fast, economically
     efficient prodn. of functional components in large quantities in an
     additive prodn. process (rapid manufg.), the metal powder according to the
     invention has a particle size distribution in the range of 5 - 150 μm
     and contains primarily iron and unavoidable impurities, wherein the iron
     proportion thereof is in the range from 89.6 to 99.9 wt.%.  The invention
     further relates to the use of such a metal powder (steel powder) for
     powder-based prodn. processes and a method for producing a metallic
     component through layered structuring and welding or sintering using such
     a metal powder.
RETABLE
   Referenced Author   |Year | VOL | PG   | Referenced Work    | Referenced
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(RAU)	(RPY)	(RVL)	(RPG)	(RWK)	File
Anon				DE 10039144 C1	CAPLUS
Anon				WO 2011152774 A1	CAPLUS

IT 1674360-61-2P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(metal powder for powder-based prodn. processes and method for prodn. of metallic component from metal powder)
RN 1674360-61-2 CAPLUS
CN Iron alloy, base, Fe 90-100,Mn 0-3.8,Si 0-1,Cu 0-0.7,Mo 0-0.6,C 0-0.5,Cr 0-0.4,Ni 0-0.4,Ti 0-0.3,Co 0-0.2,Nb 0-0.2,P 0-0.2,V 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	90 - 100	7439-89-6
Mn	0 - 3.8	7439-96-5
Si	0 - 1	7440-21-3
Cu	0 - 0.7	7440-50-8
Mo	0 - 0.6	7439-98-7
C	0 - 0.5	7440-44-0
Cr	0 - 0.4	7440-47-3
Ni	0 - 0.4	7440-02-0
Ti	0 - 0.3	7440-32-6
Co	0 - 0.2	7440-48-4
Nb	0 - 0.2	7440-03-1
P	0 - 0.2	7723-14-0
V	0 - 0.2	7440-62-2
B	0 - 0.1	7440-42-8

IPCI B22F0003-10 [I]
IPCR B22F0003-10 [I]
CC 55-4 (Ferrous Metals and Alloys)
ST steel powder metallurgy sintering welding mech property
IT 1674360-61-2P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(metal powder for powder-based prodn. processes and method for prodn. of metallic component from metal powder)
OS.CITING REF COUNT: 2 THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD (2 CITINGS)

L13 ANSWER 42 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2015:512916 CAPLUS Full-text
DOCUMENT NUMBER: 162:428425
TITLE: Metal powder for powder-based production processes and method for production of a metallic component from metal powder
INVENTOR(S): Fechte-Heinen, Rainer; Mayer, Stefan; Offergeld, Andreas; Patberg, Lothar; Cott, Andreas
PATENT ASSIGNEE(S): ThyssenKrupp Steel Europe AG, Germany
SOURCE: PCT Int. Appl., 16pp.; Chemical Indexing Equivalent to 162:428426 (DE)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2015039986	A2	20150326	WO 2014-EP69603	20140915
WO 2015039986	A3	20150827		
DE 102013110417	A1	20150326	DE 2013-102013110417	20130920
EP 3046704	A2	20160727	EP 2014-771830	20140915

PRIORITY APPLN. INFO.: DE 2013-102013110417 A 20130920
WO 2014-EP69603 W 20140915
AB The invention relates to metal powder for powder-based prodn. processes wherein a component is structured in layers or as a compact green body from metal powder and is strengthened by welding or sintering. In order

that such a metal powder is easily weldable and can be cost-effectively produced, and is thus in particular suitable for fast, economically efficient prodn. of functional components in large quantities in an additive prodn. process (rapid manufg.), the metal powder according to the invention has a particle size distribution in the range of 5 - 150 μm and contains primarily iron and unavoidable impurities, wherein the iron proportion thereof is in the range from 89.6 to 99.9 wt.%. The invention further relates to the use of such a metal powder (steel powder) for powder-based prodn. processes and a method for producing a metallic component through layered structuring and welding or sintering using such a metal powder.

IT 1674360-61-2P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(metal powder for powder-based prodn. processes and method for prodn. of metallic component from metal powder)

RN 1674360-61-2 CAPLUS

CN Iron alloy, base, Fe 90-100,Mn 0-3.8,Si 0-1,Cu 0-0.7,Mo 0-0.6,C 0-0.5,Cr 0-0.4,Ni 0-0.4,Ti 0-0.3,Co 0-0.2,Nb 0-0.2,P 0-0.2,V 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	90 - 100	7439-89-6
Mn	0 - 3.8	7439-96-5
Si	0 - 1	7440-21-3
Cu	0 - 0.7	7440-50-8
Mo	0 - 0.6	7439-98-7
C	0 - 0.5	7440-44-0
Cr	0 - 0.4	7440-47-3
Ni	0 - 0.4	7440-02-0
Ti	0 - 0.3	7440-32-6
Co	0 - 0.2	7440-48-4
Nb	0 - 0.2	7440-03-1
P	0 - 0.2	7723-14-0
V	0 - 0.2	7440-62-2
B	0 - 0.1	7440-42-8

IPCI B22F0007-02 [I]; B22F0007-02 [I]; C22C0033-02 [I]
IPCR B22F0007-02 [I]; C22C0033-02 [I]
CC 55-4 (Ferrous Metals and Alloys)
ST steel powder metallurgy sintering welding mech property
IT 1674360-61-2P
RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(metal powder for powder-based prodn. processes and method for prodn. of metallic component from metal powder)

L13 ANSWER 43 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2014:2105582 CAPLUS Full-text
DOCUMENT NUMBER: 162:84344
TITLE: Method for hot forming a zinc or zinc alloy coated strip, sheet or blank
INVENTOR(S): Hensen, Guido Cornelis; Verloop, Willem Cornelis; Neelis, Bastiaan Maarten
PATENT ASSIGNEE(S): Tata Steel IJmuiden B.V., Neth.
SOURCE: PCT Int. Appl., 22 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2014198399	A2	20141218	WO 2014-EP1540	20140606
WO 2014198399	A3	20150226		

PRIORITY APPLN. INFO.: EP 2013-3043 A 20130614
EP 2013-4166 A 20130823

AB The invention relates to a method for hot forming a strip, sheet or blank coated with a zinc or zinc based alloy layer to form a hot formed

product. According to the invention a no. of specific steps are taken to perform this method within certain limits. The invention also relates to the hot formed product produced using this method.

IT 1639926-81-0
RL: NUU (Other use, unclassified); USES (Uses)
(substrate; method for hot forming zinc or zinc alloy coated strip, sheet or blank)

RN 1639926-81-0 CAPLUS

CN Iron alloy, base, Fe 87-99,Mn 0.5-3.5,W 0-3,Nb 0-2,V 0-2,Cr 0-1,Si 0.1-0.8,C 0.1-0.5,Al 0-0.2,Ti 0-0.2,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	87 - 99	7439-89-6
Mn	0.5 - 3.5	7439-96-5
W	0 - 3	7440-33-7
Nb	0 - 2	7440-03-1
V	0 - 2	7440-62-2
Cr	0 - 1	7440-47-3
Si	0.1 - 0.8	7440-21-3
C	0.1 - 0.5	7440-44-0
Al	0 - 0.2	7429-90-5
Ti	0 - 0.2	7440-32-6
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

IPCI C22F0001-16 [I]; C23C0002-06 [I]; C23C0002-26 [I]; C23C0002-28 [I]; C23C0002-40 [I]; C21D0001-673 [I]; C23C0028-00 [I]
IPCR C23C0002-06 [I]; C21D0001-673 [I]; C23C0002-26 [I]; C23C0002-28 [I]; C23C0002-40 [I]; C23C0028-00 [I]
CC 56-6 (Nonferrous Metals and Alloys)
ST steel zinc alloy anticorrosive coating electroplating
IT Anticorrosive coating materials
Electrodeposition
Mechanical hardness
(method for hot forming zinc or zinc alloy coated strip, sheet or blank)
IT 7440-66-6, Zinc, processes 1273147-93-5, Zinc alloy
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for hot forming zinc or zinc alloy coated strip, sheet or blank)
IT 870820-47-6, 22MnB5 1639926-81-0
RL: NUU (Other use, unclassified); USES (Uses)
(substrate; method for hot forming zinc or zinc alloy coated strip, sheet or blank)

L13 ANSWER 44 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2014:1754974 CAPLUS Full-text
DOCUMENT NUMBER: 161:584497
TITLE: Product formed by hot forming of metallic coated steel sheet, method to form the product, and steel strip
INVENTOR(S): Chen, Shangping; Hensen, Guido Cornelis
PATENT ASSIGNEE(S): Tata Steel IJmuiden BV, Neth.
SOURCE: PCT Int. Appl., 18 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.		DATE
WO 2014166630	A1	20141016	WO 2014-EP951		20140409
EP 2984198	A1	20160217	EP 2014-716760		20140409
PRIORITY APPLN. INFO.:			EP 2013-1845	A	20130410
			WO 2014-EP951	W	20140409

AB The invention relates to a product formed by hot forming of a metallic coated steel sheet, wherein the formed product has a substrate layer of hot formed steel, a metal affected zone and a diffusion coating

layer on the substrate layer, and optionally a metal oxide layer on the diffusion coating layer. According to the disclosure, a low carbon zone is present between the substrate layer and the metal affected zone. The invention also relates to a method for producing a metallic coated hot formed product, and to a steel strip to be used in the method.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
ABE MASAYUKI	2012			US 20120006451 A1	
HENSEN GUIDO CORNELIS	2010			WO 2010069588 A1	CAPLUS
HIRAMATSU TERUSHI	2001			JP 2001064751 A	CAPLUS
KATAGIRI YUKIO	2011			JP 2011208164 A	CAPLUS
Karbasian, H	2010	210	2103	Journal Of Materials	CAPLUS
NAKAMURA NOBUYUKI	2009			EP 2053139 A1	CAPLUS
PUERTA VELASQUEZ JUAN D	2014			WO 2014037627 A1	CAPLUS

IT 1630724-35-4
RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process); USES (Uses)
(substrate; product formed by hot forming of metallic coated steel sheet, method to form the product, and steel strip)
RN 1630724-35-4 CAPLUS
CN Iron alloy, base, Fe 87-99,Mn 0.5-3,W 0-3,Nb 0-2,V 0-2,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Al 0-0.2,Ti 0-0.2,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	87 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
W	0 - 3	7440-33-7
Nb	0 - 2	7440-03-1
V	0 - 2	7440-62-2
Cr	0 - 1	7440-47-3
C	0.1 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Al	0 - 0.2	7429-90-5
Ti	0 - 0.2	7440-32-6
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

IPCI C22C0038-00 [I]; C21D0001-00 [I]
IPCR C22C0038-00 [I]; C21D0001-00 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet strip hot dip metal anticorrosive coating
IT Anticorrosive coating materials
Hot-dip coating process
(product formed by hot forming of metallic coated steel sheet, method to form the product, and steel strip)
IT 39308-06-0D, iron 0.011. 1630724-36-5 1630724-38-7
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(anticorrosive coating; product formed by hot forming of metallic coated steel sheet, method to form the product, and steel strip)
IT 870820-47-6, 22MnB5 1630724-35-4
RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process); USES (Uses)
(substrate; product formed by hot forming of metallic coated steel sheet, method to form the product, and steel strip)
OS.CITING REF COUNT: 3 THERE ARE 3 CAPLUS RECORDS THAT CITE THIS RECORD (3 CITINGS)

L13 ANSWER 45 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2014:755736 CAPLUS Full-text
DOCUMENT NUMBER: 160:679480
TITLE: Steel sheets for hot pressing, hot pressed steel

members, and method for manufacture of the members
INVENTOR(S): Miyoshi, Tatsuya; Nakajima, Seiji; Ando, Satoru
PATENT ASSIGNEE(S): JFE Steel Corporation, Japan
SOURCE: PCT Int. Appl., 29pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2014068939	A1	20140508	WO 2013-JP6347	20131028
KR 2015052266	A	20150513	KR 2015-7008668	20131028
KR 1731740	B1	20170428		
CN 104755655	A	20150701	CN 2013-80056511	20131028
CN 104755655	B	20170922		
EP 2915904	A1	20150909	EP 2013-850861	20131028
EP 2915904	B1	20190612		
JP 5888430	B2	20160322	JP 2014-544298	20131028
IN 2015DN02108	A	20150814	IN 2015-DN2108	20150316
IN 302263	B	20181026		
US 20150337415	A1	20151126	US 2015-14438993	20150428
US 10030290	B2	20180724		

PRIORITY APPLN. INFO.: JP 2012-239973 A 20121031
WO 2013-JP6347 W 20131028
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB Base steel sheet equipped with galvanized layer and a layer, contg. polysiloxanes having C≥4 functional group, formed in the order is claimed. Preferably, the steel sheet consists of C 0.15-0.5, Si 0.05-2.0, Mn 0.5-3, P ≤0.1, S ≤0.05, Al ≤0.10, N ≤0.010, optionally Cr 0.01-1, Ti ≤0.20, B 0.0005-0.08, and/or Sb 0.003-0.03 wt.%, and balance Fe; the galvanized layer comprises a 0.01-5 g/m2 1st layer of ≥60 wt.% Ni and balance Zn and a 10-90 g/m2 2nd layer of 10-25 wt.% Ni and balance Zn; and the polysiloxane layer also contains less wt. parts (polysiloxane basis) silane coupling agents. Also claimed is the hot pressed member of the given steel having a surface characterized by a ≥0.20 kcps x-ray diffractometry peak for Zn2SiO4 at 2θ = 36.1°. The member is manufd. by heating the sheet to a temp. between Ac3 and 1000°, e.g. at av. heating rate of ≥100°/s, followed by its hot pressing. The members are resistant to pit and crevice corrosion even when used under severe conditions and are esp. suitable for use in automobiles.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	2012			JP 4883240 B1	CAPLUS
KUZE YUKINOBU	2011			WO 2011070859 A1	CAPLUS
SAITO TAKASHI	2007			JP 2007063578 A	CAPLUS
YANO HIROKAZU	2007			JP 2007246775 A	CAPLUS

IT 1609017-11-9D, Sb(0.003-0.03)
RL: TEM (Technical or engineered material use); USES (Uses)
(steel sheets having nickel-zinc alloy and polysiloxane coatings for prepn. of hot pressed members showing excellent corrosion resistance)
RN 1609017-11-9 CAPLUS
CN Iron alloy, base, Fe 93-99,Mn 0.5-3,Si 0-2,Cr 0-1,C 0.2-0.5,Ti 0.2,Al 0.1,P 0.1,B 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	93 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Si	0 - 2	7440-21-3
Cr	0 - 1	7440-47-3
C	0.2 - 0.5	7440-44-0
Ti	0.2	7440-32-6
Al	0.1	7429-90-5
P	0.1	7723-14-0
B	0 - 0.1	7440-42-8

IPCI C23C0028-00 [I]; B21D0022-20 [I]; B32B0015-08 [I]; C21D0001-18 [I];
C21D0009-00 [I]; C22C0018-00 [I]; C22C0019-03 [I]; C22C0038-00 [I];
C22C0038-60 [I]; C25D0005-26 [I]
IPCR C23C0028-00 [I]; B21D0022-20 [I]; B32B0015-08 [I]; C21D0001-18 [I];
C21D0009-00 [I]; C22C0018-00 [I]; C22C0019-03 [I]; C22C0038-00 [I];
C22C0038-60 [I]; C25D0005-26 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 42, 56
ST hot pressing steel sheet corrosion resistant; polysiloxane coated
galvanized steel hot pressing; nickel zinc alloy underlayer silicone
coated steel
IT Polysiloxanes
RL: TEM (Technical or engineered material use); USES (Uses)
(C>4 group-contg., coating on galvanized steel;
steel sheets having nickel-zinc alloy and polysiloxane
coatings for prepn. of hot pressed members showing excellent
corrosion resistance)
IT Polysiloxanes
RL: TEM (Technical or engineered material use); USES (Uses)
(Me Ph, KR-311; steel sheets having nickel-zinc alloy and
polysiloxane coatings for prepn. of hot pressed members
showing excellent corrosion resistance)
IT Silanes
RL: MOA (Modifier or additive use); USES (Uses)
(coupling agent, in silicone layer; steel sheets
having nickel-zinc alloy and polysiloxane coatings for prepn.
of hot pressed members showing excellent corrosion resistance)
IT Polysiloxanes
RL: TEM (Technical or engineered material use); USES (Uses)
(epoxy, ES-1001N; steel sheets having nickel-zinc alloy and
polysiloxane coatings for prepn. of hot pressed members
showing excellent corrosion resistance)
IT Epoxy resins
RL: TEM (Technical or engineered material use); USES (Uses)
(polysiloxane-, ES-1001N; steel sheets having nickel-zinc
alloy and polysiloxane coatings for prepn. of hot pressed
members showing excellent corrosion resistance)
IT Metalworking
(pressing; steel sheets having nickel-zinc alloy and
polysiloxane coatings for prepn. of hot pressed members
showing excellent corrosion resistance)
IT Coupling agents
(silane, in silicone layer; steel sheets having
nickel-zinc alloy and polysiloxane coatings for prepn. of hot
pressed members showing excellent corrosion resistance)
IT Corrosion-resistant materials
Hot-press molding
(steel sheets having nickel-zinc alloy and polysiloxane
coatings for prepn. of hot pressed members showing excellent
corrosion resistance)
IT Galvanized steel
RL: PEP (Physical, engineering or chemical process); TEM (Technical or
engineered material use); PROC (Process); USES (Uses)
(steel sheets having nickel-zinc alloy and polysiloxane
coatings for prepn. of hot pressed members showing excellent
corrosion resistance)
IT 919-30-2, KBE 903 2602-34-8, KBE 403
RL: MOA (Modifier or additive use); USES (Uses)
(coupling agent, in silicone layer; steel sheets
having nickel-zinc alloy and polysiloxane coatings for prepn.
of hot pressed members showing excellent corrosion resistance)
IT 13597-65-4P, Zinc silicate (Zn2SiO4)
RL: IMF (Industrial manufacture); TEM (Technical or engineered material
use); PREP (Preparation); USES (Uses)
(steel sheets having nickel-zinc alloy and polysiloxane
coatings for prepn. of hot pressed members showing excellent
corrosion resistance)
IT 7440-36-0D, Antimony, trace in alloys 238084-01-0 1379822-01-1
1609017-10-8 1609017-11-9D, Sb(0.003-0.03)
RL: TEM (Technical or engineered material use); USES (Uses)
(steel sheets having nickel-zinc alloy and polysiloxane

coatings for prepn. of hot pressed members showing excellent corrosion resistance)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (2 CITINGS)

L13 ANSWER 46 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2014:451007 CAPLUS Full-text
DOCUMENT NUMBER: 160:475772
TITLE: Compression coil springs and their manufacture including coiling process in austenite temperature region
INVENTOR(S): Ono, Yuitirou; Shiraishi, Tohru; Ono, Yoshiki; Takahashi, Keita
PATENT ASSIGNEE(S): NHK Spring Co., Ltd., Japan
SOURCE: PCT Int. Appl., 50pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2014042066	A1	20140320	WO 2013-JP73937	20130905
JP 5361098	B1	20131204	JP 2012-202416	20120914
JP 2014055343	A	20140327		
CN 104619878	A	20150513	CN 2013-80047783	20130905
CN 104619878	B	20161116		
KR 2015054969	A	20150520	KR 2015-7009184	20130905
KR 2191407	B1	20201215		
EP 2896712	A1	20150722	EP 2013-837663	20130905
EP 2896712	B1	20190807		
KR 2020010619	A	20200130	KR 2020-7002286	20130905
US 20150252863	A1	20150910	US 2015-14427106	20150310
US 9752636	B2	20170905		
IN 2015KN00953	A	20151225	IN 2015-KN953	20150407

PRIORITY APPLN. INFO.:

JP 2012-202416	A	20120914
KR 2015-7009184	A3	20130905
WO 2013-JP73937	W	20130905

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The coil springs comprise steel wires with equiv. circle diam. 2.5-10 mm contg. C 0.45-0.80, Si 0.15-2.50, Mn 0.3-1.0 wt.%, and Fe balance, wherein (i) arbitrary cross-sections of the wires show core hardness 570-700HV, (ii) the wires have surface layers with higher-than-av. concn. of C, and (iii) the wires show compressive residual stress ≥200 MPa and ≥60 MPa at 0.2 mm-depth and 0.4 mm-depth from the surfaces, resp. along the max. principal stress direction under application of compressive load in the inner diam. side of the coil springs. Also claimed are coil springs using steel wires contg. C 0.45-0.80, Si 0.15-2.50, Mn 0.3-1.0, and Cr, B, Ni, Ti, Cu, Nb, V, Mo, and/or W 0.005-4.5 wt.%. The manufg. method, using coil spring forming app. equipped with feed rollers, coiling parts having wire guides, coiling tools, and pitch tools, cutting means, and heating means for raising temp. to austenite region within 2.5 s between the feed roller exits to the coiling tools, includes coiling steel wires by hot forming, cutting, quenching the formed coils still at temp. in austenite region, tempering, shot-peening, setting in this order, and carburizing (between heating and quenching processes) by directly spraying hydrocarbon gas on the wire surfaces. The coil springs with excellent fatigue resistance are esp. useful as automotive valve springs and clutch torsion springs.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1981			JP 56152921 A	
Anon	1989			JP 01177318 A	CAPLUS
Anon	1992			JP 499126 A	
Anon	1993			JP 586418 A	
Anon	2012			JP 5064590 B1	CAPLUS
HONDA YOSHINORI	2001			JP 2001082518 A	CAPLUS
KONDO SATORU	2000			JP 2000326036 A	CAPLUS
MORITA TOSHIYUKI	2008			JP 2008045178 A	CAPLUS

NISSAN MOTOR |2012 | | |JP 2012077367 A |CAPLUS
IT 1581259-99-5
RL: TEM (Technical or engineered material use); USES (Uses)
(manuf. of compression coil springs including coiling process in austenite temp. region)
RN 1581259-99-5 CAPLUS
CN Iron alloy, base, Fe 91-99,B 0-4.5,Cr 0-4.5,Cu 0-4.5,Mo 0-4.5,Nb 0-4.5,Ni 0-4.5,Ti 0-4.5,V 0-4.5,W 0-4.5,Si 0.2-2.5,Mn 0.3-1,C 0.4-0.8 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	91	-	99	7439-89-6
B	0	-	4.5	7440-42-8
Cr	0	-	4.5	7440-47-3
Cu	0	-	4.5	7440-50-8
Mo	0	-	4.5	7439-98-7
Nb	0	-	4.5	7440-03-1
Ni	0	-	4.5	7440-02-0
Ti	0	-	4.5	7440-32-6
V	0	-	4.5	7440-62-2
W	0	-	4.5	7440-33-7
Si	0.2	-	2.5	7440-21-3
Mn	0.3	-	1	7439-96-5
C	0.4	-	0.8	7440-44-0

IPCI C22C0038-00 [I]; B21F0003-02 [I]; B21F0035-00 [I]; B24C0001-10 [I]; B24C0011-00 [I]; C21D0001-06 [I]; C21D0007-06 [I]; C21D0008-06 [I]; C21D0009-02 [I]; C22C0038-04 [I]; C22C0038-54 [I]; C23C0008-22 [I]; C23C0008-80 [I]; F16F0001-06 [I]
IPCR C22C0038-00 [I]; B21F0003-02 [I]; B21F0035-00 [I]; B24C0001-10 [I]; B24C0011-00 [I]; C21D0001-06 [I]; C21D0007-06 [I]; C21D0008-06 [I]; C21D0009-02 [I]; C22C0038-04 [I]; C22C0038-54 [I]; C23C0008-22 [I]; C23C0008-80 [I]; F16F0001-06 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST compression coil spring manuf austenite temp region coiling; steel wire heating quenching tempering shot peening carburizing
IT 1581259-99-5
RL: TEM (Technical or engineered material use); USES (Uses)
(manuf. of compression coil springs including coiling process in austenite temp. region)
OS.CITING REF COUNT: 2 THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD (2 CITINGS)

L13 ANSWER 47 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2014:174777 CAPLUS Full-text
DOCUMENT NUMBER: 160:297675
TITLE: Hot-dip galvanized steel sheet and manufacturing method therefor
INVENTOR(S): Fujita, Soshi; Yamanaka, Shintaro
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 58pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2014021452	A1	20140206	WO 2013-JP71004	20130802
JP 5648755	B2	20150107	JP 2013-551091	20130802
KR 2015036681	A	20150407	KR 2015-7004127	20130802
KR 1653510	B1	20160901		
CN 104508169	A	20150408	CN 2013-80040033	20130802
CN 104508169	B	20170222		
TW I488978	B	20150621	TW 2013-127806	20130802
BR 112015001809	A2	20170704	BR 2015-112015001809	20130802
BR 112015001809	B1	20201110		
MX 2015001224	A	20150410	MX 2015-1224	20150127
MX 370268	B	20191209		

US 20150225829	A1	20150813	US 2015-14418852		20150130
US 10131981	B2	20181120			
IN 2015DN01525	A	20150703	IN 2015-DN1525		20150224
PRIORITY APPLN. INFO.:			JP 2012-172739	A	20120803
			WO 2013-JP71004	W	20130802

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The present invention provides a hot-dip galvanized steel sheet having excellent plating wettability and plating adhesion even when the base steel sheet contains Si and Mn, and provides a manufg. method therefor. The galvanized steel sheet pertaining to the present invention includes a base steel sheet contg. Si, Mn, and other predetd. components, and a galvanized layer formed on at least one surface of the base steel sheet. The base steel sheet has an HA value and an HB that satisfy all of the following relational expressions, wherein HA is the av. hardness of the surface layer that extends to a depth of 50 μm from the interface between the base steel sheet and the galvanized layer, and HB is the av. hardness of deep portions in excess of 50 μm from the interface. 50 ≤ HA ≤ 500 ... (1) 50 ≤ HB ≤ 500 ... (2) 0.5 ≤ HA/HB ≤ 0.9 ... (3). The galvanized steel sheet is manufd. by hot-dip galvanizing of a base steel sheet which is processed by annealing and soaking in controlled conditions (details described).

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1999			JP 11343551 A	CAPLUS
MIYATA MAI	2010			JP 2010132975 A	CAPLUS

IT 1428957-53-2

RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(base steel sheet; manuf. of hot-dip galvanized steel sheet contg. Si and Mn in base steel sheet and showing good wettability and plating adhesion)

RN 1428957-53-2 CAPLUS

CN Iron alloy, base, Fe 78-99,Mn 0.5-5,Si 0.1-3,Al 0-1,B 0-1,Ca 0-1,Cr 0-1,Cu 0-1,misch metal 0-1,Mo 0-1,Nb 0-1,Ni 0-1,Ti 0-1,V 0-1,W 0-1,Zr 0-1,C 0-0.5,P 0-0.5 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	78	-	99	7439-89-6
Mn	0.5	-	5	7439-96-5
Si	0.1	-	3	7440-21-3
Al	0	-	1	7429-90-5
B	0	-	1	7440-42-8
Ca	0	-	1	7440-70-2
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Misch metal	0	-	1	8049-20-5
Mo	0	-	1	7439-98-7
Nb	0	-	1	7440-03-1
Ni	0	-	1	7440-02-0
Ti	0	-	1	7440-32-6
V	0	-	1	7440-62-2
W	0	-	1	7440-33-7
Zr	0	-	1	7440-67-7
C	0	-	0.5	7440-44-0
P	0	-	0.5	7723-14-0

IPCI C23C0002-06 [I]; C21D0009-46 [I]; C22C0018-00 [I]; C22C0038-00 [I]; C22C0038-58 [I]; C23C0002-02 [I]; C23C0002-28 [I]

IPCR C23C0002-06 [I]; C21D0009-46 [I]; C22C0018-00 [I]; C22C0038-00 [I]; C22C0038-58 [I]; C23C0002-02 [I]; C23C0002-28 [I]

CC 55-6 (Ferrous Metals and Alloys)

ST hot dip galvanized steel base silicon manganese wettability adhesion; steel annealing soaking hot dip galvanizing base sheet hardness

IT Galvanized steel

RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(hot-dip; manuf. of hot-dip galvanized steel sheet contg. Si and Mn in base steel sheet and showing good wettability and

plating adhesion)
IT Alloying
Annealing
Hot-dip galvanizing
(manuf. of hot-dip galvanized steel sheet contg. Si and Mn in base steel sheet and showing good wettability and plating adhesion)
IT Heat treatment
(soaking; manuf. of hot-dip galvanized steel sheet contg. Si and Mn in base steel sheet and showing good wettability and plating adhesion)
IT 124-38-9, Carbon dioxide, uses 630-08-0, Carbon monoxide, uses 7727-37-9, Nitrogen, uses
RL: NUU (Other use, unclassified); USES (Uses)
(annealing atm.; manuf. of hot-dip galvanized steel sheet contg. Si and Mn in base steel sheet and showing good wettability and plating adhesion)
IT 7440-45-1D, Cerium, trace in alloy 12709-15-8D, Ce 0.02%, P 0.010%, Al 0.04%, processes 144920-07-0D, Ce 0.02%, P 0.019%, Al 0.05%, processes 1428957-53-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(base steel sheet; manuf. of hot-dip galvanized steel sheet contg. Si and Mn in base steel sheet and showing good wettability and plating adhesion)
IT 53881-87-1 109581-27-3 109581-29-5 723302-58-7 763111-21-3 1242002-97-6 1554190-57-6 1554190-62-3 1554190-66-7 1554190-71-4 1554190-72-5 1554190-73-6 1554190-78-1 1554190-82-7 1554190-84-9 1554190-88-3 1554190-90-7 1554190-95-2 1554190-99-6 1554191-01-3 1554191-06-8 1554191-11-5 1554191-14-8 1554191-17-1
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(galvanizing layer; manuf. of hot-dip galvanized steel sheet contg. Si and Mn in base steel sheet and showing good wettability and plating adhesion)
OS.CITING REF COUNT: 2 THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD (2 CITINGS)

L13 ANSWER 48 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2013:1659555 CAPLUS Full-text
DOCUMENT NUMBER: 159:643708
TITLE: Steel sheet provided with Al-Zn-Si base anticorrosive coating offering sacrificial cathodic protection, method for production of a part using the sheet
INVENTOR(S): Allely, Christian; Chassagne, Julie; Corlu, Beril
PATENT ASSIGNEE(S): ArcelorMittal Investigacion y Desarrollo SL, Spain
SOURCE: PCT Int. Appl., 26pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2013156688	A1	20131024	WO 2012-FR149	20120417
CA 2870532	A1	20131024	CA 2012-2870532	20120417
CA 2870532	C	20161213		
AU 2012377741	A1	20141204	AU 2012-377741	20120417
AU 2012377741	B2	20160317		
CN 104302802	A	20150121	CN 2012-80073231	20120417
CN 104302802	B	20170412		
KR 2015008114	A	20150121	KR 2014-7032019	20120417
KR 1667131	B1	20161017		
EP 2839049	A1	20150225	EP 2012-722750	20120417
EP 2839049	B1	20171018		
MX 2014012626	A	20150511	MX 2014-12626	20120417
MX 358552	B	20180823		
JP 2015520797	T	20150723	JP 2015-506274	20120417
JP 6348105	B2	20180627		
KR 2016114735	A	20161005	KR 2016-7026204	20120417

ES 2652028	T3	20180131	ES 2012-722750		20120417
KR 2018017229	A	20180220	KR 2018-7003561		20120417
KR 1886611	B1	20180809			
EA 30016	B1	20180629	EA 2014-1136		20120417
BR 112014025697	B1	20201020	BR 2014-112014025697		20120417
ZA 2014007327	A	20170830	ZA 2014-7327		20141009
IN 2014CN07902	A	20160701	IN 2014-CN7902		20141028
US 20150284861	A1	20151008	US 2015-14394885		20150617
US 10253418	B2	20190409			

PRIORITY APPLN. INFO.:
KR 2014-7032019 A3 20120417
KR 2016-7026204 A3 20120417
WO 2012-FR149 W 20120417

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The invention relates to a steel sheet provided with a coating offering sacrificial cathodic protection, comprising, wt.%: Zn 5-50, Si 0.1- 15, and optionally Mg up to 10 and up to 0.3 in terms of total content, of addnl. elements, as well as comprising a protective element selected from Sn 0.1-5, In 0.01-0.5 and combinations of same, the remainder consisting of Al. The invention also relates to a method for producing parts by hot or cold pressing and to the resulting parts.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
NIPPON STEEL CORP	2002			EP 1225246 A1	CAPLUS
POSCO	2009			US 20090238715 A1	
THYSSENKRUPP STEEL EURO	2011			WO 2011157690 A1	CAPLUS

IT 1173986-65-6
RL: NUU (Other use, unclassified); USES (Uses)
(steel sheet provided with Al-Zn-Si base anticorrosive coating offering sacrificial cathodic protection, method for prodn. of part using the sheet)

RN 1173986-65-6 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.2 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Cu	0 - 0.1	7440-50-8
Ni	0 - 0.1	7440-02-0
P	0 - 0.1	7723-14-0

IPCI C23C0002-04 [I]; C23C0002-12 [I]; C23C0002-28 [I]; C21D0001-673 [I]; C21D0008-02 [I]
IPCR C23C0002-04 [I]; C21D0001-673 [I]; C21D0008-02 [I]; C23C0002-12 [I]; C23C0002-28 [I]
CC 56-3 (Nonferrous Metals and Alloys)
ST steel anticorrosive coating cathodic protection aluminum zinc silicon alloy
IT Anticorrosive coating materials
Cathodic protection
(steel sheet provided with Al-Zn-Si base anticorrosive coating offering sacrificial cathodic protection, method for prodn. of part using the sheet)
IT 1469993-24-5 1469993-25-6 1469993-26-7 1469993-27-8 1469993-28-9 1469993-29-0 1469993-30-3
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(coating; steel sheet provided with Al-Zn-Si base anticorrosive coating offering sacrificial cathodic protection, method for prodn. of part using the sheet)
IT 1173986-65-6
RL: NUU (Other use, unclassified); USES (Uses)

(steel sheet provided with Al-Zn-Si base anticorrosive coating offering sacrificial cathodic protection, method for prodn. of part using the sheet)
IT 12597-69-2, Steel, uses 870820-47-6, 22MnB5
RL: NUU (Other use, unclassified); USES (Uses)
(substrate; steel sheet provided with Al-Zn-Si base anticorrosive coating offering sacrificial cathodic protection, method for prodn. of part using the sheet)
OS.CITING REF COUNT: 4 THERE ARE 4 CAPLUS RECORDS THAT CITE THIS RECORD (4 CITINGS)

L13 ANSWER 49 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2013:1612663 CAPLUS Full-text
DOCUMENT NUMBER: 161:113844
TITLE: Result prediction of steel carbonization when carbonitriding
AUTHOR(S): Gliner, R. E.; Vybornov, V. V.; Pryanichnikov, V. A.
CORPORATE SOURCE: Nizhegorodskii Gosudarstvennyi Tekhnicheskii Universitet, Nizhny Novgorod, Russia
SOURCE: Tekhnologiya Metallov (2013), (4), 8-14
CODEN: TMEEAL; ISSN: 1684-2499
PUBLISHER: OOO "Nauka i Tekhnologii"
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB The features of the steel during carburizing carbonitriding to the coeffs. of absorption and diffusion of carbon. Revealed that complete satn. of carbon and nitrogen results in a significant acceleration of the absorption of carbon and, correspondingly, the speed of the carburizing. The possibility of harmonization of different carburizing alloy steels.
IT 56995-50-7, 20KhGR
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(result prediction of steel carburization during carbonitriding)
RN 56995-50-7 CAPLUS
CN Iron alloy, base, Fe 96-98,Cr 0.75-1.05,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,Ni 0-0.30,C 0.18-0.24,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6
Cr	0.75	-	1.05	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
Ni	0	-	0.30	7440-02-0
C	0.18	-	0.24	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
ST carbonitriding steel carburization prediction
IT Absorptivity
Carbonitriding
Composition
Diffusion
Diffusion coating process
(result prediction of steel carburization during carbonitriding)
IT 74-82-8, Methane, uses 7664-41-7, Ammonia, uses
RL: NUU (Other use, unclassified); USES (Uses)
(result prediction of steel carburization during carbonitriding)
IT 39467-50-0, 20KhGNM, processes 56995-50-7, 20KhGR

71390-26-6, 07Kh3GNM 578731-16-5, 20Kh3N3MFBA
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(result prediction of steel carburization during carbonitriding)

L13 ANSWER 50 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2013:1460865 CAPLUS Full-text
DOCUMENT NUMBER: 159:503793
TITLE: Hot-pressed zinc-nickel alloy-coated steel article and its manufacture
INVENTOR(S): Nakajima, Seiji; Miyoshi, Tatsuya; Ando, Satoru
PATENT ASSIGNEE(S): JFE Steel Corp., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 11 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2013185184	A	20130919	JP 2012-49868	20120307

PRIORITY APPLN. INFO.: JP 2012-49868 20120307

AB The hot-pressed article has a plating layer satisfying total deposition of Zn and Ni 5-90 g/m2 and Ni deposition ratio based on the total deposition 10-25 wt.% on a steel sheet surface and comprises high-strength parts having tensile strength ≥1000 MPa and low-strength parts having tensile strength <1000 Pa. The article is manufd. by heating a steel sheet contg. C 0.15-0.5, Si 0.05-2.0, Mn 0.5-3, P ≤0.1, S ≤0.05, Al ≤0.1, and N ≤0.01 wt.% coated with 5-90 g/m2 of Zn-(10-25 wt.%) Ni alloy to have coexistence of high-temp. parts at ≥ Ac3 transformation point and ≤1000° and low-temp. parts at ≥0° and < Ac3 transformation point and then starting hot-pressing when the high-temp. parts become 600-800°. The article has excellent resistance to corrosion and chipping after coating and is suitable for automotive parts.

IT 1356847-15-8D, Sb(0.003-0.03%)
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(hot-pressed zinc-nickel alloy-coated steel article having high-strength parts and low-strength parts and its manuf. by heating coated steel sheet and hot-pressing)
RN 1356847-15-8 CAPLUS
CN Iron alloy, base, Fe 93-99,Mn 0.5-3,Si 0-2,Cr 0-1,C 0.2-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	93	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Si	0	-	2	7440-21-3
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C25D0005-26 [I]; C22C0038-00 [I]; C21D0009-00 [I]; C22C0038-60 [I]; C21D0001-18 [I]
IPCR C25D0005-26 [I]; C21D0001-18 [I]; C21D0009-00 [I]; C22C0038-00 [I]; C22C0038-60 [I]
CC 55-11 (Ferrous Metals and Alloys)
ST zinc nickel alloy coated steel heating hot pressing
IT Heat treatment
Hot-press molding
Metal forming
(hot-pressed zinc-nickel alloy-coated steel article having high-strength parts and low-strength parts and its manuf. by heating coated steel sheet and hot-pressing)

IT 7440-36-0D, Antimony, trace in alloy 238084-01-0 1299468-35-1
1356847-15-8D, Sb(0.003-0.03%)
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(hot-pressed zinc-nickel alloy-coated steel article having high-strength parts and low-strength parts and its manuf. by heating coated steel sheet and hot-pressing)
IT 1379822-01-1
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(primer; hot-pressed zinc-nickel alloy-coated steel article having high-strength parts and low-strength parts and its manuf. by heating coated steel sheet and hot-pressing)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 51 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2013:650770 CAPLUS Full-text
DOCUMENT NUMBER: 158:624577
TITLE: Anti-scale and anti-corrosion hybrid coatings for steel substrates
INVENTOR(S): Gordon, Douglas Jesus Figueroa; Harding, Tim; Boehm, Sivasambu; Li, Wu; Weirman, Chris
PATENT ASSIGNEE(S): Tata Steel UK Limited, UK
SOURCE: PCT Int. Appl., 15pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2013056847	A1	20130425	WO 2012-EP4384	20121019
PRIORITY APPLN. INFO.:			EP 2011-8421 A	20111019

AB Method of producing a coated steel substrate suitable for hot-forming or other high temp. applications, which comprises the steps of: (i) providing a steel substrate; (ii) prepg. a coating mixt. comprising a curable org. component as a first binder, a curable inorg. component as a second binder, a cross- linking component to chem. cross-link the curable org. component and the curable inorg. component, and a metal or metal alloy particle having an aluminum content of at least 50% and a balance of 50% or less of a non-aluminum metal; (iii) applying the mixt. on the steel substrate; (iv) curing the mixt. to produce a dense network structure of the coating on the steel substrate.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Cornelis, V	2010			WO 2010069588 A1	CAPLUS
Foscante Raymond E	1981			US 4250074 A	CAPLUS
Gen Electric	2007			WO 2007067203 A1	CAPLUS
Harding, T	2011			WO 2011069663 A2	CAPLUS
Savin Ronald Richard	1990			EP 0385880 A2	CAPLUS
Standke Burkhard	2010			US 20100159144 A1	

IT 1431293-40-1, Aluminum 0-0.1, boron 0-0.1, carbon 0.2-0.5, chromium 0-1, iron 92-99, manganese 0.5-3, molybdenum 0-0.5, niobium 0-0.1, phosphorus 0-0.1, silicon 0.1-2.5, titanium 0-0.2, vanadium 0-0.1
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(antiscale and anticorrosion hybrid coatings for steel substrates)
RN 1431293-40-1 CAPLUS
CN Iron alloy, base, Fe 92-99,Mn 0.5-3,Si 0.1-2.5,Cr 0-1,C 0.2-0.5,Mo 0-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1,V 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	92 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5

Si	0.1	-	2.5	7440-21-3
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Mo	0	-	0.5	7439-98-7
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Nb	0	-	0.1	7440-03-1
P	0	-	0.1	7723-14-0
V	0	-	0.1	7440-62-2

IPCI C21D0001-68 [I]; C23C0018-02 [I]; C09D0007-12 [I]; C09D0005-10 [I]; C09D0201-10 [I]; C09D0175-04 [I]; C09D0183-04 [I]
IPCR C21D0001-68 [I]; C09D0005-10 [I]; C09D0007-12 [I]; C09D0175-04 [I]; C09D0183-04 [I]; C09D0201-10 [I]; C23C0018-02 [I]
CC 55-6 (Ferrous Metals and Alloys)
ST antiscale anticorrosion hybrid coating steel
IT Anticorrosive coating materials
Antiscaling coating materials
Binders
(antiscale and anticorrosion hybrid coatings for steel substrates)
IT Epoxy resins
Organic compounds
Silanes
RL: NUU (Other use, unclassified); USES (Uses)
(antiscale and anticorrosion hybrid coatings for steel substrates)
IT Polyurethanes
RL: NUU (Other use, unclassified); USES (Uses)
(polyester-; antiscale and anticorrosion hybrid coatings for steel substrates)
IT Polyesters
RL: NUU (Other use, unclassified); USES (Uses)
(polyurethane-; antiscale and anticorrosion hybrid coatings for steel substrates)
IT 108-78-1, 1,3,5-Triazine-2,4,6-triamine, uses 661-20-1, Isocyanate 10344-93-1, Acrylate, uses
RL: NUU (Other use, unclassified); USES (Uses)
(antiscale and anticorrosion hybrid coatings for steel substrates)
IT 1273096-81-3, Aluminum alloy 1431293-40-1, Aluminum 0-0.1, boron 0-0.1, carbon 0.2-0.5, chromium 0-1, iron 92-99, manganese 0.5-3, molybdenum 0-0.5, niobium 0-0.1, phosphorus 0-0.1, silicon 0.1-2.5, titanium 0-0.2, vanadium 0-0.1
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(antiscale and anticorrosion hybrid coatings for steel substrates)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 52 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2013:640308 CAPLUS Full-text
DOCUMENT NUMBER: 158:593876
TITLE: High-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manufacture
INVENTOR(S): Okamoto, Isamu; Oka, Masaharu; Wakabayashi, Chisato; Azuma, Masafumi
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 24 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2013076137	A	20130425	JP 2011-217619	20110930
JP 5953693	B2	20160720		

PRIORITY APPLN. INFO.: JP 2011-217619 20110930

AB The galvanized steel sheet has a steel substrate contg. C 0.05-0.4, Si 0.01-3.0, Mn 0.1-3.0, P ≤0.04, S ≤0.05, N ≤0.01, Al 0.01-2.0, and Si + Al >0.5 wt.% while having microstructure contg. ≥40 vol.% of ferrite main phase, ≥8 vol.% of retained austenite, 3 kinds of martensite defined by using C content and hardness, and 10-0 vol.% of pearlite, (1) a hot-dip galvanized layer contg. <7 wt.% Fe and residual amts. of Zn and Al or (2) a hot-dip galvannealed layer contg. 7-15 wt.% Fe and residual amts. of Zn and Alon the substrate, and tensile strength ≥980 MPa. The galvanized steel sheet is manufd. by heating a cast slab at ≥1100° directly or after cooling, final hot-rolling at ≥Ar3 transformation point, winding at ≤700°, pickling, cold-rolling at draft 40-70%, annealing at 730-900°, primary-cooling to 600-750° at rate 0.1-20°/s while satisfying (A) annealing temp. ≥730 and <800°, (B) primary cooling stopping temp. ≥600 and <700°, and/or (C) primary cooling av. rate 0.1-5.0°/s, cooling to ≤450° at rate ≥20°/s, holding at 350-450° for ≥120 s, cooling, grinding the surface layer in thickness ≥0.1 μm for removal, preplating with 0.2-2.0 g/m2 of Ni, heating at rate ≥10°/s to [(galvanizing bath temp.) - 40]° to [(galvanizing bath temp.) + 50]°, galvanizing, and optionally heat-alloying at 470-600° for 10-40 s.

IT 1430730-21-4D, Ca(0.0005-0.01%) Mg(0.0005-0.01%) rare earth metal(0.0005-0.01%)
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrate; high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)

RN 1430730-21-4 CAPLUS

CN Iron alloy, base, Fe 80-99,Mn 0.1-3,Cr 0-3,Cu 0-3,Ni 0-3,Si 0-3,Al 0-2,Mo 0-1,V 0-0.5,C 0-0.4,Nb 0-0.3,Ti 0-0.3,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	80	-	99	7439-89-6
Mn	0.1	-	3	7439-96-5
Cr	0	-	3	7440-47-3
Cu	0	-	3	7440-50-8
Ni	0	-	3	7440-02-0
Si	0	-	3	7440-21-3
Al	0	-	2	7429-90-5
Mo	0	-	1	7439-98-7
V	0	-	0.5	7440-62-2
C	0	-	0.4	7440-44-0
Nb	0	-	0.3	7440-03-1
Ti	0	-	0.3	7440-32-6
B	0	-	0.1	7440-42-8

IPCI C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]; C23C0002-06 [I]; C23C0002-28 [I]; C23C0002-40 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]; C23C0002-06 [I]; C23C0002-28 [I]; C23C0002-40 [I]

IPCR C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-60 [I]; C23C0002-06 [I]; C23C0002-28 [I]; C23C0002-40 [I]

CC 55-6 (Ferrous Metals and Alloys)

ST hot dip galvanized steel sheet manuf plating adhesion formability

IT Annealing
Cold rolling
Cooling
Galvannealing
Grinding (machining)
Hot rolling
Hot-dip galvanizing
(high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)

IT Rare earth metals
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(trace in alloy, substrate; high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)

IT 1431127-89-7
RL: TEM (Technical or engineered material use); USES (Uses)
(galvanized layer; high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)
IT 1430730-23-6
RL: TEM (Technical or engineered material use); USES (Uses)
(galvannealed layer; high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)
IT 7440-02-0, Nickel, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(precoating with; high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)
IT 12244-31-4, Austenite, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(retained, steel substrate microstructure component; high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)
IT 12173-93-2, Martensite, uses 12427-24-6, Ferrite (ferrous metal component) 12427-27-9, Pearlite
RL: TEM (Technical or engineered material use); USES (Uses)
(steel substrate microstructure component; high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)
IT 7439-95-4D, Magnesium, trace in alloy 7440-70-2D, Calcium, trace in alloy 1430730-20-3 1430730-21-4D, Ca(0.0005-0.01%) Mg(0.0005-0.01%) rare earth metal(0.0005-0.01%)
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrate; high-strength hot-dip galvanized steel sheet with excellent plating adhesion and formability and its manuf.)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 53 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2013:637081 CAPLUS Full-text
DOCUMENT NUMBER: 158:608421
TITLE: Hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manufacture
INVENTOR(S): Wakabayashi, Chisato; Azuma, Masafumi; Okamoto, Riki; Fujita, Nobuhiro; Takahashi, Manabu
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 21 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2013076148	A	20130425	JP 2011-217995	20110930
JP 5699889	B2	20150415		

PRIORITY APPLN. INFO.: JP 2011-217995 20110930
AB The galvanized steel sheet has a steel substrate contg. C 0.05-0.4, Si 0.01-3.0, Mn 0.1-3.0, P ≤0.04, S ≤0.05, N ≤0.01, Al 0.01-2.0, and Si + Al >0.5 wt.% while having microstructure contg. ≥40 vol.% total of main phase consisting of ≥1 kind of martensite selected from 3 kinds defined by using C content including cementite and hardness and bainite, ≥8 vol.% of austenite, ≤10 vol.% of pearlite, and a residual amt. of ferrite, (1) a hot-dip galvanized layer contg. <7 wt.% Fe and residual amts. of Zn and Al or (2) a hot-dip galvannealed layer contg. 7-15 wt.% Fe and residual amts. of Zn and Al on the substrate, and tensile strength ≥980 MPa. The galvanized steel sheet is manufd. by heating a cast slab at ≥1200° directly or after cooling, final hot-rolling at ≥Ar3 transformation point, winding at ≤700°, pickling, cold-rolling at draft 40-70%, annealing at 730-900°, primary-cooling to 650-750° at rate 0.1-50°/s, cooling to ≤450° at rate ≥20°/s, holding at 350-450° for ≥120 s, cooling, pickling, grinding the surface

layer in thickness ≥0.1 μm for removal, preplating with 0.2-2.0 g/m2 of Ni, heating at rate ≥10°/s to [(galvanizing bath temp.) - 40]° to [(galvanizing bath temp.) + 50]°, galvanizing by dipping in a bath flowing at flow rate 10-50 m/min, and optionally heat-alloying at 470-600° for 10-40 s. The galvanized sheet shows good ductility and hole-expanding property.

IT 1431057-05-4D, Ca(0.0005-0.01%) Mg(0.0005-0.01%) rare earth metal(0.0005-0.01%)
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrate; hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manuf.)

RN 1431057-05-4 CAPLUS

CN Iron alloy, base, Fe 86-100,Mn 0.1-3,Si 0-3,Al 0-2,Cr 0-1,Cu 0-1,Mo 0-1,Ni 0-1,V 0-0.5,C 0-0.4,Nb 0-0.3,Ti 0-0.3,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	86	-	100	7439-89-6
Mn	0.1	-	3	7439-96-5
Si	0	-	3	7440-21-3
Al	0	-	2	7429-90-5
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Mo	0	-	1	7439-98-7
Ni	0	-	1	7440-02-0
V	0	-	0.5	7440-62-2
C	0	-	0.4	7440-44-0
Nb	0	-	0.3	7440-03-1
Ti	0	-	0.3	7440-32-6
B	0	-	0.1	7440-42-8

IPCI C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C21D0009-46 [I]; C22C0018-00 [I]; B21B0003-00 [I]; C23C0002-06 [I]; C23C0002-40 [I]; C23C0002-02 [I]; C23C0002-28 [I]; C22C0038-00 [I]; C22C0038-60 [I]; C21D0009-46 [I]; C22C0018-00 [I]; B21B0003-00 [I]; C23C0002-06 [I]; C23C0002-40 [I]; C23C0002-02 [I]; C23C0002-28 [I]

IPCR C22C0038-00 [I]; B21B0003-00 [I]; C21D0009-46 [I]; C22C0018-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C23C0002-02 [I]; C23C0002-06 [I]; C23C0002-28 [I]; C23C0002-40 [I]; C22C0038-60 [I]

CC 55-6 (Ferrous Metals and Alloys)

ST hot dip galvanized steel sheet manuf tensile strength formability

IT Annealing
Cold rolling
Cooling
Galvannealing
Grinding (machining)
Hot rolling
Hot-dip galvanizing
Pickling
(hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manuf.)

IT Recrystallization
(texture; hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manuf.)

IT Rare earth metals
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(trace in alloy, substrate; hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manuf.)

IT 1431127-89-7, (Aluminum + zinc) 93-100, iron 0-7
RL: TEM (Technical or engineered material use); USES (Uses)
(galvanized layer; hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manuf.)

IT 1430730-23-6, (Aluminum + zinc) 85-93, iron 7-15
RL: TEM (Technical or engineered material use); USES (Uses)
(galvannealed layer; hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manuf.)

IT 7440-02-0, Nickel, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(precoating with; hot-dip galvanized steel sheet with high

tensile strength and excellent formability and its manuf.)
IT 12169-32-3, Cementite 12173-93-2, Martensite, uses 12244-31-4, Austenite, uses 12427-23-5, Bainite 12427-24-6, Ferrite (ferrous metal component) 12427-27-9, Pearlite
RL: TEM (Technical or engineered material use); USES (Uses)
(steel substrate microstructure component; hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manuf.)
IT 7439-95-4D, Magnesium, trace in alloy 7440-70-2D, Calcium, trace in alloy 1428932-65-3 1431057-05-4D, Ca(0.0005-0.01%) Mg(0.0005-0.01%) rare earth metal(0.0005-0.01%)
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(substrate; hot-dip galvanized steel sheet with high tensile strength and excellent formability and its manuf.)
OS.CITING REF COUNT: 2 THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD (2 CITINGS)

L13 ANSWER 54 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2013:515313 CAPLUS Full-text
DOCUMENT NUMBER: 158:510556
TITLE: Steel sheet having hot-dip galvanized layer and exhibiting superior plating wettability and plating adhesion, and production method therefor
INVENTOR(S): Fujita, Soshi; Yamanaka, Shintaro; Sato, Koichi
PATENT ASSIGNEE(S): Nippon Steel & Sumitomo Metal Corporation, Japan
SOURCE: PCT Int. Appl., 66pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2013047804	A1	20130404	WO 2012-JP75189	20120928
CA 2848949	A1	20130404	CA 2012-2848949	20120928
CA 2848949	C	20160920		
KR 2014053322	A	20140507	KR 2014-7006759	20120928
KR 1624810	B1	20160526		
CN 103827342	A	20140528	CN 2012-80047145	20120928
CN 103827342	B	20160622		
MX 2014003789	A	20140710	MX 2014-3789	20120928
MX 359228	B	20180920		
EP 2762601	A1	20140806	EP 2012-835446	20120928
EP 2762601	B1	20180530		
TW I465581	B	20141221	TW 2012-135905	20120928
JP 5648741	B2	20150107	JP 2013-514485	20120928
RU 2584060	C2	20160520	RU 2014-117496	20120928
BR 112014007509	A2	20170404	BR 2014-112014007509	20120928
ES 2680649	T3	20180910	ES 2012-835446	20120928
IN 2014DN02028	A	20150313	IN 2014-DN2028	20140318
US 20140234656	A1	20140821	US 2014-14346618	20140321
US 9752221	B2	20170905		
ZA 2014002254	A	20150826	ZA 2014-2254	20140326
JP 2015038245	A	20150226	JP 2014-173185	20140827
JP 5907221	B2	20160426		

PRIORITY APPLN. INFO.:
JP 2011-217144 A 20110930
JP 2013-514485 A3 20120928
WO 2012-JP75189 W 20120928
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB Provided are a steel sheet that has a hot-dip galvanized layer and that exhibits superior plating wettability and plating adhesion, and a prodn. method therefor. A steel sheet contg. readily oxidizable elements including Si and Mn is used as a base material. The hot-dip galvanized steel sheet has a hot-dip galvanized layer (A) on the surface of the steel sheet and is characterized by having a (B) layer that is directly under the surface of and inside of the steel sheet. The (B) layer has a thickness of 0.001 μm to 0.5 μm. By mass, the (B) layer contains 50 mass% or more of unoxidized Fe, less than 50 mass% total of one or more oxides of Fe, Si, Mn, P, S, and/or Al, and contains unoxidized C, Si, Mn, P, S, and/or Al in the following quantities: less

than 0.05 mass% of C; less than 0.1 mass% of Si; less than 0.5 mass% of Mn; less than 0.001 mass% of P; less than 0.001 mass% of S; and less than 0.005 mass% of Al. The steel sheet has a compn. contg. C 0.05-0.50, Si 0.1-3.0, Mn 0.5-5.0, P 0.001-0.5, S 0.001-0.03, Al 0.005-1.0, and balance Fe and inevitable impurities.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
NKK Corp	2001			JP 2001200352 A	CAPLUS
Nippon Steel Corp	2001			JP 2001226742 A	CAPLUS
Nippon Steel Corp	2003			CN 101125473 A	CAPLUS
Nippon Steel Corp	2003			EP 1504134 A	CAPLUS
Nippon Steel Corp	2003			CN 1639375 A	CAPLUS
Nippon Steel Corp	2003			WO 2002101112 A2	CAPLUS
Nippon Steel Corp	2003			AU 2002304255 A	CAPLUS
Nippon Steel Corp	2003			JP 2003171752 A	CAPLUS
Nippon Steel Corp	2003			US 20040202889 A1	CAPLUS
Nippon Steel Corp	2003			KR 20070026882 A	
Nippon Steel Corp	2003			KR 20070026883 A	
Nippon Steel Corp	2003			US 20080035247 A1	CAPLUS
Nippon Steel Corp	2003			US 20090272467 A1	CAPLUS
Nippon Steel Corp	2003			BR 210265 A	
Nippon Steel Corp	2003			CA 2449604 A1	CAPLUS
Nippon Steel Corp	2003			TW 573021 B	CAPLUS
Nippon Steel Corp	2003			DE 60220191 D	
Nippon Steel Corp	2003			DE 60220191 T	

IT 1428957-53-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(manuf. of hot-dip galvanized steel sheet by annealing cold rolled steel sheet in H-contg. atm. before galvanizing)

RN 1428957-53-2 CAPLUS

CN Iron alloy, base, Fe 78-99,Mn 0.5-5,Si 0.1-3,Al 0-1,B 0-1,Ca 0-1,Cr 0-1,Cu 0-1,misch metal 0-1,Mo 0-1,Nb 0-1,Ni 0-1,Ti 0-1,V 0-1,W 0-1,Zr 0-1,C 0-0.5,P 0-0.5 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	78	-	99	7439-89-6
Mn	0.5	-	5	7439-96-5
Si	0.1	-	3	7440-21-3
Al	0	-	1	7429-90-5
B	0	-	1	7440-42-8
Ca	0	-	1	7440-70-2
Cr	0	-	1	7440-47-3
Cu	0	-	1	7440-50-8
Misch metal	0	-	1	8049-20-5
Mo	0	-	1	7439-98-7
Nb	0	-	1	7440-03-1
Ni	0	-	1	7440-02-0
Ti	0	-	1	7440-32-6
V	0	-	1	7440-62-2
W	0	-	1	7440-33-7
Zr	0	-	1	7440-67-7
C	0	-	0.5	7440-44-0
P	0	-	0.5	7723-14-0

IPCI C23C0002-06 [I]; C22C0018-00 [I]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C23C0002-02 [I]; C23C0002-40 [I]

IPCR C23C0002-06 [I]; C22C0018-00 [I]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C23C0002-02 [I]; C23C0002-40 [I]

CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 56

ST hot dip galvanization steel sheet pretreatment annealing hydrogen atm

IT Water vapor
(annealing in atm. contg.; manuf. of hot-dip galvanized steel sheet by annealing cold rolled steel sheet in H-contg. atm. before galvanizing)

IT Annealing
(in H-contg. atm.; manuf. of hot-dip galvanized steel sheet

by annealing cold rolled steel sheet in H-contg. atm. before galvanizing)

IT Cold rolling
Hot rolling
Hot-dip galvanizing
(manuf. of hot-dip galvanized steel sheet by annealing cold rolled steel sheet in H-contg. atm. before galvanizing)

IT Controlled atmospheres
(reducing, annealing in; manuf. of hot-dip galvanized steel sheet by annealing cold rolled steel sheet in H-contg. atm. before galvanizing)

IT 1333-74-0, Hydrogen, uses 7727-37-9, Nitrogen, uses 7732-18-5, Water, uses
RL: NUU (Other use, unclassified); USES (Uses)
(annealing in atm. contg.; manuf. of hot-dip galvanized steel sheet by annealing cold rolled steel sheet in H-contg. atm. before galvanizing)

IT 1428957-52-1 1428957-53-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(manuf. of hot-dip galvanized steel sheet by annealing cold rolled steel sheet in H-contg. atm. before galvanizing)

OS.CITING REF COUNT: 2 THERE ARE 2 CAPLUS RECORDS THAT CITE THIS RECORD (2 CITINGS)

L13 ANSWER 55 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 2013:11896 CAPLUS Full-text
DOCUMENT NUMBER: 158:137246
TITLE: Heat-treated hardened steel with excellent impact performance, and method for manufacturing heat-treated hardened type component using the same
INVENTOR(S): Nam, Seung-Man; Im, Hee-Joong; Lee, Seung-Ha; Kim, Dong-Eun; Lee, Bo-Ryong; Kim, Young-Jin; Moon, Man-Been
PATENT ASSIGNEE(S): Hyundai Hysco, S. Korea
SOURCE: PCT Int. Appl., 21pp.; Chemical Indexing Equivalent to 156:209484 (KR)
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Korean
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2013002441	A1	20130103	WO 2011-KR4785	20110630
KR 1108838	B1	20120131	KR 2011-64159	20110630
CN 103534372	A	20140122	CN 2011-80070743	20110630
CN 103534372	B	20160210		
EP 2728027	A1	20140507	EP 2011-868749	20110630
EP 2728027	B1	20190116		
US 20140083574	A1	20140327	US 2013-14115516	20131104
US 20160281190	A1	20160929	US 2016-15173200	20160603

PRIORITY APPLN. INFO.:
KR 2011-64159 A 20110630
WO 2011-KR4785 W 20110630
US 2013-14115516 A3 20131104

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The title heat-treated hardened steel contains (by wt.%) C 0.12-0.8, Cr 0.01-2, Mo <0.2, B 0.0005-0.08, Sb <1.0, at least one of Ti and Nb <0.2, Si, Mn, Al and Ni satisfying one of content formulas i to iii (content formula i: Si 0.5-3, Mn 1-10 and Al 0.05-2; content formula ii: Si 0.5-3, Mn 1-10, Al <0.1 and Ni 0.01-8; content formula iii: Si 0.5-3, Mn 1-10, Al 0.1-2.5 and Ni 0.01-8), and Fe and other unavoidable impurities as balance. The heat-treated hardened steel has improved impact performance, tensile strength ≥1000 MPa, yield strength ≥800 MPa and elongation ≥10%. The heat-treated hardened steel has optionally a coating layer of Al-Si, Zn and oxidn.-resistant materials.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Hyundai Hysco	2011			KR 101033767 B1	

Jfe Steel Kk |2005 | | |JP 2005126817 A |CAPLUS
Jfe Steel Kk |2005 | | |JP 2005126817 A |CAPLUS
Jfe Steel Kk |2005 | | |JP 2005126818 A |CAPLUS
Nippon Steel Corp |2002 | | |JP 2002294397 A |CAPLUS
IT 1356391-47-3 1356391-49-5 1356391-50-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(heat-treated hardened steel with excellent impact
performance, and method for manufg. heat-treated hardened type
component using the same)
RN 1356391-47-3 CAPLUS
CN Iron alloy, base, Fe 80-98,Mn 1-10,Si 0.5-3,Al 0-2,Cr 0-2,Sb 0-1,C
0.1-0.8,Mo 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	80	-	98	7439-89-6
Mn	1	-	10	7439-96-5
Si	0.5	-	3	7440-21-3
Al	0	-	2	7429-90-5
Cr	0	-	2	7440-47-3
Sb	0	-	1	7440-36-0
C	0.1	-	0.8	7440-44-0
Mo	0	-	0.2	7439-98-7
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8

RN 1356391-49-5 CAPLUS
CN Iron alloy, base, Fe 74-98,Mn 1-10,Ni 0-8,Si 0.5-3,Cr 0-2,Sb 0-1,C
0.1-0.8,Mo 0-0.2,Nb 0-0.2,Ti 0-0.2,Al 0-0.1,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	74	-	98	7439-89-6
Mn	1	-	10	7439-96-5
Ni	0	-	8	7440-02-0
Si	0.5	-	3	7440-21-3
Cr	0	-	2	7440-47-3
Sb	0	-	1	7440-36-0
C	0.1	-	0.8	7440-44-0
Mo	0	-	0.2	7439-98-7
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8

RN 1356391-50-8 CAPLUS
CN Iron alloy, base, Fe 72-98,Mn 1-10,Ni 0-8,Si 0.5-3,Al 0.1-2.5,Cr 0-2,Sb
0-1,C 0.1-0.8,Mo 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	72	-	98	7439-89-6
Mn	1	-	10	7439-96-5
Ni	0	-	8	7440-02-0
Si	0.5	-	3	7440-21-3
Al	0.1	-	2.5	7429-90-5
Cr	0	-	2	7440-47-3
Sb	0	-	1	7440-36-0
C	0.1	-	0.8	7440-44-0
Mo	0	-	0.2	7439-98-7
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8

IPCI C22C0038-00 [I]; C21D0009-46 [I]; C22C0038-58 [I]; C21D0008-00 [I];
C23C0002-04 [I]
IPCR C22C0038-00 [I]; C21D0008-00 [I]; C21D0009-46 [I]; C22C0038-58 [I];

C23C0002-04 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST thermally hardened steel impact resistance strength
IT Elongation, mechanical
Galvanizing
Heat treatment
Tensile strength
Yield strength
(heat-treated hardened steel with excellent impact performance, and method for manufg. heat-treated hardened type component using the same)
IT 1356391-47-3 1356391-49-5 1356391-50-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(heat-treated hardened steel with excellent impact performance, and method for manufg. heat-treated hardened type component using the same)
IT 7440-66-6, Zinc, uses 11099-22-2
RL: TEM (Technical or engineered material use); USES (Uses)
(heat-treated hardened steel with excellent impact performance, and method for manufg. heat-treated hardened type component using the same)

L13 ANSWER 56 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2012:665719 CAPLUS Full-text
DOCUMENT NUMBER: 156:594034
TITLE: Method for manufacturing automobile part having different local strengths using heat-treatment hardening steel plate
INVENTOR(S): Nam, Seung-Man; Chae, Su-Hong; Kwon, Min-Suck; Kim, Hyo-Sub; Im, Hee-Joong; Lee, Bo-Ryong; Moon, Man-Been
PATENT ASSIGNEE(S): Hyundai Hysco, S. Korea
SOURCE: PCT Int. Appl., 19pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Korean
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2012060496	A1	20120510	WO 2010-KR7829	20101108
KR 1033767	B1	20110509	KR 2010-108528	20101103
CN 102712962	A	20121003	CN 2010-80038066	20101108
CN 102712962	B	20170524		
JP 2013501631	T	20130117	JP 2012-541934	20101108
JP 5509337	B2	20140604		
EP 2636759	A1	20130911	EP 2010-855727	20101108
EP 2636759	B1	20190605		
US 20120216920	A1	20120830	US 2012-13390537	20120215
US 20150167111	A1	20150618	US 2015-14630390	20150224

PRIORITY APPLN. INFO.:
KR 2010-108528 A 20101103
WO 2010-KR7829 W 20101108
US 2012-13390537 A3 20120215
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The present invention relates to a method for manufg. automobile parts having different local strengths, and more specifically, to a method for manufg. automobile parts using a heat-treatment hardened steel having different local thicknesses. The present invention provides a method for manufg. automobile parts comprising: a blank sheet prepn. step for prepg. blank sheets using a heat-treatment hardening steel plate having different thicknesses, and a heat-treatment hardening steel plate having different materials, according to the strength required; a blank conjugate forming step for forming a blank conjugate by connecting the blank sheets using laser welding; a cold molding step for cold press molding the blank conjugates; and a heat-treatment hardening step for heating the cold-molded part to above AC3 temp., then resolving mold retention stress by quenching the part when constrained in a metal mold, and enhancing the strength thereby.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File

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======================+=====+=====+======+====================+===========
Aisin Takaoka Ltd     |2004 |     |      |JP 2004058082 A     |CAPLUS
Hyundai Hysco         |2009 |     |      |KR 100902857 B1     |
Sumitomo Metal Ind Ltd |2007 |     |      |JP 2007154257 A     |CAPLUS
Voestalpine Automotive |2006 |     |      |WO 2006015849 A2    |CAPLUS
IT   1374118-68-9
     RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
     (Technical or engineered material use); PROC (Process); USES (Uses)
        (method for manufg. automobile part having different local strengths
        using heat-treatment hardening steel plate)
RN   1374118-68-9  CAPLUS
CN   Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.2-0.5,Ti
     0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1,S 0-0.1  (CA INDEX NAME)

Component   Component      Component
             Percent    Registry Number
=========+=============+===============
    Fe     94    -  99        7439-89-6
    Mn      0.5 -   3        7439-96-5
    Cr      0   -   1        7440-47-3
    C       0.2 -   0.5      7440-44-0
    Si      0.2 -   0.5      7440-21-3
    Ti      0   -   0.2      7440-32-6
    Al      0   -   0.1      7429-90-5
    B       0   -   0.1      7440-42-8
    P       0   -   0.1      7723-14-0
    S       0   -   0.1      7704-34-9

IPCI C21D0008-02 [I]; C21D0001-00 [I]; B21D0022-00 [I]; B23K0026-20 [I]
IPCR C21D0008-02 [I]; B21D0022-00 [I]; B23K0026-20 [I]; C21D0001-00 [I]
CC   55-5 (Ferrous Metals and Alloys)
ST   steel heat treatment welding molding hardening zinc coating automobile
IT   Automobile parts
       Coating materials
     Cold-press molding
     Hardening (mechanical)
     Heat treatment
     Laser welding
     Quenching (cooling)
        (method for manufg. automobile part having different local strengths
        using heat-treatment hardening steel plate)
IT   Stress, mechanical
        (residual; method for manufg. automobile part having different local
        strengths using heat-treatment hardening steel plate)
IT   7429-90-5, Aluminum, processes   7440-66-6, Zinc, processes   11133-86-1
     RL: PEP (Physical, engineering or chemical process); TEM (Technical or
     engineered material use); PROC (Process); USES (Uses)
        (coating; method for manufg. automobile part having different
        local strengths using heat-treatment hardening steel plate)
IT   7439-98-7, Molybdenum, uses   7440-02-0, Nickel, uses   7440-03-1,
     Niobium, uses   7440-36-0, Antimony, uses   7440-48-4, Cobalt, uses
     7440-50-8, Copper, uses
     RL: MOA (Modifier or additive use); USES (Uses)
        (method for manufg. automobile part having different local strengths
        using heat-treatment hardening steel plate)
IT   1297459-46-1, processes   1297459-50-7, processes   1374118-68-9
     1374118-70-3, processes   1374118-73-6
     RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
     (Technical or engineered material use); PROC (Process); USES (Uses)
        (method for manufg. automobile part having different local strengths
        using heat-treatment hardening steel plate)


L13  ANSWER 57 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2012:340397  CAPLUS Full-text
DOCUMENT NUMBER:         156:316277
TITLE:                   Method for manufacture coated steel parts by hot
                         forming
INVENTOR(S):             Verloop, Willem Cornelis; Genderen, Marc Jacco Van;
                         Tol, Ronald Theodoor Van; Hensen, Guido Cornelis;
                         Loiseaux, Jenny
PATENT ASSIGNEE(S):      Tata Steel IJmuiden BV, Neth.
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SOURCE: PCT Int. Appl., 15 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2012028224	A1	20120308	WO 2011-EP3601	20110719
CA 2809187	A1	20120308	CA 2011-2809187	20110719
CN 103108964	A	20130515	CN 2011-80041783	20110719
CN 103108964	B	20150617		
EP 2611945	A1	20130710	EP 2011-734020	20110719
EP 2611945	B1	20180228		
KR 2013099042	A	20130905	KR 2013-7006164	20110719
JP 2013542315	T	20131121	JP 2013-525155	20110719
BR 112013004952	A2	20160816	BR 2013-112013004952	20110719
ES 2663005	T3	20180410	ES 2011-734020	20110719
US 9127329	B2	20150908	US 2013-13818041	20130220
US 20130153094	A1	20130620		
MX 2013002063	A	20130405	MX 2013-2063	20130221
IN 2013CN02333	A	20160603	IN 2013-CN2333	20130325

PRIORITY APPLN. INFO.: EP 2010-9041 A 20100831
WO 2011-EP3601 W 20110719
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The invention relates to a method for manufg. a coated part having high mech. properties using hot forming techniques. The method comprises the following steps: providing an annealed steel strip or blank or pre-shaped part that was coated with a metal or alloy before the annealing; cutting a blank from the strip before or after the annealing; optionally forming a pre-shaped part from the blank; heating the blank or pre-shaped part to a temp. of 500° at an av. heating rate of 16°/s or more; further heating the blank or pre-shaped part to a temp. between 700 and 1000°; hot forming the blank or pre-shaped part into a hot formed part; hardening the hot formed part. The steel has the following compn., wt.%: C 0.1-0.5, Mn 0.5-3.0, Si 0.1-0.5, Cr <1.0, Ti <0.2, Al <0.1, P <0.1, S <0.05, B 0.0005-0.08, optionally Nb and V <0.1 each, and Fe - the balance. The coating is a zinc alloy comprising Al and Mg 1.0-5.0 wt.% each. The invention also relates to a method for manufg. a coated steel strip, blank or pre-shaped part, and to a coated steel strip, blank, or part and a hot formed part.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Cornelis, V	2010			WO 2010069588 A1	CAPLUS
Kazuh, K	2010			WO 2010005121 A1	CAPLUS
Thyssenkrupp Steel Ag	2009			DE 102008022400 A1	CAPLUS
Voestalpine Stahl Gmbh	2010			EP 2177641 A1	CAPLUS
Volks	2010			WO 2010085983 A1	CAPLUS

IT 1360605-36-2
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manuf. coated steel parts by hot forming)
RN 1360605-36-2 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Nb 0-0.1,P 0-0.1,V 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.1 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Nb	0 - 0.1	7440-03-1
P	0 - 0.1	7723-14-0

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    V       0   -   0.1      7440-62-2

IPCI C21D0008-04 [I]; C21D0009-46 [I]; C22C0038-02 [I]; C22C0038-04 [I];
     C21D0001-673 [I]; C21D0009-48 [I]
IPCR C21D0008-04 [I]; C21D0001-673 [I]; C21D0009-46 [I]; C21D0009-48 [I];
     C22C0038-02 [I]; C22C0038-04 [I]
CC   55-3 (Ferrous Metals and Alloys)
ST   steel strip coating hot deformation
IT   Plastic deformation
        (hot; method for manuf. coated steel parts by hot
        forming)
IT   1360605-37-3
     RL: TEM (Technical or engineered material use); USES (Uses)
        (coating; method for manuf. coated steel
        parts by hot forming)
IT   1360605-36-2
     RL: PEP (Physical, engineering or chemical process); TEM (Technical or
     engineered material use); PROC (Process); USES (Uses)
        (method for manuf. coated steel parts by hot
        forming)
OS.CITING REF COUNT:     1     THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD
                               (1 CITINGS)


L13  ANSWER 58 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2012:296418  CAPLUS Full-text
DOCUMENT NUMBER:         156:290294
TITLE:                   Steel sheet for hot pressing, its manufacturing
                         method, and hot-pressed material
INVENTOR(S):             Nakajima, Seiji; Nakamaru, Hiroki
PATENT ASSIGNEE(S):      JFE Steel Corp., Japan
SOURCE:                  Jpn. Kokai Tokkyo Koho, 10pp.
                         CODEN: JKXXAF
DOCUMENT TYPE:           Patent
LANGUAGE:                Japanese
FAMILY ACC. NUM. COUNT:  1
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     JP 2012041610        A    20120301    JP 2010-184840           20100820
     JP 5672849           B2   20150218
PRIORITY APPLN. INFO.:                    JP 2010-184840           20100820
AB   The steel sheet for hot pressing has an Al-Fe alloy coating layer
     contg. Fe 25-90%, Si 25-90%, and the balance of Al and inevitable
     impurities at an amt. of 10-200 g/m2 per one side of the steel sheet,
     and it is obtained from a steel sheet contg. C 0.15-0.5, Si 0.05-2.0, Mn
     0.5-3, P ≤0.1, S ≤0.05, Al ≤0.1 and N ≤0.01%
     by hot-dipping in an Al system bath to form the Al-Fe alloy layer and
     then hot-dip coated with an Al layer.  The steel sheet is heated to
     Ac3 to 1000°C and hot pressed.
IT   1356847-15-8
     RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM
     (Technical or engineered material use); PROC (Process); USES (Uses)
        (steel sheet for hot pressing, its manufg. method, and
        hot-pressed material)
RN   1356847-15-8  CAPLUS
CN   Iron alloy, base, Fe 93-99,Mn 0.5-3,Si 0-2,Cr 0-1,C 0.2-0.5,Ti 0-0.2,Al
     0-0.1,B 0-0.1,P 0-0.1  (CA INDEX NAME)

Component   Component      Component
             Percent    Registry Number
=========+=============+===============
    Fe     93   -  99        7439-89-6
    Mn      0.5 -   3        7439-96-5
    Si      0   -   2        7440-21-3
    Cr      0   -   1        7440-47-3
    C       0.2 -   0.5      7440-44-0
    Ti      0   -   0.2      7440-32-6
    Al      0   -   0.1      7429-90-5
    B       0   -   0.1      7440-42-8
    P       0   -   0.1      7723-14-0
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IPCI C23C0002-12 [I]; C22C0038-60 [I]; C22C0038-00 [I]; C22C0021-00 [I];
C23C0002-20 [I]; C23C0002-28 [I]; C23C0002-12 [I]; C22C0038-60 [I];
C22C0038-00 [I]; C22C0021-00 [I]; C23C0002-20 [I]; C23C0002-28 [I]
IPCR C23C0002-12 [I]; C22C0021-00 [I]; C22C0038-00 [I]; C22C0038-60 [I];
C23C0002-20 [I]; C23C0002-28 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST steel sheet aluminum iron alloy coating hot pressing
IT Hot-dip coating process
Hot-press sintering
(steel sheet for hot pressing, its manufg. method, and hot-pressed material)
IT 1359940-94-5 1359940-95-6
RL: TEM (Technical or engineered material use); USES (Uses)
(coating; steel sheet for hot pressing, its manufg. method, and hot-pressed material)
IT 1299468-35-1 1356847-15-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel sheet for hot pressing, its manufg. method, and hot-pressed material)
IT 7429-90-5, Aluminum, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(steel sheet for hot pressing, its manufg. method, and hot-pressed material)
OS.CITING REF COUNT: 3 THERE ARE 3 CAPLUS RECORDS THAT CITE THIS RECORD (3 CITINGS)

L13 ANSWER 59 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2012:274720 CAPLUS Full-text
DOCUMENT NUMBER: 156:290355
TITLE: Method for manufacturing steel product with different strength using laser heat treatment
INVENTOR(S): Lim, Hui Jung; Nam, Seung Man; Lee, Bo Ryong; Kim, Gyeong Bo; Jung, Yeon Il
PATENT ASSIGNEE(S): Hyundai Hysco Co., Ltd., S. Korea
SOURCE: Repub. Korea, 10pp.
CODEN: KRXXFC
DOCUMENT TYPE: Patent
LANGUAGE: Korean
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.		DATE
KR 1119173	B1	20120222	KR 2011-100174		20110930
WO 2013047939	A1	20130404	WO 2011-KR7703		20111017
CN 103842527	A	20140604	CN 2011-80073901		20111017
EP 2762577	A1	20140806	EP 2011-873399		20111017
EP 2762577	B1	20160427			
JP 2014534334	T	20141218	JP 2014-533173		20111017
JP 5898772	B2	20160406			
US 20140227553	A1	20140814	US 2014-14343955		20140310
US 20150211086	A1	20150730	US 2015-14683933		20150410
PRIORITY APPLN. INFO.:			KR 2011-100174	A	20110930
			WO 2011-KR7703	W	20111017
			US 2014-14343955	A3	20140310

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The title method comprises: (1) prepg. material composed of, by wt.%,: C 0.1-0.5, Si 0.1-0.5, Mn 0.5-3.0, P <0.1, S <0.05, Cr 0.01-1.0, Al <0.1, Ti <0.2, B 0.0005-0.08, and Fe and unavoidable impurities as balance, (2) forming the material into a preset shape to obtain a formed body, and (3) performing laser heat treatment for the part needing high strength on the formed body to locally strengthen the high-strength part. In the method, it is possible to perform local strengthening using laser heat treatment.
IT 1358890-23-9
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manufg. steel product with different strength using laser heat treatment)
RN 1358890-23-9 CAPLUS
CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.1-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.1 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

IPCI C21D0001-09 [I]; C22C0038-38 [I]; C23C0002-04 [I]
IPCR C21D0001-09 [I]; C22C0038-38 [I]; C23C0002-04 [I]
CC 55-12 (Ferrous Metals and Alloys)
ST steel molding laser heat treatment mech property
IT Heat treatment
(laser; method for manufg. steel product with different strength using laser heat treatment)
IT Lasers
Mechanical properties
Molding
(method for manufg. steel product with different strength using laser heat treatment)
IT 7429-90-5, Aluminum, processes 7440-66-6, Zinc, processes 11133-86-1 12635-57-3
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(coating; method for manufg. steel product with different strength using laser heat treatment)
IT 1358890-23-9
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manufg. steel product with different strength using laser heat treatment)

L13 ANSWER 60 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2012:198116 CAPLUS Full-text
DOCUMENT NUMBER: 156:236353
TITLE: Steel sheet for hot stamping, and process for manufacturing hot-stamped steel products using steel sheet for hot stamping
INVENTOR(S): Nakajima, Seiji; Miyoshi, Tatsuya; Nakamaru, Hiroki
PATENT ASSIGNEE(S): JFE Steel Corporation, Japan
SOURCE: PCT Int. Appl., 23pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2012018014	A1	20120209	WO 2011-JP67680	20110802
JP 4883240	B1	20120222	JP 2011-157378	20110719
JP 2012233247	A	20121129		
CA 2806263	A1	20120209	CA 2011-2806263	20110802
CA 2806263	C	20140325		
AU 2011286715	A1	20130214	AU 2011-286715	20110802
AU 2011286715	B2	20131205		
CN 103038398	A	20130410	CN 2011-80037013	20110802
CN 103038398	B	20141203		
KR 2013045898	A	20130506	KR 2013-7001759	20110802
KR 1361605	B1	20140211		
EP 2602359	A1	20130612	EP 2011-814639	20110802
EP 2602359	B1	20181010		
ZA 2013000566	A	20140326	ZA 2013-566	20110802
RU 2520847	C1	20140627	RU 2013-104193	20110802
MY 154711	A	20150715	MY 2013-333	20110802
BR 112013002586	A2	20160607	BR 2013-112013002586	20110802

BR 112013002586	B1	20201027				
TW I451004	B	20140901	TW 2011-127564			20110803
US 20130122322	A1	20130516	US 2013-13813328			20130130
US 9023488	B2	20150505				
IN 2013KN00256	A	20130705	IN 2013-KN256			20130130
IN 292658	B	20180209				
MX 2013001343	A	20130322	MX 2013-1343			20130201
PRIORITY APPLN. INFO.:			JP 2010-174957	A		20100804
			JP 2011-553	A		20110105
			JP 2011-91633	A		20110418
			JP 2011-157378	A		20110719
			WO 2011-JP67680	W		20110802

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The purpose of the present invention is to provide a steel sheet which is to be hot-stamped and which can yield hot-stamped products with excellent pitting corrosion resistance and a process for manufg. hot-stamped steel products using the steel sheet. A steel sheet for hot stamping, characterized by bearing, successively on the surface of a substrate steel sheet, a plating layer (I) which contains at least 60% by mass of Ni, with the balance consisting of Zn and unavoidable impurities, and which has a plating wt. of 0.01 to 5 g/m2, and a plating layer (II) which contains 10 to 25% by mass of Ni, with the balance consisting of Zn and unavoidable impurities, and which has a plating wt. of 10 to 90 g/m2.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Kobe Steel Ltd	1995			JP 07166371 A	CAPLUS
Sumitomo Metal Industri	1999			JP 11-350198 A	CAPLUS
Sumitomo Metal Industri	2003			CN 101144162 A	CAPLUS
Sumitomo Metal Industri	2003			EP 1439240 A1	CAPLUS
Sumitomo Metal Industri	2003			CN 1575348 A	CAPLUS
Sumitomo Metal Industri	2003			WO 2003035922 A1	
Sumitomo Metal Industri	2003			JP 2003129209 A	CAPLUS
Sumitomo Metal Industri	2003			JP 200373774 A	
Sumitomo Metal Industri	2003			US 20040166360 A1	CAPLUS
Sumitomo Metal Industri	2003			US 20050252262 A1	
Sumitomo Metal Industri	2003			KR 20060090309 A	
Sumitomo Metal Industri	2003			AT 468416 T	CAPLUS
Sumitomo Metal Industri	2003			DE 60236447 D	
United Technologies Cor	2004			SG 134989 A	CAPLUS
United Technologies Cor	2004			EP 1405934 A2	CAPLUS
United Technologies Cor	2004			CN 1497065 A	CAPLUS
United Technologies Cor	2004			KR 20040026618 A	
United Technologies Cor	2004			US 20040058189 A1	CAPLUS
United Technologies Cor	2004			JP 2004115914 A	CAPLUS
United Technologies Cor	2004			US 20050058848 A1	CAPLUS
United Technologies Cor	2004			CA 2441718 A	CAPLUS
United Technologies Cor	2004			CA 2441718 A1	CAPLUS
United Technologies Cor	2004			TW 276707 B	
United Technologies Cor	2004			BR 304193 A	
United Technologies Cor	2004			AT 397683 T	CAPLUS
United Technologies Cor	2004			DE 60321435 D	

IT 1356847-15-8

RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel sheet for hot stamping, and process for manufg. hot-stamped steel products using steel sheet for hot stamping)

RN 1356847-15-8 CAPLUS

CN Iron alloy, base, Fe 93-99,Mn 0.5-3,Si 0-2,Cr 0-1,C 0.2-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	93	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Si	0	-	2	7440-21-3
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0

Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C25D0005-26 [I]; B21D0022-20 [I]; C22C0018-00 [I]; C22C0019-03 [I]; C22C0038-00 [I]; C22C0038-60 [I]
IPCR C25D0005-26 [I]; B21D0022-20 [I]; C22C0018-00 [I]; C22C0019-03 [I]; C22C0038-00 [I]; C22C0038-60 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 72
ST hot stamping steel sheet nickel zinc alloy electrodeposition
IT Metalworking
(stamping; steel sheet for hot stamping, and process for manufg. hot-stamped steel products using steel sheet for hot stamping)
IT Electrodeposition
Pitting corrosion
(steel sheet for hot stamping, and process for manufg. hot-stamped steel products using steel sheet for hot stamping)
IT Polysiloxanes
RL: TEM (Technical or engineered material use); USES (Uses)
(steel sheet for hot stamping, and process for manufg. hot-stamped steel products using steel sheet for hot stamping)
IT 7440-02-0, Nickel, uses 238084-01-0
RL: TEM (Technical or engineered material use); USES (Uses)
(coating; steel sheet for hot stamping, and process for manufg. hot-stamped steel products using steel sheet for hot stamping)
IT 7631-86-9, Colloidal silica, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(colloidal; steel sheet for hot stamping, and process for manufg. hot-stamped steel products using steel sheet for hot stamping)
IT 1299468-35-1 1356847-15-8
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(steel sheet for hot stamping, and process for manufg. hot-stamped steel products using steel sheet for hot stamping)
IT 3227-63-2, Zirconium acetate 11138-49-1, Sodium aluminate 12627-14-4, Lithium silicate 39302-37-9, Lithium titanate
RL: TEM (Technical or engineered material use); USES (Uses)
(steel sheet for hot stamping, and process for manufg. hot-stamped steel products using steel sheet for hot stamping)
OS.CITING REF COUNT: 5 THERE ARE 5 CAPLUS RECORDS THAT CITE THIS RECORD (5 CITINGS)

L13 ANSWER 61 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2012:169521 CAPLUS Full-text
DOCUMENT NUMBER: 156:209484
TITLE: Heat-treated hardened steel with excellent impact performance, and method for manufacturing heat-treated hardened type component using the same
INVENTOR(S): Nam, Seung Man; Lim, Hui Jung; Lee, Seung Ha; Kim, Dong Eun; Lee, Bo Ryong; Kim, Yeong Jin; Moon, Man Bin
PATENT ASSIGNEE(S): Hyundai Hysco Co., Ltd., S. Korea
SOURCE: Repub. Korea, 14pp.; Chemical Indexing Equivalent to 158:137246 (WO)
CODEN: KRXXFC
DOCUMENT TYPE: Patent
LANGUAGE: Korean
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
KR 1108838	B1	20120131	KR 2011-64159	20110630
WO 2013002441	A1	20130103	WO 2011-KR4785	20110630

CN 103534372	A	20140122	CN 2011-80070743		20110630
CN 103534372	B	20160210			
EP 2728027	A1	20140507	EP 2011-868749		20110630
EP 2728027	B1	20190116			
US 20140083574	A1	20140327	US 2013-14115516		20131104
US 20160281190	A1	20160929	US 2016-15173200		20160603
PRIORITY APPLN. INFO.:			KR 2011-64159	A	20110630
			WO 2011-KR4785	W	20110630
			US 2013-14115516	A3	20131104

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The title heat-treated hardened steel contains (by wt.%) C 0.12-0.8, Cr 0.01-2, Mo <0.2, B 0.0005-0.08, Sb <1.0, at least one of Ti and Nb <0.2, Si, Mn, Al and Ni satisfying one of content formulas i to iii (content formula i: Si 0.5-3, Mn 1-10 and Al 0.05-2; content formula ii: Si 0.5-3, Mn 1-10, Al <0.1 and Ni 0.01-8; content formula iii: Si 0.5-3, Mn 1-10, Al 0.1-2.5 and Ni 0.01-8), and Fe and other unavoidable impurities as balance. The heat-treated hardened steel has improved impact performance, tensile strength ≥1000 MPa, yield strength ≥800 MPa and elongation ≥10%. The heat-treated hardened steel has optionally a coating layer of Al-Si, Zn and oxidn.-resistant materials.

IT 1356391-47-3 1356391-49-5 1356391-50-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(heat-treated hardened steel with excellent impact performance, and method for manufg. heat-treated hardened type component using the same)

RN 1356391-47-3 CAPLUS
CN Iron alloy, base, Fe 80-98,Mn 1-10,Si 0.5-3,Al 0-2,Cr 0-2,Sb 0-1,C 0.1-0.8,Mo 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	80	-	98	7439-89-6
Mn	1	-	10	7439-96-5
Si	0.5	-	3	7440-21-3
Al	0	-	2	7429-90-5
Cr	0	-	2	7440-47-3
Sb	0	-	1	7440-36-0
C	0.1	-	0.8	7440-44-0
Mo	0	-	0.2	7439-98-7
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8

RN 1356391-49-5 CAPLUS
CN Iron alloy, base, Fe 74-98,Mn 1-10,Ni 0-8,Si 0.5-3,Cr 0-2,Sb 0-1,C 0.1-0.8,Mo 0-0.2,Nb 0-0.2,Ti 0-0.2,Al 0-0.1,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	74	-	98	7439-89-6
Mn	1	-	10	7439-96-5
Ni	0	-	8	7440-02-0
Si	0.5	-	3	7440-21-3
Cr	0	-	2	7440-47-3
Sb	0	-	1	7440-36-0
C	0.1	-	0.8	7440-44-0
Mo	0	-	0.2	7439-98-7
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8

RN 1356391-50-8 CAPLUS
CN Iron alloy, base, Fe 72-98,Mn 1-10,Ni 0-8,Si 0.5-3,Al 0.1-2.5,Cr 0-2,Sb 0-1,C 0.1-0.8,Mo 0-0.2,Nb 0-0.2,Ti 0-0.2,B 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number

Fe	72	-	98	7439-89-6
Mn	1	-	10	7439-96-5
Ni	0	-	8	7440-02-0
Si	0.5	-	3	7440-21-3
Al	0.1	-	2.5	7429-90-5
Cr	0	-	2	7440-47-3
Sb	0	-	1	7440-36-0
C	0.1	-	0.8	7440-44-0
Mo	0	-	0.2	7439-98-7
Nb	0	-	0.2	7440-03-1
Ti	0	-	0.2	7440-32-6
B	0	-	0.1	7440-42-8

IPCI C22C0038-00 [I]; C21D0009-46 [I]; C21D0008-00 [I]; C23C0002-04 [I]
IPCR C22C0038-00 [I]; C21D0008-00 [I]; C21D0009-46 [I]; C23C0002-04 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST thermally hardened steel impact resistance strength
IT Elongation, mechanical
Galvanizing
Heat treatment
Tensile strength
Yield strength
(heat-treated hardened steel with excellent impact performance, and method for manufg. heat-treated hardened type component using the same)
IT 1356391-47-3 1356391-49-5 1356391-50-8
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(heat-treated hardened steel with excellent impact performance, and method for manufg. heat-treated hardened type component using the same)
IT 7440-66-6, Zinc, uses 11099-22-2
RL: TEM (Technical or engineered material use); USES (Uses)
(heat-treated hardened steel with excellent impact performance, and method for manufg. heat-treated hardened type component using the same)

L13 ANSWER 62 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2010:880522 CAPLUS Full-text
DOCUMENT NUMBER: 153:180874
TITLE: Process for manufacture of high tensile strength hot-dip galvanized steel sheet with uniform galvanized coating
INVENTOR(S): Yamanaka, Shintaro
PATENT ASSIGNEE(S): Nippon Steel Corp., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 11pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2010156029	A	20100715	JP 2009-199	20090105
JP 5594559	B2	20140924		

PRIORITY APPLN. INFO.: JP 2009-199 20090105
AB The base steel comprises C 0.001-0.3, Si 0.5-2.0, Mn 1.0-3.0, P 0.002-0.2, S 0.001-0.03, Al 0.005-1 wt.%, and balance Fe. The manufg. process includes continuous hot-dip galvanization. When a steel sheet is put into plating bath, the sheet temp. is 100-180° higher than the plating bath temp. The plating bath temp. is kept 440-470°. Optionally the base steel contains total 0.05-1.0 wt.% Ti, Nb, B, Cr, and/or Mo. The galvanized steel sheet has uniform galvanized coating and good appearance.
IT 1234653-91-8
RL: TEM (Technical or engineered material use); USES (Uses)
(base steel; manuf. of high tensile strength hot-dip galvanized steel sheet with uniform galvanized coating)
RN 1234653-91-8 CAPLUS
CN Iron alloy, base, Fe 92-98,Mn 1-3,Si 0.5-2,Al 0-1,B 0-1,Cr 0-1,Mo 0-1,Nb

0-1,Ti 0-1,C 0-0.3,P 0-0.2 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	92	-	98	7439-89-6
Mn	1	-	3	7439-96-5
Si	0.5	-	2	7440-21-3
Al	0	-	1	7429-90-5
B	0	-	1	7440-42-8
Cr	0	-	1	7440-47-3
Mo	0	-	1	7439-98-7
Nb	0	-	1	7440-03-1
Ti	0	-	1	7440-32-6
C	0	-	0.3	7440-44-0
P	0	-	0.2	7723-14-0

IPCI C23C0002-06 [I]; C23C0002-40 [I]; C22C0038-00 [I]; C22C0038-06 [I];
C22C0038-38 [I]; C21D0009-46 [I]; C23C0002-06 [I]; C23C0002-40 [I];
C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-38 [I]; C21D0009-46 [I]
IPCR C23C0002-06 [I]; C21D0009-46 [I]; C22C0038-00 [I]; C22C0038-06 [I];
C22C0038-38 [I]; C23C0002-40 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST high tensile strength hot dip galvanized steel
IT Hot-dip galvanizing
(continuous; manuf. of high tensile strength hot-dip galvanized steel sheet with uniform galvanized coating)
IT Galvanized steel
RL: TEM (Technical or engineered material use); USES (Uses)
(hot-dip; manuf. of high tensile strength hot-dip galvanized steel sheet with uniform galvanized coating)
IT 12697-71-1, uses 57923-89-4 144920-07-0, uses 797752-03-5, uses
1234653-91-8 1234653-92-9, uses 1234653-94-1, uses
1234653-96-3 1234653-97-4, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(base steel; manuf. of high tensile strength hot-dip galvanized steel sheet with uniform galvanized coating)

L13 ANSWER 63 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2010:267926 CAPLUS Full-text
DOCUMENT NUMBER: 152:316673
TITLE: Aluminum-containing copper alloy-coated steel member and its manufacture by thermal diffusion of aluminum
INVENTOR(S): Fujii, Takahiro; Tadano, Masayoshi; Hiraoka, Masashi; Izumi, Keiji
PATENT ASSIGNEE(S): Nisshin Steel Co., Ltd., Japan
SOURCE: Jpn. Kokai Tokkyo Koho, 9pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2010047791	A	20100304	JP 2008-211413	20080820
JP 5561920	B2	20140730		

PRIORITY APPLN. INFO.: JP 2008-211413 20080820
AB The steel member has a Cu alloy coating layer with thickness 0.5-100 μm and Al content 1-15 wt.%. The coating layer may have compn. of Al 1-15, Ni ≤7, Fe ≤6, Cr ≤2, Mn ≤2 wt.%, and balance Cu at the center of the thickness. The manufg. process includes plating a steel substrate contg. 1-20 wt.% Al with Cu and heating at 600-1050° in nonoxidizing atm. for diffusion of Al from the substrate to the Cu plating layer. The Cu plating layer may be formed on a Ni undercoating layer by electrodeposition. The coating layer has good adhesion to the substrate. Al-contg. Cu alloy-coated steel members can be manufd. at a low cost and they have excellent resistance to oxidn., corrosion, and wear.

IT 1213779-75-9
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(substrate before diffusion; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
RN 1213779-75-9 CAPLUS
CN Iron alloy, base, Fe 0-99,Cr 0-35,Ni 0-24,Al 1-20,Cu 0-6,Mn 0-5,Mo 0-5,Si 0-3,B 0-1,C 0-1,Nb 0-1,Ti 0-1,V 0-1,N 0-0.5,Ca 0-0.1,Mg 0-0.1,misch metal 0-0.1,P 0-0.1,Y 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	0 - 99	7439-89-6
Cr	0 - 35	7440-47-3
Ni	0 - 24	7440-02-0
Al	1 - 20	7429-90-5
Cu	0 - 6	7440-50-8
Mn	0 - 5	7439-96-5
Mo	0 - 5	7439-98-7
Si	0 - 3	7440-21-3
B	0 - 1	7440-42-8
C	0 - 1	7440-44-0
Nb	0 - 1	7440-03-1
Ti	0 - 1	7440-32-6
V	0 - 1	7440-62-2
N	0 - 0.5	17778-88-0
Ca	0 - 0.1	7440-70-2
Mg	0 - 0.1	7439-95-4
Misch metal	0 - 0.1	8049-20-5
P	0 - 0.1	7723-14-0
Y	0 - 0.1	7440-65-5

IPCI C23C0010-28 [I]; C22C0009-01 [I]; C22C0009-06 [I]; C22C0009-00 [I]; C22C0009-05 [I]; C22C0038-00 [I]; C22C0038-58 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C23C0010-28 [I]; C22C0009-01 [I]; C22C0009-06 [I]; C22C0009-00 [I]; C22C0009-05 [I]; C22C0038-00 [I]; C22C0038-58 [I]; C21D0009-46 [I]; C22C0038-06 [I]; C25D0005-26 [I]; C25D0005-50 [I]
IPCR C23C0010-28 [I]; C21D0009-46 [I]; C22C0009-00 [I]; C22C0009-01 [I]; C22C0009-05 [I]; C22C0009-06 [I]; C22C0038-00 [I]; C22C0038-06 [I]; C22C0038-58 [I]; C25D0005-26 [I]; C25D0005-50 [I]
CC 55-6 (Ferrous Metals and Alloys)
Section cross-reference(s): 56
ST aluminum copper alloy coated steel manuf diffusion
IT Coating materials
(abrasion-resistant; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
IT Abrasion-resistant materials
(coatings; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
IT Anticorrosive coating materials
Thermal diffusion
(manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
IT Chemically resistant coating materials
(oxidation-resistant; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
IT 1213779-71-5P
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)
(coating; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
IT 1213779-73-7 1213779-74-8
RL: MSC (Miscellaneous)
(coating; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)

IT 7440-50-8, Copper, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(plating layer; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
IT 12597-69-2, Steel, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(substrate after diffusion; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
IT 1197343-32-0 1213779-75-9 1213779-76-0 1213779-77-1
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(substrate before diffusion; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
IT 7440-02-0, Nickel, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(undercoating layer; manuf. of Al-contg. Cu alloy-coated steel members by thermal diffusion of Al from steel substrate to Cu plating layer)
OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 64 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2009:1460891 CAPLUS Full-text
DOCUMENT NUMBER: 151:574971
TITLE: Composite with a ballistic protective effect
INVENTOR(S): Becker, Jens-Ulrik; Hofmann, Harald; Hoeckling, Christian; Kern, Andreas; Schriever, Udo; Tamler, Horst Walter; Tschersich, Hans-Joachim
PATENT ASSIGNEE(S): ThyssenKrupp Steel Europe A.-G., Germany
SOURCE: Eur. Pat. Appl., 18pp.
CODEN: EPXXDW
DOCUMENT TYPE: Patent
LANGUAGE: German
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
EP 2123447	A1	20091125	EP 2008-103856	20080507
EP 2123447	B1	20181226		
ES 2709433	T3	20190416	ES 2008-103856	20080507
US 20120174752	A1	20120712	US 2009-436415	20090506
US 8545993	B2	20131001		

PRIORITY APPLN. INFO.: EP 2008-103856 A 20080507
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB The composite with a ballistic protective effect contains a 1st outer layer made of an alloy steel and ≥1 2nd layer made of an alloy steel which is arranged below the 1st layer. The 1st alloy steel contains C 0.06-1.05, Si 0.05-1.65, Mn 0.3-2.65, Al 0.015-1.55, Cr ≤1.2, Ti ≤0.13, Mo ≤0.7, Nb ≤0.1, B ≤0.005, P ≤0.08, S ≤0.01, Ni ≤4.0, and V ≤0.5%. The 2nd alloy steel contains C ≤1.0, Si ≤8.0, Mn 0.05-30.0, Al ≤10.0, Cr ≤10.0, Ti ≤0.5, Nb ≤0.5, B ≤0.1, V ≤0.5, Mo ≤5.0, P ≤0.1, S ≤0.03, N ≤0.3, Ni ≤8.0, Cu ≤3.0, and Sn ≤0.04%. The 2nd layer has a higher elongation than that of the 1st layer. Typically, the composite is produced by roll plating. The composite has enhanced ballistic properties; decreased wall thicknesses of parts are required. The composite is esp. suitable for motor vehicles and structural parts.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Allegheny Ludlum Corp	1996			EP 0731332 A	CAPLUS
Boehler & Co Ag Geb	1976			GB 1444063 A	CAPLUS
Creusot Loire	1992			EP 0509854 A	CAPLUS
Grell Karl-Ludwig	1995			US 5418074 A	CAPLUS
Junius Hans-Toni	2003			US 20030029530 A1	CAPLUS
Leger Jacques	1993			US 5213905 A	CAPLUS

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Liebowitz, B            |1948 |      |       |US 2438759 A         |
Nippon Steel Corp       |1994 |      |       |JP 06093370 A        |CAPLUS
Pircher Hans            |1987 |      |       |US 4645720 A         |CAPLUS
Thyssenkrupp Steel Ag   |2006 |      |       |DE 102005006606 B3   |
Voest Alpine Ag         |1983 |      |       |AT 372113 B          |
Voest Alpine Ag         |1987 |      |       |EP 0247020 A         |CAPLUS
IT   1196665-70-9
     RL: TEM (Technical or engineered material use); USES (Uses)
        (in prodn. of composite with ballistic protective effect)
RN   1196665-70-9  CAPLUS
CN   Iron alloy, base, Fe 23-100,Mn 0-30,Al 0-10,Cr 0-10,Ni 0-8,Si 0-8,Mo
     0-5,Cu 0-3,C 0-1,Nb 0-0.5,Ti 0-0.5,V 0-0.5,N 0-0.3,B 0-0.1,P 0-0.1  (CA
     INDEX NAME)

Component   Component      Component
             Percent    Registry Number
=========+=============+===============
    Fe      23  - 100        7439-89-6
    Mn       0  -  30        7439-96-5
    Al       0  -  10        7429-90-5
    Cr       0  -  10        7440-47-3
    Ni       0  -   8        7440-02-0
    Si       0  -   8        7440-21-3
    Mo       0  -   5        7439-98-7
    Cu       0  -   3        7440-50-8
    C        0  -   1        7440-44-0
    Nb       0  -   0.5      7440-03-1
    Ti       0  -   0.5      7440-32-6
    V        0  -   0.5      7440-62-2
    N        0  -   0.3     17778-88-0
    B        0  -   0.1      7440-42-8
    P        0  -   0.1      7723-14-0

IPCI B32B0015-01 [I]; C21D0009-42 [I]; F41H0005-04 [I]
IPCR B32B0015-01 [I]; C21D0009-42 [I]; F41H0005-04 [I]
CC   55-4 (Ferrous Metals and Alloys)
ST   steel laminated composite
IT   1196665-67-4   1196665-70-9   1196665-73-2, uses   1196665-75-4
     1196665-77-6   1196665-79-8
     RL: TEM (Technical or engineered material use); USES (Uses)
        (in prodn. of composite with ballistic protective effect)
OS.CITING REF COUNT:     8     THERE ARE 8 CAPLUS RECORDS THAT CITE THIS RECORD
                               (8 CITINGS)


L13  ANSWER 65 OF 103  CAPLUS  COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER:        2009:887390  CAPLUS Full-text
DOCUMENT NUMBER:         151:202847
TITLE:                   Method for manufacturing stamped coated steel products
INVENTOR(S):             Drillet, Pascal; Spehner, Dominique; Kefferstein,
                         Ronald
PATENT ASSIGNEE(S):      ArcelorMittal France, Fr.
SOURCE:                  PCT Int. Appl., 27pp.
                         CODEN: PIXXD2
DOCUMENT TYPE:           Patent
LANGUAGE:                English
FAMILY ACC. NUM. COUNT:  2
PATENT INFORMATION:
     PATENT NO.          KIND  DATE        APPLICATION NO.          DATE
     ---------------     ----  --------    ---------------------    --------
     WO 2009090555        A1   20090723    WO 2009-IB322            20090112
     WO 2009090443        A1   20090723    WO 2008-IB79             20080115
     CA 2713685           A1   20090723    CA 2009-2713685          20090112
     CA 2713685           C    20120320
     KR 2010112602        A    20101019    KR 2010-7017170          20090112
     EP 2242863           A1   20101027    EP 2009-701846           20090112
     EP 2242863           B1   20140108
     CN 101910426         A    20101208    CN 2009-80102269         20090112
     JP 2011512455        T    20110421    JP 2010-542705           20090112
     JP 6146941           B2   20170614
     KR 2013008657        A    20130122    KR 2013-7000047          20090112
     KR 1508861           B1   20150407
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RU 2499847	C2	20131127	RU 2010-134002		20090112
ES 2448551	T3	20140314	ES 2009-701846		20090112
BR 2009007223	A2	20150714	BR 2009-7223		20090112
BR 2009007223	B1	20170606			
MX 2010007428	A	20100903	MX 2010-7428		20100705
IN 2010CN04187	A	20110107	IN 2010-CN4187		20100706
IN 289869	B	20171201			
PRIORITY APPLN. INFO.:			WO 2008-IB79	A	20080115
			KR 2010-7017170	A3	20090112
			WO 2009-IB322	W	20090112

AB The invention relates to a process for making a hot stamped coated steel sheet product. The methods comprises the steps of pre-coating a steel strip or sheet by aluminum or aluminum-iron-silicon alloy, cutting said pre-coated strip to obtain a pre-coated steel blank, heating the blank in a furnace preheated to a temp. and during a time defined by diagram according to thickness, at a heating rate Vc of 4-12°/s between 20 and 700° and at a heating rate Vc' of 1.5 and 6°/s between 500 and 700°, to obtain a heated blank. Further steps include transferring said heated blank to a die, hot stamping, cooling at a mean rate Vr of at least 30°/s between the exit of the heated blank from the furnace and down to 400°.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Kefferstein Ronald	2001			US 20010042393 A1	
Lorraine Laminage	2000			EP 0971044 A	CAPLUS
Nissan Motor	2004			EP 1380666 A	CAPLUS
Usinor	2003			FR 2833504 A	CAPLUS

IT 1173986-65-6
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manufg. stamped coated steel products)

RN 1173986-65-6 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.2 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Cu	0 - 0.1	7440-50-8
Ni	0 - 0.1	7440-02-0
P	0 - 0.1	7723-14-0

IPCI C21D0008-02 [I]; C22C0038-32 [I]; C22C0038-38 [I]; B21D0053-26 [I]; C23C0002-12 [I]

IPCR C21D0008-02 [I]; B21D0053-26 [I]; C22C0038-32 [I]; C22C0038-38 [I]; C23C0002-12 [I]

CC 55-11 (Ferrous Metals and Alloys)

ST steel aluminum coating hot stamping

IT Hot-dip coating process
(method for manufg. stamped coated steel products)

IT Metalworking
(stamping, hot; method for manufg. stamped coated steel products)

IT 1173986-72-5
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(interdiffusion layer; method for manufg. stamped coated steel products)

IT 1173986-68-9
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(intermediate and superficial layer; method for manufg.

stamped coated steel products)
IT 1173986-67-8 1173986-76-9
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(intermediate layer; method for manufg. stamped coated steel products)
IT 1173986-70-3 1173986-74-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(intermetallic layer; method for manufg. stamped coated steel products)
IT 952598-91-3 1058743-89-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(main coating; method for manufg. stamped coated steel products)
IT 1173986-65-6 1173986-66-7, processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manufg. stamped coated steel products)
IT 1173986-77-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(superficial layer; method for manufg. stamped coated steel products)

L13 ANSWER 66 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2009:887389 CAPLUS Full-text
DOCUMENT NUMBER: 151:202846
TITLE: Method for manufacturing stamped coated steel products
INVENTOR(S): Drillet, Pascal; Spehner, Dominique; Kefferstein, Ronald
PATENT ASSIGNEE(S): ArcelorMittal France, Fr.
SOURCE: PCT Int. Appl., 27pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2009090443	A1	20090723	WO 2008-IB79	20080115
CA 2713685	A1	20090723	CA 2009-2713685	20090112
CA 2713685	C	20120320		
WO 2009090555	A1	20090723	WO 2009-IB322	20090112
KR 2010112602	A	20101019	KR 2010-7017170	20090112
EP 2242863	A1	20101027	EP 2009-701846	20090112
EP 2242863	B1	20140108		
CN 101910426	A	20101208	CN 2009-80102269	20090112
JP 2011512455	T	20110421	JP 2010-542705	20090112
JP 6146941	B2	20170614		
KR 2013008657	A	20130122	KR 2013-7000047	20090112
KR 1508861	B1	20150407		
RU 2499847	C2	20131127	RU 2010-134002	20090112
ES 2448551	T3	20140314	ES 2009-701846	20090112
CN 104651590	A	20150527	CN 2014-10799052	20090112
BR 2009007223	A2	20150714	BR 2009-7223	20090112
BR 2009007223	B1	20170606		
ZA 2010004497	A	20110330	ZA 2010-4497	20100625
MX 2010007428	A	20100903	MX 2010-7428	20100705
IN 2010CN04187	A	20110107	IN 2010-CN4187	20100706
IN 289869	B	20171201		
US 20110006491	A1	20110113	US 2010-834162	20100712
US 8733142	B2	20140527		
US 8066829	B2	20111129	US 2011-13118077	20110527
US 20120064362	A1	20120315	US 2011-13301403	20111121
US 8440323	B2	20130514		
JP 2017159364	A	20170914	JP 2017-40554	20170303
JP 6588047	B2	20191009		

PRIORITY APPLN. INFO.: WO 2008-IB79 A 20080115
CN 2009-80102269 A3 20090112

JP 2010-542705 A3 20090112
KR 2010-7017170 A3 20090112
WO 2009-IB322 W 20090112
US 2010-834162 A1 20100712

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB The invention relates to a process for making a hot stamped coated steel sheet product. The methods comprises the steps of pre-coating a steel strip or sheet by aluminum or aluminum-iron-silicon alloy, cutting said pre-coated strip to obtain a pre-coated steel blank, heating the blank in a furnace preheated to a temp. and during a time defined by diagram according to thickness, at a heating rate Vc of 4-12°/s between 20 and 700° and at a heating rate Vc' of 1.5 and 6°/s between 500 and 700°, to obtain a heated blank. Further steps include transferring said heated blank to a die, hot stamping, cooling at a mean rate Vr of at least 30°/s between the exit of the heated blank from the furnace and down to 400°.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Kefferstein Ronald	2001			US 20010042393 A1	
Lorraine Laminage	2000			EP 0971044 A	CAPLUS
Nissan Motor	2004			EP 1380666 A	CAPLUS
Usinor	2003			FR 2833504 A	CAPLUS

IT 1173986-65-6
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manufg. stamped coated steel products)

RN 1173986-65-6 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,Cu 0-0.1,Ni 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	94	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Si	0.1	-	0.5	7440-21-3
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
Cu	0	-	0.1	7440-50-8
Ni	0	-	0.1	7440-02-0
P	0	-	0.1	7723-14-0

IPCI C21D0008-02 [I]; C22C0038-32 [I]; C22C0038-38 [I]; B21D0053-26 [I]; C23C0002-12 [I]

IPCR C21D0008-02 [I]; B21D0053-26 [I]; C22C0038-32 [I]; C22C0038-38 [I]; C23C0002-12 [I]

CC 55-11 (Ferrous Metals and Alloys)

ST steel aluminum coating hot stamping

IT Hot-dip coating process
(method for manufg. stamped coated steel products)

IT Metalworking
(stamping, hot; method for manufg. stamped coated steel products)

IT 1173986-67-8 1173986-72-5
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(interdiffusion layer; method for manufg. stamped coated steel products)

IT 1173986-68-9
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(intermediate and superficial layers; method for manufg. stamped coated steel products)

IT 1173986-74-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(intermediate layer; method for manufg. stamped

coated steel products)
IT 1173986-70-3 1173986-76-9
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(intermetallic layer; method for manufg. stamped coated steel products)
IT 952598-91-3 1058743-89-7
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(main coating; method for manufg. stamped coated steel products)
IT 1173986-65-6 1173986-66-7, processes
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(method for manufg. stamped coated steel products)
IT 1173986-77-0
RL: PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(superficial layer; method for manufg. stamped coated steel products)
OS.CITING REF COUNT: 6 THERE ARE 6 CAPLUS RECORDS THAT CITE THIS RECORD (6 CITINGS)

L13 ANSWER 67 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2008:556603 CAPLUS Full-text
DOCUMENT NUMBER: 148:521251
TITLE: Coated steel strips, methods of making the same, methods of using the same, stamping blanks prepared from the same, stamped products prepared from the same, and articles of manufacture which contain such a stamped product
INVENTOR(S): Drillet, Pascal; Spehner, Dominique; Kefferstein, Ronald
PATENT ASSIGNEE(S): Arcelor France, Fr.
SOURCE: PCT Int. Appl., 43 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: English
FAMILY ACC. NUM. COUNT: 2
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2008053273	A1	20080508	WO 2006-IB4019	20061030
CA 2668393	A1	20080508	CA 2006-2668393	20061030
CA 2668393	C	20130813		
EP 2086755	A1	20090812	EP 2006-842403	20061030
EP 2086755	B1	20171129		
KR 2009086970	A	20090814	KR 2009-7008891	20061030
KR 1327648	B1	20131112		
CN 101583486	A	20091118	CN 2006-80056246	20061030
CN 101583486	B	20140827		
JP 2010508438	T	20100318	JP 2009-533969	20061030
JP 5334854	B2	20131106		
RU 2395593	C1	20100727	RU 2009-114832	20061030
BR 2006022071	A2	20140527	BR 2006-22071	20061030
EP 3290199	A1	20180307	EP 2017-192410	20061030
EP 3290199	B1	20190821		
EP 3290200	A1	20180307	EP 2017-192418	20061030
EP 3587104	A1	20200101	EP 2019-185736	20061030
EP 3587105	A1	20200101	EP 2019-185743	20061030
ES 2754621	T3	20200420	ES 2017-192410	20061030
ZA 2009002611	A	20101027	ZA 2009-2611	20090416
MX 2009004453	A	20090511	MX 2009-4453	20090424
IN 2009CN02275	A	20100319	IN 2009-CN2275	20090424
IN 324293	B	20191108		
US 20110165436	A1	20110707	US 2011-447777	20110318
US 20130029172	A1	20130131	US 2012-13621015	20120915
US 9708683	B2	20170718		
US 20170260603	A1	20170914	US 2017-15606770	20170526
US 10550447	B2	20200204		
US 20190271055	A1	20190905	US 2019-16413774	20190516

US 10590507	B2	20200317			
US 20190271056	A1	20190905	US 2019-16413799		20190516
US 20190271057	A1	20190905	US 2019-16413825		20190516
US 20190271058	A1	20190905	US 2019-16414022		20190516
US 10597747	B2	20200324			
US 20190276912	A1	20190912	US 2019-16413729		20190516
US 10577674	B2	20200303			

PRIORITY APPLN. INFO.:

EP 2006-842403	A3	20061030
EP 2017-192410	A3	20061030
WO 2006-IB4019	W	20061030
US 2011-447777	A3	20110318
US 2012-13621015	A1	20120915
US 2017-15606770	A1	20170526

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB Coated steel having a well defined and uniform thickness is useful and advantageous for prepg. products by hot stamping. Products prepd. by hot stamping such a steel are particularly advantageous when subjected to a subsequent spot welding step.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Arcelor France	2006			WO 2006097593 A	CAPLUS
Armco Inc	1990			EP 0356783 A2	CAPLUS
Bhp Steel Jla Pty Ltd	2003			EP 1336666 A	CAPLUS
Laurent Jean-Pierre	2001			US 6296805 B1	CAPLUS
Lorraine Laminage	1995			FR 2720079 A1	CAPLUS
Lorraine Laminage	1998			FR 2758571 A1	CAPLUS
Lorraine Laminage	2000			EP 1013785 A1	CAPLUS

IT 1022915-01-0
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)

RN 1022915-01-0 CAPLUS

CN Iron alloy, base, Fe 94-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	94 - 99	7439-89-6
Mn	0.5 - 3	7439-96-5
Cr	0 - 1	7440-47-3
C	0.2 - 0.5	7440-44-0
Si	0.1 - 0.5	7440-21-3
Ti	0 - 0.2	7440-32-6
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
P	0 - 0.1	7723-14-0

IPCI B32B0015-00 [I]; C21D0009-46 [I]
IPCR B32B0015-00 [I]; C21D0009-46 [I]
CC 55-11 (Ferrous Metals and Alloys)
ST aluminum coated steel strip stamping article spot welding
IT Metalworking
(stamping; aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)
IT 7429-90-5, Aluminum, uses 952598-91-3, Aluminum 87-90, iron 2-4, silicon 8-11
RL: NUU (Other use, unclassified); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)
IT 1022915-01-0
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(aluminum coated steel strips stamping blanks and articles of manuf. which contain such a stamped product)
OS.CITING REF COUNT: 7 THERE ARE 7 CAPLUS RECORDS THAT CITE THIS RECORD (7 CITINGS)

L13 ANSWER 68 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2006:322586 CAPLUS Full-text
DOCUMENT NUMBER: 144:354988
TITLE: Oxidation-resistant units and oxidation-resistant coating materials for turbines
INVENTOR(S): Yasutomi, Yoshiyuki; Kitaoka, Satoshi; Matsudaira, Tsuneaki; Kawashima, Naoki; Wada, Masashi; Sugita, Yuji; Kagitani, Yukio; Nakajo, Koji
PATENT ASSIGNEE(S): Fine Ceramics Center, Japan; Chubu Electric Power Co., Inc.
SOURCE: Jpn. Kokai Tokkyo Koho, 17 pp.
CODEN: JKXXAF
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
JP 2006089796	A	20060406	JP 2004-275373	20040922
JP 4542857	B2	20100915		

PRIORITY APPLN. INFO.: JP 2004-275373 20040922

AB The title unit is equipped with a structure body contg. an electron conducting region (R1) placed at oxidizing atm. side and an oxide layer placed at the oxidizing atm. side of R1, and a means for collecting neg. charge to R1. The region R1 may contain electron-conducting materials chosen from Ti, Ta, W, Ir, Pt-type alloys, heat-resistant steel contg. C 0-1, Si 0-3, Mn 0-2, Cr 0-30, Ni 0-50, Mo 0-10, W 0-8, Nb 0-5, Ti 0-5, Al 0-2, B 0-0.2, N 0-0.2, V 0-1, Cu 0-5, Zr 0-0.3 wt.%, Fe-based superalloys, Fe-Ni-Co-Cr alloys contg. C 0-0.5, Si 0-2, Mn 0-5, Cr 0-30, Ni 0-50, Co 0-50, Mo 0-10, W 0-8, Nb 0-5, Ti 0-5, Al 0-1, B 0-0.1, N 0-0.2, V 0-5, and Cu 0-5 wt.%, Co-based superalloys contg. C 0-1, Si 0-2, Mn 0-2, Ni 0-30, Cr 0-30, Mo 0-8, W 0-20, Nb 0-5, Ta 0-10, Ti 0-5, Al 0-0.5, Fe 0-5, B 0-0.5, Zr 0-2 wt.%, MCrAlR alloys (M = Ni, Co, and/or Fe; R = rare earth metals), TiC, TiN, TaC, TaN, LaCrO3, and LaCoO3. The unit provides high oxidn. resistance by ion blocking effects and elec. repulsion.

IT 881036-95-9 881036-96-0 881036-97-1
RL: TEM (Technical or engineered material use); USES (Uses)
(substrate; oxidn.-resistant units and coating materials having oxide surface for turbines)

RN 881036-95-9 CAPLUS
CN Iron alloy, base, Fe 0-100,Ni 0-50,Cr 0-30,Mo 0-10,W 0-8,Cu 0-5,Nb 0-5,Ti 0-5,Si 0-3,Al 0-2,Mn 0-2,C 0-1,V 0-1,Zr 0-0.3,B 0-0.2,N 0-0.2 (9CI) (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	0 - 100	7439-89-6
Ni	0 - 50	7440-02-0
Cr	0 - 30	7440-47-3
Mo	0 - 10	7439-98-7
W	0 - 8	7440-33-7
Cu	0 - 5	7440-50-8
Nb	0 - 5	7440-03-1
Ti	0 - 5	7440-32-6
Si	0 - 3	7440-21-3
Al	0 - 2	7429-90-5
Mn	0 - 2	7439-96-5
C	0 - 1	7440-44-0
V	0 - 1	7440-62-2
Zr	0 - 0.3	7440-67-7
B	0 - 0.2	7440-42-8
N	0 - 0.2	17778-88-0

RN 881036-96-0 CAPLUS
CN Iron alloy, base, Fe 0-100,Co 0-50,Ni 0-50,Cr 0-30,Mo 0-10,W 0-8,Cu 0-5,Mn 0-5,Nb 0-5,Ti 0-5,V 0-5,Si 0-2,Al 0-1,C 0-0.5,N 0-0.2,B 0-0.1 (9CI) (CA INDEX NAME)

Component	Component Percent	Component Registry Number

Fe	0	-	100	7439-89-6
Co	0	-	50	7440-48-4
Ni	0	-	50	7440-02-0
Cr	0	-	30	7440-47-3
Mo	0	-	10	7439-98-7
W	0	-	8	7440-33-7
Cu	0	-	5	7440-50-8
Mn	0	-	5	7439-96-5
Nb	0	-	5	7440-03-1
Ti	0	-	5	7440-32-6
V	0	-	5	7440-62-2
Si	0	-	2	7440-21-3
Al	0	-	1	7429-90-5
C	0	-	0.5	7440-44-0
N	0	-	0.2	17778-88-0
B	0	-	0.1	7440-42-8

RN 881036-97-1 CAPLUS
CN Cobalt alloy, base, Co 0-100,Cr 0-30,Ni 0-30,W 0-20,Ta 0-10,Mo 0-8,Fe 0-5,Nb 0-5,Ti 0-5,Mn 0-2,Si 0-2,Zr 0-2,C 0-1,Al 0-0.5,B 0-0.5 (9CI) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Co	0	-	100	7440-48-4
Cr	0	-	30	7440-47-3
Ni	0	-	30	7440-02-0
W	0	-	20	7440-33-7
Ta	0	-	10	7440-25-7
Mo	0	-	8	7439-98-7
Fe	0	-	5	7439-89-6
Nb	0	-	5	7440-03-1
Ti	0	-	5	7440-32-6
Mn	0	-	2	7439-96-5
Si	0	-	2	7440-21-3
Zr	0	-	2	7440-67-7
C	0	-	1	7440-44-0
Al	0	-	0.5	7429-90-5
B	0	-	0.5	7440-42-8

IPCI C23C0030-00 [I]; C22C0019-05 [I]; C22C0019-07 [I]; C22C0038-00 [I]; C22C0038-58 [I]; C23F0013-00 [I]; F01D0005-28 [I]; F01D0025-00 [I]; F02C0007-00 [I]; C23C0030-00 [I]; C22C0019-05 [I]; C22C0019-07 [I]; C22C0038-00 [I]; C22C0038-58 [I]; C23F0013-00 [I]; F01D0005-28 [I]; F01D0025-00 [I]; F02C0007-00 [I]
IPCR C23C0030-00 [I]; C22C0019-05 [I]; C22C0019-07 [I]; C22C0038-00 [I]; C22C0038-58 [I]; C23F0013-00 [I]; F01D0005-28 [I]; F01D0025-00 [I]; F02C0007-00 [I]
CC 56-10 (Nonferrous Metals and Alloys)
Section cross-reference(s): 55, 57
ST oxidn resistant oxide coating superalloy turbine
IT Turbines
(oxidn.-resistant units and coating materials having oxide surface for turbines)
IT Coating materials
(oxidn.-resistant; oxidn.-resistant units and coating materials having oxide surface for turbines)
IT Superalloys
RL: TEM (Technical or engineered material use); USES (Uses)
(substrate; oxidn.-resistant units and coating materials having oxide surface for turbines)
IT 7440-06-4, Platinum, uses
RL: TEM (Technical or engineered material use); USES (Uses)
(neg. charge collector; oxidn.-resistant units and coating materials having oxide surface for turbines)
IT 1306-38-3, Ceria, uses 1309-48-4, Magnesia, uses 1314-20-1, Thorium oxide (ThO2), uses 1314-23-4, Zirconia, uses 1314-36-9, Yttria, uses 1314-61-0, Tantalum pentoxide 1344-28-1, Alumina, uses 12003-65-5, Aluminum lanthanum oxide (AlLaO3) 12004-39-6, Aluminum titanium oxide (Al2TiO5) 12055-23-1, Hafnia 13463-67-7, Titania, uses 97330-34-2, Beryllium oxide (BeO2)

RL: TEM (Technical or engineered material use); USES (Uses)
(oxidn.-resistant units and coating materials having oxide surface for turbines)

IT 7439-88-5, Iridium, uses 12016-86-3, Cobalt lanthanum oxide (CoLaO3) 12017-94-6, Chromium lanthanum oxide (CrLaO3) 12033-62-4, Tantalum nitride (TaN) 12070-06-3, Tantalum carbide (TaC) 12070-08-5, Titanium carbide (TiC) 25583-20-4, Titanium nitride (TiN) 73283-66-6, CoNiCrAlY 881036-95-9 881036-96-0 881036-97-1
RL: TEM (Technical or engineered material use); USES (Uses)
(substrate; oxidn.-resistant units and coating materials having oxide surface for turbines)

OS.CITING REF COUNT: 1 THERE ARE 1 CAPLUS RECORDS THAT CITE THIS RECORD (1 CITINGS)

L13 ANSWER 69 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2006:31898 CAPLUS Full-text
DOCUMENT NUMBER: 144:132328
TITLE: Annular concentrically twisted bead cord
INVENTOR(S): Sasabe, Hiroshi; Wakahara, Hitoshi; Okamoto, Kenichi
PATENT ASSIGNEE(S): Sumitomo(Sei) Steel Wire Corp., Japan; Sumitomo Electric Tochigi Co. Ltd.
SOURCE: PCT Int. Appl., 29 pp.
CODEN: PIXXD2
DOCUMENT TYPE: Patent
LANGUAGE: Japanese
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2006004054	A1	20060112	WO 2005-JP12227	20050701
JP 2006062641	A	20060309	JP 2005-177763	20050617
JP 3779313	B2	20060524		
EP 1764238	A1	20070321	EP 2005-765284	20050701
EP 1764238	B1	20100414		
CN 101039811	A	20070919	CN 2005-80020724	20050701
CN 100572110	C	20091223		
EP 2213485	A1	20100804	EP 2009-13332	20050701
KR 2007043812	A	20070425	KR 2007-7002311	20070130
US 7735307	B2	20100615	US 2007-629490	20070712

PRIORITY APPLN. INFO.:

JP 2004-198329	A	20040705
JP 2004-224303	A	20040730
JP 2005-177631	A	20050617
JP 2005-177763	A	20050617
EP 2005-765284	A3	20050701
WO 2005-JP12227	W	20050701

ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT

AB An annular concentrically twisted bead cord reduced in wt. and cost and improved in molding properties and annular core corrosive resistance. The annular core is formed of a medium carbon steel or an alloy steel obtained by suppressing carbon content and adding the proper amts. of specified elements thereto. The diam. (dc) of the annular core to the diam. (ds) of peripheral wires meets the requirement of the expression, $1.04 \leq dc/ds \leq 1.30$, and the peripheral wires with a coil diam. of 0.5 to 1.3 times the coil diam. of the annular core are used to provide the bead cord reduced in wt. and cost and improved in molding properties. Also, an Al-Zn alloy plating or a thick Zn plating layer is formed on the surface of the steel wire of the annular core or a stainless steel is used as the material of the annular core to increase the corrosive resistance of the annular core.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Fuji Seiko Kabushiki Ka	1989			JP 01-273707 A	
Fuji Seiko Kabushiki Ka	1992			JP 04-266506 A	
Kanai, H	1987			Microfilm of the spe	
Kobe Steel Ltd	1996			JP 08-188851 A	CAPLUS
Nippon Steel Corp	2001			JP 2001164337 A	CAPLUS
Nippon Steel Corp	2003			JP 2003129178 A	CAPLUS
Sumitomo Rubber Industr	2001			JP 2001301430 A	
Tokyo Rope Manufacturin	1993			JP 05-163686 A	

Toyo Tire And Rubber Co|1974 | | |GB 1466114 A |
Toyo Tire And Rubber Co|1974 | | |FR 2221290 A |
Toyo Tire And Rubber Co|1974 | | |DE 2405127 A |
Toyo Tire And Rubber Co|1974 | | |JP 49-102002 A |
Toyo Tire And Rubber Co|1975 | | |JP 50-131201 A |

IT 873188-74-0
RL: NUU (Other use, unclassified); USES (Uses)
(annular concentrically twisted bead cord)
RN 873188-74-0 CAPLUS
CN Iron alloy, base, Fe 93-99,Mn 0.5-2,Si 0.3-2,Cr 0.2-2,C 0.1-0.3,Al 0-0.1,B 0-0.1,Mg 0-0.1,Nb 0-0.1,Ti 0-0.1,V 0-0.1 (9CI) (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	93 - 99	7439-89-6
Mn	0.5 - 2	7439-96-5
Si	0.3 - 2	7440-21-3
Cr	0.2 - 2	7440-47-3
C	0.1 - 0.3	7440-44-0
Al	0 - 0.1	7429-90-5
B	0 - 0.1	7440-42-8
Mg	0 - 0.1	7439-95-4
Nb	0 - 0.1	7440-03-1
Ti	0 - 0.1	7440-32-6
V	0 - 0.1	7440-62-2

IPCI B60C0015-04 [ICM,7]; B60C0009-00 [ICS,7]; C22C0038-00 [ICS,7]; C22C0038-18 [ICS,7]; C22C0038-54 [ICS,7]; D07B0001-06 [ICS,7]
CC 55-3 (Ferrous Metals and Alloys)
ST steel annular concentrically twisted bead cord aluminum zinc coating
IT Coating materials
Cords
(annular concentrically twisted bead cord)
IT 11107-04-3 11109-50-5 11121-90-7, Carbon steel, uses 12597-68-1, Stainless steel, uses 12597-69-2, Steel, uses 12709-14-7, uses 12709-21-6, uses 37261-75-9, uses 39286-11-8, uses 873188-71-7, uses 873188-72-8, uses 873188-73-9, uses 873188-74-0
RL: NUU (Other use, unclassified); USES (Uses)
(annular concentrically twisted bead cord)
IT 7440-66-6, Zinc, uses 11149-84-1
RL: NUU (Other use, unclassified); USES (Uses)
(coating; annular concentrically twisted bead cord)
OS.CITING REF COUNT: 4 THERE ARE 4 CAPLUS RECORDS THAT CITE THIS RECORD (10 CITINGS)

L13 ANSWER 70 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2001:916938 CAPLUS Full-text
DOCUMENT NUMBER: 136:72669
TITLE: Acceleration of diffusion saturation processes in nonisothermal thermochemical treatment
AUTHOR(S): Gyulikhandanov, E. L.; Khaidorov, A. D.
CORPORATE SOURCE: St. Petersburg State Technical University, St. Petersburg, Russia
SOURCE: Metal Science and Heat Treatment (Translation of Metallovedenie i Termicheskaya Obrabotka Metallov) (2001), 43(5-6), 228-232
CODEN: MHTRAN; ISSN: 0026-0673
PUBLISHER: Kluwer Academic/Consultants Bureau
DOCUMENT TYPE: Journal
LANGUAGE: English
AB Various of nonisothermal processes of carburizing, nitrocarburizing, and nitriding were studied. The steels 20KhGNR, 40Kh, and 40KhMFA were investigated. The diffusion satn. were performed by carburizing with an additive of 5% NH3, high-temp. nitrocarburizing in a mixt. of 50% natural gas and 50% NH3, and nitriding in NH3. In all the cases thermochem. treatment (TCT) was not conducted by preliminary heat treatment. The thickness of the diffusion layers and their structure and properties were detd. The measurement of the diffusion layers involved in low-temp. nitrocarburizing and nitriding was carried out by durometry. It

was assumed that the boundary between the layer and the core had a microhardness of 300 HV and exceeded somewhat the hardness of the core of the studied steels. The efficiency of nonisothermal and combined TCT multiplicity of the growth of the layer equal to the ratio of the effective thickness of the layers obtained in nonisothermal and isothermal regimes. Using combined regimes of thermochem. treatment that included thermocycling and isothermal stages, a substantial acceleration of the diffusion process was detected which increased considerably the thickness of the diffusion layer. A method was suggested that enabled to calc. the kinetics of nonisothermal processes of TCT according to the model of single-phase diffusion with the use of effective diffusivities.

RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Gyulikhandanov, E	1992		2	Metalloved Term Obra	
Shmykov, A	1991			Thermodynamics and K	

IT 37312-00-8, 20KhGNR
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(diffusion satn. processes in nonisothermal thermochem. treatment of steel)

RN 37312-00-8 CAPLUS

CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
ST steel carburizing nitrocarburizing nitriding microstructure diffusion
IT Carbonitriding
Carburizing
Diffusion
Nitriding
(diffusion satn. processes in nonisothermal thermochem. treatment of steel)
IT Microstructure
(diffusion satn. processes in nonisothermal thermochem. treatment of steel in relation to)
IT 37312-00-8, 20KhGNR 39344-94-0, 40Kh, processes 64721-16-0, 40KhMFA
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(diffusion satn. processes in nonisothermal thermochem. treatment of steel)
IT 7664-41-7, Ammonia, uses
RL: NUU (Other use, unclassified); USES (Uses)
(diffusion satn. processes in nonisothermal thermochem. treatment of steel in relation to use of)

L13 ANSWER 71 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2000:113096 CAPLUS Full-text
DOCUMENT NUMBER: 132:230489
TITLE: Equipment for nitriding in pulsating current plasma

AUTHOR(S): Dostanko, A. P.; Bosyakov, M. N.; Bondarenko, S. V.; Grunskii, D. I.; Zhuk, D. V.; Kukharev, S. A.; Matusevich, P. A.; Savilov, A. V.
CORPORATE SOURCE: Beloruss. Gos. Univ. Inform. i Radioelektron., Minsk, 220027, Belarus
SOURCE: Elektronnaya Obrabotka Materialov (1999), (3), 66-69 CODEN: EOBMAF; ISSN: 0013-5739
PUBLISHER: Institut Prikladnoi Fiziki AN Respubliki Moldova
DOCUMENT TYPE: Journal
LANGUAGE: Russian

AB The characteristics of the installation for hardening ion nitriding treatment in plasma of a pulsating current are adduced. The main advantages of processing in pulsating plasma with ref. to constructional and tool steels in comparison with gas nitriding are discussed. The summary table for different types of processed details., marks of steels, and characteristics of nitriding layer - depth and surface hardness is adduced.

IT 12742-15-3, 20KhNR
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(equipment for nitriding in pulsating current plasma of steels and coating properties)

RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 76-11 (Electric Phenomena)
Section cross-reference(s): 55
ST equipment nitriding pulsating current plasma steel
IT Apparatus
Coating materials
Hardness (mechanical)
Plasma nitriding
(equipment for nitriding in pulsating current plasma of steels and coating properties)
IT 7440-37-1, Argon, uses
RL: NUU (Other use, unclassified); USES (Uses)
(equipment for nitriding in pulsating current plasma of steels and coating properties)
IT 1333-74-0, Hydrogen, processes 7727-37-9, Nitrogen, processes
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(equipment for nitriding in pulsating current plasma of steels and coating properties)
IT 12604-95-4, 38KhMYuA 12631-59-3, 40KhN2MA 12681-03-7, 20KhN3A 12718-23-9, 18KhGT 12725-23-4, R6M5 12731-80-5, 38KhMA, properties 12741-57-0, 4Kh5MFS 12741-70-7, Kh 12 12741-98-9, 25KhGT 12742-00-6, Kh12M 12742-05-1, 40KhN 12742-15-3, 20KhNR 12742-29-9, 4Kh5V2FS 12773-74-9, 35KhGSA 12784-22-4, 12Kh2N4A 37203-00-2, 4Kh4VMFS 37245-26-4, 30Kh13 37268-90-9, Steel 45, properties 37311-99-2, 40KhGNM 37323-42-5, 30KhGT 37323-91-4, 5KhNM 37329-39-8, 20Kh, properties 37329-44-5, R9K10 37360-28-4, 3Kh2V8 39344-94-0, 40Kh, properties 50947-86-9, 40Kh9S2 54790-83-9, 55Kh20G9AN4 61431-72-9, 15KhGN2TA 67540-49-2, 3Kh3M3F 68445-91-0, 20KhGNMTA

72026-34-7, 15KhF, properties 83653-82-1, 5KhNMF
RL: PEP (Physical, engineering or chemical process); PRP (Properties);
PROC (Process)
(equipment for nitriding in pulsating current plasma of steels and coating properties)

L13 ANSWER 72 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 2000:34644 CAPLUS Full-text
DOCUMENT NUMBER: 132:96225
TITLE: Coated hot-rolled and cold-rolled steel sheet with high strength and corrosion resistance after heat treatment
INVENTOR(S): Laurent, Jean-Pierre; Devroc, Jacques; Hennechart, Jean-Paul; Spehner, Dominique; Laminage, Lorraine
PATENT ASSIGNEE(S): Sollac, Fr.
SOURCE: Eur. Pat. Appl., 7 pp.
CODEN: EPXXDW
DOCUMENT TYPE: Patent
LANGUAGE: French
FAMILY ACC. NUM. COUNT: 1
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
EP 971044	A1	20000112	EP 1999-401690	19990707
EP 971044	B1	20030514		
FR 2780984	A1	20000114	FR 1998-8793	19980709
FR 2780984	B1	20010622		
CA 2276911	A1	20000109	CA 1999-2276911	19990707
CA 2276911	C	20090505		
AT 240419	T	20030515	AT 1999-401690	19990707
PT 971044	E	20030829	PT 1999-401690	19990707
ES 2196740	T3	20031216	ES 1999-401690	19990707
BR 9902712	A	20000308	BR 1999-2712	19990708
JP 2000038640	A	20000208	JP 1999-195664	19990709
JP 3931251	B2	20070613		
US 6296805	B1	20011002	US 1999-350100	19990709
US 44153	E1	20130416	US 2011-13205126	20110808
US 44940	E1	20140610	US 2013-13863100	20130415

PRIORITY APPLN. INFO.:
FR 1998-8793 A 19980709
US 1999-350100 E 19990709
US 2011-13205126 A1 20110808
ASSIGNMENT HISTORY FOR US PATENT AVAILABLE IN LSUS DISPLAY FORMAT
AB A hot-rolled and cold-rolled steel sheet contg. C 0.15-0.5, Mn 0.5-3, Si 0.1-0.5, Cr 0.01-1, Ti ≤0.2, Al ≤0.1, P ≤0.1, S ≤0.05, and B 0.0005-0.08% is coated in a molten Al bath, heated at 5-600°/s, and annealed above 750°. The coated sheet has a high strength, shock-, fatigue-, abrasion-, wear-, and corrosion resistance, and adhesion to paints and adhesives.
RETABLE

Referenced Author (RAU)	Year (RPY)	VOL (RVL)	PG (RPG)	Referenced Work (RWK)	Referenced File
Anon	1989			JP 01176056 A	CAPLUS
Anon	1989			FR 2625227 A	CAPLUS
Anon	1990			JP 02263954 A	CAPLUS
Anon	1993			JP 05247588 A	CAPLUS
Anon	1993			GB 2261879 A	CAPLUS
Anon	1993			FR 2684392 A	CAPLUS
Anon	1993			DE 4143270 A	CAPLUS
Anon	1993			US 5178688 A	CAPLUS
Anon	1994			JP 06179944 A	CAPLUS
Anon	1994			JP 6093375 A	
Anon	1994			KR 9402139 B	
Anon	1995			IT 1252862 B	
Anon	1995			JP 7062212 B	
Anon	1996			JP 2034275 C	
Anon	1997			JP 2686755 B	

IT 254455-64-6
RL: TEM (Technical or engineered material use); USES (Uses)
(aluminum-coated hot-rolled and cold-rolled steel sheet with high strength and corrosion resistance)

RN 254455-64-6 CAPLUS
CN Iron alloy, base, Fe 95-99,Mn 0.5-3,Cr 0-1,C 0.2-0.5,Si 0.1-0.5,Ti 0-0.2,Al 0-0.1,B 0-0.1,P 0-0.1 (9CI) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	99	7439-89-6
Mn	0.5	-	3	7439-96-5
Cr	0	-	1	7440-47-3
C	0.2	-	0.5	7440-44-0
Si	0.1	-	0.5	7440-21-3
Ti	0	-	0.2	7440-32-6
Al	0	-	0.1	7429-90-5
B	0	-	0.1	7440-42-8
P	0	-	0.1	7723-14-0

IPCI C22C0038-32 [ICM,6]
IPCR C23C0002-12 [I]; C21D0008-02 [I]; C22C0038-00 [I]; C22C0038-32 [I]; C22C0038-38 [I]; C23C0002-28 [I]; C23C0030-00 [I]
CC 55-3 (Ferrous Metals and Alloys)
ST aluminum coated steel sheet
IT Coating process
(hot-dipping; of hot-rolled and cold-rolled steel sheet with aluminum alloy)
IT 110107-84-1, uses 254455-64-6
RL: TEM (Technical or engineered material use); USES (Uses)
(aluminum-coated hot-rolled and cold-rolled steel sheet with high strength and corrosion resistance)
IT 37296-00-7 254455-65-7
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(coating of hot-rolled and cold-rolled steel sheet with)
OS.CITING REF COUNT: 16 THERE ARE 16 CAPLUS RECORDS THAT CITE THIS RECORD (19 CITINGS)

L13 ANSWER 73 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1999:474181 CAPLUS Full-text
DOCUMENT NUMBER: 131:274752
TITLE: Effect of electrode drying conditions and preheating temperature on cold cracking in welded joints of low-alloy high-resistance coated-electrode electric-arc steels
AUTHOR(S): da Silva, Paulo Guedes; Maciel, Theophilo Moura
CORPORATE SOURCE: Centro de Ciencias e Tecnologia, Universidade Federal da Paraiba - UFPb, Brazil
SOURCE: Congresso Anual - Associacao Brasileira de Metalurgia e Materiais (1998), Volume Date 1997, 52nd(II Congresso Internacional de Tecnologia Metalurgica e de Materiais), 4358-4368
CODEN: CAAMEU
PUBLISHER: Associacao Brasileira de Metalurgia e Materiais
DOCUMENT TYPE: Journal; (computer optical disk)
LANGUAGE: Portuguese
AB The effects of the electrode moisture level and of the cooling rate on the cold cracking of welded joints of HSLA steels was evaluated. The shielded metal arc Welding process was employed. The weld deposits were made with AWS E 12018-G electrode, using the SAR 120 T (ASTM 514 B) as steel base metal. The cooling rate was varied by varying the pre-heating temp. and the moisture level was varied by varying the electrode redried time. The results obtained indicated a significative redn. on the cracks with the increase of the pre-heating temp. and with the increases of the redried times, without signification changes at the weld metal microstructure and hardness. The absence of cracks was found for welds deposited with pre-heating above 180 °C and with electrodes redried for 2 h at 240 °C.
IT 52346-86-8, ASTM A514B, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(effect of electrode drying conditions and preheating temp. on cold cracking in welded joints of low-alloy steel using

high-resistance coated-electrode elec.-arc welding fillers)
RN 52346-86-8 CAPLUS
CN Steel, (UNS K11630) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	0.70	-	1.00	7439-96-5
Cr	0.40	-	0.65	7440-47-3
Si	0.20	-	0.35	7440-21-3
Mo	0.15	-	0.25	7439-98-7
C	0.12	-	0.21	7440-44-0
V	0.03	-	0.08	7440-62-2
S	0	-	0.04	7704-34-9
P	0	-	0.035	7723-14-0
Ti	0.01	-	0.03	7440-32-6
B	0.0005	-	0.005	7440-42-8

CC 55-9 (Ferrous Metals and Alloys)
ST steel weld cracking electrode drying preheating
IT Drying
Humidity
(effect of electrode drying conditions and preheating temp. on cold cracking in welded joints of low-alloy steel using high-resistance coated-electrode elec.-arc welding fillers)
IT Welding of metals
(electrodes; effect of electrode drying conditions and preheating temp. on cold cracking in welded joints of low-alloy steel using high-resistance coated-electrode elec.-arc welding fillers)
IT Welding of metals
(shielded metal arc; effect of electrode drying conditions and preheating temp. on cold cracking in welded joints of low-alloy steel using high-resistance coated-electrode elec.-arc welding fillers)
IT 52346-86-8, ASTM A514B, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(effect of electrode drying conditions and preheating temp. on cold cracking in welded joints of low-alloy steel using high-resistance coated-electrode elec.-arc welding fillers)
IT 12597-69-2, Steel, processes
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)
(welded; effect of electrode drying conditions and preheating temp. on cold cracking in welded joints of low-alloy steel using high-resistance coated-electrode elec.-arc welding fillers)
IT 154804-42-9, AWS E12018G
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)
(welding electrode; effect of electrode drying conditions and preheating temp. on cold cracking in welded joints of low-alloy steel using high-resistance coated-electrode elec.-arc welding fillers)

L13 ANSWER 74 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1997:607427 CAPLUS Full-text
DOCUMENT NUMBER: 127:296559
ORIGINAL REFERENCE NO.: 127:57923a,57926a
TITLE: Nondestructive testing of carburizing
AUTHOR(S): Bochenin, V. I.; Burnakov, K. K.
CORPORATE SOURCE: Kurgan. Gos. S-kh. Akad. im. Mal'tseva, Kurgan, Russia
SOURCE: Vestnik Mashinostroeniya (1997), (3), 31-33
CODEN: VMASAV; ISSN: 0042-4633
PUBLISHER: Mashinostroenie
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB A nondestructive testing technique is developed for the detn. of the depth of a carburized layer. It consists in γ-quantum narrow-beam examn. of a controlled medium material and detn. of the degree of photon absorption in different layers of the product surface, the C amt. being

detected based on the γ-phase content. The results of exptl. testing conducted on three different steels showed a little discrepancy between the new technique and conventionally used chem. anal.

IT 37312-00-8, 20KhGNR
RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(nondestructive testing of carburized layer depth in steel carburizing)

RN 37312-00-8 CAPLUS

CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
Section cross-reference(s): 79

ST steel carburization carbon distribution nondestructive testing

IT Carburizing
(nondestructive testing of carburized layer depth in steel carburizing)

IT Testing of materials
(nondestructive; nondestructive testing of carburized layer depth in steel carburizing)

IT 12742-08-4, 20Kh2N4A 12742-21-1, 18Kh2N4VA 37312-00-8, 20KhGNR
RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)
(nondestructive testing of carburized layer depth in steel carburizing)

L13 ANSWER 75 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 1991:147833 CAPLUS Full-text

DOCUMENT NUMBER: 114:147833

ORIGINAL REFERENCE NO.: 114:24995a,24998a

TITLE: Development of technology for electrospark hardening of steel steam turbine parts

AUTHOR(S): Skoblo, T. S.; Sidenko, V. N.; Tripolko, V. K.; Rudyuk, A. S.

CORPORATE SOURCE: USSR

SOURCE: Tyazheloe Mashinostroenie (1990), (7), 25-6
CODEN: TYMAEZ; ISSN: 1024-7106

DOCUMENT TYPE: Journal

LANGUAGE: Russian

AB The valves of steam turbine distributor made from 20Kh1M1F1TR were hardened by electrospark treatment using electrodes from 40Kh13, 1Kh18N10T, and KhN77TYuR. The max. increase of wear resistance was obtained for 1Kh18N10T electrode: the wear resistance increases 1.8-fold compared with that of nitrided parts. After holding in air at 540° for 1000 h, no corrosion was obsd. at the hardened surface; the hardness and depth of the layer were unaffected by the holding.

IT 37311-91-4, 20Kh1M1F1TR
RL: USES (Uses)
(steam turbine parts from, electrospark hardening of)

RN 37311-91-4 CAPLUS

CN Iron alloy, base, Fe 95-98,Cr 0.90-1.40,Mo 0.80-1.10,V 0.70-1.00,Mn 0-0.50,Si 0-0.37,Cu 0-0.30,Ni 0-0.30,C 0.17-0.24,Ti 0.05-0.12,P 0-0.030,S 0-0.030,B 0.005 (20Kh1M1F1TR) (9CI) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Cr	0.90	-	1.40	7440-47-3
Mo	0.80	-	1.10	7439-98-7
V	0.70	-	1.00	7440-62-2
Mn	0	-	0.50	7439-96-5
Si	0	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
Ni	0	-	0.30	7440-02-0
C	0.17	-	0.24	7440-44-0
Ti	0.05	-	0.12	7440-32-6
P	0	-	0.030	7723-14-0
S	0	-	0.030	7704-34-9
B	0.005			7440-42-8

CC 55-9 (Ferrous Metals and Alloys)
Section cross-reference(s): 47
ST electrospark hardening steel steam turbine; electrode electrospark hardening steel turbine
IT Electric spark
(hardening by, of high-temp. steel parts for steam turbines)
IT Turbines
(steam, parts, from pearlitic high-temp. steel, electrospark hardening of, electrodes for)
IT 12719-18-5, KhN77TYuR 39412-98-1, 40Kh13 54611-20-0, 1Kh18N10T
RL: USES (Uses)
(electrode, for electrospark hardening of steam turbine parts from pearlitic high-temp. steel)
IT 37311-91-4, 20Kh1M1F1TR
RL: USES (Uses)
(steam turbine parts from, electrospark hardening of)

L13 ANSWER 76 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1990:518966 CAPLUS Full-text
DOCUMENT NUMBER: 113:118966
ORIGINAL REFERENCE NO.: 113:20121a,20124a
TITLE: Role of thermally hardened layers obtained by laser treatment in the wear resistance of contact pairs during fretting corrosion
AUTHOR(S): Dorozhkin, N. N.; Dubnyakov, V. N.; Kukin, S. F.; Pasakh, E. V.
CORPORATE SOURCE: PO Minsk. Trakt. Zavod, Minsk, USSR
SOURCE: Trenie i Iznos (1990), 11(2), 264-9
CODEN: TRIZD6; ISSN: 0202-4977
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Fretting corrosion tests of steel 20KhNP and cast iron SCh20 after laser hardening showed that the wear intensity of the metastable surface structure of the steel is 1/5th and that of the gray iron is 1/3rd of the values obtained for nonhardened materials. Surface deformation during the frictional interaction facilitates phase transformation in the metastable structure ensuring an increase in ductility at high values of hardness, which results in an increase in the wear resistance of the laser-hardened steel and cast iron during fretting corrosion.
IT 12742-15-3
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(laser hardening of, fretting corrosion in relation to)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number

Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-10 (Ferrous Metals and Alloys)
ST laser hardening steel fretting corrosion; cast iron laser hardening corrosion
IT 12742-15-3 72645-39-7, SCh20
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(laser hardening of, fretting corrosion in relation to)

L13 ANSWER 77 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1987:71034 CAPLUS Full-text
DOCUMENT NUMBER: 106:71034
ORIGINAL REFERENCE NO.: 106:11649a,11652a
TITLE: A nondestructive measurement of residual bulk stresses in welded steel specimens by use of magnetically induced velocity changes for ultrasonic waves
AUTHOR(S): Kwun, Hegeon
CORPORATE SOURCE: Nondestr. Eval. Sci. Technol. Div., Southwest Res. Inst., San Antonio, TX, USA
SOURCE: Materials Evaluation (1986), 44(13), 1560-6
CODEN: MAEVAD; ISSN: 0025-5327
DOCUMENT TYPE: Journal
LANGUAGE: English
AB The distributions of residual bulk stresses in butt-welded ASTM A-588 [63849-06-9] steel and a T-shaped full-penetration-welded ASTM A514 [63747-69-3] steel were nondestructively measured by use of magnetically induced velocity changes (MIVC) for longitudinal and shear waves. The stress effects on MIVC obsd. under various uniaxial stress conditions were used to det. the residual bulk stresses. The results agree with stress values detd. by a layer-removal technique. The MIVC method may be developed to measure biaxial and triaxial stress states.
IT 52346-86-8, properties
RL: PRP (Properties)
(residual stresses in welded, detn. by magnetically induced velocity changes for ultrasonic waves)
RN 52346-86-8 CAPLUS
CN Steel, (UNS K11630) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	0.70	-	1.00	7439-96-5
Cr	0.40	-	0.65	7440-47-3
Si	0.20	-	0.35	7440-21-3
Mo	0.15	-	0.25	7439-98-7
C	0.12	-	0.21	7440-44-0
V	0.03	-	0.08	7440-62-2
S	0	-	0.04	7704-34-9
P	0	-	0.035	7723-14-0
Ti	0.01	-	0.03	7440-32-6
B	0.0005	-	0.005	7440-42-8

CC 55-9 (Ferrous Metals and Alloys)
IT Welds
(steel, residual bulk stresses in, detn. by magnetically induced velocity changes for ultrasonic waves)
IT 52346-86-8, properties 61299-90-9, properties

RL: PRP (Properties)
(residual stresses in welded, detn. by magnetically induced velocity changes for ultrasonic waves)
IT 12597-69-2
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(welds, steel, residual bulk stresses in, detn. by magnetically induced velocity changes for ultrasonic waves)

L13 ANSWER 78 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1986:190490 CAPLUS Full-text
DOCUMENT NUMBER: 104:190490
ORIGINAL REFERENCE NO.: 104:30111a,30114a
TITLE: Structure and properties of a boronized layer of carbon and low-alloy steels from high-frequency current heating
AUTHOR(S): Zozulya, V. F.; Pavlyuchenko, A. A.; Legeida, V. N.
CORPORATE SOURCE: USSR
SOURCE: Vestn. Khar'k. Politekhn. In-ta (1985), (255), 42-4
From: Ref. Zh., Metall. 1986, Abstr. No. 2E285
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Title only translated.
IT 37311-91-4
RL: PRP (Properties)
(structure of boronized layer in, high-frequency heating in relation to)
RN 37311-91-4 CAPLUS
CN Iron alloy, base, Fe 95-98,Cr 0.90-1.40,Mo 0.80-1.10,V 0.70-1.00,Mn 0-0.50,Si 0-0.37,Cu 0-0.30,Ni 0-0.30,C 0.17-0.24,Ti 0.05-0.12,P 0-0.030,S 0-0.030,B 0.005 (20Kh1M1F1TR) (9CI) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Cr	0.90	-	1.40	7440-47-3
Mo	0.80	-	1.10	7439-98-7
V	0.70	-	1.00	7440-62-2
Mn	0	-	0.50	7439-96-5
Si	0	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
Ni	0	-	0.30	7440-02-0
C	0.17	-	0.24	7440-44-0
Ti	0.05	-	0.12	7440-32-6
P	0	-	0.030	7723-14-0
S	0	-	0.030	7704-34-9
B	0.005			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
ST steel boronized layer structure; heating high frequency boronizing steel
IT Boronizing
(of steel, carbon- and low-alloy, high-frequency heating effect on diffusion layer structure in)
IT 12651-65-9, properties 12725-36-9, properties 37311-91-4
RL: PRP (Properties)
(structure of boronized layer in, high-frequency heating in relation to)

L13 ANSWER 79 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1986:113747 CAPLUS Full-text
DOCUMENT NUMBER: 104:113747
ORIGINAL REFERENCE NO.: 104:17971a,17974a
TITLE: Cavitation-resistant diffusion layers on low-alloy steels
AUTHOR(S): Abacharaev, M. M.
CORPORATE SOURCE: Dagest. Politekh. Inst., Makhachkala, USSR
SOURCE: Zashchitnye Pokrytiya na Metallakh (1985), 19, 15-18
CODEN: ZPMEAC; ISSN: 0514-5864
DOCUMENT TYPE: Journal
LANGUAGE: Russian

AB A new criterion was developed for evaluation of the cavitation resistance of diffusion-coated low-alloy steels. The criterion was used in detn. of the cavitation resistance of quenched, Ti- and Mn-cemented, chromized, or chromized and cemented steels 20KhNR [12742-15-3], 40KhN [12742-05-1], and 38Kh2MYuA [12604-95-4]. The exptl. study and an anal. evaluation of steel cavitation resistance showed good coincidence using the criterion. The highest range of cavitation resistance was recorded for Cr + Mn-satd. steel 40KhN, Cr + Ti-satd. steel 20KhNR, and chromized steel 38Kh2MYuA.

IT 12742-15-3
RL: USES (Uses)
(cavitation-resistance of diffusion-satd., criterion for evaluation of)

RN 12742-15-3 CAPLUS

CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

CC 55-7 (Ferrous Metals and Alloys)

ST steel diffusion coating cavitation resistance; criterion steel cavitation resistance evaluation; chromizing steel cavitation resistance; manganese cementation steel cavitation resistance; titanium cementation steel cavitation resistance

IT Chromizing
(of low-alloy steel, cavitation resistance by, criterion for evaluation of)

IT Cavitation
(resistance of low-alloy diffusion-satd. steel to, criterion for evaluation of)

IT 12604-95-4 12742-05-1 12742-15-3
RL: USES (Uses)
(cavitation-resistance of diffusion-satd., criterion for evaluation of)

IT 7439-96-5, reactions 7440-32-6, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(cementation of low-alloyed steels with, cavitation resistance by, criterion for evaluation of)

L13 ANSWER 80 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 1985:581691 CAPLUS Full-text

DOCUMENT NUMBER: 103:181691

ORIGINAL REFERENCE NO.: 103:29223a,29226a

TITLE: Study of a dark constituent in carbonitridation layers

AUTHOR(S): Shapochkin, V. I.; Semenova, L. M.

CORPORATE SOURCE: VPO "VNIITMASh", Volgograd, USSR

SOURCE: Izvestiya Vysshikh Uchebnykh Zavedenii, Chernaya Metallurgiya (1985), (5), 125-9
CODEN: IVUMAX; ISSN: 0368-0797

DOCUMENT TYPE: Journal

LANGUAGE: Russian

AB Low-alloy steels such as 20Kh [37329-39-8], 40Kh [39344-94-0], 25KhGT [12741-98-9], 25KhGM [51433-85-3], etc., were carbonitrided to 0.9-1.1% C and 0.4-0.5% N content in a 0.05 mm-deep layer. A dark constituent of the carbonitrided layer was studied by metallog., electron microscopy, and physicochem. anal. Pptn. of irregular-shaped inclusions surrounded by

an easily etched zone, which usually crumbles during specimen prepn., was related to formation of the dark constituent.

IT 12742-15-3 37312-00-8 56995-50-7,
reactions
RL: USES (Uses)
(carbonitriding of, defect structure formation in)

RN 12742-15-3 CAPLUS

CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

RN 37312-00-8 CAPLUS

CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

RN 56995-50-7 CAPLUS

CN Iron alloy, base, Fe 96-98,Cr 0.75-1.05,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,Ni 0-0.30,C 0.18-0.24,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6
Cr	0.75	-	1.05	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
Ni	0	-	0.30	7440-02-0
C	0.18	-	0.24	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9

Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
ST steel carbonitriding defect structure ppt
IT Carbonitridation and Cyanidation
(of low-alloy steels, defect structure formation in)
IT 12681-03-7 12741-98-9, reactions 12742-08-4 12742-15-3
37312-00-8 37329-39-8, reactions 39344-94-0, reactions
51433-85-3, reactions 56995-50-7, reactions 66772-46-1
92049-05-3
RL: USES (Uses)
(carbonitriding of, defect structure formation in)

L13 ANSWER 81 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1984:495400 CAPLUS Full-text
DOCUMENT NUMBER: 101:95400
ORIGINAL REFERENCE NO.: 101:14571a,14574a
TITLE: Thermochemical treatment of steel parts in continuous furnaces with automatic control of carbon potential
AUTHOR(S): Kirnos, I. V.; Klyshnikov, S. T.; Kukui, B. G.; Lobachev, I. A.; Pegisheva, S. A.; Radzievskii, B. V.
CORPORATE SOURCE: VNIITMASh, USSR
SOURCE: Metallovedenie i Termicheskaya Obrabotka Metallov (1984), (4), 24-8
CODEN: MTOMAX; ISSN: 0026-0819
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB A continuous furnace for steel carburization was developed. A math. model was used for automatic control of the carburization process by monitoring the C potential and moisture content of the furnace atm. Tests were made on steels 20KhNR [12742-15-3] and 25KhGT [12741-98-9]. Good agreement of calcd. and exptl. data for C distribution in the hardened layers, related to process parameters, was obtained.
IT 12742-15-3
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, in continuous furnace, control of, model for)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
ST steel carburization continuous furnace control; model steel carburization furnace control
IT Furnaces
(continuous, for steel carburization, control of, model for)
IT Controlled atmospheres
(in continuous furnace for steel carburization)
IT Process simulation, physicochemical
(of carburization of steel in continuous process)
IT Carburizing

(of steel, in continuous furnace, control of, model for)
IT 12741-98-9, reactions 12742-15-3
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, in continuous furnace, control of, model for)

L13 ANSWER 82 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1984:495398 CAPLUS Full-text
DOCUMENT NUMBER: 101:95398
ORIGINAL REFERENCE NO.: 101:14570h,14571a
TITLE: Thermocyclic carbonitridation of gears
AUTHOR(S): Bashnin, Yu. A.; Semenova, L. M.; Burenkova, O. S.; Borodova, I. A.; Ban'kovskii, A. I.
CORPORATE SOURCE: VNIITMASh, USSR
SOURCE: Metallovedenie i Termicheskaya Obrabotka Metallov (1984), (4), 14-15, 1 plate
CODEN: MTOMAX; ISSN: 0026-0819
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Tractor gears were made from steels 25KhGT [12741-98-9] and 20KhGNR [37312-00-8], and carbonitrided in a furnace with endothermic atm. using thermocycling (heating to 880° and cooling in controlled amt.). The effect of the thermocycling on contact-fatigue strength of hardened gears was studied in comparison with conventional thermochem. treatments (isothermal carbonitridation or carburization). It was found that thermocycle-treated steels had the same amt. of C and N in hardened layers, but had lower amt. of residual austenite, smaller martensite needles, and finer carbonitride particles. Durability of thermocycle-treated gears was 2.5 times that of conventionally treated ones.
IT 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carbonitridation of, for tractor wear, thermocycling in, structure and mech. properties and wear resistance in relation to)
RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
IT Carbonitridation and Cyanidation
(of steel, for tractor gears, thermocycling in, structure and mech. properties and wear resistance in relation to)
IT Tractors
(steel parts for, carbonitridation of, thermocycling in, structure and mech. properties and wear resistance in relation to)
IT Gears
(steel, for tractors, carbonitridation of, thermocycling in, structure and mech. properties and wear resistance in relation to)
IT 12741-98-9, reactions 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carbonitridation of, for tractor wear, thermocycling in, structure and mech. properties and wear resistance in relation to)

L13 ANSWER 83 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1983:526476 CAPLUS Full-text
DOCUMENT NUMBER: 99:126476
ORIGINAL REFERENCE NO.: 99:19427a,19430a
TITLE: Types of bainite in carburized layers of gears, hardness and effective thickness of layers containing bainite
AUTHOR(S): Susin, A. A.; Aleksandrov, B. I.; Val'ko, A. L.
CORPORATE SOURCE: USSR
SOURCE: Poverkh. Metody Uprochneniya Met. i Splavov v Mashinostr. Materialy Seminara, M. (1983) 32-6
From: Ref. Zh., Metall. 1983, Abstr. No. 8I1029
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Title only translated.
IT 12742-15-3
RL: USES (Uses)
(case carburization of gear, bainite morphol. in)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)
ST carburizing gear steel bainite
IT Carburizing
(of steel gears, for case hardening, bainite morphol. in)
IT Gears
(steel, case carburization of, bainite morphol. in)
IT 12742-15-3
RL: USES (Uses)
(case carburization of gear, bainite morphol. in)
IT 12427-23-5
RL: PRP (Properties)
(morphol. of, in case-carburized steel gears)

L13 ANSWER 84 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1983:408990 CAPLUS Full-text
DOCUMENT NUMBER: 99:8990
ORIGINAL REFERENCE NO.: 99:1493a,1496a
TITLE: Ion nitriding behavior of several low alloy steels
AUTHOR(S): Robino, C. V.; Inal, O. T.
CORPORATE SOURCE: Dep. Metall. Mater. Eng., New Mexico Inst. Min. Technol., Socorro, NM, 87801, USA
SOURCE: Materials Science and Engineering (1983), 59(1), 79-90
CODEN: MSCEAA; ISSN: 0025-5416
DIGITAL OBJECT ID: 10.1016/0025-5416(83)90090-3
DOCUMENT TYPE: Journal
LANGUAGE: English
AB The ion nitriding of several low-alloy steels, U.S. Steel T1 type A [52346-86-8], AISI 4140 [12672-16-1], AISI 6150 [39370-53-1], and Nitralloy 135M [61333-12-8], was examd. under varying process conditions

using microhardness-depth correlations, friction and wear measurements, and optical and transmission electron microscopy. The process variables included time (2-4 h) and temp. (400-600°). All 4 steels exhibited a diffusion layer case growth rate which was dependent on the square root of the exposure time. The highest nitrided hardnesses and lowest case depths were obsd. in the Nitralloy 135M steel while the lowest hardnesses and highest case depths in the T1 steel. The behaviors of the T1, AISI 4140, and 6150 steels were similar. The white layer thickness was independent of the material and increased with increasing time. Both the case depth and the white layer thickness increased strongly with temp. while the hardness decreased. Only slight differences arise in the bulk structure during nitriding. Nitriding produces platelet or disk ppts. approx. 5-20 nm across on {001} matrix planes. These platelets show a striated morphol. which is the result of strain within the matrix. Electron microscopy showed tempering to continue in the core region during nitriding. The wear resistance of the steels increased by factors of 3.7-8.5 by nitriding. The coeff. of friction increased in the nitrided samples.

IT 52346-86-8, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(ion nitridation of)

RN 52346-86-8 CAPLUS

CN Steel, (UNS K11630) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	0.70	-	1.00	7439-96-5
Cr	0.40	-	0.65	7440-47-3
Si	0.20	-	0.35	7440-21-3
Mo	0.15	-	0.25	7439-98-7
C	0.12	-	0.21	7440-44-0
V	0.03	-	0.08	7440-62-2
S	0	-	0.04	7704-34-9
P	0	-	0.035	7723-14-0
Ti	0.01	-	0.03	7440-32-6
B	0.0005	-	0.005	7440-42-8

CC 55-7 (Ferrous Metals and Alloys)

ST nitriding ion steel wear

IT Plasma nitriding
(of steels, low-alloy)

IT 12672-16-1, reactions 39370-53-1, reactions 52346-86-8, reactions 61333-12-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(ion nitridation of)

OS.CITING REF COUNT: 27 THERE ARE 27 CAPLUS RECORDS THAT CITE THIS RECORD (27 CITINGS)

L13 ANSWER 85 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 1982:601438 CAPLUS Full-text

DOCUMENT NUMBER: 97:201438

ORIGINAL REFERENCE NO.: 97:33693a,33696a

TITLE: The use of controlled 20 and 40% hydrogen atmospheres in cementation and carbonitridation

AUTHOR(S): Tikhonov, A. K.; Sheindlin, B. E.; Chaikovskii, S. Z.; Krishtal, M. A.

CORPORATE SOURCE: Volgogr. Alum. Zavod, Volgograd, USSR

SOURCE: Metallovedenie i Termicheskaya Obrabotka Metallov (1982), (6), 30-3
CODEN: MTOMAX; ISSN: 0026-0819

DOCUMENT TYPE: Journal

LANGUAGE: Russian

AB The effect of H concn. in controlled furnace atms. contg. 20 and 40% H on mech. properties and the rate of satn. of samples of Armco Fe and case-hardenable (18KhGT [12718-23-9], 30KhGT [37323-42-5], 20Kh3NA [12681-03-7], 20KhGNR [37312-00-8], and 19KhGN [37311-96-9]) and structural (45Kh [60999-09-9] and ShKh15 [12725-40-5]) steels and automobile parts of steel 16KhG [54342-41-5] during carburizing and carbonitriding was studied by reducing the atms. to a common C potential

and maintaining the latter through the entire expt. The thickness of the layer during carburizing of autoparts in the atms. with 20 and 40% H was 1.4 and 1.6 mm, resp., and in carburizing of steel samples 1.3 and 1.4 mm, resp. The impact toughness, strength, and breaking force during static bending test were higher in the 20% H atm. In carbonitridation, C content in the 20% H atm. was 0.1% higher than that at 40% H, and the rate of part satn. was practically the same. In the atm. with 20% H, heat losses through the furnace brickwork decreased by 25%.

IT 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization and carbonitridation of case-hardenable, hydrogen in furnace controlled atms. for, mech. properties and satn. rate in relation to)

RN 37312-00-8 CAPLUS

CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-7 (Ferrous Metals and Alloys)

ST steel carburizing atm hydrogen; carbonitridation atm hydrogen steel; Armco iron carbonitridation carburizing hydrogen

IT Controlled atmospheres
(endothermic, for carburization and carbonitridation of Armco iron and steels, hydrogen in, mech. properties and satn. rate in relation to)

IT Controlled atmospheres
(exothermic, for carburization and carbonitridation of Armco iron and steels, hydrogen in, mech. properties and satn. rate in relation to)

IT Carbonitridation and Cyanidation
Carburizing
(gas, of Armco iron and steels, hydrogen-contg. controlled atms. for, mech. properties and satn. rate in relation to)

IT 37311-96-9, reactions 37312-00-8 37323-42-5
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization and carbonitridation of case-hardenable, hydrogen in furnace controlled atms. for, mech. properties and satn. rate in relation to)

IT 1333-74-0, uses and miscellaneous
RL: USES (Uses)
(in carburization and carbonitridation atm. for Armco iron and case-hardenable and structural steels)

L13 ANSWER 86 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN

ACCESSION NUMBER: 1981:195784 CAPLUS Full-text

DOCUMENT NUMBER: 94:195784

ORIGINAL REFERENCE NO.: 94:32003a,32006a

TITLE: Prediction of the effective thickness of a case-hardened layer

AUTHOR(S): Gliner, R. E.; Kharkevich, N. I.

CORPORATE SOURCE: Gor'k. Avto. Zavod, Gorkiy, USSR

SOURCE: Avtomobil'naya Promyshlennost (1981), 46(1), 26-8
CODEN: AVPRA3; ISSN: 0005-2337

DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB The carburization of hollow cylinders with wall thickness of 20 mm for steels 20Kh [37329-39-8], 27KhGR [58209-72-6], 20KhN2M [39411-21-7], 30KhMA [12672-15-0], and 18KhGT [12718-23-9] was done 7-14 h at 870-80° in endogas atm. with natural gas addns. The cylinders were then quenched in oil at 140°. Surface carburization was detd. in relation to C distribution in the carburized layer and hardness. Equation was developed for predicting the case depth.
IT 58209-72-6, uses and miscellaneous
RL: USES (Uses)
(case depth of carburized)
RN 58209-72-6 CAPLUS
CN Iron alloy, base, Fe 96-98,Cr 0.70-1.00,Mn 0.70-1.00,Si 0.17-0.37,C 0.25-0.31,Cu 0-0.30,Ni 0-0.30,W 0-0.30,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (27KhGR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6
Cr	0.70	-	1.00	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
C	0.25	-	0.31	7440-44-0
Cu	0	-	0.30	7440-50-8
Ni	0	-	0.30	7440-02-0
W	0	-	0.30	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

CC 55-6 (Ferrous Metals and Alloys)
ST steel cylinder carburizing
IT Carburizing
(case depth in, hardness of steel in relation to)
IT 12672-15-0, uses and miscellaneous 12718-23-9, uses and miscellaneous 37329-39-8, uses and miscellaneous 39411-21-7 58209-72-6, uses and miscellaneous 58209-73-7
RL: USES (Uses)
(case depth of carburized)

L13 ANSWER 87 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1980:412105 CAPLUS Full-text
DOCUMENT NUMBER: 93:12105
ORIGINAL REFERENCE NO.: 93:2075a,2078a
TITLE: Interaction of titanium nitride with metallic melts
AUTHOR(S): Gurevich, Yu. G.; Frage, N. R.
CORPORATE SOURCE: Mashinostroit. Inst., Kurgen, USSR
SOURCE: Tezisy Nauchn. Soobshch. Vses. Konf. Str. Svoistvam Met. Shlakovykh Rasplavov, 3rd (1978), Volume 2, 184-6. Akad. Nauk SSSR, Ural. Nauchn. Tsentr: Sverdlovsk, USSR.
CODEN: 43GIAR
DOCUMENT TYPE: Conference
LANGUAGE: Russian
AB The kinetics of TiN dissoln. in Fe-O [12739-25-2], Fe-Ni [11148-11-1], steel ShKh15 [12725-40-5], 25KhGT [12741-98-9], and 20KhGNR [37312-00-8] were studied by using the rotating-specimen method. The TiN oxidn. rate in FeO in the 1st min was greatest and independent of time, in the 2nd min the rate decreased sharply, and after 2 min the TiN dissoln. ceased. TiN was coated with a dense oxide film. No TiN dissoln. occurred in Fe contg. <3% Ni. At >3% Ni TiN dissolved, and the Ti content in the melt increased. The Ti bonds increase in melts with increasing Ni concn. and decreased with stability of TiN in the melts.
IT 37312-00-8
RL: USES (Uses)
(soln. kinetics in molten, of titanium nitride)

RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 56-7 (Nonferrous Metals and Alloys)
ST titanium nitride soln steel; iron soln titanium nitride; oxygen soln titanium nitride; nickel soln titanium nitride
IT 11148-11-1 12725-40-5 12739-25-2 12741-98-9, uses and miscellaneous
37312-00-8
RL: USES (Uses)
(soln. kinetics in molten, of titanium nitride)
IT 25583-20-4
RL: PRP (Properties)
(soln. kinetics of, in iron and steel melts)

L13 ANSWER 88 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1979:424887 CAPLUS Full-text
DOCUMENT NUMBER: 91:24887
ORIGINAL REFERENCE NO.: 91:4085a,4088a
TITLE: Diffusion saturation of steels with chromium
AUTHOR(S): Babushkin, B. V.; Makharov, D. M.
CORPORATE SOURCE: USSR
SOURCE: Metallurgiya (Minsk) (1978), 12, 92-3
CODEN: MTRGBV; ISSN: 0369-2450
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Chromizing of steels 20KhNR [12742-15-3], 40KhN [12742-05-1], and 20Kh13 [37241-55-7] was carried out by aluminothermic redn. at 1050-1100° in a powder composed of Al2O3 29.40, Cr2O3 51.45, Al 17.15, and NH4Cl 2%. The diffusion layer contained a carbide zone of (Cr,Fe)23C6 and (Cr,Fe)7C3 phases and a solid soln. zone of high-Cr ferrite. The total depth of the diffusion zone decreased and the depth of the carbide zone increased with increasing C content. The max. microhardness (>2000 kg/mm2) was obsd. for Cr carbides on steel 40KhN, and min. (~1350 kg/mm2) for Cr carbides on steel 20Kh13.
IT 12742-15-3
RL: RCT (Reactant); RACT (Reactant or reagent)
(chromizing of, pack)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8

C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

CC 55-6 (Ferrous Metals and Alloys)
ST chromizing pack steel structure
IT Chromizing
(pack, of steels, carbide morphol. in)
IT 12742-05-1 12742-15-3 37241-55-7
RL: RCT (Reactant); RACT (Reactant or reagent)
(chromizing of, pack)
IT 12012-72-5DP, solid soln. with chromium carbide (Cr23C6) 12075-40-0DP, solid soln. with iron carbide (Fe7C3) 12075-42-2DP, solid soln. with chromium carbide (Cr7C3) 12105-81-6DP, solid soln. with iron carbide (Fe23C6)
RL: FORM (Formation, nonpreparative); PREP (Preparation)
(formation of, in chromized steel)

L13 ANSWER 89 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1978:567295 CAPLUS Full-text
DOCUMENT NUMBER: 89:167295
ORIGINAL REFERENCE NO.: 89:25893a,25896a
TITLE: Stress corrosion susceptibility of highway bridge construction steels - phase IIB
AUTHOR(S): Caton, R. G.; Guthrie, J. L.; Carter, C. S.
CORPORATE SOURCE: Boeing Commerc. Airplane Co., Seattle, WA, USA
SOURCE: U. S. NTIS, PB Rep. (1976), PB-272493, 73 pp. Avail.: NTIS
From: Gov. Rep. Announce. Index (U. S.) 1977, 77(25), 135
CODEN: XPBRCA; ISSN: 0099-8583
DOCUMENT TYPE: Report
LANGUAGE: English
AB Eleven steels typically used in highway bridge construction were evaluated for stress corrosion resistance in various environments under tension. The effects of welding and 5% cold work were also investigated. Lab. tests were verified by exposure of specimens at selected locations in the United States. Both ASTM A325 [67954-12-5] and ASTM A490 [67954-11-4] bolts were evaluated for stress corrosion resistance in similar environments. The effects of hot dip galvanizing and mech. galvanizing on the stress corrosion susceptibility were also detd. Suspension cable and prestressing wires were evaluated for stress corrosion resistance. The suspension cable wires were tested with no coating, and with hot dip galvanized and electrogalvanized coatings.
IT 52346-86-8, properties
RL: PRP (Properties)
(stress-corrosion susceptibility of, for highway bridge construction)
RN 52346-86-8 CAPLUS
CN Steel, (UNS K11630) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	0.70	-	1.00	7439-96-5
Cr	0.40	-	0.65	7440-47-3
Si	0.20	-	0.35	7440-21-3
Mo	0.15	-	0.25	7439-98-7
C	0.12	-	0.21	7440-44-0
V	0.03	-	0.08	7440-62-2
S	0	-	0.04	7704-34-9
P	0	-	0.035	7723-14-0
Ti	0.01	-	0.03	7440-32-6
B	0.0005	-	0.005	7440-42-8

CC 55-9 (Ferrous Metals and Alloys)

ST steel bridge construction stress corrosion; structural steel stress corrosion; galvanizing steel stress corrosion; weld steel stress corrosion; cold work steel stress corrosion

IT Galvanized iron and steel
RL: USES (Uses)
(for highway bridge construction)

IT Bridges
(for highways, structural steels for, stress-corrosion susceptibility of)

IT Welds
(in structural steels, in highway bridge construction)

IT Bolts
(structural steel, for highway bridge construction)

IT 12725-37-0, properties 12731-93-0, properties 12732-02-4, properties 12732-05-7, properties 52346-86-8, properties 58397-66-3, properties 63747-69-3, properties 63849-06-9, properties 67954-11-4, properties 67954-12-5, properties
RL: PRP (Properties)
(stress-corrosion susceptibility of, for highway bridge construction)

L13 ANSWER 90 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1978:533594 CAPLUS Full-text
DOCUMENT NUMBER: 89:133594
ORIGINAL REFERENCE NO.: 89:20639a,20642a
TITLE: Effect of atmospheric corrosion on fatigue strength of steels and welded joints
AUTHOR(S): Gregor, Vladimir
CORPORATE SOURCE: Mater. Test. Lab., Weld. Res. Inst., Bratislava, Czech.
SOURCE: Zvaracske Spravy (1976), 26(4), 73-80
CODEN: ZVSPDI; ISSN: 0322-9785
DOCUMENT TYPE: Journal
LANGUAGE: English/Slovak

AB Fatigue strength of base metal and butt-welded joints was detd. in bending and cyclic tension for the low-alloy steel, grades 15217.1 [12742-62-0], 11523.1 [71497-79-5], 16224 [60707-55-3], and 16224 + 0.37% Cu. Effects of corrosion on fatigue strength were detd. for accelerated chamber corrosion (5-150 cycles at 35° in SO2-contg. atm., with humidity and drying), and after 1-yr atm. exposure at a chem. plant. Corrosion rates were similar for all steels. The Cu-modified 16224 steel lost its surface corrosion layer after 30-50 cycles and developed a roughened surface, while the regular 16224 steel did not. Fatigue strength was rapidly decreased by corrosion exposure to ≤40 cycles, remaining nearly const. for longer cycling. Performance of 15217.1 steel was comparable to that of 11523.1 steel.

IT 60707-55-3
RL: PRP (Properties)
(fatigue and weld strength of, after corrosion)

RN 60707-55-3 CAPLUS

CN Iron alloy, base, Fe 95-97,Cr 0.70-1.00,Mn 0.70-1.00,Ni 0.70-1.00,Mo 0.30-0.50,Si 0.12-0.35,Cu 0-0.30,C 0.12-0.18,V 0.03-0.08,Ti 0-0.04,P 0-0.030,S 0-0.030,B 0.002-0.005 (CSN 16 224) (9CI) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Cr	0.70	-	1.00	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Ni	0.70	-	1.00	7440-02-0
Mo	0.30	-	0.50	7439-98-7
Si	0.12	-	0.35	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.12	-	0.18	7440-44-0
V	0.03	-	0.08	7440-62-2
Ti	0	-	0.04	7440-32-6
P	0	-	0.030	7723-14-0
S	0	-	0.030	7704-34-9
B	0.002	-	0.005	7440-42-8

CC 55-9 (Ferrous Metals and Alloys)

ST corrosion fatigue low alloy steel; weld fatigue corrosion steel; cyclic corrosion fatigue steel
IT Welding
(arc, of low-alloy steels, for fatigue and corrosion test)
IT Welds
(butt, in low-alloy steels, fatigue strength in relation to atm. corrosion of)
IT 12742-62-0 60707-55-3 71497-79-5, properties
RL: PRP (Properties)
(fatigue and weld strength of, after corrosion)
IT 7440-50-8, uses and miscellaneous
RL: USES (Uses)
(in low-alloy steels, accelerated chamber corrosion in relation to)
IT 64941-69-1 67661-29-4, uses and miscellaneous 67663-48-3, uses and miscellaneous
RL: USES (Uses)
(welding electrodes, for low-alloy steels)

L13 ANSWER 91 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1978:463151 CAPLUS Full-text
DOCUMENT NUMBER: 89:63151
ORIGINAL REFERENCE NO.: 89:9753a,9756a
TITLE: Determination of the chemical reaction rate constant during the treatment of steel in an endothermic atmosphere
AUTHOR(S): Gyulikhandanov, E. L.; Kislenkov, V. V.
CORPORATE SOURCE: Leningrad, USSR
SOURCE: Izvestiya Akademii Nauk SSSR, Metally (1978), (3), 189-91
CODEN: IZNMAQ; ISSN: 0568-5303
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB The high-temp. measurement of elec. resistivity change in steel foil during carburization and decarburization were used to det. the temp. dependence of the reaction const. between endothermic atms. of different compns. and unalloyed γ-Fe. The reaction const. was related to the thermodn. activity of C in alloyed austenite at 925°, i.e., the carburization temp. The value is applicable to any alloy steel and with the diffusion coeff. data is useful in detg. the C distribution through the layer during carburization in the endothermic atm. Foils of Armco Fe and carburizing steels 12KhN3A [12750-62-8], 18Kh2N4VA [12742-21-1], 20KhGNR [37312-00-8], and 20Kh3MVF [37246-14-3] were used in the measurements.
IT 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, in endothermic atm.)
RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-6 (Ferrous Metals and Alloys)

ST steel carburization endothermic atm
IT Carburizing
(of iron and steel in endothermic atm.)
IT 12742-21-1 12750-62-8 37246-14-3 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, in endothermic atm.)

L13 ANSWER 92 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1977:62593 CAPLUS Full-text
DOCUMENT NUMBER: 86:62593
ORIGINAL REFERENCE NO.: 86:9887a,9890a
TITLE: Protection of parts in nonmuffle units from gaseous carbonitridation by chromium plating
AUTHOR(S): Rotin, A. I.; Fishtein, B. M.; Shluger, M. A.
CORPORATE SOURCE: Rostov.-na-Donu Nauchno-Issled. Inst. Tekhnol. Mashinostr., Rostov-on-Don, USSR
SOURCE: Zashchita Metallov (1976), 12(6), 716-18
CODEN: ZAMEA9; ISSN: 0044-1856
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Steel plated with Cr from a bath contg. CrO3 350-400, H2SO4 1.9-2.0, Cr2O3 5-8, NaOH 40-60 g/L, at temp. 18-19° and c.d. 20-100 A/dm2 and after previous anodic surface cleaning at c.d. 25-60 A/dm2 had no diffusion of C or N in it. The depth of the cabronitridated layer in the nonprotected surfaces of the steel was 0.9-1.1 mm after 12.5 h.
IT 59738-82-8, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(carbonitridation of, chromium electroplate in prevention of)
RN 59738-82-8 CAPLUS
CN Steel, (20KhGNTR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	97	-	98	7439-89-6
Mn	0.80	-	1.00	7439-96-5
Cr	0.40	-	0.70	7440-47-3
Ni	0.40	-	0.70	7440-02-0
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.18	-	0.24	7440-44-0
Ti	0.03	-	0.09	7440-32-6
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
B		0.001		7440-42-8

CC 72-6 (Electrochemistry)
ST chromium electroplate steel carbonitridation
IT Carbonitridation and Cyanidation
(of steel, chromium electroplating in prevention of)
IT 12718-23-9, uses and miscellaneous 37329-39-8, uses and miscellaneous 51258-45-8 59738-82-8, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(carbonitridation of, chromium electroplate in prevention of)
IT 7440-47-3, uses and miscellaneous
RL: PRP (Properties)
(electroplating of, on steel, for carbonitridation prevention)

L13 ANSWER 93 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1977:20628 CAPLUS Full-text
DOCUMENT NUMBER: 86:20628
ORIGINAL REFERENCE NO.: 86:3299a,3302a
TITLE: Hardness of metals during strengthening by surface plastic deformation
AUTHOR(S): Yankov, N. I.; Aleksandrov, B. I.; Yankov, I. I.
CORPORATE SOURCE: Inst. Probl. Nadezhnosti Dolgovechnosti Mash., Minsk, USSR
SOURCE: Vestsi Akademii Navuk BSSR, Seryya Fizika-Tekhnichnykh Navuk (1976), (3), 5-9

CODEN: VABFAF; ISSN: 0002-3566
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB The stress-strain relation for Cu, Al, and steels was examd. A method was applied for calcg. the max. hardness of the surface layer during strengthening by surface plastic deformation. For steels, the calcd. results agreed with exptl. data.
IT 59738-82-8, uses and miscellaneous
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(hardening of, by surface plastic deformation)
RN 59738-82-8 CAPLUS
CN Steel, (20KhGNTR) (CA INDEX NAME)

Component	Component Percent	Component Registry Number
Fe	97 - 98	7439-89-6
Mn	0.80 - 1.00	7439-96-5
Cr	0.40 - 0.70	7440-47-3
Ni	0.40 - 0.70	7440-02-0
Si	0.17 - 0.37	7440-21-3
Cu	0 - 0.30	7440-50-8
C	0.18 - 0.24	7440-44-0
Ti	0.03 - 0.09	7440-32-6
P	0 - 0.035	7723-14-0
S	0 - 0.035	7704-34-9
B	0.001	7440-42-8

CC 56-7 (Nonferrous Metals and Alloys)
ST copper surface layer hardness; aluminum surface layer hardness; steel surface layer hardness; surface plastic deformation metal
IT 7429-90-5, properties 7440-50-8, properties 11121-90-7, properties 12611-78-8 12725-40-5 12731-93-0, properties 12732-25-1 12742-05-1 12742-24-4 12742-30-2 12743-82-7, uses and miscellaneous 12750-62-8 37268-90-9, properties 37269-19-5, properties 39294-21-8 59738-82-8, uses and miscellaneous 61431-72-9
RL: PEP (Physical, engineering or chemical process); PROC (Process)
(hardening of, by surface plastic deformation)

L13 ANSWER 94 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1976:546672 CAPLUS Full-text
DOCUMENT NUMBER: 85:146672
ORIGINAL REFERENCE NO.: 85:23487a,23490a
TITLE: Protecting parts from gas carburization and carbonitriding by electroplating with chromium
AUTHOR(S): Rotin, A. I.; Fishtein, B. M.; Shluger, M. A.
CORPORATE SOURCE: Nauchno-Issled. Inst. Tsvetn. Metall., Rostov-on-Don, USSR
SOURCE: Metallovedenie i Termicheskaya Obrabotka Metallov (1976), (5), 49-50
CODEN: MTOMAX; ISSN: 0026-0819
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Cylindrical specimens of 20Kh [37329-39-8], 18KhGT [12718-23-9], 12KhN3A [12750-62-8], and 20KhGNTR [59738-82-8] steels were electroplated with Cr. Then, specimens were carbonitrided at 870° in an atm. contg. CO 18-19, H 42-44, CH4 1-2, NH3 3%, and balance N and oil quenched from 830°. The carbonitrided layer depth was 0.9-1.1 mm on the surface of the uncoated specimens. A 5 μ thick Cr coating inhibited diffusion of C and N. During carbonitriding, a thin interlayer of Cr23C6 and Cr7C3 formed at the Cr-steel interface. This carbide interlayer acted as a barrier to C diffusion.
IT 59738-82-8, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization and carbonitriding of, chromium electroplating for stopoff in)
RN 59738-82-8 CAPLUS
CN Steel, (20KhGNTR) (CA INDEX NAME)

Component	Component Percent	Component Registry Number

Fe	97	-	98	7439-89-6
Mn	0.80	-	1.00	7439-96-5
Cr	0.40	-	0.70	7440-47-3
Ni	0.40	-	0.70	7440-02-0
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.18	-	0.24	7440-44-0
Ti	0.03	-	0.09	7440-32-6
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
B		0.001		7440-42-8

CC 55-6 (Ferrous Metals and Alloys)
ST chromium electroplating protection steel carbonitriding
IT Carbonitridation and Cyanidation
Carburization
(of steel, chromium electroplate for stopoff in)
IT 12718-23-9, reactions 12750-62-8 37329-39-8, reactions
59738-82-8, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization and carbonitriding of, chromium electroplating for stopoff in)
IT 7440-47-3, uses and miscellaneous
RL: USES (Uses)
(electroplating on steel, as stopoff for carburization and carbonitriding prevention)

L13 ANSWER 95 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1976:48042 CAPLUS Full-text
DOCUMENT NUMBER: 84:48042
ORIGINAL REFERENCE NO.: 84:7875a,7878a
TITLE: Diffusion saturation of steel by carbon and manganese
AUTHOR(S): Rishchev, I. A.; Shcherbakov, E. D.; Khudokormova, R. N.; Martynyuk, M. N.
CORPORATE SOURCE: USSR
SOURCE: Khim.-Term. Obrab. Met. Splavov, Tezisy Dokl. Vses. Nauchn. Konf., 2nd (1974), 122-3. Editor(s): Lyakhovich, L. S. Beloruss. Politekh. Inst.: Minsk, USSR.
CODEN: 31GQAQ
DOCUMENT TYPE: Conference
LANGUAGE: Russian
AB The simultaneous cementation of 8 C and low-alloy steels with C and Mn [7439-96-5] in powd. Bondyuzhsk carburizing agent or ferromanganese [12604-53-4] or their mixts. contg. Al2O3 and NH4Cl (ferromanganese-Al2O3-NH4Cl ratio 67:30:3) took place in metal crucibles with consumable covers at 1000° during 4, 6, and 8 hr. The diffusion layers of high-Mn austenite with finely dispersed carbide inclusions formed in mixts. contg. the carburizer 50-80, ferromanganese 15-30, NH4Cl 1-2%, and the rest Al2O3, had wear resistances higher than that of G13 austenitic Mn steel.
IT 12742-15-3
RL: USES (Uses)
(carburization and manganese cementation of, with ferromanganese-contg. compns.)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0

W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

CC 55-6 (Ferrous Metals and Alloys)
ST steel cementation carbon manganese; carburization steel ferromanganese; ferromanganese cementation steel
IT Cementation
(of steel with manganese, with ferromanganese-contg. mixts.)
IT Carburization
(of steels, combined with manganese cementation, with ferromanganese-contg. compns.)
IT 12725-33-6, uses and miscellaneous 12731-92-9, uses and miscellaneous 12742-15-3 12742-21-1 12743-82-7, uses and miscellaneous 12750-62-8 37268-90-9, uses and miscellaneous 73286-08-5, reactions
RL: USES (Uses)
(carburization and manganese cementation of, with ferromanganese-contg. compns.)
IT 12604-53-4
RL: USES (Uses)
(cementation of steels with mixts. contg., for simultaneous carburization and manganese cementation)
IT 7439-96-5, uses and miscellaneous
RL: USES (Uses)
(cementation with, combined with carburization, of carbon and low-alloy steels)

L13 ANSWER 96 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1975:483285 CAPLUS Full-text
DOCUMENT NUMBER: 83:83285
ORIGINAL REFERENCE NO.: 83:13051a,13054a
TITLE: Magnetic, electric, and mechanical properties of 20KhGR and 20KhGNR steels and their carburized layers
AUTHOR(S): Kuznetsov, I. A.; Somova, V. M.; Tsar'kova, T. P.; Bashkirov, Yu. P.
CORPORATE SOURCE: USSR
SOURCE: Struktura i svoistva tverdykh tel (1973), (1), 164-84
From: Ref. Zh., Metall. 1974, Abstr. No. 7I547
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Title only translated.
IT 37312-00-8 56995-50-7, properties
RL: USES (Uses)
(elec. and magnetic and mech. properties of carburized)
RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

RN 56995-50-7 CAPLUS
CN Iron alloy, base, Fe 96-98,Cr 0.75-1.05,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,Ni 0-0.30,C 0.18-0.24,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	96	-	98	7439-89-6
Cr	0.75	-	1.05	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
Ni	0	-	0.30	7440-02-0
C	0.18	-	0.24	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-8 (Ferrous Metals and Alloys)
Section cross-reference(s): 76, 77
ST steel carburized property; magnetic property carburized steel; mech property carburized steel; elec property carburized steel
IT Electric property
Magnetic property and Magnetism
(of carburized steel)
IT 37312-00-8 56995-50-7, properties
RL: USES (Uses)
(elec. and magnetic and mech. properties of carburized)

L13 ANSWER 97 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1975:101616 CAPLUS Full-text
DOCUMENT NUMBER: 82:101616
ORIGINAL REFERENCE NO.: 82:16213a,16216a
TITLE: Carburization in an electrothermal fluidized bed
AUTHOR(S): Androshchuk, V. N.; Tsubanov, A. G.; Nikitin, V. S.
CORPORATE SOURCE: USSR
SOURCE: Sbornik Nauchnykh Trudov, Belorusskii Institut Mekhanizatsii Sel'skogo Khozyaistva (1972), 21, 195-7
CODEN: SBMKAP; ISSN: 0370-8640
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Carburization of 10-20 × 20-30 mm 20Kh, 20KhNR, and 18KhGT steel was accomplished in a Kryptol fluidized bed elec. furnace at 900-1000°. The carburization gas contained CO 20, CH4 3.8, H 13.5, CO2 1.2, and O 0.35%. A 1.25-mm carburized layer was obtained in 30 min. at 1000°.
IT 12742-15-3
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, in fluidized bed)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7

V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

CC 55-6 (Ferrous Metals and Alloys)
ST carburization chromium steel; electrothermal fluidized bed carburizing
IT Carburization
(of steel, in fluidized bed)
IT 12718-23-9, reactions 12742-15-3 37329-39-8, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, in fluidized bed)

L13 ANSWER 98 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1974:405409 CAPLUS Full-text
DOCUMENT NUMBER: 81:5409
ORIGINAL REFERENCE NO.: 81:883a,886a
TITLE: Thermophysical properties of steel scale at different temperatures
AUTHOR(S): Severdenko, V. P.; Makushok, E. M.; Ravin, A. N.
CORPORATE SOURCE: Fiz.-Tekh. Inst., Minsk, USSR
SOURCE: Vestsi Akademii Navuk BSSR, Seryya Fizika-Tekhnichnykh Navuk (1974), (1), 33-7
CODEN: VABFAF; ISSN: 0002-3566
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB The thermophys. properties (d. sp. heat, heat cond., and heat cond. coeff.) at 20-700° were detd. for the scale component oxides and for the scales on widely used forged and rolled 45, 25KhGT, 20KhNR, 40Kh, ShKh15, and Kh18N10T steels.
IT 12742-15-3
RL: USES (Uses)
(thermophys., of scale coatings on)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B		0.001		7440-42-8

CC 55-8 (Ferrous Metals and Alloys)
ST thermophys property steel scale; oxide scale forged rolled steel; stainless steel scale; alloy low steel scale
IT Heat capacity
Thermal conductivity and conduction
(of scale, on steel)
IT Scale (coating)
(thermophys. properties of, on steel)
IT 1309-37-1, properties 1317-61-9 1345-25-1, properties
RL: PRP (Properties)
(thermophys., in scale on steel)
IT 12611-78-8 12725-40-5 12741-98-9, properties 12742-15-3 37268-90-9, properties 39344-94-0, properties
RL: USES (Uses)

(thermophys., of scale coatings on)

L13 ANSWER 99 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1974:29530 CAPLUS Full-text
DOCUMENT NUMBER: 80:29530
ORIGINAL REFERENCE NO.: 80:4865a,4868a
TITLE: Effect of chemicothermal treatment in hydrogen-containing atmospheres on static crack and brittle strengths of case-hardened steel
AUTHOR(S): Dukarevich, I. S.; Balter, M. A.
CORPORATE SOURCE: USSR
SOURCE: Vestnik Mashinostroeniya (1973), 53(8), 62-5
CODEN: VMASAV; ISSN: 0042-4633
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Thermochem. treatment is developed in controlled gas atm. contg. H, which is readily adsorbed on the surface. The diffusion coeff. of H is 3-4 orders higher than the diffusion coeffs. of C and N in Fe, and therefore the depth of H-satd. zone is considerably greater than that of the case-hardened or carbonitrided layers. The effects of H satn. on static and brittle strength of steels, after various carburizing treatments in natural gas, carbonitridation in natural gas and ammonia, hardening of carburized steel with heating in endogas with or without addn. of natural gas were studied for the core and the diffusion-coated layer at a relative carburized layer depth 0.25-0.33. A decrease in strength and plasticity during static bending and elongation testing of carburized 20Kh2N4A (Cr-Ni) steel was obsd. The effect of H pickup of steel during treatment in a H-contg. atm., causing a decrease in static and brittle strengths, must be considered in use of diffusion coating. For casehardening and carbonitridation the steel contains ≤0.25% C. Steel with 0.30-0.35% C is extremely sensitive to embrittlement by H. Satn. with H during casehardening and carbonitridation does not decrease the resistance to brittle fracture if the steel is subsequently hardened after heating in air for H desorption, resulting in improved strength and plasticity.
IT 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, hydrogen effect on plasticity and strength in relation to)
RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-6 (Ferrous Metals and Alloys)
ST carburization steel mech property; carbonitridation steel mech property; cementation steel hydrogen embrittlement
IT Natural gas
RL: USES (Uses)
(carbonitridation in, of steels, plasticity and strength in relation to)
IT Diffusion
(of hydrogen in casehardening of steels, plasticity and

strength in relation to)
IT Carbonitridation and Cyanidation
Carburization
(of steels, hydrogen effect on plasticity and strength in relation to)
IT 1333-74-0, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(carbonitridation in gases contg., of steels, plasticity and strength in relation to)
IT 7664-41-7, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(carbonitridation in, of steels, plasticity and strength in relation to)
IT 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, hydrogen effect on plasticity and strength in relation to)

L13 ANSWER 100 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1973:482245 CAPLUS Full-text
DOCUMENT NUMBER: 79:82245
ORIGINAL REFERENCE NO.: 79:13333a,13336a
TITLE: Improvement of gas carburization
AUTHOR(S): Beloruchev, L. V.; Korolev, V. A.; Cherepkova, K. F.
CORPORATE SOURCE: USSR
SOURCE: Nadezhnost Dolgovechnost Metal. Mater. Mashinostr. Priborostr. (1972) 99-102
From: Ref. Zh., Met. 1973, Abstr. No. 1I786
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB Progress in gas carburization by using endothermically controlled atms. as carrier gas in the USSR and abroad was studied. The feasibility of carburization in N with addn. of natural gas was tested. Steel 20KhGNR (Cr-Mn-Ni-B) was heated in an exptl. furnace at 940° for 10 hr in a mixt. of N with 6% H and 5% natural gas. A 1-8 mm carburized layer was obtained and internal oxidn. was absent. The carburizing capacity of a N-natural gas mixt. was high as was the diffusion rate of C in this mixt.
IT 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, in natural gas contg. nitrogen)
RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-6 (Ferrous Metals and Alloys)
ST gas carburization alloy steel; natural gas carburization steel; chromium manganese steel carburization; nickel chromium steel carburization; boron contg steel carburization
IT Natural gas
RL: USES (Uses)
(carburization of steel in nitrogen-contg.)
IT Carburization

(of steel, in natural gas contg. nitrogen)
IT 7727-37-9, reactions
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of steel in natural gas contg.)
IT 37312-00-8
RL: RCT (Reactant); RACT (Reactant or reagent)
(carburization of, in natural gas contg. nitrogen)

L13 ANSWER 101 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1973:162649 CAPLUS Full-text
DOCUMENT NUMBER: 78:162649
ORIGINAL REFERENCE NO.: 78:26093a,26096a
TITLE: Strength characteristics of scale
AUTHOR(S): Severdenko, V. P.; Makushok, E. M.; Ravin, A. N.
CORPORATE SOURCE: Minsk, USSR
SOURCE: Izvestiya Akademii Nauk SSSR, Metally (1973), (1), 123-7
CODEN: IZNMAQ; ISSN: 0568-5303
DOCUMENT TYPE: Journal
LANGUAGE: Russian
AB A method for detg. the yield strength, σ, of scales on St. 45, ShKh15, Kh18N10T, 20KhNR, and 25KhGT steels is discussed, and σ values for these scales at various temps. (t = 600-1150°) and degrees of deformation (0.50-0.80) are tabulated. At high temp. and similar deformation conditions, the strengths of scales are lower than those of steels, i.e. scale decreases the friction coeff. of steels and can act as a lubricant during forming of steel. In absence of phase transformation in scales, their σ-t relations are exponential.
IT 12742-15-3, properties
RL: USES (Uses)
(yield strength of scale on)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-11 (Ferrous Metals and Alloys)
ST yield strength mill scale; friction steel scale strength
IT Scale (coating)
(mill, yield strength of)
IT 12725-40-5 12741-98-9, properties 12742-15-3, properties 37268-90-9, properties 54611-20-0
RL: USES (Uses)
(yield strength of scale on)

L13 ANSWER 102 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1972:529437 CAPLUS Full-text
DOCUMENT NUMBER: 77:129437
ORIGINAL REFERENCE NO.: 77:21303a,21306a
TITLE: Use of protective glass coatings during the heat treatment of steel components
AUTHOR(S): Emel'yanenko, N. L.; Shagabutdinov, R. I.; Valeev, R.

M.; Smirnova, L. P.
CORPORATE SOURCE: Chelyab. Trakt. Zavod, Chelyabinsk, USSR
SOURCE: Metallovedenie i Termicheskaya Obrabotka Metallov (1972), (7), 74-5
CODEN: MTOMAX; ISSN: 0026-0819
DOCUMENT TYPE: Journal
LANGUAGE: Russian

AB The protective capacities of various coatings deposited on the surfaces of R12 and R18 (Cr-W-V), St. 45, R6M3 and R9K5 (Cr-Co-W-V), R9M4 (Cr-W-V), 20Kh (Cr), and 20KhGNR (Cr-Mn-Ni-B) steels during heating at 1250-1400° were examd. All the steels were preheated at 860° for 30 min, annealed at 1240-70° for 15-20 min, and oil quenched. Preliminary results showed that the best protective properties were achieved by using an enamel of the EZh-01 type contg. ~25% Al2O3. The same enamel was used to protect the steels 20KhGNR and 18Kh2N4VA (Cr-Ni-W) from decarburization during their thermal treatment (annealing at 870° for 2 hr and quenching from 880°, then tempering at 220° for 4 hr). In the presence of EZh-01, decarburization is completely suppressed, whereas in its absence the depth of the decarburized zone may reach 0.1 mm. After the thermal treatment, the coating can be easily removed by shot blasting or by dissolving in molten KOH or NaOH at 500-50°.

IT 37312-00-8
RL: USES (Uses)
(heat treatment of, protective glass coatings for)

RN 37312-00-8 CAPLUS
CN Iron alloy, base, Fe 95-97,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.70-1.00,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhGNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	97	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.70	-	1.00	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55-6 (Ferrous Metals and Alloys)
ST coating steel heat treatment; enamel coating steel; decarburization prevention steel enameling

IT Coating removers
(alkali metal hydroxide, for protective glass dissoln. on steel after heat treatment)

IT Enamels
(aluminum oxide-contg., on steel for decarburization prevention during heat treatment)

IT Glass
RL: USES (Uses)
(coatings, on steel for decarburization prevention during heat treatment)

IT Coating materials
(glass, on steel for decarburization prevention during heat treatment)

IT 1310-58-3, uses and miscellaneous 1310-73-2, uses and miscellaneous
RL: USES (Uses)
(glass coating removal by molten, from heat-treated steel)

IT 12715-04-7, uses and miscellaneous 12743-13-4 37241-62-6 37302-40-2 37302-41-3 37302-42-4, uses and miscellaneous 37312-00-8 37329-39-8, uses and miscellaneous
RL: USES (Uses)

(heat treatment of, protective glass coatings for)

L13 ANSWER 103 OF 103 CAPLUS COPYRIGHT 2021 ACS on STN
ACCESSION NUMBER: 1972:116614 CAPLUS Full-text
DOCUMENT NUMBER: 76:116614
ORIGINAL REFERENCE NO.: 76:18841a,18844a
TITLE: Mechanical properties of nitrocemented steels at static loads
AUTHOR(S): Rozenberg, S. E.
CORPORATE SOURCE: USSR
SOURCE: Khim.-Term. Obrab. Metal. Splavov (1971) 98-101
From: Ref. Zh., Met. 1971, Abstr. No. 10I398
DOCUMENT TYPE: Journal
LANGUAGE: Russian

AB The effects of the carbonitrided layer depth (0.55, 0.8, and 1.1), chem. compn., and microstructure on the notch toughness and tensile strength (during bending and torsion) were detd. for the 20KhNR, 25KhGM, and 25KhGT steels. The carbonitrided 20KhNR steel had better mech. properties than the 25KhGM and 25KhGT steels. An increase in the carbonitrided layer depth from 0.55 to 1.1 mm results in a decrease of tensile strength during bending, notch toughness, and torsion angle, but increased the torsional strength. The content of N in the carbonitrided layer should be ≤0.3%. Cold treatment decreased all of the mech. properties. The carbonitrided 25KhGM steel has a strength similar to that of the 20KhNR steel. The 25KhGT steel has the lowest strength but the plasticity of its carbonitrided layer is higher than that on the 25KhGM steel.

IT 12742-15-3, properties
RL: PRP (Properties)
(mech., carbonitridation effect on)
RN 12742-15-3 CAPLUS
CN Iron alloy, base, Fe 95-98,Ni 0.80-1.10,Cr 0.70-1.10,Mn 0.60-0.90,Si 0.17-0.37,Cu 0-0.30,C 0.16-0.23,W 0-0.20,Mo 0-0.15,V 0-0.05,P 0-0.035,S 0-0.035,Ti 0-0.03,B 0.001 (20KhNR) (CA INDEX NAME)

Component	Component Percent			Component Registry Number
Fe	95	-	98	7439-89-6
Ni	0.80	-	1.10	7440-02-0
Cr	0.70	-	1.10	7440-47-3
Mn	0.60	-	0.90	7439-96-5
Si	0.17	-	0.37	7440-21-3
Cu	0	-	0.30	7440-50-8
C	0.16	-	0.23	7440-44-0
W	0	-	0.20	7440-33-7
Mo	0	-	0.15	7439-98-7
V	0	-	0.05	7440-62-2
P	0	-	0.035	7723-14-0
S	0	-	0.035	7704-34-9
Ti	0	-	0.03	7440-32-6
B	0.001			7440-42-8

CC 55 (Ferrous Metals and Alloys)
ST carbonitrided steel property
IT Carbonitridation and Cyanidation
(of steel, mech. properties in relation to)
IT 12597-69-2, properties 12741-98-9, properties 12742-15-3, properties
RL: PRP (Properties)
(mech., carbonitridation effect on)

=>

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16413799
Filing Date	2019-05-16
First Named Inventor	Pascal DRILLET
Art Unit	
Examiner Name	SCHLEIS, DANIEL J
Attorney Docket Number	20631.1028CON5

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5116645	A	1992-05-26	ARMCO STEEL CO LP	
	2	4257549	A	1981-03-24	ROBERTSON CO H H	
	3	5495736	A	1996-03-05	Nishi et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020114884	A1	2002-08-22	FRIEDERSDORF FRITZ J et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	19749706	DE	C1	1999-03-04	MANNESMANN AG	See English Abstract and EPO machine translation	

EFS Web 2.1.17

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	Filing Date	2019-05-16
	First Named Inventor	Pascal DRILLET
	Art Unit	
	Examiner Name	SCHLEIS, DANIEL J
	Attorney Docket Number	20631.1028CON5

	2	0724919	EP	A2	1996-08-07	HITACHI LTD	In English	
	3	1657004	EP	A1	2006-05-17	ARVEDI GIOVANNI	In English	
	4	2573226	CA	A1	2006-01-19	NIPPON STEEL CORP	In English	
	5	0692549	EP	A1	1996-01-17	UNITAS SA	In English	
	6	1063314	EP	A1	2000-12-27	KAWASAKI STEEL CO	In English	
	7	2720079	FR	A1	1995-11-24	LORRAINE LAMINAGE	See English Abstract and EPO machine translation	
	8	622697	AU	B2	1992-04-16	ARMCO INC	In English	
	9	H08144037	JP	A	1996-06-04	SUMITOMO METAL IND	See English Abstract and EPO machine translation	
	10							
	11							
	12							

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16413799
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	Art Unit	
	Examiner Name	SCHLEIS, DANIEL J
	Attorney Docket Number	20631.1028CON5

	13							

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	1	Stahl und Eisen 120 (2000) Nr. 8, Seiten 51 bis 56, "Die neue Verzinkungsanlage 2 bei Eko Stahl", "The new No. 2 hot-dip galvanizing line at Eko Stahl", Autoren: Karl Döring, Jürgen Nathow, Dietrich Kern, Michael Breiter und Dietmar Lowenberg.	
	2	Andrews, K.W. Empirical Formulae for the Calculation of Some Transformation Temperatures. Journal of the Iron and Steel Institute, 203, Part 7, July 1965, 721-727.	
	3	Enlarged Fig. 7 of U.S. 16413825 (present application)	
	4	Low Carbon, Heat-Treatable Boron Steel - Uncoated or Aluminized PreCoated, GM Worldwide Engineering Standards, GMW14400.	
	5	Patent Trial and Appeal Board Final Decision in IPR2019-01275, US 9708683, dated January 5, 2021	
	6	Gokhale, Arun M., "Report on quantitative characterization of the microstructure of Aluminium alloy surface coating on hot-stamped US BOR 1500 steel blanks" School of Materials Science and Engineering, Georgia Institute of Technology, 13 May 2019	
	7	Fan, Dong Wei et al., "Formation of an Aluminide Coating on Hot Stamped Steel" ISIJ International, Vol. 50, No. 11, 2010, pp 1713-1718	
	8	Summons in EP proceeding for EP 09701846, dated 11/18/2016	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	Pascal DRILLET
	Art Unit	
	Examiner Name	SCHLEIS, DANIEL J
	Attorney Docket Number	20631.1028CON5

	9	Bourouga, Brahim, "Report on the heating of coated steel blanks for hot stamping" Laboratoire de therminque et enqerie de Nantes, 30 Aprill 2019
	10	Imose, Masayuki, "Heating and Cooling Technology in the Continuous Annealing" Transactions ISIJ, Vol. 25, 1985, 911-932
	11	Kolleck, R. et al., "Investigation on induction heating for hot stamping of boron alloyed steel" CIRP Annals - Manufacturing Technology 58, (2009), 275-278
	12	Kahl, Martin, "Some like it hot" Technology focus - Hot stamping, September/October 2004 AMS
	13	Self-study programme 339, The Passat 2006

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16413799
	Filing Date	2019-05-16
	First Named Inventor	Pascal DRILLET
	Art Unit	
	Examiner Name	SCHLEIS, DANIEL J
	Attorney Docket Number	20631.1028CON5

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/William C. Gehris/	Date (YYYY-MM-DD)	2021-01-07
Name/Print	William C. Gehris	Registration Number	38,156

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Application of:	ARCELORMITTAL
Inventor(s):	Drillet et al.
Application No.:	16/413,799
Filed:	May 16, 2019
Attorney Docket No.:	20631.1028CON5
Confirmation No.:	7637
Examiner:	Daniel J. Schleis
Title:	Coated Steel Strips, Coated Stamped Products and Methods

Submitted electronically via EFS-WEB January 8, 2021

RCE AND RESPONSE TO FINAL OFFICE ACTION

Dear Sir or Madam:

In response to the Final Office Action dated July 10, 2020, please re-consider the above-identified patent application based on the following:

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1 to 47 (canceled).

Claim 48 (previously presented): A precoated steel product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean iron composition,

(b) an intermediate layer having a second mean iron composition different from the first mean iron composition,

(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron composition being higher than the second mean iron composition; and

(d) a superficial layer having a fourth mean iron composition different from the third mean iron composition,

wherein the coating has a thickness greater than 30 micrometers.

Claim 49 (previously presented): The precoated steel product as recited in claim 48 wherein the layers (c) and (d) are quasi continuous by occupying at least 90% of a level corresponding to each of the layers (c) and (d) and wherein less than 10% of layer (c) is present at an extreme surface of the product.

Claim 50 (previously presented): The precoated steel product as recited in claim 48 wherein the base steel includes the following components by weight based on total weight:

0.15%<carbon<0.5%;

0.5%<manganese<3%;

0.1%<silicon<0.5%;

0.01%<chromium<1%;

titanium<0.2%;

aluminum<0.1%;

phosphorus<0.1%;

sulfur<0.05%;

0.0005%<boron<0.08%;

and further comprises iron and impurities inherent in processing.

Claim 51 (previously presented): The precoated steel product as recited in claim 48 wherein the base steel comprises the following components by weight based on total weight:

0.20%<carbon<0.5%;

0.8%<manganese<1.5%;

0.1%<silicon<0.35%;

0.01%<chromium<1%;

titanium<0.1%;

aluminum<0.1%;

phosphorus<0.05%;

sulfur<0.03%;

0.0005%<boron<0.01%;

and further comprises iron and impurities inherent in processing.

Claim 52 (previously presented): The precoated steel product as recited in claim 48 wherein the base steel comprises 20 ppm or less of sulfur.

Claim 53 (previously presented): The precoated steel product as recited in claim 49 wherein the base steel comprises 20 ppm or less of sulfur.

Claim 54 (previously presented): The precoated steel product as recited in claim 48 wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 55 (previously presented): The precoated steel product as recited in claim 49 wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 56 (previously presented): The precoated steel product as recited in claim 48 wherein the layer (a) has a thickness less than 15 micrometers.

Claim 57 (previously presented): The precoated steel product as recited in claim 48 wherein the layer (a) has a thickness less than 10 micrometers.

Claim 58 (previously presented): The precoated steel product as recited in claim 48 wherein the interdiffusion layer comprises the following components by weight based on total weight: 86 to 95% Fe, 4 to10% Al, and 0 to 5% Si.

Claim 59 (previously presented): The precoated steel product as recited in claim 48 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 60 (previously presented): The precoated steel product as recited in claim 48 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 61 (previously presented): The precoated steel product as recited in claim 48 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 62 (previously presented): The precoated steel product as recited in claim 58 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 63 (previously presented): The precoated steel product as recited in claim 62 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 64 (previously presented): The precoated steel product as recited in claim 63 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 65 (previously presented): The precoated steel product as recited in claim 48 wherein the interdiffusion layer has a thickness of from 1 micron to 15 microns.

Claim 66 (previously presented): The precoated steel product as recited in claim 48 wherein the first mean iron composition is 90 percent, the second mean iron composition is 43 percent, the third mean iron composition is 63 percent and the fourth mean iron composition is 45 percent.

Claim 67 (previously presented): The precoated steel product as recited in claim 48 wherein the fourth mean iron composition is lower than the third mean iron composition.

Claim 68 (previously presented): A precoated steel product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean iron composition,

(b) an intermediate layer having a second mean iron composition different from the first mean iron composition,

(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron concentration being higher than the second mean iron composition, and

(d) a superficial layer having a fourth mean iron composition different from the first, second and third mean iron compositions,

wherein the coating has a thickness greater than 30 micrometers.

Claim 69 (previously presented): The precoated steel product as recited in claim 68 wherein the fourth mean iron composition is lower than the third mean iron composition.

Claim 70 (previously presented): The precoated steel product as recited in claim 69 wherein the fourth mean iron composition is higher than the second mean iron composition.

Claim 71 (previously presented): A precoated steel product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean aluminum composition,

(b) an intermediate layer having a second mean aluminum composition different from the first mean aluminum composition,

(c) an intermetallic layer having a third mean aluminum composition different from the first and second mean aluminum compositions, and

(d) a superficial layer having a fourth mean aluminum composition different from the first, second and third mean aluminum compositions, the second mean aluminum composition being greater than the third mean aluminum composition;

wherein the coating has a thickness greater than 30 micrometers.

Claim 72 (previously presented): The precoated steel product as recited in claim 71 wherein the fourth mean aluminum composition is less than the second mean aluminum composition.

Claim 73 (previously presented): The precoated steel product as recited in claim 71 wherein the layer (a) has a thickness less than 15 micrometers.

Claim 74 (previously presented): The precoated steel product as recited in claim 71 wherein the interdiffusion layer comprises the following components by weight based on total weight: 86 to 95% Fe, 4 to10% Al, and 0 to 5% Si.

Claim 75 (previously presented): The precoated steel product as recited in claim 71 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 76 (previously presented): The precoated steel product as recited in claim 71 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 77 (previously presented): The precoated steel product as recited in claim 71 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

REMARKS

This paper is submitted in response to the Final Office Action dated July 10, 2020. Claims 48 to 77 are pending.

Claims 48-50 and 54-77 stand rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent Number 6,296,805 (Laurent); and claims 51-53 stand rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Laurent.

Claims 48, 68, and 71 are independent claims. Each of the independent recites a strip of based steel having a coating on one or both sides where " the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating." Each claim also specifies that the coating has a thickness greater than 30 micrometers. The claims differ in the claimed layers in the coating, where:

In claim 48: "the coating includes, proceeding from the base steel outwards:
(a) an ***interdiffusion layer*** having ***a first mean iron*** composition,
(b) ***an intermediate layer*** having a ***second mean iron*** composition ***different from*** the ***first mean iron*** composition,
(c) ***an intermetallic layer*** having a ***third mean iron*** composition ***different from*** the ***first and second mean iron*** compositions, the ***third mean iron*** composition ***being higher than*** the ***second mean iron*** composition; and
(d) ***a superficial layer*** having a ***fourth mean iron*** composition ***different from*** the ***third mean*** iron composition"

In claim 68: "the coating includes, proceeding from the base steel outwards:
(a) ***an interdiffusion layer*** having a ***first mean iron*** composition,
(b) ***an intermediate layer*** having a ***second mean*** iron composition ***different from*** the ***first mean iron*** composition,
(c) ***an intermetallic layer*** having ***a third mean iron*** composition ***different from*** the ***first and second mean iron*** compositions, the ***third mean iron*** concentration being ***higher than*** the ***second mean iron*** composition, and
(d) ***a superficial layer*** having a ***fourth mean iron*** composition ***different from*** the ***first, second and third mean iron*** compositions,

In claim 71: " the coating includes, proceeding from the base steel outwards:
(a***) an interdiffusion layer*** having a ***first mean aluminum*** composition,
(b) ***an intermediate layer*** having a ***second mean aluminum*** composition ***different from*** the ***first mean aluminum*** composition,

(c) ***an intermetallic layer*** having ***a third mean aluminum*** composition ***different from*** the ***first and second mean aluminum*** compositions, and
(d) ***a superficial layer*** having a ***fourth mean aluminum*** composition ***different from*** the ***first, second and third mean aluminum*** compositions, the ***second mean aluminum*** composition being ***greater than*** the ***third mean aluminum*** composition"

The Examiner concedes that Laurent does not disclose a coating resulting "from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating" that has four layers in the claimed arrangement (interdiffusion, intermediate, intermetallic, superficial), or that such layers would have the specifically claimed mean iron or mean aluminum compositions. Indeed, at best, Laurent discloses a two layered coating. (col. 3, lines 15-23).

Instead, at pages 4-5 of the Final Office Action the Examiner contends that the Laurent "process appears to be identical or substantially identical to the process set forth in the specification of the instant application, which produces the claimed product," citing Laurent at col. 1, lines 6-8 and 47-64, col. 2, lines 37-45, col. 3, lines 26-44 and 61-65, and col. 4, lines 4-9. The Examiner alleges that "[w]here the claimed and prior art products are identical or substantially identical, or are produced by identical or substantially identical processes, the Office can require an applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of the claimed product." Final Office Action, p. 6. In making this assertion, the Examiner relies, inter alia, on the discussion of an " increase in temperature to an excess of 5° C/second" (col. 3, lines 26-29) and heat treatment of a 1 mm thick coated sheet at "900 C for 5 min" (column 4, lines 8-9), which the Examiner alleges is substantially the same as the process disclosed in the present application, citing to paragraph [0059] thereof..

Applicant respectfully traverses. First, the process of Laurent is not "identical or substantially identical to the process set forth in the specification of the instant application."

The process of Laurent comprises:

- Shaping the coated steel sheet to form a “casting” (col.3, line 26, claims 4 and 11);

- Then heating the coating at a heating rate of 5-600°C/s (col.2, lines 23-25, col.3, lines 26-31, claims 4 and 11) to a temperature higher than 750°C (col. 2, line 28, claim 12), for example 900°C for 5 min for a 1 mm thick sheet (col. 4, lines 4-9); and

- Cooling with a cooling rate of at least 27°C/s. (col. 4, lines 2-9).

For the reasons detailed below, this process of Laurent is not "identical or substantially identical to the process set forth in the specification of the instant application," at least because:

(i) no hot-stamping is performed after heating to the temperature higher than 750° C, for example 900° C;

(ii) no hot-stamping is performed after the heating rate of 5-600° C/s is applied;

(iii) the heating rate is not Vc according to the cited passages of the present application because the heating rate of 5-600 C/s is from room temperature to the final heating temperature (e.g. a temperature higher than 750°C (col. 2, line 28, claim 12), for example 900°C), and not between 20-700°C/s as in the process described in the present application; and

(iv) the cited heating of 900°C for 5 min for a 1 mm thick sheet is not according to the limits of diagram "ABCD" at least because the referenced 5 minutes refers not to the dwell time of diagram "ABCD", but rather to the total time in the furnace.

This process is therefore not according to the process described in the present application.

First, applicant points out that although Laurent discloses that hot-shaping may be performed on the sheet of Laurent (col.1, lines 44-46, col. 2, lines 49-52, col. 3, lines 56-59), Laurent does not provide any detail regarding the hot-shaping process, and this process is not performed after the heating rates cited by the Examiner.

In particular, the heat treatment at 900 C for 5 mins in Laurent is not followed by hot stamping, as in the process described in the present application. Further, and independently, the process of Laurent lacks the **heating rate Vc** during the heat treatment, which applicant's specification explains at paragraph [0059] is critical to obtaining the layer disposition in combination to furnace temperature and dwell time:

> [0059] For sheets of total thicknesses greater or equal to 0.7 mm, and less than or equal to 1.5 mm, the preferred treatment conditions: (furnace temperature, total dwell time in the furnace) are illustrated in FIG. 7 by conditions lying within the limits of diagram "ABCD" For sheets of total thicknesses greater than 1. 5 mm, and less than or equal to 3 mm, the preferred treatment conditions: (furnace temperature, total dwell time in the furnace) are illustrated in FIG. 7 by diagram "EFGH". **The heating rate Vc is comprised between 4 and 12° C./s for producing a favorable alloyed layer disposition. In this**

> **regard, this "heating rate" reflects the temperature rise which is experienced by the pre-coated steel upon being located in the preheated furnace. Vc is defined as the mean heating rate between 20 and 700° C.** The inventors have discovered that the control of Vc in this precise range is a key factor, because it controls directly the nature and the morphology of the alloyed layers which are formed**. It is here underlined that the heating rate Vc is different from the mean heating rate, which is the heating rate between room temperature and furnace temperature**.

In alleging that Laurent includes the heating rate Vc, the Examiner cites to col 3, lines 26-29 as describing that "[a]fter the shaping of a casting the coating is subjected to an increase in temperature to an excess of 5° C/second, which may exceed 600 C/second." However, the referenced heating cannot be compared to Vc for a number of reasons.

First, the cited passage of Laurent at col 3, lines 26-29 is discussing a heating rate increase in "excess of 5° C/second, which may exceed 600 C/second" in reference to heating after a forming operation:

> The first alloy layer may crack when the sheet is shaped for the manufacture of castings.
>
> According to the invention, after the shaping of the casting, the coating is subjected to an increase in temperature at a speed in excess of 5° C./second, which may exceed 600° C./second. This rise in temperature makes possible a rapid remelting of the aluminum which fills in the cracks generated by the operation of shaping of the casting.

Thus, the heating rate of 5-600° C/s disclosed by Laurent expressly does not apply to the hot-shaping process described in the present application, and thus this heating rate in Laurent is not part of a process that is "identical or substantially identical to the process set forth in the specification of the instant application, which produces the claimed product," as alleged by the Examiner. (Office Action, p. 5).

Rather, Laurent discloses on column 3, lines 26-29, as well as in claims 4, 6, 8, 10 and 11 that the increase in temperature at a rate of at least 5°C/s, preferably at least 600°C/s is performed after the shaping.

And indeed, Laurent stresses that this heating rate is especially designed to allow remelting the aluminum coating which fills the cracks which were generated during the shaping operation, see col.3, l.26-31:

> According to the invention, after the shaping of the casting, the coating is subjected to an increase in temperature at a speed in excess of 5.degree. C./second, which may exceed 600.degree. C./second. This rise in temperature makes possible a rapid remelting of the aluminum which fills in the cracks generated by the operation of shaping of the casting

Therefore, the heating rate of 5 to 600°C/s disclosed by Laurent is not the heating rate before hot-stamping and is not transposable to the hot-shaping process.

There is no indication that this process forms to claimed four layer structure, or that the referenced 4 ° C /second has any relation to the Vc used in the completely different process for obtaining the claimed four layer structure is the heat treatment discussed at paragraph [0059] quoted above. Thus, the heating rate in Laurent is not part of a process that is "identical or substantially identical to the process set forth in the specification of the instant application, which produces the claimed product," as alleged by the Examiner. (Office Action, p. 5).

Second, and independently, even if Laurent had disclosed a heating rate prior to hot-stamping of at least 5°C/s, Laurent would still not disclose nor even suggest a process implementing a specific heating rate in the temperature range 20-700°C comprised between 4 and 12°C/s.

In particular, the heating rate mentioned in Laurent, after shaping, is the mean heating rate between room temperature and the final heating temperature. The present specification is express in stating that this is not Vc:

> **The heating rate Vc is comprised between 4 and 12° C./s for producing a favorable alloyed layer disposition. In this regard, this "heating rate" reflects the temperature rise which is experienced by the pre-coated steel upon being located in the preheated furnace. Vc is defined as the mean heating rate between 20 and 700° C.** The inventors have discovered that the control of Vc in this precise range is a key factor, because it controls directly the nature and the morphology of the alloyed layers which are formed. **It is here underlined that the heating rate Vc is different from the mean heating rate, which is the heating rate between room temperature and furnace temperature.**

It is therefore clear that the heating rate in Laurent does not correspond Vc, which is the mean heating rate between 20°C and 700°C. Accordingly, having a mean heating rate to the final heating temperature of at least 5°C/s cannot lead to any conclusion as to Vc. For this reason as well, the heating rate in Laurent is not part of a process that is "identical or substantially identical to the process set forth in the specification of the instant application, which produces the claimed product," as alleged by the Examiner. (Office Action, p. 5).

Finally, Laurent also fails to disclose the combination of heating temperature and time disclosed in the present application. Indeed, Laurent discloses, as an example, an austenitizing at 900°C for 5 min for a 1 mm thick sheet (col.4, line 8). First, Laurent does not disclose that this austenitizing is performed in a hot stamping process. Rather, the paragraph in which this austenitization is disclosed does not mention any hot stamping step, and rather seems to relate to the embodiment of Laurent wherein the heating is performed after stamping. This is confirmed by col.2, lines 27-28 which stress that the heating above 750°C, which corresponds to the heating above 750°C disclosed in the paragraph bridging columns 3 and 4, is performed on the "casting" therefore after shaping. In any event, Laurent does not disclose any dwell time, but merely discloses a holding time of 5 min. Therefore, Laurent does not disclose the temperature/time diagram of the process of the application, and for this reason as well, does not describe a process that is "identical or substantially identical to the process set forth in the specification of the instant application, which produces the claimed product," as alleged by the Examiner. (Office Action, p. 5).

Accordingly, in view of the fact that the process described in Laurent is not substantially the same as the process described in the present specification for the created the claimed four layer arrangement, and that there is no indication whatsoever that Laurent provides the claimed four layer arrangement, and in fact, discusses at most two layers (col. 3, lines 15-31), withdrawal of the Examiners rejections under 35 U.S.C. §§ 102 and 103 is respectfully requested.

Information Disclosure Statement

An information disclosure statement is submitted herewith.

It is respectfully submitted that the application is in condition for allowance and applicants respectfully request such action

If any fees are deemed to be due at this time, the Assistant Commissioner is authorized to charge payment of the same to Deposit Account No. 50-0552.

Respectfully submitted,
DAVIDSON, DAVIDSON & KAPPEL, LLC

By: /Cary Kappel/
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)

Docket Number (Optional): 20631.1028CON5

Application Number: 16413799 | Filed: 05-16-2019

For: Coated Steel Strips, Coated Stamped Products and Methods

Art Unit: 7637 | Examiner: SCHLEIS, DANIEL J

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	Micro Entity Fee	
☐ One month (37 CFR 1.17(a)(1))	$220	$110	$55	$
☐ Two months (37 CFR 1.17(a)(2))	$640	$320	$160	$
☑ Three months (37 CFR 1.17(a)(3))	$1,480	$740	$370	$ 1480
☐ Four months (37 CFR 1.17(a)(4))	$2,320	$1,160	$580	$
☐ Five months (37 CFR 1.17(a)(5))	$3,160	$1,580	$790	$

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☑ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 500552.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 38156.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/williamcgehris/ — Signature

January 8, 2021 — Date

William C. Gehris — Typed or printed name

212 736 1940 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☐ * Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	16413799	Filing Date	2019-05-16	Docket Number (if applicable)	20631.1028CON5	Art Unit	1784
First Named Inventor	Pascal DRILLET			Examiner Name	SCHLEIS, DANIEL J		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 500552

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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Signature of Registered U.S. Patent Practitioner			
Signature	/williamcgehris/	Date (YYYY-MM-DD)	2021-01-08
Name	William C. Gehris	Registration Number	38156

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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Electronic Patent Application Fee Transmittal

Application Number:	16413799
Filing Date:	16-May-2019
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Filer:	William C. Gehris/Simon Steiner
Attorney Docket Number:	20631.1028CON5

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 3 months with $0 paid	1253	1	1480	1480
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1360	1360
		Total in USD ($)		**2840**

Electronic Acknowledgement Receipt	
EFS ID:	41581760
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	William C. Gehris/Simon Steiner
Filer Authorized By:	William C. Gehris
Attorney Docket Number:	20631.1028CON5
Receipt Date:	08-JAN-2021
Filing Date:	16-MAY-2019
Time Stamp:	11:45:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$2840
RAM confirmation Number	E202118B45414923
Deposit Account	500552
Authorized User	Simon Steiner
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Foreign Reference	DE19749706wtranslation.pdf	435020 0acbd07871f1be79d37532de1e8fb46a401cdeac	no	10
Warnings:					
Information:					
2	Foreign Reference	EP919.PDF	590302 7956f475505af853e2d6c706b2c79ef10683b8da	no	9
Warnings:					
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3	Foreign Reference	CA2573226A1.pdf	3436169 2f414e0096772910ca709ef408ce81936f765885	no	23
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7	Foreign Reference	AU622697B2.pdf	4037030 69544783454ef9ea5c71e94e8225ca076e0df78e	no	25
Warnings:					
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8	Foreign Reference	JP037FF0001.PDF	926244 3f804da7a6170632e9878ac6fb89674ea33f3e2a	no	16
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9	Non Patent Literature	StahlundEisen120.pdf	1958384 f61797214b2fbb05113ea5fc644bd2a95947aae1	no	7
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10	Non Patent Literature	EmpiricalFormulaefortheCalculationofSomeTransformationTemperatures.pdf	1427555 97966ff782828aa64b59817987c34a4ff2cc0362	no	7
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11	Non Patent Literature	16413825.pdf	146432 64f3e7e5265481a26f8adc60baa3bff8dbadf361	no	1
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12	Non Patent Literature	LowCarbon_GMW14400.pdf	1858447 0cf16db800a67b628a1ca2c5f3d5d4f62cc7cf4f	no	8
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14	Non Patent Literature	Summons09701846.pdf	2977220 640452c08febc14075ee304f843167bd0ea908dc	no	21
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15	Non Patent Literature	BourougaReportibheating.pdf	1129784 81e7ff805aa75aba5745254893 0bb68dcb8c8264	no	11
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20	Foreign Reference	EP7004ff.pdf	6932 a8cf268dcc466ed594b43ef3e0d978f6b5d34088	no	2
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21	Information Disclosure Statement (IDS) Form (SB08)	IDSJan2021ff.PDF	1037121 2abbf215a93c7f7966ee13c52a864db0713745f5	no	6
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22	Non Patent Literature	PTABfinaldecisionIPR20190127 5.pdf	649900 c021dc44e5feec30e3d2d9c7a3b1a1a484e0ffe2	no	52
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23		206311028con5RCE-ResFOA_4Jan21.pdf	346640 1587488e49e996cf2f16780ad246ba1152837c7c	yes	14

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Response After Final Action	1	1
	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	14

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24	Non Patent Literature	PssatSelfStudy2006FF1.pdf	20380819 35820288b7edeba89842db362126055426b66ccb	no	35
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25	Non Patent Literature	PssatSelfStudy2006FF2.pdf	16003383 087410d1c012eef0384a8304c7ba1cb73cb71c3b	no	41
Warnings:					
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26	Extension of Time	extension-0001.PDF	172408 9029b0e39d1aaf98c95ee80b0c8a4d21163e40f2	no	2
Warnings:					

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27	Request for Continued Examination (RCE)	RCE.PDF	1349952 9abc7f77d7a11efe0d32eaec2bcc244529e1c900	no	3
Warnings:					
Information:					
28	Fee Worksheet (SB06)	fee-info.pdf	32624 b8d964124c2b1421d7117ad6663ca03a41764ed3	no	2
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Espacenet

Bibliographic data: DE19749706 (C1) — 1999-03-04

Producing hot rolled thin steel strip

Inventor(s): KIRCHER WERNER DIPL ING [DE] ± (KIRCHER, WERNER, DIPL.-ING., 40882 RATINGEN, DE)

Applicant(s): MANNESMANN AG [DE] ± (MANNESMANN AG, 40213 DUESSELDORF, DE)

Classification: - **international:** ***B21B1/24; B21B1/46;*** *B21B37/26;* (IPC1-7): B21B1/24; B21B1/46
- **cooperative:** **B21B1/24 (EP); B21B1/466 (EP);** B21B2201/02 (EP); B21B2201/04 (EP); B21B37/26 (EP)

Application number: DE19971049706 19971031

Priority number(s): DE19971049706 19971031

Abstract of DE19749706 (C1)

A first length of a strip to be coiled is rolled by a reduced number of roll stands to a thickness above 1 mm. By addition of further roll stands of the finish rolling section, a second and possibly further lengths of the coil are rolled at an increased speed to a strip with a final thickness less than 1 mm and down to as far as 0.8 mm. Subsequently, during a recoiling operation, the strip lengths with different thicknesses are separated.

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DESCRIPTION DE19749706C1

10 The invention relates to a method for the production of thin hot-rolled steel strip with a final thickness <1 mm from strip-shaped cast pre-material in successive steps, in which the solidified pre-material leaving the casting plant is divided into pre-strip lengths and heated to rolling temperature in a continuous furnace to convert it into a multi-stand Roll out the finishing train in a temperature-controlled manner and then wind it up into a coil.

15 Such a method is known from DE 195 40 978 A1.

16 Hot-rolled steel strip is produced, for example, in such a way that a cast semi-finished product, the weight of which is determined by the subsequent coil weight of the finished product, is reshaped to the desired geometric dimensions by one or more rolling processes. Usually these processes run one after the other and not simultaneously. It is only in the recent past that fully continuous or semicontinuous casting and rolling systems have increasingly been proposed. Although such systems were mentioned very early in the literature, it was always pointed out that these configurations can hardly be used in practice, since the parameters necessary for setting the desired strip properties could not be represented at that time.

24 In connection with single-strand systems, so-called semi-endless rolling has already been proposed, in which case long slabs are fed to a rolling mill via correspondingly long roller hearth furnaces. The slab is only divided into individual strips after the rolling mill. With this technology it is possible to roll several coils of very thin strips (0.8 mm) from relatively thick slabs at high speed (20 m / s). However, this high speed can only be achieved if the strip is clamped between the stands and the reel.

30 The introduction of the beginning of the strip into the last stands of the finishing line and the transport of the beginning of the strip over the outfeed roller table to the reel can only take place at a much lower speed, a maximum of 10 to 12 m / s. In particular, when very thin and slightly cooling strips are to be rolled at austenitic temperatures, there are problems with the high rolling speeds of the thin hot strips on the run-out roller table due to the continuous law and when the strips are threaded into the rolling stands.

36 The object of the present invention is to propose a method for the production of thin hot-rolled steel strip with which thin strips can be rolled austenitically at high speeds and then coiled into

coils and in which the threading of these strips into the rolling stands and into the reel also occurs small tape thickness is made possible.

40 To solve the problem, based on the features specified in the preamble of claim 1, the invention proposes that a first strip length range of the coil to be wound is rolled into a strip with a thickness> 1 mm on a reduced number of stands of the finishing train, that by connecting additional stands the finishing train, a second and possibly further strip length areas of the coil is reduced at increased rolling speed to a strip with a final thickness <1 mm to 0.8 mm, and that in a later wrapping process of the coil, the strip length areas of different thicknesses are separated.

47 The proposed method enables the rolling of 0.8 mm thick finished strip in the austenitic temperature range by grading the strip thickness. Because the first strip length area is rolled with a greater thickness and correspondingly lower speed on a reduced number of roll stands, there are no problems with threading and winding the head area of this strip on the reel system. Threading the relatively thick strip into the last finishing stands and transporting it over the outfeed roller table is also not problematic, because the thicker strip is still sufficiently rigid. Only after a preselected strip length range has been reeled in is the strip reduced further by adding additional stands to the finishing train, which also increases the rolling speed. The now further reduced, preferably rolled out to 0.8 mm thick strip is coiled on the same reel as the previous strip length; a separation of the differently thick band length areas is only carried out during a later wrapping process of the coil.

58 According to the invention, it is thus easily possible to roll strips of different thickness graded strips from one and the same thin slab, which are later separated depending on the customer's request and / or the rolling program.

61 Preferably, in one embodiment of the invention, the first strip length range of the coil to be wound is rolled to a thickness of approx.1.5 mm in a maximum of six stands of the finishing train, the rest of the coil is graded after connecting additional stands or completely in any smaller thickness with the This thickness and the temperature of the rolled strip adjusted rolling speed rolled to the final thickness.

66 In order to specifically solve the problem of starting the tape, it is proposed in a further embodiment of the invention that the first tape length range of the coil to be wound is rolled at low speed and in such a length that the head of the tape is inserted into the reel and Strip tension is built up between the reel and the finishing train, that after increasing the speed and reducing the strip thickness, the remaining coil length is rolled, and that the thickened head piece is cut off when the strip is wrapped around. In this way, a lost starting piece is created that can be cut off on a separate rewinding system, but the method enables a very thin strip to be rolled out at very high speeds after the head of the strip has run into the reel.

74 According to a further feature of the invention, complete recrystallization of the material is achieved by a correspondingly large distance between the first and second finishing stands.

76 The process is suitable for two-stage rolling in the finishing train, with austenitic rolling in the first finishing stand and exclusively ferritic rolling in the further finishing stands, and targeted cooling of the strip between the first and second rolling stands.

79 If a long roller hearth furnace (up to 100 m) is used, high specific coil weights can be achieved.

With the winding of the tape according to the invention, the output losses due to the severing of the head piece are avoided if a partial length of a thicker tape that can be sold is wound up at the beginning of the coil. Large coil weights reduce the frequency with which the beginning of the strip is cropped, so that cropping losses can be kept low even if a thicker length of strip is only produced for winding the strip onto the reel.

85 An embodiment of a casting and rolling plant according to the invention is shown in the drawing figures and is explained below:

87 1 shows a single-strand casting installation on which the method according to the invention can be carried out,

89 With the same system configuration, FIG. 2 shows a two-strand casting system with transverse slab transport.

91 In Fig. 1, 1 denotes the ladle turret, which supplies the casting machine numbered with 2 of a continuous sheet caster with melt. A length of approx. 100 m is cut from the pre-strip cast in the mold by means of the pendulum shears 3 after it has entered the roller hearth furnace 4. The pre-strip is then introduced into the first finishing stand 5 and rolled there austenitically before it is pierced into the other stands of the finishing train 7. The rolled strip leaves the finishing train 7 and runs over the run-out roller table with strip cooling to the reel 9, where it is wound into a coil. As proposed in the invention, a clear distance is provided between the first finishing stand 5 and the first stand of the finishing train 7, which makes a complete recrystallization of the material between these two stands possible. In addition, by installing a strip cooling system between these stands, ferritic rolling is also possible, with an austenitic structure then still being present in the first finishing stand 5 and a ferritic structure in the finishing stands of the finishing train 7.

102 The stands of the finishing train 7 can be switched on and off individually so that work can be carried out according to the proposal of the invention.

104 The system in Fig. 2 differs from that in Fig. 1 only in that the casting machine 2, the pendulum shear 3 and the furnace 4 are present twice, the only finishing line being served by lateral displacement of slabs cut to length via a slab transverse transport can.

107 The inventive method can be carried out on the system shown, for example, as follows: The pre-strip leaving the roller hearth furnace with a length of approx. 100 m becomes a strip with a thickness of in the first finishing stand 5 and at the same time in the following five stands of the finishing line 7 rolled out approx. 1.5 mm. As soon as the strip rolled in this way has reached the reel 9 via the run-out roller table 8 and has been wound up there, the strip is further reduced to 0.8 mm in thickness, for example, by connecting the last stand of the finishing train 7, thereby increasing the run-out speed of the strip The outfeed roller table is unproblematic because the strip is clamped between the finishing train 7 and the reel 9 and the very thin strip can therefore be rolled out at extremely high speeds. When the cooling device 6 is used between the first finishing stand and the finishing train 7, ferritic rolling can be carried out on the thin strip at high speeds and thus a two-stage rolling process can be carried out.

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CLAIMS DE19749706C1

1.

13 Process for the production of thin hot-rolled steel strip with a final thickness <1 mm from strip-shaped cast raw material in successive steps, in which the solidified raw material leaving the casting plant is divided into pre-strip lengths and heated to rolling temperature in a continuous furnace in order to roll it out in a temperature-controlled multi-stand finishing train and then wind it up to form a coil, characterized in that a first strip length range of the coil to be wound is rolled into a strip with a thickness> 1 mm on a reduced number of stands of the finishing train, that by connecting further stands of the finishing train, a second and possibly further strip length areas of the coil is reduced with increased rolling speed to a strip with a final thickness <1 mm to 0.8 mm and that in a later wrapping process of the coil, the strip length areas of different thicknesses are separated .

2.

26 Process for the production of thin hot-rolled steel strip according to claim 1, characterized in that the first strip length range of the coil to be wound is rolled to a thickness of approx. 1.5 mm in a maximum of six stands of the finishing train and the rest of the coil is graded or graded after additional stands are connected is completely rolled in any thickness with the respective thickness and the temperature of the rolled strip adjusted rolling speed to the final thickness.

3.

34 A method for producing thin hot-rolled steel strip according to claim 1 or 2, characterized in that the first strip length range of the coil to be wound is rolled at low speed and in such a length that the head of the strip is inserted into the reel and the strip is pulled between the reel and The finishing mill is constructed so that after increasing the speed and reducing the strip thickness,

the remaining coil length is rolled and that the thickened head piece is cut off when the strip is wrapped around.

4.

43 Process for the production of thin, hot-rolled steel strip according to one of Claims 1 to 3, characterized in that a complete recrystallization of the strip takes place with a corresponding distance between the first and the second roll stand.

5.

49 Process for the production of thin hot-rolled steel strip according to one of Claims 1 to 4, characterized in that rolling is carried out in two stages in the finishing train, with austenitic rolling in the first finishing stand and exclusively ferritic rolling in the further finishing stands and a targeted one between the first and second rolling stands The belt is cooled down.

(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENT- UND MARKENAMT

(12) **Patentschrift**

(10) **DE 197 49 706 C 1**

(51) Int. Cl.[6]: **B 21 B 1/24**
B 21 B 1/46

(21) Aktenzeichen: 197 49 706.3-14
(22) Anmeldetag: 31. 10. 97
(43) Offenlegungstag: –
(45) Veröffentlichungstag der Patenterteilung: 4. 3. 99

Innerhalb von 3 Monaten nach Veröffentlichung der Erteilung kann Einspruch erhoben werden

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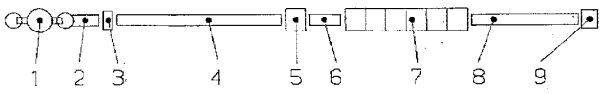
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(56) Für die Beurteilung der Patentfähigkeit in Betracht gezogene Druckschriften:
DE 1 95 40 978 A1

(54) Verfahren zur Herstellung von dünnem warmgewalztem Stahlband

(57) Die Erfindung betrifft ein Verfahren zur Herstellung von dünnem warmgewalzten Stahlband mit einer Enddicke < 1 mm aus bandförmig gegossenem Vormaterial in aufeinander folgenden Schritten, bei dem das die Gießanlage verlassende erstarrte Vormaterial in Vorbandlängen aufgeteilt und in einem Durchlaufofen auf Walztemperatur erwärmt wird, um es in einer mehrgerüstigen Fertigstraße temperaturgesteuert auszuwalzen und im Anschluß daran zu einem Coil aufzuwickeln. Dabei wird ein erster Bandlängenbereich des aufzuwickelnden Coil auf einer reduzierten Anzahl von Gerüste der Fertigstraße zu einem Band mit einer Dicke > 1 mm gewalzt, dann wird durch Zuschalten weiterer Gerüste der Fertigstraße ein zweiter und gegebenenfalls weitere Bandlängenbereiche des Coils mit erhöhter Walzgeschwindigkeit zu einem Band mit einer Dicke < 1 mm bis 0,8 mm reduziert und bei einem später erfolgenden Umwickelvorgang des Coils wird eine Auftrennung der Bandlängenbereiche unterschiedlicher Dicke vorgenommen.



DE 197 49 706 C 1

DE 197 49 706 C 1

Beschreibung

Die Erfindung betrifft ein Verfahren zur Herstellung von dünnem warmgewalzten Stahlband mit einer Enddicke < 1 mm aus bandförmig gegossenem Vormaterial in aufeinanderfolgenden Schritten, bei dem das die Gießanlage verlassende erstarrte Vormaterial in Vorbandlängen aufgeteilt und in einem Durchlaufofen auf Walztemperatur erwärmt wird, um es in einer mehrgerüstigen Fertigstraße temperaturgesteuert auszuwalzen und im Anschluß daran zu einem Coil aufzuwickeln.

Ein derartiges Verfahren ist aus der DE 195 40 978 A1 bekannt.

Die Herstellung von warmgewalztem Stahlband erfolgt beispielsweise derart, daß ein gegossenes Halbzeug, dessen Gewicht durch das spätere Bundgewicht des Fertigproduktes bestimmt ist, durch einen oder mehrere Walzprozesse auf die gewünschten geometrischen Abmessungen umgeformt wird. Üblicherweise laufen diese Prozesse hintereinander und nicht simultan ab. Erst in der jüngeren Vergangenheit werden vermehrt vollkontinuierlich oder semikontinuierlich arbeitende Gieß-Walzanlagen vorgeschlagen. Zwar sind derartige Anlagen in der Literatur schon sehr früh erwähnt worden, es wurde jedoch stets darauf verwiesen, daß diese Konfigurationen praktisch kaum anwendbar sind, da die zur Einstellung der gewünschten Bandeigenschaften notwendigen Parameter zur damaligen Zeit nicht dargestellt werden konnten.

Im Zusammenhang mit Einstranganlagen ist bereits eine sogenannte Semi-Endloswalzung vorgeschlagen worden, dabei werden lange Brammen über entsprechend lange Rollenherdöfen einem Walzwerk zugeführt. Die Unterteilung der Bramme in einzelne Bänder erfolgt erst hinter dem Walzwerk. Bei dieser Technik besteht die Möglichkeit, aus relativ dicken Brammen mehrere Coils sehr dünner Bänder (0,8 mm) mit hoher Geschwindigkeit (20 m/s) zu walzen. Diese hohe Geschwindigkeit kann aber nur dann gefahren werden, wenn das Band zwischen Gerüsten und Haspel eingespannt ist.

Das Einführen des Bandanfanges in die letzten Gerüste der Fertigstraße sowie der Transport des Bandanfanges über den Auslaufrollgang zum Haspel kann nur mit wesentlich geringerer Geschwindigkeit, maximal 10 bis 12 m/s erfolgen. Insbesondere dann, wenn sehr dünne und leicht abkühlende Bänder bei austenitischen Temperaturen gewalzt werden sollen, gibt es Probleme bei den aufgrund des Konti-Gesetzes hohen Walzgeschwindigkeiten der dünnen Warmbänder auf dem Auslaufrollgang sowie beim Einfädeln der Bänder in die Walzgerüste.

Aufgabe der vorliegenden Erfindung ist es, ein Verfahren zur Herstellung von dünnem warmgewalzten Stahlband vorzuschlagen, mit dem dünne Bänder mit hohen Geschwindigkeiten austenitisch gewalzt und im Anschluß zu Bunden aufgecoilt werden können und bei dem das Einfädeln dieser Bänder in die Walzgerüste und in den Haspel auch bei geringer Banddicke ermöglicht wird.

Zur Lösung der Aufgabe wird ausgehend von den im Oberbegriff des Anspruchs 1 angegebenen Merkmalen erfindungsgemäß vorgeschlagen, daß ein erster Bandlängenbereich des aufzuwickelnden Coils auf einer reduzierten Anzahl von Gerüsten der Fertigstraße zu einem Band mit einer Dicke > 1 mm gewalzt wird, daß durch Zuschalten weiterer Gerüste der Fertigstraße ein zweiter und gegebenenfalls weitere Bandlängenbereiche des Coils mit erhöhter Walzgeschwindigkeit zu einem Band mit einer Enddicke < 1 mm bis 0,8 mm reduziert wird, und daß bei einem später erfolgenden Umwickelvorgang des Coils eine Auftrennung der Bandlängenbereiche unterschiedlicher Dicke vorgenommen wird.

Das vorgeschlagene Verfahren ermöglicht das Walzen von 0,8 mm dickem Fertigband in austenitischem Temperaturbereich durch Abstufung der Banddicke. Weil der erste Bandlängenbereich mit einer größeren Dicke und entsprechend geringerer Geschwindigkeit auf einer reduzierten Anzahl von Walzgerüsten angewalzt wird, bestehen keine Probleme beim Einfädeln und Anwickeln des Kopfbereiches dieses Bandes auf der Haspelanlage. Das Einfädeln des relativ dicken Bandes in die letzten Fertiggerüste und der Transport über den Auslaufrollgang ist ebenfalls nicht problematisch, weil das dickere Band noch genügende Steifigkeit aufweist. Erst nach Anhaspeln eines vorgewählten Bandlängenbereichs wird durch Zuschalten zusätzlicher Gerüste der Fertigstraße eine weitere Reduzierung des Bandes vorgenommen, wodurch auch die Walzgeschwindigkeit erhöht wird. Das nunmehr weiter reduzierte, vorzugsweise bis auf 0,8 mm dicke ausgewalzte Band wird auf dem gleichen Haspel wie die vorherige Bandlänge aufgecoilt; eine Trennung der unterschiedlich dicken Bandlängenbereiche wird erst bei einem späteren Umwickelvorgang des Coils vorgenommen. Nach der Erfindung ist es somit leicht möglich, auf ein und derselben Anlage aus ein und derselben Dünnbramme unterschiedlich in ihrer Dicke abgestufte Bänder zu walzen, die später je nach Kundenwunsch und/oder Walzprogramm getrennt werden.

Vorzugsweise wird in einer Ausgestaltung der Erfindung der erste Bandlängenbereich des aufzuwickelnden Coils in maximal sechs Gerüsten der Fertigstraße auf eine dicke von ca. 1,5 mm gewalzt, der Rest des Coils wird nach Zuschalten weiterer Gerüste abgestuft oder komplett in jeder beliebigen geringeren Dicke mit der dieser Dicke und der Temperatur des gewalzten Bandes angepaßter Walzgeschwindigkeit auf die Enddicke gewalzt.

Um speziell das Problem des Anwickelns des Bandes zu lösen, ist in einer weiteren Ausgestaltung der Erfindung vorgeschlagen, daß der ersten Bandlängenbereich des aufzuwickelnden Coils bei niedriger Geschwindigkeit so lange und in einer solchen Länge gewalzt wird, bis der Kopf des Bandes in den Haspel eingeführt und Bandzug zwischen Haspel und Fertigstraße aufgebaut ist, daß nach Erhöhung der Geschwindigkeit und Reduzierung der Banddicke die restliche Coillänge gewalzt wird, und daß bei einem Umwickelvorgang des Bandes das verdickte Kopfstück abgetrennt wird. Auf diese Weise entsteht zwar ein verlorenes Anfangsstück, das auf einer separaten Umwickelanlage abgetrennt werden kann, doch ermöglicht das Verfahren nachdem der Kopf des Bandes im Haspel eingelaufen ist das Auswalzen eines sehr dünnen Bandes mit sehr hohen Geschwindigkeiten,.

Durch einen entsprechend großen Abstand zwischen dem ersten und dem zweiten Fertiggerüst wird nach einem weiteren Merkmal der Erfindung eine vollständige Rekristallisation des Materials erreicht.

Das Verfahren eignet sich zur zweistufigen Walzung in der Fertigstraße, wobei im ersten Fertiggerüst austenitisch und in den weiteren Fertiggerüsten ausschließlich ferritisch gewalzt wird und zwischen dem ersten und zweiten Walzgerüst eine gezielte Abkühlung des Bandes vorgenommen wird.

Wenn ein langer Rollenherdofen (bis 100 m) eingesetzt wird, können hohe spezifische Coilgewichte erreicht werden. Mit dem erfindungsgemäßen Anwickeln des Bandes werden die Ausbringungsverluste durch Abtrennen des Kopfstückes vermieden, wenn eine Teillänge eines verkaufsfähigen dickeren Bandes am Anfang des Coils aufgewickelt wird. Große Coilgewichte reduzieren die Häufigkeit des Schopfens des Bandanfanges, so daß selbst dann, wenn

eine dickere Bandlänge nur zum Anwickeln des Bandes auf dem Haspel hergestellt wird, die Schopfverluste gering zu halten sind.

Ein Ausführungsbeispiel einer erfindungsgemäßen Gieß- und Walzanlage ist in Zeichnungsfiguren dargestellt und wird nachfolgend erläutert:

Fig. 1 zeigt eine einsträngige Gießanlage, auf der das erfindungsgemäße Verfahren durchgeführt werden kann,

Fig. 2 zeigt bei gleicher Anlagenkonfiguration eine zweisträngige Gießanlage mit Brammenquertransport.

In **Fig.** 1 ist mit **1** der Pfannendrehturm bezeichnet, der die mit 2 bezifferte Gießmaschine einer Bogenstranggießanlage mit Schmelze versorgt. Von dem in der Kokille gegossenen Vorband wird eine Länge von ca. 100 m mittels der Pendelschere **3** abgetrennt, nachdem sie in den Rollenherdhofen **4** eingelaufen ist. Das Vorband wird sodann in das erste Fertiggerüst **5** eingeführt und dort austenitisch gewalzt, bevor es in die weiteren Gerüste der Fertigstraße **7** angestochen wird. Das gewalzte Band verläßt die Fertigstraße **7** und läuft über den Auslaufrollgang mit Bandkühlung zum Haspel **9**, wo es zu einem Coil aufgewickelt wird. Wie in der Erfindung vorgeschlagen, ist zwischen dem ersten Fertiggerüst **5** und dem ersten Gerüst der Fertigstraße **7** ein deutlicher Abstand vorgesehen, der eine vollständige Rekristallisierung des Materials zwischen diesen beiden Gerüsten möglich macht. Zusätzlich ist durch den Einbau einer Bandkühlung zwischen diesen Gerüsten auch ferritisches Walzen möglich, wobei dann im ersten Fertiggerüst **5** noch austenitisches und in den Fertiggerüsten der Fertigstraße **7** ferritisches Gefüge vorliegt. Die Gerüste der Fertigstraße **7** sind einzeln zu- und abschaltbar, so daß nach dem Vorschlag der Erfindung gearbeitet werden kann.

Die Anlage in **Fig.** 2 unterscheidet sich von der in **Fig.** 1 nur dadurch, daß die Gießmaschine **2**, die Pendelschere **3** und der Ofen **4** doppelt vorhanden sind, wobei durch seitliches Verschieben von in Länge geschnittenen Brammen über einen Brammenquertransport die einzige Fertigstraße bedient werden kann.

Das erfindungsgemäße Verfahren läßt sich auf der dargestellten Anlage beispielsweise wie folgt durchführen: Das den Rollenherdofen verlassende Vorband mit einer Länge von ca. 100 m wird in dem ersten Fertiggerüst **5** und gleichzeitig in den nachfolgenden fünf Gerüsten der Fertigstraße **7** zu einem Band mit einer Dicke von ca. 1,5 mm ausgewalzt. Sobald das so gewalzte Band über den Auslaufrollgang **8** den Haspel **9** erreicht und dort angewickelt worden ist, wird durch Zuschalten des letzten Gerüstes der Fertigstraße **7** eine weitere Reduzierung des Bandes auf beispielsweise 0,8 mm Dicke durchgeführt, dabei erhöht sich die Auslaufgeschwindigkeit des Bandes auf dem Auslaufrollgang unproblematisch, weil das Bandes zwischen der Fertigstraße **7** und dem Haspel **9** eingespannt ist und somit das sehr dünne Band mit extrem hohen Geschwindigkeiten ausgewalzt werden kann. Bei Einsatz der Kühlvorrichtung **6** zwischen dem ersten Fertigwalzgerüst und der Fertigstraße **7** läßt sich bei dem Dünnband ein ferritisches Walzen mit hohen Geschwindigkeiten durchführen und somit ein zweistufiger Walzprozeß ausführen.

Patentansprüche

1. Verfahren zur Herstellung von dünnem warmgewalzten Stahlband mit einer Enddicke < 1 mm aus bandförmig gegossenem Vormaterial in aufeinander folgenden Schritten, bei dem das die Gießanlage verlassende erstarrte Vormaterial in Vorbandlängen aufgeteilt und in einem Durchlaufofen auf Walztemperatur erwärmt wird, um es in einer mehrgerüstigen Fertigstraße temperaturgesteuert auszuwalzen und im Anschluß daran zu einem Coil aufzuwickeln, **dadurch gekennzeichnet**, daß ein erster Bandlängenbereich des aufzuwickelnden Coils auf einer reduzierten Anzahl von Gerüste der Fertigstraße zu einem Band mit einer Dicke > 1 mm gewalzt wird, daß durch Zuschalten weiterer Gerüste der Fertigstraße ein zweiter und gegebenenfalls weitere Bandlängenbereiche des Coils mit erhöhter Walzgeschwindigkeit zu einem Band mit einer Enddicke < 1 mm bis 0,8 mm reduziert wird und daß bei einem später erfolgenden Umwickelvorgang des Coils eine Auftrennung der Bandlängenbereiche unterschiedlicher Dicke vorgenommen wird.

2. Verfahren zur Herstellung von dünnem warmgewalzten Stahlband nach Anspruch 1, dadurch gekennzeichnet, daß der erste Bandlängenbereich des aufzuwickelnden Coils in maximal sechs Gerüsten der Fertigstraße auf eine Dicke von ca. 1,5 mm gewalzt wird und der Rest des Coils nach Zuschalten weiterer Gerüste abgestuft oder komplett in jeder beliebigen Dicke mit der jeweiligen Dicke und der Temperatur des gewalzten Bandes angepaßter Walzgeschwindigkeit auf die Enddicke gewalzt wird.

3. Verfahren zur Herstellung von dünnem warmgewalzten Stahlband nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der erste Bandlängenbereich des aufzuwickelnden Coils bei niedriger Geschwindigkeit so lange und in einer solchen Länge gewalzt wird, bis der Kopf des Bandes in den Haspel eingeführt und Bandzug zwischen Haspel und Fertigstraße aufgebaut ist, daß nach Erhöhung der Geschwindigkeit und Reduzierung der Banddicke die restliche Coillänge gewalzt wird und daß bei einem Umwickelvorgang des Bandes das verdickte Kopfstück abgetrennt wird.

4. Verfahren zur Herstellung von dünnem warmgewalzten Stahlband nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß bei entsprechendem Abstand zwischen dem ersten und dem zweiten Walzgerüst eine vollständige Rekristallisierung des Bandes erfolgt.

5. Verfahren zur Herstellung von dünnem warmgewalzten Stahlband nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß in der Fertigstraße zweistufig gewalzt wird, wobei im ersten Fertiggerüst austenitisch und in den weiteren Fertiggerüsten ausschließlich ferritisch gewalzt wird und zwischen dem ersten und dem zweiten Walzgerüst eine gezielte Abkühlung des Bandes vorgenommen wird.

Hierzu 1 Seite(n) Zeichnungen

Nummer: **DE 197 49 706 C1**
Int. Cl.[6]: **B 21 B 1/24**
Veröffentlichungstag: 4. März 1999

FIG. 1

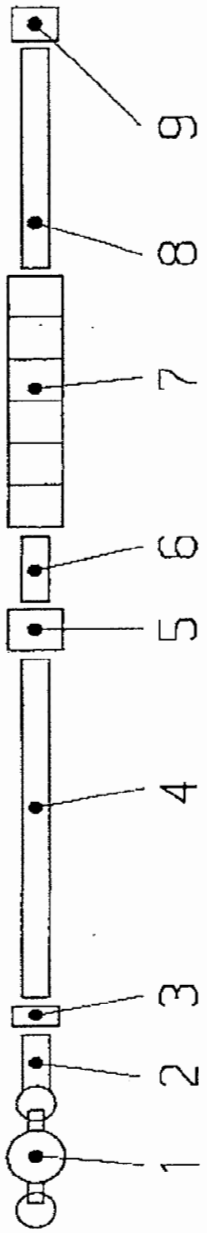
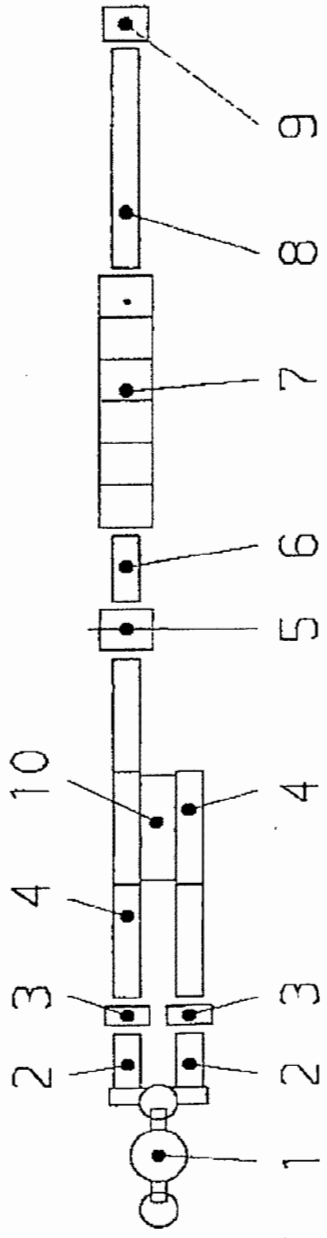


FIG. 2



802 169/265

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 724 919 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
29.08.2001 Bulletin 2001/35

(51) Int Cl.[7]: **B21B 1/36**, B21B 45/06, B21C 47/24

(21) Application number: **96105424.4**

(22) Date of filing: **25.06.1993**

(54) Method for descaling and cold rolling metal strip

Verfahren zum Entzundern und Kaltwalzen von Metallband

Procédé pour le décalaminage et le laminage à froid de bandes métalliques

(84) Designated Contracting States:
DE GB

(30) Priority: **02.07.1992 JP 17548292**

(43) Date of publication of application:
07.08.1996 Bulletin 1996/32

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
93304976.9 / 0 577 345

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Printed by Jouve, 75001 PARIS (FR)

EP 0 724 919 B1

Description

[0001] This invention relates to a method and apparatus for the descaling and subsequent cold-rolling of metal strip, particularly but not exclusively steel sheet in the form of strip.

[0002] In the making of steel strip, there is a descaling step for removing rust (or scale) from the surface of a hot coil and a cold rolling step for reducing the strip to a predetermined thickness. The descaling step has had its efficiency improved by combining a chemical method (e.g. pickling) and a mechanical method. On the other hand, the cold rolling step is exemplified by either a reversing mill for rolling multiple passes reversibly, or by a tandem mill system for rolling in one pass in one direction through a plurality of rolling machines.

[0003] Many existing general plants perform the descaling step and the cold rolling step discontinuously. Since the descaling step employs a continuous line passing hot coils sequentially, an expensive welder is arranged at the entrance side of the descaler. In order to prevent interruption of the line during the welding, moreover, a long accumulator (looper) and a long pickling tank are provided. Since, moreover, the pickled coil has to be fed to the cold rolling mill line, the pickled coil is divided again at the exit of the pickling equipment so that it may be sized suitably for the transfer and storage in the factory, until it is taken up for cold rolling. Between the pickling equipment and the cold rolling mill line, there may be a wide coil yard for absorbing the difference between the production schemes of the two equipments. This yard is equipped with facilities for transferring, storing and managing the coils.

[0004] An alternative approach has already been practiced using continuous pickling and cold rolling equipment, in which the pickling equipment and the tandem mill are directly connected.

[0005] With the aim of obtaining benefit from use of a single multi-pass reversing roll mill, it has been proposed to employ large size coils, composed of a strip having a length several times, e.g. five times, that of the normal transportable coil. JP-B-57-39844 (US-A-4 123 011) shows a welder for joining short coils, after which the strip is wound into a large size coil. The welding line stops when the large size coil is completed, and this coil is then unwound through a Sendzimir mill. Multi-pass rolling through this mill takes place, rewinding at each end being onto further drums. The final rolling pass leads to rewinding into the small coils, with shears subdividing the strip. The function of the large coil is to achieve a high yield and high production capacity of the reversing mill, by minimizing the periods of acceleration and deceleration of the mill and of threading the strip. Yield is also increased. However, this document does not concern itself with the combination of a descaler and a mill.

[0006] Another use of such large size coils, for a different purpose, is shown by JP-B-59-52710 (JP-A-54-58664). This discloses a line having a welder, an accumulator, a descaler, shears and large size coils on a pair of interchangeable drums. A single pass tandem mill is fed from the large coils alternatingly and delivers rolled strip to shears and drums for small coils. The size of the large coil is said to be five to ten times the standard small size. The reason given for the use of the large coil is to allow continued operation of the descaler even when the mill is stopped. There may be many reasons for stoppage of the mill such as roll changing. Thus, the formation of the large coils is apparently necessary only in order to deal with such a stoppage of the mill. Since there are no particular restrictions on the capacity of the descaler, the objective in this apparatus must be to maximize the capacity of the expensive tandem rolling mill. This means that the capacity of the descaler must be equal to the desired capacity of the rolling mill, and consequently the throughput speed of the descaler must be at least equal to that of the rolling mill. A large and expensive descaler is required. The capacity of a tandem mill is in principle much greater than that of a reversing mill.

[0007] A clear distinction in the prior art exists between the concept of using a tandem mill, where the aim is to achieve maximum use of the very high capacity of the expensive tandem mill, and on the other hand the concept of use of a reversing multi-pass cold rolling mill, whose capacity is much less than that of the tandem mill. The aim of this second concept is to arrange the plant to achieve, in an economical way, a maximum throughput through the reversing mill, together with if possible, high quality of product.

[0008] Figs. 3 and 4 illustrate this distinction by presenting data of the descaling equipment (i.e. the pickling equipment) and the cold rolling equipment prevailing at present in Japan.

[0009] Fig. 3 plots the correlation between the nominal production capacity (per month) of the pickling equipment and the line length of each line. These correlations naturally disperse depending upon the layout of the individual equipments and the product mixing ratios.

[0010] However, as a whole it can be seen that:

(1) a large line length is required for a high production capacity; and
(2) the line will not always become short in proportion to the capacity in an equipment having a low production capacity.

[0011] On the other hand, Fig. 4 presents the distribution of the nominal production capacity (per month) and the number of such cold rolling plants existing in Japan. For example, numeral 1 indicates a so-called "single-stand reversing mill", and numeral 5 indicates a so-called "five-stand tandem mill". For cold rolling plants, as a whole it can concluded that:

(1) a higher production capacity can be achieved by a larger number of stands of the rolling mill; and
(2) a small production capacity can be realized by a single stand mill.

[0012] Thus, the situation for a descaling and cold rolling apparatus at present is as follows:

(1) a production capacity higher than 100,000 tons per month can be achieved by a large-scale pickling equipment having a line length of 200 to 300 m and a large-scale tandem mill having 5 to 6 stands; and
(2) a production capacity lower than 30,000 tons per month can be achieved by a pickling equipment having a line of length 100 m, which is rather long in relation to the production capacity and a single stand reversing mill of the smallest scale.

[0013] However, for a line having a medium production capacity of about 50,000 tons per month between the foregoing capacities (1) and (2):

(3) the pickling equipment requires a scale as large as that of 100,000 tons per month; and
(4) the cold rolling equipment has to adopt a multi-stand tandem mill having a scale as large as 100,000 tons per month because it is required to effect a predetermined thickness reduction in one pass, or a plurality of single stand reversing mills having a low production capacity have to be provided.

[0014] Thus, the equipment is so redundant relative to the desired production capacity that high and uneconomical investment is required.

[0015] On the other hand, the needs for the production and supply of steel sheet materials are not domestic but worldwide, and instead of the large-scale mills which have existed, medium-scale steel sheet production facilities are desired near the markets for the product.

[0016] In order to satisfy the above-specified needs, facilities are required for realizing a highly economical descaling and cold rolling method which is compact for the production scale but requires no excessive investment, and apparatus for realizing that method. However, these are hard to realize with the methods of the prior art.

[0017] With the existing plants of the prior art, the following problems are present.

(1) The continuous pickling line connects hot coils consecutively, so that an expensive welder is arranged at the entrance of the pickling equipment. In order to avoid interruption of the line during the welding, a long accumulator is arranged together with a long pickling tank, so that the line length is seriously enlarged as a whole.
(2) The pickled coils to be fed to the cold rolling equipment at a subsequent step are made by dividing the strip again so that their size may be suited for transfer and storage in the factory.
(3) It is also necessary to interpose between the pickling equipment and the cold rolling equipment a wide coil yard for absorbing the difference between the production schemes of the two equipments and plant facilities for transferring, storing and managing the coil in that region.

[0018] On the other hand, the above-specified items (2) and (3) are rationalized in the continuous pickling and cold rolling apparatus proposed in the prior art in which the pickling equipment and the tandem mill are directly connected. However, this apparatus naturally requires large-scale devices such as a large accumulator between the pickling equipment and the tandem mill so that it is effective for the very high production capacity of the tandem mill, but is of excessive size and cost for a plant having a medium production capacity.

[0019] Next, as to the cold rolling equipment, the tandem mills described above are suited for the large-scale plant having a large production capacity but not for a plant having a medium production ability.

[0020] On the other hand, the reversing mill has a scale suitable for the case in which a small production capacity is to be attained, but it has been thought that the number of such mills has to be increased for a medium-scale production capacity. A proposal is made in JP-A-57-64403 to combine a descaler and a reversing mill in a continuous line, but this results in a large, expensive and impractical plant, whose capacity is actually limited. JP-A-57-64403 describes a plant for continuous descaling and multi-pass reversing-mill rolling. A welder joins the strip, before entry to a descaler, from which the strip passes directly to the mill region. In the mill region, there are large strip accumulators whose intention is to allow the reversing mill to operate on the strip, portion by portion with multi-pass reverse rolling, while not interrupting the progress of the descaler. The strip is not sub-divided or coiled in the mill region. Fig. 3 of this document shows that the capacity becomes saturated, or nearly so, with a cycle length (i.e. the unit length of strip which is subjected to three-pass reversing rolling at one time) of 1,000 to 1,500 meters. Such a length is too short to obtain large benefits in the rolling operation. The apparatus also is impractical. Not only are the large accumulators expensive and bulky, but also it appears that their size limits the capacity of the machine. A large increase of accumulator capacity would result only in a small increase of productivity of the mill.

[0021] As mentioned above, JP-B-57-39844 proposes an improvement in the use of a reversing mill, but does not disclose a combined descaling and rolling line. Merely to provide a descaling line in front of the mill of JP-B-57-39844 would lead to an expensive plant, employing two welders and requiring space for storage of the coils, after descaling. The descaling apparatus, if

placed after the welder shown in JP-B-57-39844, would be stopped when the welder stops, which is highly unsatisfactory for a descaler which should operate continuously to avoid over-pickling of parts of the strip. This stop time of the descaler would mean that the descaler has to be larger in nominal capacity than is required by the rolling mill capacity. Another disadvantage of the process of JP-B-57-39844 is the need to stop welding and winding a large coil on an entry drum during the first pass rolling, which reduces capacity. Yet another disadvantage is the need to stop the mill during its final pass at each time of coil division, which also reduces capacity.

[0022] The object of the present invention is to provide a solution to at least some of the problems identified above and to provide a descaling and cold rolling method for metal strip, which can be compact and have efficient and economical production capacity at a suitable scale.

[0023] The invention is based on the realization that, in a single apparatus line, the descaler and the reversing cold rolling mill can be operated simultaneously and at respective different strip entry speeds, by the interposition between them of means for forming large coils. This has the advantages, not appreciated in the prior art, that the descaler operating at a relatively low speed can be relatively short and therefore inexpensive, while the reversing mill is operated at appropriate speeds to give it a maximum production capacity. In this way, production capacities of both descaler and rolling mill can be maximized, without excessive investment cost, because each does not interfere in the operation of the other.

[0024] The production capacity of the relatively short descaler is matched to that of the reversing mill. Idle periods of the descaler and the mill in normal operation can be minimized or are eliminated. The descaler can operate continuously, with its output being divided to form the large coils, so avoiding over-pickling and other problems due to an idle period of the descaler, and avoiding the need for repeated threading of the descaler. Only one strip joining device such as a welder is required. The apparatus can operate almost as a fully continuous line, with interruption of continuity arising only on changing of the large coils fed into the reversing mill. The benefits of rolling long lengths in the reversing mill (i.e. reduction of number of reversals, reduction of threading time, improvement of yield due to reduction of strip end waste) are obtained.

[0025] In consequence, the welding, descaling, reversing rolling and re-division of the strip can be carried out high efficiently with a compact and economic apparatus, having a production capacity making a maximum use of the reversing mill.

[0026] The long strip length which is coiled to form the large coils is typically several times the length of the conventional transportable coil. In one example, this long strip length is at least 5000m, preferably more than 8000m, e.g. 8000-12000 m.

[0027] The invention provides a method of descaling and cold rolling metal strip as set out in claim 1.

[0028] In this specification and claims, the terms "long strip length" and "large coil" are not intended to define particular sizes, but merely to indicate that the strip lengths rolled in the invention are substantially longer than the coils from which they are formed, and than the coils which are finally produced.

[0029] Embodiments of the invention will be described below by way of non-limitative example with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic diagram showing the construction of the descaling and cold rolling apparatus according to one embodiment of the present invention;

Fig. 2 is a schematic diagram of the construction of the descaling and cold rolling apparatus according to a second embodiment of the present invention;

Fig. 3 is a graph illustrating the relation between the nominal production capacity of pickling equipment existing in Japan and the equipment line length; and

Fig. 4 is a graph illustrating the number of cold rolling lines existing in Japan for respective nominal production capabilities, numerical values in bar graphs indicating the number of rolling mill stands in the individual lines.

[0030] In Fig. 1, the descaling and cold rolling apparatus embodying the present invention is a single line with a descaler 5 and a cold rolling mill 13 for reversible multi-pass cold rolling. At the entrance of the descaler 5, there is arranged a welder 4 for welding a plurality of hot-rolled coils 1 of regular transportable size to be fed to the descaler 5. Transport means 2 for the coils 1 is indicated. Between the descaler 5 and the reversible rolling mill 13, there is arranged an entrance side take-up and let-off device 7 for coiling the descaled strip to form a large coil 6 and simultaneously uncoiling the large coil 10A on the same line to feed it to the reversible rolling mill 13. At the exit of this reversible rolling mill 13, on the other hand, there is arranged a shearing machine 16 acting as re-dividing means for dividing again the cold-rolled large coil 15. Between the reversible rolling mill 13 and the shearing machine 16, there is arranged an exit side take-up and let-off device 11 for coiling the cold-rolled strips to form a large coil 10B and simultaneously uncoiling a large coil 14 on the same line to feed it to the shearing machine 16. A hot-rolled coil let-off reel 3 is arranged at the entrance side of the welder 4, and a cold-rolled coil take-up reel 18 is arranged at the exit side of the shearing machine 16.

[0031] Not shown in Fig. 1 are an accumulator (looper) between the welder 4 and the descaler 5, and a shears after the descaler for dividing the strip exiting from the descaler 5 for coiling.

[0032] The entrance take-up and let-off device 7 and the exit take-up and let-off device 11 are each of the well-

known carousel reel type, in which two expandable reel drums 8 and 9, and 12 and 14 are rotatably bome on rotary discs 7a and 11a so that they each can rotate on their individual axes, and can rotate as a pair about a central axis of the disc 7a or 11a to exchange their positions mutually.

[0033] An advantage of the Carousel devices 7, 11 illustrated here is that a high power driving motor is required only for the drums 9, 12 coiling or uncoiling the material being rolled by the mill. Relatively small motors are required for the drums 8, 14. The carousels 7,11 can therefore be arranged so that the drums 8, 9 and 12, 14 are interchanged in rotation of the discs 7a, 11a, but the respective motors are not interchanged. This reduces overall the cost of the motors required.

[0034] The regular size hot-rolled coils 1 are delivered by a hot -rolled coil car 2 from outside of the line onto the hot-rolled coil let-off reel 3 so that they are consecutively let off and welded by the welder 4. The coils delivered may vary in width and are cold. Then, a large coil 6 is taken up after the descaler 5 onto the drum 8 of the entrance take-up and let-off device 7. On the other hand, simultaneously using the other drum 9 of the entrance take-up and let-off device 7 and the drum 12 of the exit take-up and let-off device 11 a previous long strip length of forming coils 10A and 10B is rolled a predetermined number of passes (e.g. three or five) by the reversible rolling mill 13. Simultaneously, also the large coil 15 on the other drum 14 of the exit take-up and let-off device 11 is uncoiled and divided again by the shearing machine 16 so that it is taken up as a plurality of regular size cold-rolled coils 17 by the take-up reel 18. The coils 17 are delivered to outside of the line by the cold-rolled coil car 19.

[0035] Between the coiling and uncoiling of the large coils 6 and 10A between the descaler 5 and the reversible rolling mill 13, the disc 7a is rotated to interchange the positions of the drums 8 and 9. Likewise, the coiling and uncoiling of the large coils 10B and 15 between the reversible rolling mill 13 and the shearing machine 16 are likewise carried out with interchange of the positions of the drums 12 and 14.

[0036] There will now be described typical specifications of the large coils 6 and 10A, and 10B and 15. The hot coil handled by a conventional reversing mill has a weight of 10 to 20 tons, a length of about 500 to 1,000 m and a diameter of about 1.5 to 2 m. In the present embodiment of the invention in contrast, the large coils 6 etc. having a very large weight need not be transported, e.g. by the crane of the plant. Thus, no difficulty arises even if several regular size hot-rolled coils are connected to form a long strip length having a weight of 100 tons or more and a length of about 10,000 m. The length of the large coil may be 10 times as large as that of the regular hot-rolled coil, but the diameter of the large coil is about 5 m at most so that it can be handled with adequate ease.

[0037] In the present embodiment thus far described, the descaled strip is once taken up as the large coil 6 by the entrance take-up and let-off device 7, and the large coil 10A is let off and fed to the reversible rolling mill 13 so that the descaling step and the rolling step are carried highly efficiently independently in parallel without any interference. On the other hand, the strip thus rolled to a predetermined thickness is divided again to form the regular size coils 17. By the exit take-up and let-off device 11, moreover, the cold-rolled strip is taken up again, and-the long coil 15 is let off and fed to the shearing machine 16. As a result, the rolling step and the redividing step are also carried highly efficiently independently without any interference.

[0038] At this time, the rolling step is usually carried out by the multi-pass reversible rolling and takes the longest time for one large coil. As a result, the descaling step and the re-dividing step have their internal line speed relatively reduced compared with the entry speed at each pass of the mill 13. Since, therefore, the descaler 5 is a chemical descaler, i.e., uses the pickling method, the pickling tank can be short. If a mechanical descaler is used in combination with the chemical descaler, the descaler 5 can have its line length shortened and made compact.

[0039] Moreover, the various operations can be accomplished under selected conditions without interfering with each other. For example, the redividing and final coiling steps can be carried out at a low line speed for inspecting the surfaces of the rolled product. Thus, a treating step can be added, if required, to the re-dividing step.

[0040] As a result, the welding step, descaling step, reversible rolling step and re-dividing step of the coil can be carried out highly efficiently without any mutual interference. The strip entry speed of the descaler 5 is different from the higher strip entry speeds in the rolling passes in the mill 13. There is no waste between the descaling step and the cold-rolling step and between the cold-rolling step and the re-dividing step, while a suitable production scale is maintained. Only one expensive welder 4 is required so that a highly compact and economical apparatus can be realized.

[0041] Since the coil length rolled is long, the frequency of changing pass direction, which can cause trouble, can be drastically reduced to elongate the rolling time period of one cycle, so that the operation can be run stably with high productivity and production yield.

[0042] The rolling step is reversible using a large coil so that the productivity and production yield can become better than in reversible rolling methods of the prior art. The rolling mill need not be interrupted even at the welding time or the re-dividing time to improve the quality of the surface, yield and productivity of the product.

[0043] Fig.2 shows another embodiment of the apparatus of the invention, in which the parts corresponding to those of Fig.1 are given the same reference numbers and will not be fully described again. From the reel 3, the uncoiling strip from the hot-rolled coil 1 passes

through a straightener 3a and optional end shears 3b to the welder 4. After the welder 4 there is shown an accumulator (looper) 4a used to ensure that welding can take place without interruption of the descaler 5. The descaler 5 includes a scale breaker section 5a, an acid pickling tank 5b and a rinse tank 5c. A small accumulator 5d is located after the descaler 5, before an edge trimmer 5e (which prepares the descaled strip for coiling) and shears 5f, which divide the joined strip passing continuously through the descaler 5 into the successive long strip lengths for coiling as the large coils 6. The remainder of the line is substantially as shown in and described for Fig.1.

[0044] This embodiment of Fig. 2 has a production capacity of about 60,000 tons/month (or 700,000 tons/year). The pickling line (from the reel 3 to the carousel device 7) occupies a space about 100m in length.

[0045] It can be understood that the length of the long strip in each coil 6 does not correspond to an integral multiple of the length of the input coils 1. The length of the large coil 6 is chosen suitably for the cold rolling operation.

[0046] The descaling method and the descaler 5 are not limited to the chemical or mechanical types. These two types may be combined. It is also apparent that the type of the single stand reversing rolling mill is not especially limited. A six-high roll stand is indicated by way of example.

[0047] The take-up and let-off devices 7 and 11 may have carousel reel drums as solid drums which are not expandable nor contractible. In this case, the drum structures to be used need not be complex.

[0048] Furthermore, the present embodiment has been described with carousel reels in the take-up and let-off device 7 between the descaling step and the rolling step. However, the means for connecting those two steps as the same line can be exemplified devices such as a coil car, a coil conveyor or a coil hoist. The positional relation and distance between the two steps is not limited to those of the foregoing embodiments. Specifically, unlike the pickled coils of regular size of past practice in the art, the large coils formed at the descaling step are not extracted to be stored outside the line prior to rolling. Preferably the large coils are fed to the rolling step substantially in the order of preparation.

Claims

1. A method of descaling and cold rolling metal strip, comprising the following steps performed in a single apparatus line:-

   (a) joining a plurality of coils of said strip to form a plurality of long strip lengths,
   (b) sequentially passing said long strip lengths through a descaler (5),
   (c) winding said long strip lengths into large coils (6), and
   (d) sequentially cold rolling said long strip lengths in a cold rolling mill (13) from said large coils,

   characterized in that the descaler (5) and the cold rolling mill (13) operate simultaneously on two of the long strip lengths,

   in step (d) each said long strip length is rolled in a plurality of passes, with reversing, through a reversible multi-pass cold rolling mill (13) with unwinding of the long strip length and rewinding thereof between each two said passes through said mill,
   the speed of said strip in said descaler (5) being slower than the entry speed of the strip in each of said passes through said mill (13).

2. A method according to claim 1 wherein in step (c) the long strip length is coiled onto one of a first pair of coiling drums (8,9) to form said large coil, and thereafter said first pair of coiling drums (8,9) are mutually interchanged in position before unwinding of said large coil.

3. A method according to claim 1 or claim 2 wherein after the final one of said cold rolling passes said long strip length is recoiled onto a first one of a second pair of coiling drums (12,14), thereafter said second pair of coiling drums (12,14) are mutually interchanged in position, and then said long strip length is uncoiled from said first one of said second pair of coiling drums, subdivided and recoiled as a plurality of smaller coils.

Patentansprüche

1. Verfahren zum Entzundern und Kaltwalzen von Metallband mit den folgenden Schritten, die in einer einzigen Fertigungsstraße ausgeführt werden:

   (a) Verbinden einer Vielzahl von Coils des genannten Bands, um eine Vielzahl langer Bandabschnitte auszubilden,
   (b) aufeinanderfolgendes Hindurchführen der langen Bandabschnitte durch einen Entzunderer (5),
   (c) Aufwickeln der langen Bandabschnitte zu großen Coils (6), und
   (d) aufeinanderfolgendes Kaltwalzen der langen Bandabschnitte von den besagten großen Coils in einer Kaltwalzstraße (13),

   dadurch gekennzeichnet, daß der Entzunderer (5) und das Kaltwalzwerk (13) gleichzeitig zwei der langen Bandabschnitte bearbeiten,

in Schritt (d) jeder der langen Bandabschnitte in einer Vielzahl von Durchgängen mit Umkehrung durch eine Vieldurchgangs-Umkehrkaltwalzstraße (13) gewalzt wird, wobei die langen Bandabschnitte abgewickelt und zwischen jeweils zwei der besagten Durchgänge durch die Straße wieder aufgewikkelt werden, und die Geschwindigkeit des Bands in dem Entzunderer (5) langsamer ist als die Eintrittsgeschwindigkeit des Bands in jedem der Durchgänge durch die Straße (13).

2. Verfahren nach Anspruch 1, wobei der lange Bandabschnitt in Schritt (c) von einem ersten Paar Wikkeltrommeln (8, 9) auf die eine davon gewickelt wird, um das besagte große Coil zu bilden, und anschließend die Wickeltrommeln (8, 9) dieses ersten Paars vor dem Abwickeln des großen Coils in ihren Positionen gegenseitig ausgetauscht werden.

3. Verfahren nach Anspruch 1 oder 2, wobei der lange Bandabschnitt nach dem letzten der Kaltwalzdurchgänge von einem zweiten Paar Wickeltrommeln (12, 14) auf eine davon gewickelt wird, anschließend die Wickeltrommeln (12, 14) dieses zweiten Paars in ihren Positionen gegenseitig vertauscht und dann der lange Bandabschnitt von der ersten des zweiten Paars Wickeltrommeln abgewickelt, unterteilt und als eine Vielzahl kleinerer Coils wieder aufgewickelt wird.

Revendications

1. Procédé de décalaminage et de laminage à froid de feuillard, comprenant les étapes suivantes, exécutées dans une seule ligne de machines :

(a) réunir une pluralité de bobines dudit feuillard pour former une pluralité de grandes longueurs de feuillard,
(b) faire successivement passer lesdites grandes longueurs de feuillard dans une décalamineuse (5),
(c) enrouler lesdites grandes longueurs de feuillard en grosses bobines (6), et
(d) successivement laminer à froid lesdites grandes longueurs de feuillard dans un laminoir à froid (13) à partir desdites grosses bobines,

caractérisé en ce que la décalamineuse (5) et le laminoir à froid (13) agissent simultanément sur deux des grandes longueurs de feuillard,

lors de l'étape (d), chaque dite grande longueur de feuillard est laminée en une pluralité de passes, en va-et-vient, dans un laminoir à froid réversible multipasse (13) avec déroulement de la grande longueur de feuillard et rembobinage de celle-ci entre deux dites passes dans ledit laminoir,
la vitesse dudit feuillard dans ladite décalamineuse (5) étant inférieure à la vitesse d'entrée du feuillard lors de chacune desdites passes dans ledit laminoir (13).

2. Procédé selon la revendication 1, dans lequel, lors de l'étape (c), la grande longueur de feuillard est enroulée sur un premier tambour parmi deux tambours d'enroulement (8, 9) pour former ladite grosse bobine, après quoi lesdits deux tambours d'enroulement (8, 9) prennent chacun la place de l'autre avant que ladite grosse bobine ne soit déroulée.

3. Procédé selon la revendication 1 ou la revendication 2, dans lequel, après la passe finale parmi lesdites passes de laminage à froid, ladite grande longueur de feuillard est réenroulée sur un premier tambour parmi deux tambours d'enroulement (12, 14), après quoi lesdits deux tambours d'enroulement (12, 14) prennent chacun la place de l'autre, puis ladite grande longueur de feuillard est déroulée dudit premier desdits deux tambours d'enroulement, est subdivisée et réenroulée sous la forme d'une pluralité de bobines plus petites.

Fig. 1

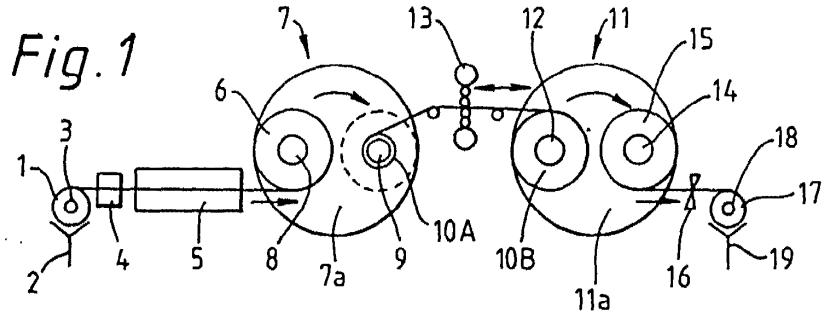

7
13
12
11
15
6
14
3
18
1
17
10A
10B
2
4
5
8
7a
9
16
19
11a

Fig. 2

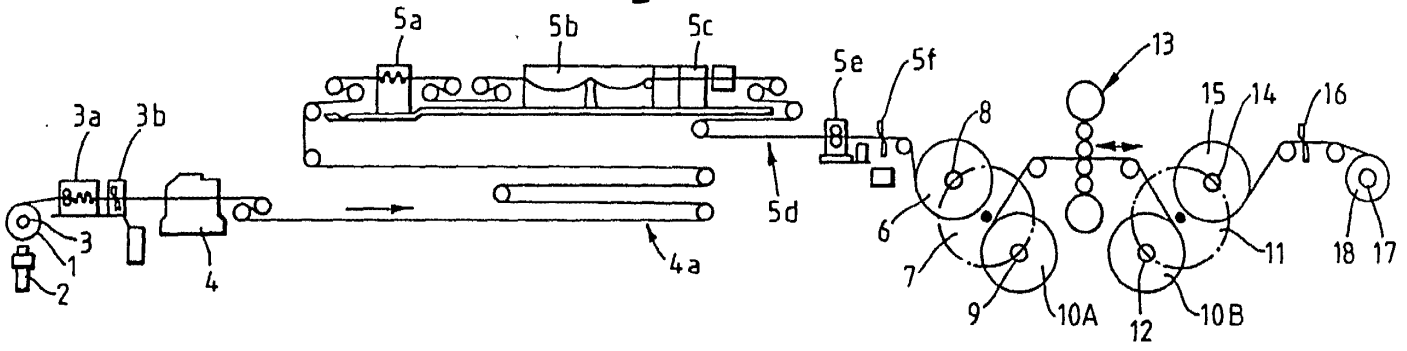

5a
5b
5c
5e
5f
13
3a
3b
8
15
14
16
5d
6
11
18
17
3
1
4a
7
2
4
9
10A
12
10B

Fig. 3

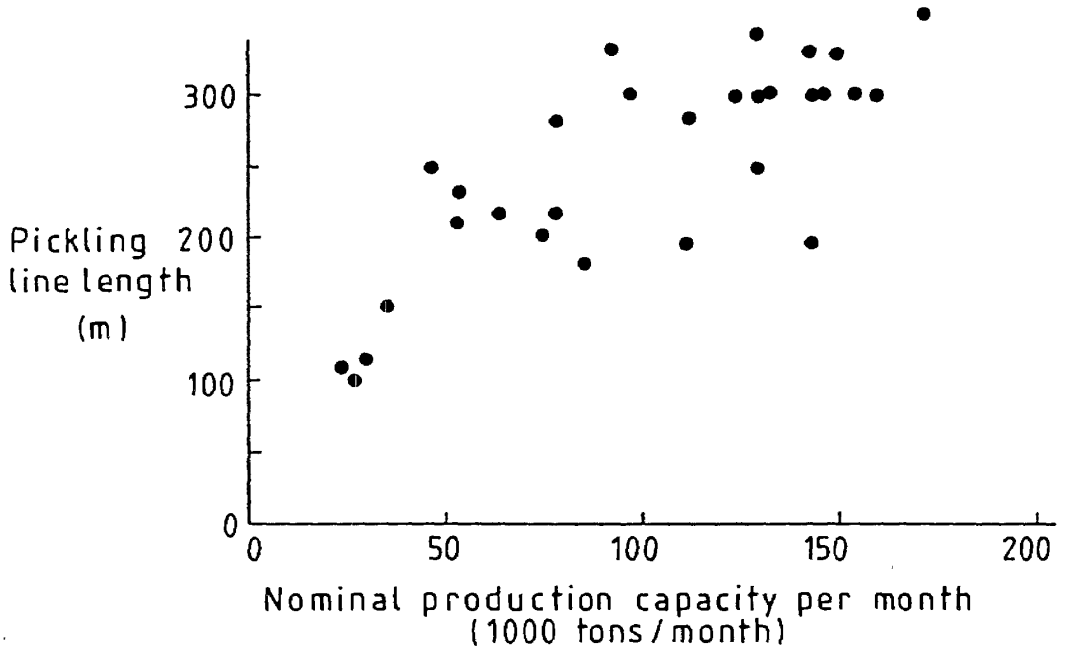
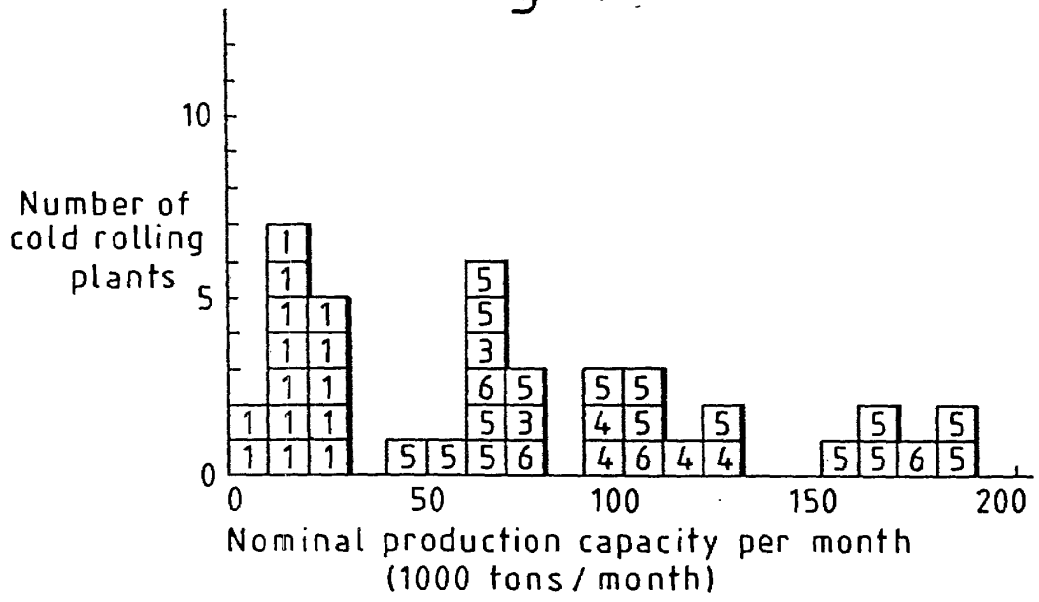

Pickling line length (m)
300
200
100
0
0
50
100
150
200
Nominal production capacity per month (1000 tons / month)

Fig. 4


Number of cold rolling plants
10
5
0
0
50
100
150
200
Nominal production capacity per month (1000 tons / month)

B21D 22/20 20060101AFI20050715BHJP B21D 53/88 20060101ALI20050715BHJP C23C 2/06
20060101ALI20050715BHJP C23C 2/12 20060101ALI20050715BHJP C23C 2/40
20060101ALI20050715BHJP

(19) Canadian Intellectual Property Office
An Agency of Industry Canada

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(11) **CA 2 573 226** (13) **A1**

(40) **19.01.2006**
(43) **19.01.2006**

(12)

(21) **2 573 226**

(22) **15.07.2005**

(51) Int. Cl.:

(85) **08.01.2007**

(86) **PCT/JP05/013518**

(87) **WO06/006742**

(30) **2004-208326 JP 15.07.2004**
2005-203748 JP 13.07.2005

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(54) METHODE D'EMBOUTISSAGE A CHAUD POUR ELEMENT HAUTE RESISTANCE PARTANT DE TOLE D'ACIER ET DE PIECES EMBOUTIES A CHAUD

(54) METHOD OF HOT PRESSING HIGH STRENGTH MEMBER USING STEEL SHEET AND SUCH HOT PRESSED PARTS

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Canadian Intellectual Property Office
An agency of Industry Canada

CA 2573226 A1 2006/01/19

(21) 2 573 226

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2005/07/15
(87) Date publication PCT/PCT Publication Date: 2006/01/19
(85) Entrée phase nationale/National Entry: 2007/01/08
(86) N° demande PCT/PCT Application No.: JP 2005/013518
(87) N° publication PCT/PCT Publication No.: 2006/006742
(30) Priorités/Priorities: 2004/07/15 (JP2004-208326); 2005/07/13 (JP2005-203748)

(51) Cl.Int./Int.Cl. *B21D 22/20* (2006.01), *B21D 53/88* (2006.01), *C23C 2/06* (2006.01), *C23C 2/12* (2006.01), *C23C 2/40* (2006.01)

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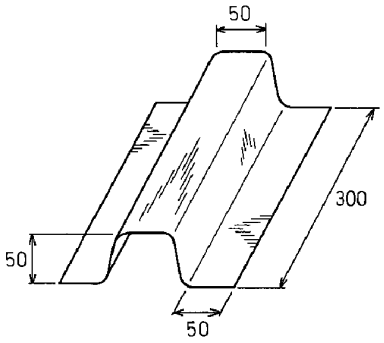
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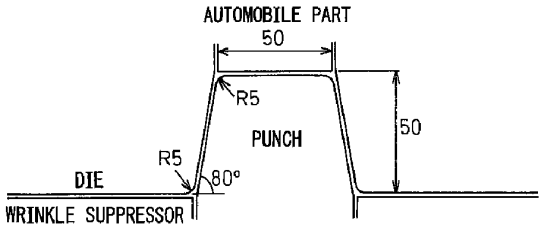
(54) Titre : METHODE D'EMBOUTISSAGE A CHAUD POUR ELEMENT HAUTE RESISTANCE PARTANT DE TOLE D'ACIER ET DE PIECES EMBOUTIES A CHAUD

(54) Title: HOT PRESSING METHOD FOR HIGH STRENGTH MEMBER USING STEEL SHEET AND HOT PRESSED PARTS

(a)



(b)



(57) Abrégé/Abstract:
A hot pressing method for a high strength automobile member wherein the member is produced by the use of, as a steel component, a steel sheet containing 0.05 to 0.5 mass % of C or a steel sheet plated with a metal material containing Al or Zn as a

(21) 2 573 226

(13) A1

(57) Abrégé(suite)/Abstract(continued):
main component, and by the employment of a hot pressing method, characterized in that the heating temperature before pressing is Ac_3 or higher and 1100°C or lower, and the atmosphere during heating has a hydrogen concentration of 6 vol % or less and exhibits a dew point of 10°C or lower; and a hot pressed member manufactured by the above method. The above hot pressing method or hot pressed member uses a hot-rolled or cold-rolled steel sheet or an Al-based metal plated steel sheet or a Zn-based metal plated steel sheet, and can provide a member having a strength of 1200 MPa or higher after a forming at a high temperature and also being almost free from the fear of hydrogen embrittleness.

ABSTRACT

The present invention provides a method of hot pressing using hot rolled and cold rolled steel sheet or Al-based plated steel sheet or Zn-based plated steel sheet enabling a strength of at least 1200 MPa to be obtained after high temperature forming and with extremely little possibility of hydrogen embrittlement and such hot pressed parts, that is, a method of hot pressing a high strength automobile parts comprising using steel sheet containing as steel compositions by wt% C:0.05 to 0.5% or steel sheet plated mainly with Al or Zn to produce automobile members by hot pressing during which making the heating temperature before pressing Ac_3 or more to 1100°C or less, making the hydrogen concentration in the heating atmosphere 6 vol% or less, and making the dew point 10°C or less and such hot pressed parts.

DESCRIPTION

METHOD OF HOT PRESSING HIGH STRENGTH MEMBER USING STEEL SHEET AND SUCH HOT PRESSED PARTS

TECHNICAL FIELD

The present invention relates to a method of hot pressing comprising using cold rolled or hot rolled steel sheet or Al-based or Zn-based plated steel sheet to hot press automobile pillars, door impact beams, bumper beams, or other strength parts and such hot pressed parts.

BACKGROUND ART

To lighten the weight of automobiles, an issue arising from the problem of global warming, it is necessary to make the steel sheet used for automobiles as high in strength as possible. In general, if making steel sheet high in strength, the elongation and r value decrease and the formability deteriorates. To solve this problem, technology for hot forming materials and using the heat at that time to raise the strength is disclosed in Japanese Patent Publication (A) No. 2000-234153. This technology aims at suitably controlling the steel compositions, heating the steel in the ferrite temperature region, and utilizing precipitation strengthening in this temperature region to raise the strength.

Further, Japanese Patent Publication (A) No. 2000-87183 proposes high strength steel sheet improved in press forming precision by reducing the yield strength at the formation temperature to much lower than the yield strength at ordinary temperature. However, these technologies may be limited in the obtained strength. On the other hand, technology for obtaining a higher strength by heating the material to the high temperature austenite single-phase region after formation and transforming it to a hard phase in the subsequent cooling

process is proposed in Japanese Patent Publication (A) No. 2000-38640.

However, if heating and rapidly cooling a sheet after forming, problems may arise in the shape precision. As technology for overcoming this defect, technology for heating steel sheet to the austenite single-phase region, then cooling in the press formation process by a cooling rate of at least the critical cooling rate of martensite transformation determined by the steel compositions is disclosed in the Document (SAE, 2001-01-0078) and Japanese Patent Publication (A) No. 2001-181833. The former document discloses to suppress scaling of the surface at the time of heating by using Al-plated steel sheet. This type of pressing process is called "hot pressing" in the present invention.

As prior technology relating to hot pressing using such plated steel sheet, the following may be mentioned. Japanese Patent Publication (A) No. 2003-147499 discloses an example of using steel sheet covered by a plating layer comprised of an Fe-Zn alloy for hot pressing, while Japanese Patent Publication (A) No. 2003-41343 discloses an example of using Al-based plated steel sheet covered by a plating layer comprised of an Fe-Al alloy for hot pressing.

Further, Japanese Patent Publication (A) No. 2002-282951 discloses the example of a method of using a die and punch to press a heated metal sheet wherein the die clearance is defined from the viewpoint of the formability and hardenability.

DISCLOSURE OF THE INVENTION

In this way, the higher the strength, the more high strength steel sheet used for automobiles etc. has the above-mentioned problem of formability and the inherent problem, in particular in high strength materials of over 1000 MPa, of hydrogen embrittlement (also called aging cracks and delayed fracture), as is known from the past. Therefore, when using steel sheet as sheet for hot

pressing, it is important to lower the amount of hydrogen of the material.

The present invention was made to solve this problem and provides a method of hot pressing using hot rolled or cold rolled steel sheet or an Al-based plated steel sheet or a Zn-based plated steel sheet able to give a strength of 1200 MPa or more after high temperature forming and with extremely little liability of hydrogen embrittlement and such pressed parts.

The inventors engaged in various studies to solve the above problem. As a result, they discovered that controlling the atmosphere and temperature at the time of heating to the austenite single-phase region before pressing is important for producing hot pressed parts superior in resistance to hydrogen embrittlement. That is, since the atmosphere at the time of heating includes hydrogen, this hydrogen invades the steel sheet. Even if moisture is included, similarly hydrogen may invade the steel sheet, so it is important to reduce hydrogen and moisture. Further, the inventors discovered that to prevent hydrogen embrittlement, it is important to suitably select the die clearance. The gist of the present invention based on this discovery is as follows:

(1) A method of hot pressing a high strength automobile parts comprising using steel sheet containing as a steel compositions, by wt%, C:0.05 to 0.5% or steel sheet plated mainly by Al or Zn to hot press an automobile member during which making the heating temperature before pressing at least the Ac_3 and not more than 1100°C, making the hydrogen concentration in the heating atmosphere not more than 6 vol%, and making the dew point not more than 10°C.

(2) A method of hot pressing a high strength automobile parts as set forth in (1), characterized in that a hydrogen concentration in the heating atmosphere is not more than 1 vol% and a dew point is not more than

10°C.

(3) A method of hot pressing a high strength automobile parts as set forth in (1) or (2), characterized by introducing the steel sheet after heating into a press machine and making a clearance between a die and punch at the time of forming 1.0 to 1.8 times the thickness of the steel material used.

(4) A hot pressed part characterized by using a method of hot pressing as set forth in any one of (1) to (3).

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an external view of a hat shaped die used for a processing test of the examples.

BEST MODE FOR WORKING THE INVENTION

Next, the reasons for limitation of the present invention will be explained.

As explained above, the present invention comprises heating hot rolled or cold rolled steel sheet or Al-based or Zn-based plated steel sheet to 700°C or more, then hot forming it and immediately cooling and hardening it in a die to obtain the desired strength. The present invention defines the steel sheet before heating and press forming. The steel sheet compositions have to be superior in hardenability. Therefore, the amount of C must be 0.05% or more, preferably 0.1% or more. As other steel elements, Si, Mn, Ti, B, Cr, Mo, Al, P, S, N, or other elements are sometimes added. Si has an effect on the fatigue characteristics, so when included, 0.05 to 1% is preferable. Mn, B, Cr, and Mo contribute to the improvement of the hardenability, so when included, Mn: 0.5 to 3%, B: 0.05% or less, Cr: 2% or less, and Mo: 0.5% or less are preferable. Ti and Al improve the oxidation resistance of Al-based plated steel sheet, so when included, Ti: 0.5% or less and Al: 0.1% or less are preferable.

As to the type of plating, steel sheet given Al-based or Zn-based plating may be considered. If using

these for hot pressing, formation of iron oxide at the surface is suppressed and corrosion resistance can be imparted.

First, the configuration of the Al-based plating layer will be explained. At the present time, Al-based plated steel sheets are being produced for various applications. The present invention may be used for these steel sheets. As the to configuration of the Al-based plating layer, there is steel sheet with plating mainly comprised of Al and, to suppress the formation of an alloy layer at the time of hot dip Al coating, preferably containing 3 to 15% of Si. In addition, as elements for improving more the corrosion resistance of the plating layer, there are Cr, Mg, Ti, Sn, etc. These may also be added. At this time, Cr: 0.1 to 1%, Mg: 0.5 to 10%, Ti: 0.1 to 1%, and Sn: 1 to 5% are desirably further included. Note that the Al-based plating layer contains Fe as an impurity. The amount is normally 0.05 to 0.5%.

Note that after heating, the surface may be formed with intermetallic compounds such as $FeAl_3$, Fe_2Al_5, Fe_3Al, and Fe_2Al_8Si. These phases tend typically to be composite layer structures of five layers, but no matter what these phase structures, the gist of the invention of the present invention is not affected. Further, the composition is mainly Al and Fe. When adding Si to the Al plating bath, Si is also included in an amount of about 5 to 10%. These elements form at least 90% of the total. Further, there may be some slight amount of residual Al not alloyed, but if a small amount, it does not have any particular effect on the performance. After heating, an Al-based oxide or nitride covers the surface, but these amounts are not particularly defined.

Next, the configuration of the Zn-plating layer will be explained. Zn-based plated steel sheets are currently being produced in various compositions. The present invention can be applied to these steel sheets. As typical configurations of Zn-based plating layers, the

following may be mentioned: Zn-0.2%Al, Zn-5%Al-0.1%Mg, Zn-5%Al-0.1%Mg-mische metal, Zn-7%Al-3%Mg, Zn-11%Al-3%Mg-0.1%Si, Zn-55%Al-1.6%Si, etc. In addition, by plating in a Zn-0.1%Al bath, then heating, this may be changed to Zn-10%Fe. In addition, as elements for improving more the corrosion resistance of the plating layer, there are Cr, Mg, Ti, Sn, etc. These may also be added. At this time, Cr: 0.1 to 1%, Mg: 0.5 to 10%, Ti: 0.1 to 1%, and Sn: 1 to 5% are preferably contained.

Note that after heating, the surface may be formed with ζ, $\delta 1$, Γ, $\Gamma 1$ phases or other intermetallic compounds or a ferrite phase containing Zn in solid solution. These phases may be distributed in layers or distributed in the form of particles, but no matter what these phase structures, the gist of the invention of the present application is not affected. Further, if plating comprised including Al, formation of the above-mentioned Fe-Al-based compound is also possible. In the case of Zn-based plating, after the heating, a Zn-based or Al-based oxide film is formed, but even if these are formed, the gist of the present invention is not affected.

The amount of deposition of the Al-based or Zn-based plating, the treatment before plating, and the treatment after it are not particularly limited, but the plating deposition is preferably at least 50 g/m^2 on one side. This is because the greater the amount of plating deposition, the more improved the effect of suppression of oxidation at the time of heating and the corrosion resistance of the part after heating and forming. As such treatment after plating, chromate treatment, resin coating, etc. for primary rust prevention and lubrication are possible, but an organic resin is consumed upon heating, so is not preferred. For the chromate treatment as well, considering the recent restrictions on hexavalent chrome, electrolytic chromate or other trivalent coatings are preferred. Even not imparting a chromate coating and just coating with oil is possible in

the case of Al-based plated steel sheet superior in corrosion resistance.

In the present invention, the temperature and atmosphere at the time of heating are defined. The temperature is made at least Ac_3 and not more than 1100°C. This is because for the steel sheet to completely transform to the austenite single-phase region, the Ac_3 temperature or more is necessary. On the other hand, if the heating temperature is too high, the surface oxidizes and hydrogen more actively invades the steel. If using a Zn-based plating, in addition to this, since the boiling point of Zn is about 910°C and, at a high temperature, Zn will completely evaporate away and the steel sheet will become seriously oxidized, 1000°C is preferably made the upper limit. More preferably, the upper limit temperature is 920°C. The lower limit temperature is preferably made 800°C. This is because even if heating to the Ac_3 temperature or more, in the interval after heating when the steel sheet is taken out from the furnace and transported to the press machine, the temperature drops and ferrite ends up being formed in some cases.

The heating atmosphere is made one with a hydrogen concentration of 6 vol% or less. This is because, as explained above, the invasion of hydrogen into the steel will increase the liability of hydrogen embrittlement. No lower limit is particularly set, but the lower the better. More preferably, the amount of hydrogen is 1% or less. Similarly, the inventors discovered in the present invention that the moisture in the atmosphere may also easily invade the steel as hydrogen. Therefore, the moisture in the atmosphere is also preferably low. In practice, the dew point is measured to measure the moisture content. The upper limit of the dew point is made 10°C. Note that the following equation is known for conversion of the dew point and moisture content. The moisture content at this time is 1.2 vol%. In particular,

when using a Zn-based plated steel sheet, having the atmosphere contain oxygen causes the steel sheet surface to be formed with a Zn oxide and suppress the evaporation of Zn. Therefore, when using a Zn-based plated steel sheet, the atmosphere preferably contains oxygen in an amount of 1 to 21%. Further, not only plated steel sheet, but also not plated steel sheet (bare material) is invaded by hydrogen during heating, so the hydrogen concentration and moisture content of the heating atmosphere must be controlled.

Equation 1

$$pH_2O = \exp\left(-\frac{44016 - 118.774 * Tdp}{8.314 * Tdp}\right)$$

pH_2O: hydrogen concentration (vol%)

Tdp: dew point (absolute temperature)

The heating method is not particularly prescribed. It may be radiant heating by radiant tubes etc., induction heating, conduction heating, etc. The heating rate at this time is not limited. This naturally depends largely on the sheet thickness and the shape.

Hot pressing is characterized by cooling from an austenite phase to obtain a hardened microstructure. Naturally, the effect of the cooling rate after heating is great. In the present invention, it is necessary to cool by at least the critical cooling rate for obtaining a martensite structure as determined by the steel compositions, but as a general measure, the average cooling temperature from 700°C to 350°C is preferably at least 15°C/sec. This cooling rate depends on the steel ingredients. In a steel with a good hardenability, even with a cooling rate of about 20°C/sec, a desired structure mainly comprised of martensite can be obtained. Depending on the type of the steel, a cooling rate of about 30°C/sec

may become necessary.

At the time of pressing, the clearance between the die and punch is an important factor. In the present invention, this clearance is preferably 1.0 to 1.8 times the sheet thickness. If the clearance is small, the sheet will have difficulty flowing resulting in ironing, so the surface of the steel sheet will suffer from galling which may form the starting point for hydrogen embrittlement. Further, if large, hardening tends to become difficult, the part will become uneven in strength, residual stress will remain in the part, and the possibility of hydrogen embrittlement will rise.

EXAMPLES

Next, examples will be used to explain the present invention in further detail.

(Example 1)

Cold rolled steel sheets having the steel compositions shown in Table 1 and having thicknesses of 1.4 mm were heated under various conditions, then formed by a hat shaped die as shown in FIG. 1. The clearance was made 1.1 times the sheet thickness. After this, in the flange of each part, 5 mmϕ holes were punched at 10 points with a clearance of 0.5 mm (two sides). After the elapse of seven days, a 20X power loupe was used to examine the punched out parts and judge the presence of microcracks. The samples were heated by insertion in an electric furnace controlled in atmosphere. The time for raising the temperature to 900°C was about 4 minutes, the time from the furnace to the press was about 10 seconds, and the press start temperature was about 750°C. The cooling was performed in the die. The average cooling rate from 700°C to 350°C was 40°C/sec. The heating conditions and the presence of any microcracks are shown in Table 2. Note that after forming, part was cut out and measured for Vicker's hardness at a load of 10 kgf, whereupon the Hv was in the range of 410 to 510 and a martensite

microstructure was exhibited at all levels. Further, after hot pressing, the surfaces of these steel sheets were formed with iron oxide.

No. 8 of Example 1 was high in dew point, so five or more microcracks occurred. No. 1 and No. 3 had amounts of hydrogen of over 1%, so small amounts of microcracks occurred.

Table 1

Symbol	C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
A	0.15	0.1	2.1	0.01	0.004	0.03	0.004	0.02	0.4	0.01	0.003
B	0.21	0.2	0.9	0.02	0.005	0.015	0.005	0.01	0.9	0.4	0.004
C	0.27	0.15	0.88	0.01	0.002	0.02	0.004	0.02	0.23	0.5	0.003

Table 2

No.	Steel	Temp. (°C)	Holding temp. (min)	Heating atmosphere			Occurrence of microcracks	
				Hydrogen (vol%)	Dew point (°C)	Oxygen (vol%)		
1	A	950	1	5	8	0.01	F	Inv. ex.
2	A	900	1	0.1	2	0.3	VG	Inv. ex.
3	B	800	2	2	-10	0.5	G	Inv. ex.
4	B	850	3	0.5	0	21	VG	Inv. ex.
5	C	1000	1	0.1	-30	21	VG	Inv. ex.
6	C	850	5	0.05	2	21	VG	Inv. ex.
7	A	900	10	0.07	6	21	VG	Inv. ex.
8	B	850	8	0.1	13	21	P	Comp. ex.
9	B	850	5	0.2	0	21	VG	Inv. ex.
10	C	850	2	0.1	-10	21	VG	Inv. ex.

Scoring of occurrence of microcracks:
Total number of microcracks at 10 points: VG (very good): 0, G (good): 1, F (fair): less than 5, P (poor): 5 or more

(Example 2)

Cold rolled steel sheets of the steel compositions shown in Table 3 after the ordinary hot rolling and cold rolling processes (sheet thickness 1.4 mm) were used as materials for hot dip Al coating. The hot dip Al coating was performed using a nonoxidizing furnace-reduction furnace type line. After plating, the gas wiping method was used to adjust the plating deposition to 80 g/m^2 per side, then the sheets were cooled. The plating appearance

was good with no nonplated areas. The type of plating and the bath temperature are shown in Table 9. The plating bath composition at this time was Al-10%Si-2%Fe and the bath temperature was 660°C. The Fe in the bath was unavoidable Fe from the plating equipment or strip. The plating appearance was good with no nonplated areas. The thus hot dip Al coated steel sheets were heated under various conditions, then formed by a hat shaped die shown in FIG. 1. The clearance was made 1.1 times the sheet thickness. After this, in the flange of each part, 5 mmϕ holes were punched at 10 points with a clearance of 0.5 mm (two sides). After the elapse of seven days, a 20X power loupe was used to examine the punched out parts and judge the presence of microcracks. The samples were heated by insertion in an electric furnace controlled in atmosphere. The time for raising the temperature to 900°C was about 4 minutes, the time from the furnace to the press was about 10 seconds, and the press start temperature was about 750°C. The cooling was performed in the die. The average cooling rate from 700°C to 350°C was 40°C/sec. The heating conditions and the presence of any microcracks are shown in Table 4. Note that after forming into the hats, parts were cut out and measured for Vicker's hardness at a load of 10 kgf, whereupon the Hv's were in the range of 410 to 510 and a martensite structure was exhibited at all levels. Further, after hot pressing, the surfaces of these steel sheets were not formed with iron oxide.

Table 3

C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
0.22	0.21	1.20	0.02	0.003	0.027	0.003	0.002	0.18	0.02	0.0018

Table 4

No.	Temp. (°C)	Holding temp. (min)	Heating atmosphere			Occurrence of microcracks	
			Hydrogen (vol%)	Dew point (°C)	Oxygen (vol%)		
1	800	5	0.01	2	0.3	VG	Inv. ex.
2	900	3	0.02	1	0.5	VG	Inv. ex.
3	1000	2	0.1	3	0.8	VG	Inv. ex.
4	1100	2	N.D.	1	1	VG	Inv. ex.
5	900	2	10	0	0.01	P	Comp. ex.
6	900	2	4	1	0.01	F	Inv. ex.
7	900	2	1	-1	0.01	VG	Inv. ex.
8	900	2	0.1	15	0.01	P	Comp. ex.
9	900	2	0.1	6	0.1	VG	Inv. ex.
10	900	2	0.05	2	0.1	VG	Inv. ex.
11	900	2	2	-20	0.5	G	Inv. ex.
12	900	2	0.01	7	21	VG	Inv. ex.
13	900	2	0.01	1	21	VG	Inv. ex.
14	980	8	0.01	1	21	VG	Inv. ex.
15	1050	5	0.01	1	21	VG	Inv. ex.
16	900	10	5	6	0.06	F	Inv. ex.

Scoring of occurrence of microcracks:
Total number of microcracks at 10 points: VG (very good): 0, G (good): 1, F (fair): less than 5, P (poor): 5 or more

As shown in Table 4, the amount of hydrogen invading the steel changes and the sensitivity to microcracks changes depending on the heating atmosphere and temperature. No. 5 with a hydrogen concentration of 10 vol% and No. 8 with a dew point of 15°C exhibited five or more cracks. As the hydrogen concentration and dew point are lowered, the formation of cracks is suppressed, but in the case of Nos. 6, 11, and 16, some cracks were formed.

(Example 3)

Cold rolled steel sheets having the steel compositions shown in Table 5 and having thicknesses of 1.4 mm were used for various types of Zn-based plating. The type of plating, bath compositions, and bath temperature at this time are shown in Table 6. These Zn-based plated steel sheets were used to form hats in the same way as in Example 1. The presence of any microcracks after punching was examined. The relationship between the

heating conditions and the state of formation of cracks at this time is shown in Table 7. The cooling was performed in the die. The average cooling rate from 700°C to 350°C was 20°C/sec. The samples were measured for cross-sectional hardness after formation in the same way as in Example 1, whereupon all the samples had Hv's in the range of 410 to 510 and the structures were martensite microstructures. Further, after hot pressing, the surfaces of these steel sheets were not formed with iron oxide.

Table 5

Symbol	C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
A	0.15	0.1	2.1	0.01	0.004	0.03	0.004	0.02	0.4	0.01	0.003
B	0.21	0.2	0.9	0.02	0.005	0.015	0.005	0.01	0.9	0.4	0.004
C	0.27	0.15	0.88	0.01	0.002	0.02	0.004	0.02	0.23	0.5	0.003

Table 6

Symbol	Composition of plating layer	Single side deposition (g/m^2)	Bath temp. (°C)
GI	Zn-0.2%Al	85	460
GA	Zn-10.5%Fe	70	460
GL	Zn-55%Al-1.6%Si	75	610
GAM	Zn-6%Al-3%Mg	65	420
GAMS	Zn-11%Al-3%Mg-0.1%Si	80	430

Table 7

No.	Steel	Plating	Temp. (°C)	Holding time (min)	Heating atmosphere			Occurrence of microcracks	
					Hydrogen (vol%)	Dew point (°C)	Oxygen (vol%)		
1	A	GI	950	1	5	8	0.01	F	Inv. ex.
2	A	GA	900	1	0.1	2	0.3	VG	Inv. ex.
3	B	GL	800	2	2	-10	0.5	G	Inv. ex.
4	B	GAM	850	3	0.5	0	21	VG	Inv. ex.
5	C	GAMS	1000	1	0.1	-30	21	VG	Inv. ex.
6	C	GI	850	5	0.05	2	21	VG	Inv. ex.
7	A	GI	900	10	0.07	6	21	VG	Inv. ex.
8	B	GA	850	8	0.1	13	21	P	Comp. ex.
9	B	GA	850	5	0.2	0	21	VG	Inv. ex.
10	C	GL	850	2	0.1	-10	21	VG	Inv. ex.

Scoring of occurrence of microcracks:

Total number of microcracks at 10 points: VG (very good):

0, G (good): 1, F (fair): less than 5, P (poor): 5 or more

In the same way as in Examples 1 and 2, No. 8 of Table 7 had a high dew point, so microcracks occurred. Nos. 1 and 3 had amounts of hydrogen larger than 1%, so some microcracks occurred. Further, Nos. 1 to 3 had low oxygen concentrations, so the furnace became dirty along with evaporation of the Zn in the furnace and deterioration of the surfaces of the steel sheets were observed.

(Example 4)

Cold rolled steel sheets of the steel compositions shown in Table 8 after the ordinary hot rolling and cold rolling processes (sheet thickness 1.4 mm) were used as materials. Parts were coated with Al by hot dipping or coated with Zn by hot dipping. The hot dipping was performed using a nonoxidizing furnace-reduction furnace type line. After plating, the gas wiping method was used to adjust the plating deposition, then the sheets were cooled. The plating appearance was good with no nonplated areas. The type of plating and the bath temperature are shown in Table 9.

Table 8

C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
0.22	0.21	1.20	0.02	0.003	0.027	0.003	0.002	0.18	0.02	0.0018

Table 9

Sym-bol	Composition of plating layer	Single side deposition (g/m^2)	Bath temp. (°C)
AL	Al-10%Si-2%Fe	80	660
GI	Zn-0.2%Al	85	460
GA	Zn-10.5%Fe	70	460

The thus produced steel sheets were heated under various conditions and then formed by the hat shaped die shown in FIG. 1. The clearance at the time of hot pressing is shown in Table 10. After this, in the flange

of each part, 5 mmϕ holes were punched at 10 points with a clearance of 0.5 mm (two sides). After the elapse of seven days, a 20X power loupe was used to examine the punched out parts and judge the presence of microcracks. The samples were heated by insertion in an electric furnace controlled in atmosphere. The time for raising the temperature to 900°C was about 4 minutes, the time from the furnace to the press was about 10 seconds, and the press start temperature was about 750°C. The cooling was performed in the die. The average cooling rate from 700°C to 350°C was 40°C/sec. The heating conditions and the presence of any microcracks are shown in Table 10. Note that after forming into the hat, part was cut out and measured for Vicker's hardness at a load of 10 kgf, whereupon the Hv was in the range of 410 to 510 and a martensite microstructure was exhibited at all levels.

Table 10

No.	Clearance at hot press (thickness ratio)	Type of plating	Temp. (°C)	Holding time (min)	Heating atmosphere			Occurrence of microcracks	Production of iron oxide	
					Hydrogen (vol%)	Dew point (°C)	Oxygen (vol%)			
1	0.8	CR	900	3	0.02	1	0.5	P	Yes	Comp. ex.
2	1.0	CR	900	3	0.02	1	0.5	VG	Yes	Inv. ex.
3	1.1	CR	900	3	0.02	1	0.5	VG	Yes	Inv. ex.
4	1.4	CR	900	3	0.02	1	0.5	VG	Yes	Inv. ex.
5	1.7	CR	900	3	0.02	1	0.5	G	Yes	Inv. ex.
6	1.9	CR	900	3	0.02	1	0.5	P	Yes	Comp. ex.
7	0.8	GI	900	10	0.07	6	21	P	No	Comp. ex.
8	1.0	GI	900	10	0.07	6	21	VG	No	Inv. ex.
9	1.1	GI	900	10	0.07	6	21	VG	No	Inv. ex.
10	1.4	GI	900	10	0.07	6	21	VG	No	Inv. ex.
11	1.7	GI	900	10	0.07	6	21	G	No	Inv. ex.
12	1.9	GI	900	10	0.07	6	21	P	No	Comp. ex.
13	0.8	GA	850	5	0.2	0	21	P	No	Comp. ex.
14	1.0	GA	850	5	0.2	0	21	VG	No	Inv. ex.
15	1.1	GA	850	5	0.2	0	21	VG	No	Inv. ex.
16	1.4	GA	850	5	0.2	0	21	VG	No	Inv. ex.
17	1.7	GA	850	5	0.2	0	21	G	No	Inv. ex.
18	1.9	GA	850	5	0.2	0	21	P	No	Comp. ex.

Scoring of occurrence of microcracks:

Total number of microcracks at 10 points: VG (very good): 0, G (good): 1, F (fair): less than 5, P (poor): 5 or more

Nos. 1, 7, and 13 of Table 10 had clearances of the die at the time of hot pressing of less than the limit, so five or more microcracks were observed. Nos. 6, 12, and 18 of Table 10 had die clearances at the time of hot pressing of over the limit, so were uneven in strength and had residual stress remaining in the parts, so five or more microcracks were observed. Nos. 5, 11, and 17 had somewhat larger die clearances at the time of hot pressing, so were uneven in strength and tended to have residual stress remaining in the parts, so some microcracks occurred.

INDUSTRIAL APPLICABILITY

According to the present invention, it is possible to use hot rolled or cold rolled steel sheet or Al-based plated steel sheet or Zn-based plated steel sheet to produce high strength members by the hot pressing method and possible to use them without hydrogen embrittlement.

CLAIMS

1. A method of hot pressing a high strength automobile parts comprising using steel sheet containing as a steel compositions, by wt%, C:0.05 to 0.5% or steel sheet plated mainly by Al or Zn to form an automobile member by hot pressing during which making the heating temperature before pressing at least Ac_3 and not more than 1100°C, making the hydrogen concentration in the heating atmosphere not more than 6 vol%, and making the dew point not more than 10°C.

2. A method of hot pressing a high strength automobile parts as set forth in claim 1, characterized in that a hydrogen concentration in the heating atmosphere is not more than 1 vol% and a dew point is not more than 10°C.

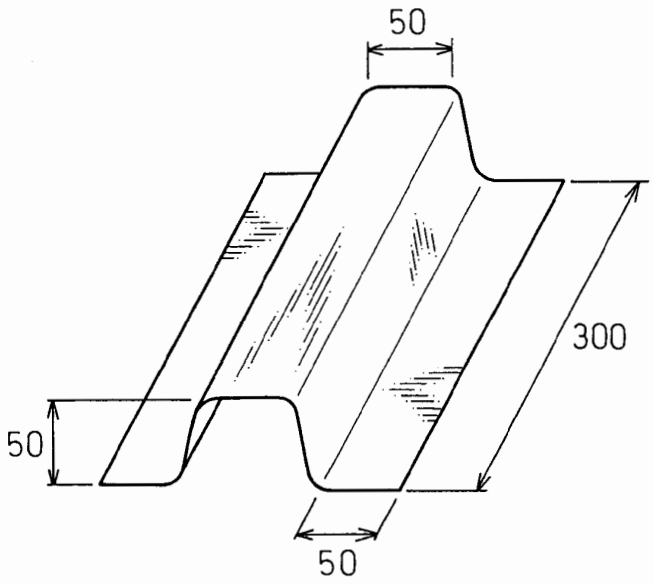
3. A method of hot pressing a high strength automobile member as set forth in claim 1 or 2, characterized by introducing the steel sheet after heating into a press machine and making a clearance between a die and punch at the time of shaping 1.0 to 1.8 times the thickness of the steel material used.

4. A hot pressed part characterized by using a method of hot pressing as set forth in any one of claim 1 to claim 3.

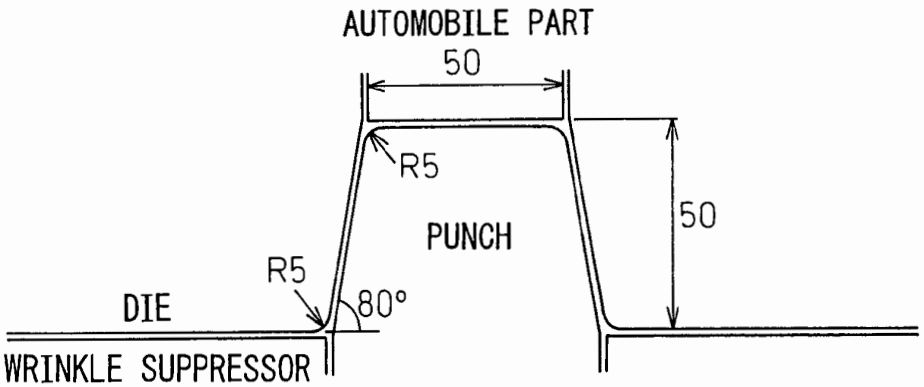
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Fig. 1

(a)


50
300
50
50

(b)


AUTOMOBILE PART
50
R5
50
PUNCH
R5
80°
DIE
WRINKLE SUPPRESSOR

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 692 549 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.01.1996 Bulletin 1996/03

(51) Int. Cl.[6]: **C23C 2/20**

(21) Application number: **94110948.0**

(22) Date of filing: **14.07.1994**

(84) Designated Contracting States:
AT BE DE ES FR GB GR IT LU NL PT SE

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(54) Apparatus and method for control of metallic coating-weight by the use of gas knives

(57) A gas wiping die is provided with a predetermined arrangement of cams (41) which act against a flexible lip (21) either directly or through intermediate push rods (31) or the like to adjust the opening of the wiping die orifice (29). The invention may involve several cam shafts (43) which may be rotated by a so-called stepping motor or motors. The arrangement allows a smooth progression of changes in the opening and camber of the coating die gas orifice slot. Various contours of cam shaft may be provided to provide easily implemented programs of die adjustment, either smoothly or discretely, to adjust for variations in coating conditions or procedure.

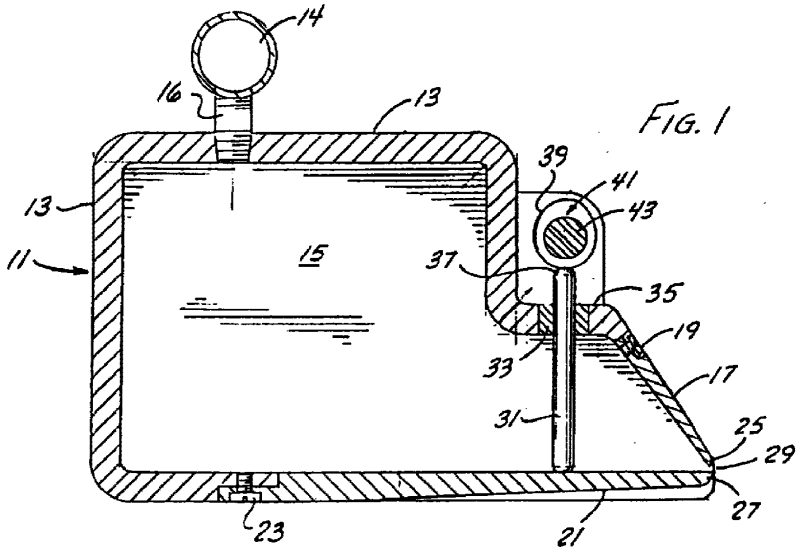


FIG. 1

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Description

Background of the Invention

(1) Field of the Invention.

This invention relates to the coating of metal strips with uniform coating weights and more particularly to the determination or control of the coating weight on hot-metal coated strips with so-called gas doctors or gas knives, and particularly to the use of adjustable orifice gas knives.

(2) Description of the Prior Art.

Various means have been used to control the coating weight of so-called hot dip coated strip and sheet material and particularly ferrous-base sheet and strip material which is passed through molten baths of tern, zinc, aluminum, aluminum-zinc and the like. In the coating of such material, the ferrous substrate material as it exits from the bath surface, draws up with it a cuantity of at least temporarily adhering molten metal, which, as the ferrous material passes upwardly, solidifies on the surface of the base material. If the strip or sheet material is withdrawn from the bath sufficiently slowly, the excess molten metal will drain from the surface naturally establishing a coating thickness or weight dependent basically upon the temperature of the substrate as well as the coating plus the physical characteristics of the unsolidified coating material, particularly the weight or specific gravity. As coating lines have been accelerated, however, too much excess coating has been drawn up from the molten bath upon the surface of the substrate and has not had sufficient time to drain back into the molten bath causing overly thick as well as uneven coatings on the coated product.

Various expedients have been used to wipe this excess coating from the substrate surface including charcoal or the like floating upon the bath surface, stationary wipers between which the strip passes, so-called coating rolls between which the strip passes and in more modern practice blasts of gas which wipe the molten coating back into the bath leaving the desired residual surface layer which then solidifies, forming the ultimate coating upon the substrate.

The use of coating or doctor rolls between which the ferrous substrate passed as it exited from the molten bath was a very significant improvement in hot metal coating of sheet and strip material and over a period, the use of such rolls became very sophisticated in design and implementation. These coating rolls essentially limited the amount of metal drawn out of the metal bath with the substrate and then allowed the metal to be recoated with hot metal from the limited reservoir of metal between the rolls. The coating weight could be controlled by the pressure applied between the rolls and the depth the rolls were submerged in the molten bath. Almost all such sophisticated coating roll systems have now, however, been superseded by even more sophisticated gas or fluid wiping apparatus which is more flexible and longer lasting and, in general, does a better job at a lesser cost.

In the fluid or gas wiping process as used in the steel industry, a gas such as steam, air, nitrogen or other gaseous fluid is forced from a plenum chamber through a narrow slot or slit and directed against a molten metal coated steel strip or sheet as it passes upwardly from the molten coating bath past or by the slot. The narrow elongated blast of gas issuing from the slot wipes excess molten coating from the surface of the metal base and generally smooths the molten surface. Such gas wiping devices are generally referred to as fluid knives or wipers, or, if air is the wiping fluid, usually as air knives or wipers. They are also sometimes referred to as air doctors.

Fluid-wiping techniques have, in turn, developed into very sophisticated systems and a number of apparatus designs have been developed to wipe or smooth various molten coatings including zinc and aluminum and combinations of zinc and aluminum. One persistent problem has been that of so-called edge buildup in which the coating is thicker along the edges of the coated material due generally to less effective wiping at the edges as the result of interference between oppositely directed blasts of gas wiping the two opposite sides of the strip or sheet material. This has necessitated the use of increased slot diameters at the ends of the gas wiping orifices or slots near the sides of the strip or sheet material. However, since the ultimate coating weight is a function of a number of factors, including, primarily, strip or line speed, strip width and surface finish, strip temperature as well as the molten bath temperature, distance of the gas nozzle from the strip, gas flow through the nozzle and configuration of the nozzle, it is difficult to provide and, in fact, so far as it is known, impossible to provide a single nozzle or slot width and configuration that will be suitable for all coating conditions. Superimposed upon these enumerated factors in any particular coating bath is the further complication that each coating material has its own characteristics which inherently change the characteristics of the wiping operation. For example, molten zinc is inherently heavier than molten aluminum so that the effects of gravity tend to be more pronounced and a lesser blast of wiping gas will, in most cases, be effective to remove more molten zinc coating material than aluminum coating material. The amount of edge buildup, furthermore, is likely to be significantly less. Thus, in changing from one to another coating material, a new coating nozzle or wiping air die is usually necessary, requiring not only the changing of nozzles or wiping dies, a not inconsiderable job, but the maintenance of an inventory of different nozzles and dies which inventory is by no means inexpensive.

Changes in line speed during operation of a coating bath, cooling of the strip, particularly if it has been heated in batch-type rather than in-line furnaces, changes in bath temperature and the like may also have considerable influence upon the wiping of the molten coated surface with a fluid wiper. For example, the molten bath and the strip or sheet being coated are seldom, if ever, of similar temperatures when they are brought together by the strip being immersed in the bath. Consequently, if the strip is cooler, the bath will tend to be cooled and, if the strip is hotter, the bath will tend to be heated as the strip is passed through the bath and the bath will tend to recover in the intervals between strips. This factor in itself causes the coating on the strip to vary progressively in a pattern from end to end. While small, such variation may assume importance for certain products and can be of relatively great economic significance in large scale operations, where any excess coating can assume considerable importance in cost of coating.

It has been recognized, therefore, that it would be desirable to have an infinitely adjustable slot width within normal operating limits which could, in particular, be adjusted while a coating line is operating to make adjustments for other variable factors of the coating operation as well as to make deliberate changes when such appear desirable. For example, it may at times be convenient to change the coating weight part way through the coating of a coil to accommodate a particular order and the like.

It would, in particular, be convenient if the width and configuration of the slot of a gas wiping die could be altered or varied easily, not only between orders or dependent upon coating conditions, but also as a coating operation progresses. Among prior attempts to provide variable orifices to conveniently make changes in the coating of a substrate may be mentioned the following:

U.S. Patent 2,415,644 issued February 11, 1947 to L.W. Leonhard et al. discloses an early form of doctor blade or air knife for smoothing and wiping the coating on a strip or web. Changes in the coating weight obtained by changing various parameters of the coating process, including the gas pressure, the width of the gas wiping orifice and other expedients are mentioned or discussed. Leonhard et al. discloses an air knife having two halves held together by adjusting and locking bolts. These bolts extending through the center of the enclosed chamber may in one embodiment be adjusted by a mechanical arrangement to adjust the opening of the gas orifice between the two halves of the die body in accordance with a control system. While the Leonhard et al. apparatus is designed especially for coating nonmetallic webs and the like and is arranged to operate on only one side of the web, it would probably be applicable also to the coating of metal strip and sheet material.

U.S. Patent 3,753,418 issued August 21, 1973 to R. Roncan discloses a wiping die arrangement for ferrous sheet and strip incorporating a nonadjustable upper lip opposed to an adjustable or flexible lip. The flexible lower lip may be adjusted by means of a mechanical screw arrangement which, through a series of rotating arms and intermediate intermeshing gears, forces the flexible lip up and down to adjust the distance between the lips. Differential adjustment along the length of the lip is said to be attainable.

U.S. Patent 3,841,557 issued October 15, 1974 to E.S. Atkinson discloses a gas wiping die in which the width of the slot from which the gas issues can be selectively adjusted by means of heating elements positioned at closely spaced intervals in one-half of the die. Atkinson, in his background discussion, discloses prior use of removable shims or inserts and the use of adjusting screws or bolts to warp the walls of the gas slot with respect to each other. These prior methods were slow and required an excessive amount of labor, however.

U.S. Patent 3,917,888 issued November 4, 1975 to D.J. Beam et al. discloses a gas wiping die in which the orifice width can be selectively changed by sliding into place on one lip, a variable insert member. The rate of taper of the opening can be adjusted by inserting different adjustment strips on the lip.

U.S. Patent 3,938,468 issued February 17, 1976 to J.B. Kirschner discloses a gas wiping die having a variable slot valve means mounted in or between the lips of the gas orifice of the die to change the effective cross section of the orifice. The valve means is in the form of a long, substantially round member or bar mounted in a circular opening within the die lips. The circular member is relieved in a certain pattern along one side to form a variable valve surface to allow the escape of gas past the rotatable valve member.

U.S. Patent 4,106,429 issued August 15, 1978 to I.J. Phillips discloses a gas wiping die in which the wiping orifice may be varied in size by moving the lips of the wiping orifice of the die longitudinally toward or away from the material being wiped. The lips are moved longitudinally with respect to the remainder of the wiping die. Such longitudinal movement is effected by a rotatable cam arrangement journaled within the lip structure itself. When a cam is rotated, it causes the separate lip structure to slide laterally with respect to the remaining structure of the wiping die, in effect, lengthening or shortening the lips.

U.S. Patent 4,524,716 issued June 25, 1985 to H.J. Mueller discloses a recent gas wiping die particularly for use in the paper coating arts. The Mueller die has converging lips and is provided with a flexible gas flow modification member in the form of a semi-stopper directly behind the opening of the lips. This stopper may be moved toward and away from the opening in the lips to relatively open or close the orifice and thereby control the flow of gas from the lips.

U.S. Patent 5,127,581 to Kuwano et al. discloses a fluid jetting pipe for use with powered chemical sprayers, blow cleaners and the like. The jetting pipe has an opening at the end and is provided with variable pivoted outlet members or throttling means projecting forward from the normal outlet of the jetting pipe. These pivoting outlet members are geared to each other by an intermediate intermeshing gearing which coordinates the opening or outward movement of

one outlet member with the other. The intermeshing gears jointly serve as a linkage unit for simultaneously turning both the variable outlet members in opposite directions. While this U.S. Patent is directed toward a special type of nozzle, principally different from the inventional means, it does broadly disclose two variable position outlet members which are spring biased away from each other (by a separate spring) and which has a mechanical arrangement for overcoming the spring biasing, and describes interlocking gears to coordinate the movement of the two variable position outlet members. The toothed gear arrangement which is disclosed in this U.S. Patent shows gears one jaw or closure member of a pair of closure members together so they have equal movement. The actual movement of the jaw members is not effected by the gearing between them, however. If this U.S. Patent would be combined with e.g. U.S. 2,415,644 therefore, this would result in coordinating the opening of the two sets of outlet members together so that both operate equally or are opened or closed equally by being geared together. If the general arrangement of U.S. 5,127,581 would be changed to a presumably less preferred, merely once mentioned cam arrangement such cam arrangement would then also be used as a linkage unit for simultaneously turning both of the variable outlet members in opposite directions.

As can be seen from the above citations of prior patented gas wiping dies, there have been a fair number of attempts to produce a practical wiping die having a variable, and preferably, an infinitely variable die orifice. However, each has had certain disadvantages and no really satisfactory arrangement for varying the contour of the lips of the gas die to vary the flow of gas through various portions of the gas die to allow for varying conditions on a coating line have been either designed or developed. There is, consequently, a need for a practical gas wiping die or gas doctor, particularly for wiping and smoothing molten metal on the surface of ferrous strip and sheet material that may be conveniently varied in cross section to quickly vary the amount of gas issuing from the die at any given location across the face of the die to allow for variations in the operation of the coating line.

Objects of the Invention

It is an object of the present invention, therefore, to provide a gas wiping die in which the width of the wiping orifice may be varied from portion-to-portion or location-to-location across the face of the die to adjust for changes in the operating parameters of a coating line.

It is a further object of the invention to provide a gas wiping die in which the opening of the gas wiping orifice may be easily varied in a predetermined ratio across the face of the die with changes in the coating operation.

It is a still further object of the invention to provide a substantially infinitely adjustable orifice across the face of a gas wiping die to facilitate control of the wiping gas force upon various portions of a coated strip or sheet passing the coating die.

It is a still further object of the invention to provide an arrangement for differentially varying the width of the opening in a gas wiping die by means of a predetermined cam-shaft arrangement acting directly upon the lips of a wiping die.

It is a still further object of the invention to provide an arrangement for varying the opening of the orifice of a gas wiping die across the face of the die by means of a predetermined shape of a rotatable cam shaft controlling the position of the lips.

It is a still further object of this invention to provide an arrangement for varying the opening of a wiping die by means of an easily changeable cam shaft.

It is a still further object of the invention to provide a method of varying the wiping of a strip or sheet material with a gas wiping die during the coating of a single length of coil in a predetermined manner to allow for a progressive change in line or coating conditions during the coating of a single coil.

It is a still further object of the invention to provide a coating die apparatus that is effective to accurately and conveniently vary, in a predetermined manner, the opening of the wiping orifice of a gas wiping die by a single, foolproof mechanical arrangement.

It is a still further object of the invention to provide a convenient and effective arrangement for varying the opening across the face of a gas wiping die by means of a series of interconnected cams.

It is a still further object of the invention to provide a convenient and effective arrangement for varying the opening of a gas wiping die by means of a series of interconnected cams or a cam shaft extending more or less parallel to the opening of the die and acting upon a flexible lip of said die.

It is a still further object of the invention to provide an arrangement for varying the opening of a gas wiping die by use of more than one cam shaft.

Further objects and advantages of the invention will become evident from review of the following description and discussion together with the appended drawings.

The inventional solution is as defined in claims 1 and 12. Preferable features and embodiments are defined in the subclaims 2 to 11 and 13 to 15. The inventional apparatus is suitable for smoothing and wiping liquid material on a strip, liquid molten metal coated strips or liquid coating material on a flat base material.

The inventional method according to claims 16 to 19 can advantageously be performed with a cam arrangement as defined in the preceding device claims.

Brief Description of the Invention

The present invention provides a gas wiping die for the wiping of molten coatings on flat material passing from a molten coating bath and particularly a molten metal coating bath. The wiping die is provided with at least one flexible or movable lip which is preferably permanently biased in one direction and urged in the opposite direction to tend to open or close the gas wiping die orifice by a multiple cam arrangement. The multiple cams are mounted upon or form an integral part of a cam shaft which is in mechanical contact either directly or indirectly with the flexible lip. Rotation of the cam shaft causes the multiple cams or the various sections of a differential cam or cams to exert more or less force against the movable or flexible lips to adjust them to open or close the die orifice at the effective location of the particular cam diameter in order to control the passage of wiping gas through this portion of the wiping die orifice. More than one cam shaft may be used to exert variable force against the flexible lip. Preferably an electrical stepping motor or motors is or are used to operate the cam shaft or shafts which control the opening between the lips of the die orifice at various positions along the orifice. The cam shafts may be used in conjunction with and/or replaced by differently contoured cam shaft assemblies to vary the adjustments possible. The cam shaft assemblies or equivalent functioning arrangements may be used to progressively vary the opening of wiping dies in a predetermined manner as a strip passes through a coating line to adjust for regularly recurring changes in coating distribution from one end of a coated strip to the other.

The Applicant has proved that if a differential cam arrangement is provided on a cam shaft with the cams in contact with a flexible lip pf the wiping die that a very practical and inexpensive method and means for adjusting the lips of the wiping die differentially both across the face of the strip and temporally along the strip as coating continues is attained. The arrangement of the invention is at once simple, practical and inexpensive.

In the inventional apparatus the cam shaft is preferably provided with a plurality of discreet cam patterns providing different contours to the lip openings in a predetermined time-related sequence when moved at a controlled rate by a motive means connected thereto.

Furthermore, the cam shaft may be advantageously provided with a plurality of smoothly changing cam surface patterns which effectively blend into each other to provide a sequence of preset time-related lip openings blending into each other as the cam patterns are moved at a controlled rate by a motive means connected thereto.

The time sequence essentially is dependent not upon an outside sequence of events, but directly upon a preset contour of a cam arrangement which may be designed to correspond with outside events such as liquid level speed, strip length, temperature or any of a number of other parameters, but is nevertheless preset once made.

Brief Description of the Drawings

Figure 1 is a transverse cross section through a preferred embodiment of the improved wiping die of the invention.

Figure 2 is a longitudinal view of the wiping die shown in Figure 1 viewed in the direction of, or facing the wiping orifice, but with the upper front lip of the die removed.

Figure 3 is a diagrammatic sketch showing the cam arrangement and drive arrangement from the front of the wiping die.

Figure 4 is an end view of a typical cam shaft of the invention showing various diameters and contours of the cams on such shaft.

Figure 5 is a diagrammatic sketch similar to Figure 3, but of an alternative embodiment of the invention incorporating two cam shafts.

Figure 6 is a diagrammatic sketch of a further alternative embodiment showing three cam shafts providing additional flexibility with respect to the corn action.

Figure 7 is a transverse cross section of an alternative embodiment of the invention in which the cam arrangement directly contacts the flexible lower lip section of the wiping die from outside the plenum chamber of the wiping die.

Figure 8 is a longitudinal view of the arrangement of Figure 7 viewed in the direction of the wiping gas orifice with the protective cover normally mounted over the cam arrangement removed.

Figure 9 is a transverse cross section of an alternative embodiment of the invention wherein the cam shaft directly contacts the flexible lower lips from inside the wiping die plenum chamber.

Figure 10 is a front view of the embodiment shown in Figure 9.

Figure 11 is a transverse cross section of an alternative embodiment of the invention wherein the cam shaft directly contacts the upper lip of the coating die from inside the plenum chamber.

Figure 12 is a front view of the embodiment shown in Figure 11.

Figure 13 is a diagrammatic sketch of a control system asscciated with a pair of wiping dies similar to those shown in Figures 1 and 2 mounted on a hot dip coating line.

Figure 14 is a view along the side in a longitudinal direction of a cam shaft made in accordance with one frequent arrangement or embodiment of the invention.

Figure 15 is a view along the side in a longitudinal direction of an integral cam shaft and cam arrangement in accordance with another embodiment of the invention.

Figure 16 is a view along the side in a longitudinal direction of a further embodiment of the present invention.

Figure 17 is an end view of one contour of cam arrangement on a cam shaft in accordance with the present invention.

Figure 18 is an end view of an alternative cam contour on the cam shaft of an alternative embodiment of the present invention.

Figure 19 is a graphical presentation of the contour of the coating of a coated strip exhibiting a differential contour from end to end, said strip having been coated without using the present invention.

Figure 20 is a graphical presentation of the contour of the coating from one end to the other of a coated strip made using the present invention.

Description of the Preferred Embodiments

As indicated in the foregoing introductory remarks, the ultimate coating weight on a hot metal coated strip is a function of a number of factors, including (a) the line speed, (b) the width and surface finish of the strip, (c) strip temperature (d) molten bath temperature, (e) distance of the gas nozzle from the strip, (f) gas flow through the nozzle, and (g) the configuration of the nozzle which determines the configuration of the gas stream issuing from the gas knife and against the strip. One of the primary factors is the configuration of the gas stream issuing from the gas wiping orifice of the gas wiping die. Furthermore, conditions tend to change as the coating process proceeds. Consequently, it would be desirable to have a universally adjustable gas wiping orifice on a gas wiping die, which orifice could be adjusted not only with respect to the relative opening of said orifice, but also with respect to the contour or relative opening across the lateral extent of the gas orifice. In other words, it may be desirable in some operations, to have the gas wiping orifice relatively wide in the center and narrow toward the two edges so a heavier blast of gas issues from the center of said orifice. On the other hand, it is more frequently desirable to have the ends of the gas orifice relatively wider so that a heavier discharge of gas issues from the ends or extremities of the orifice providing more wiping action upon the edges of the strip where a heavy coating buildup tends to occur due primarily to interference between two oppositely moving gas streams or curtains from the two oppositely directed gas wiping orifices on opposite sides of the strip near the strip edges. This is the so-called edge-wiping or heavy edge phenomenon. If a sheet or strip with a uniformly heavy edge is coiled in the normal manner, the edges of the strip will be progressively turned upwardly as the coil is wound causing an unstable winding condition and in a long section of strip resulting in a coil having a severe camber when uncoiled. Such coils often require a separate flattening operation before being used. In addition, the excess coating on the edges is an economic loss, since, if the specification for the thickness of the coating is attained in the center of the coated strip, the sides of the strip will be too heavily coated with a resulting substantial loss in coating material, the cost of which cannot be recovered due to the fact that the coating weight meets a lesser specification overall.

Various arrangements and mechanisms have been proposed in the past for adjusting the width over all of the coating die orifice or, alternatively, adjusting the shape of the orifice. Such methods may comprise most basically the provision of a series of wiping dies having various configurations of orifice openings. Such arrangements may also comprise separate lip assemblies having differential or adjustable openings between them. A still further alternative which has been used to some extent, but not widely, has been in those arrangements in which the lips of the wiping die may be adjusted either mechanically, usually by rotating a threaded rod of some form to move the lips of the wiping die toward or away from each other, or, in at least one case, thermally, to differentially vary the shape and opening between the lips of the gas wiping die. While these various methods for adjusting the lips of a gas wiping die have had some success, they have, in general, not been satisfactory overall. A major detriment of such prior systems has been the multiple adjustments that must be effected in order to differentially adjust the lips of the coating die. This can require the use of multiple control and motor means. Consequently, there has been a need for a practical, easily operable and easily adjustable means for universally and differentially adjusting the opening between the lips of the wiping die or between various portions of the lips of a wiping die.

The present invention provides the practical arrangement, therefore, for varying the opening between the lips of a wiping die on a predetermined pattern basis as well as for making changes in the gauge of the wiping die in response to changing conditions on a coating line. Such changing conditions may involve changing from one order to a different order frequently requiring as a result different gauges of metal, different heating conditions or different coating materials. For example, one order may be for one gauge of strip or sheet material and the immediately following order may have a different gauge.

Since metal to be coated seldom, if ever, is entered into a coating pot at the same temperature as the molten metal within the coating pot, any new gauge strip entered into a coating pot will be either extracting heat from the coating pot at a greater or lesser rate or adding heat to the coating pot at a greater or lesser rate than the immediately preceding strip of a preceding order. In many cases, the material being coated will be heated to a higher temperature during pretreatment than the molten coating bath, depending, of course on the composition of the coating bath, and this additional heat is taken advantage of to maintain the temperature of the coating bath. However, a heavier gauge strip or sheet of the same temperature will add more heat to the molten bath displacing, over a period, the temperature of the bath upwardly and resulting in different wiping properties of the molten metal. Since the heated metal strip enters the

bath at a very high rate of speed, it may cause relatively significant temperature changes in a very short time. Meanwhile, although adjustments of the heating of the coating pot by its principal heating means may be made to counteract changes in the heating of the strip, such changes can only be made relatively slowly. If relatively quick adjustments of the wiping gas can be made, however, these other changes can be often compensated for.

While the pressure of the gas and thereto, the volume of wiping gas have previously been adjustable relatively quickly, differential adjustment of the wiping gas orifices has not been conveniently attainable on an accelerated basis. The differences which differential heating may make in the relative coating weight across the width of a strip may, by the use of the present invention, be immediately compensated for by changing the relative opening of the slot of the coating die. This is done by adjusting the cam arrangement of the invention to bias one of the lips of the coating die more or less from the opposing lip to open or close that particular portion of the coating die orifice as may be appropriate to maintain uniform conditions of coating of the strip.

The coating characteristics of various coating materials such as, for example, zinc, aluminum and aluminum-zinc combinations are also different and the gauge of the coating across the face of the strip varies particularly dependent upon the weight or density of the coating, since different densities cause more or less of the coating to drain downwardly upon the strip surface back into the molten bath merely through the action of gravitational force. Normally upon the changing of the coating material within the pot, it will be necessary to also change the wiping dies in order to have a wiping die with an orifice contour appropriate to that particular coating material. Obviously, however, changing the coating dies adds an extra cost factor, and even if accomplished during the changing of other elements of the coating bath arrangement, still requires additional personnel, not to say the danger of working above or in the vicinity of a hot metal coating material. By the use of the present invention, however, that is with the use of a cam arrangement for varying the width of the slot orifice in the coating die, rapid changes from one coating material to another may be easily adjusted for merely by providing a cam having sections about its diameter appropriate for several alternative coating materials. This still allows a certain amount of specialized variation on the cam which will enable the process to be adjusted for the particular specialized changes which may be encountered with any particular coating material. Alternatively, a different cam rod with a different cam ratio may be easily substituted for a previous cam rod to alter the available adjustments to the orifice opening available during operation.

The following description in conjunction with the appended drawings is designed to make clear the full advantages as well as the operation of the process of the invention and the construction of the necessary equipment for implementing the process of the invention.

In Figure 1 there is shown a typical gas wiping coating die 11 comprising a chamber having more or less angular side walls 13 which enclose an open plenum chamber 15. It will be recognized that the plenum chamber 15 extends outwardly and inwardly from the plane of the drawing to form a fairly extensive open space for the receipt of a wiping gas such as air, steam, nitrogen or other suitable gas to be used for providing an elongated gas blast from the orifice of the wiping die to wipe the surface of a metal strip passing the orifice of the wiping die. Such wiping gas may be supplied to the plenum chamber 15 via headers 14 from which a suitable gas is fed via conduits 16 to the plenum chamber 15. The wiping die 11 is provided also with an upper lip 17 secured to the side walls 13 by fastenings 19, usually large industrial or machine screws. Likewise, the lower lip 21 is also secured to the side walls 13 through machine screws 23. It will be understood that the machine screws 19 and 23 extend more or less in a row along the face of the coating die as shown in various of the figures such as, for example, Figures 3, 5, 6 and 8 which show the upper lip fastenings 19. The lower end of the upper lip 17 is designated as 25 while the outer end of the lower lip 21 is designated as 27. These ends 25 and 27 are contiguous with each other and define between their surfaces a narrow gas slot 29 through which the gas wiping jet or sheet of gas extends. This slot orifice 29 may have an operating width of perhaps three (3) one hundreds to 4.5 one hundreds inches and is preferably adjustable in accordance with the invention within a range of .025 to .050 inches. As may be seen from Figure 2, this adjustment is fairly critical and may be accomplished across the extent of the lip through the action of a continuous series of push or adjustment rods 31 as shown in Figure 3, only one of which is shown in Figure 1. Such rods 31 are arranged to press downwardly upon the lower lip 21 to bias it away from the upper lip 17. It will be understood that there are a series of adjustment rods 31 as shown in Figures 2 and 3 spaced at intervals along the wiping die in a position to exert downward force against the lower lip at various positions along the length of the wiping die. The lower lip 21 is meanwhile arranged to have a natural resilient action which will tend to bring it back or flex it toward the upper lip 17. In this manner, the resilience of the metal in the lower lip is arranged to tend to close the slot orifice 29 while the adjustment rods 31 are arranged to resist this closure and maintain the slot orifice sufficiently open for the exit of the amount of wiping gas which it is desired to have pass through that particular portion of the slot.

The upper portions of the adjustment rods 31 pass through a series of bushings 33 in the upper surface of the side walls 13 of the coating die 11. As shown in Figure 11, the bushings are arranged in a step 35 in the upper portion of the side walls 13 of the coating die 11. However, it will be understood, that the bushings 33 could be positioned in any convenient location within the upper portions of the coating die 11. The upper bearing end 37 of each of the push rods 31 are arranged to contact various cam surfaces 39 of cams 41 spaced at intervals along a cam shaft 43. The cam shaft 43 extends longitudinally along the step 35 of the wiping die and is journaled in conventional fashion in suitable bearings,

not shown, at the ends or positioned at strategic intervals along the step 35, or, in other words, along the longitudinal extent of the coating die 11. As shown diagrammatically in Figure 2, the cam shaft 43 may be turned either by manual adjustment from a suitable crank or other manual means, not shown, for applying torque to the cam shaft 43, or more preferably, by a remote drive means such as an electrical stepping motor or the like controlled from a remote location away from the coating line, or at least away from the immediate vicinity of the hot metal bath. Motor control of the position of the cam shaft may be either controlled by manually operated controls or by computer means as shown, for example, in Figure 13.

Figure 3 shows the end of the cam shaft driven by a chain drive 47 from a stepping motor 49 through the action of sprockets 51 and 53 mounted respectively upon the end of the cam shaft and the stepping motor shaft. The stepping motor 49 is in turn shown supported from an overhang on the end of the coating die. Such overhang 55 comprises the end of a structural member or bracket 57 which passes over the top of the coating die 11 and is secured to the upper portion of the side walls 13 of the coating die in any suitable manner. It will be understood that the bracket 57 may be replaced by any other suitable arrangement for supporting the coating die and/or the stepping motor 49.

Figure 4 shows an enlarged end view of the cam shaft 43 with the series of separate cams of varying sizes and configurations 41 spaced at various locations along the extent of the cam shaft 43. Normally the cams 41 located at or toward the ends of the cam shaft 43 will be larger in general diameter or "higher" at their largest portion than the cams 41 towards the center of the cam shaft 43. The smaller diameter portion of the cams 41 may be substantially the same height as the surface of the cam shaft 43 or may will be mere extensions of the surface of the cam shaft. Alternatively, they may comprise discrete cam sections on a separate shaft as shown in Figures 1 to 3.

As may be seen by reference to Figures 1 and 2, when the cam shaft 43 is rotated by the stepping motor 49 shown in Figure 3, the cams 41 will be rotated into various positions, depending on how much the stepping motor 49 is turned. If the cam shaft 43 is turned from an initial position in which all the cam surfaces are the same elevation or distance from the center 59 of the cam shaft 43, as shown at the upper left in Figure 4, to a position 180 degrees from the initial position, the cams will be brought into a position in which the distance of the cam surfaces 39 of each cam will be at a maximum distance from the center 59 of the cam shaft 43. This will bias the push rods or adjustment rods 31, as shown in Figures 1, 2, 3 and 4, downwardly to a degree dependent upon which diameter of the cam is bearing on its top bearing surface 37. Since the cams 41 designated A, B, C and D in Figure 3 from the ends of the coating die have the greatest maximum diameters in decreasing order, the push rods 31 at the ends of the die will bias the lower lip 21 of the die downwardly farther at the ends of the coating die than toward the center of the coating die. The minimum biasing is at the center of the coating die where the cam surface 39 of the various cams designated in Figure 3, for example, as L, M and N, in increasing order from the center cam L, has the minimum diameter or the minimum distance from the center 59 of the cam shaft 43 to the outer cam surface 39.

It will be seen from the above, therefore, that when the cam shaft is in the minimum position, i.e. wherein the cam surface 39 is the minimum distance from the center 59 of the center of the cam shaft 43, the camber of the slot opening 29, or, in other words, the differential between the opening on the ends of the coating die orifice and the opening of the center of the coating die orifice, will be a minimum. In the case where the cam surfaces are all of equal height at this point, the coating die will be arranged with the orifice having the same diameter along the entire extent of the orifice. When such cam shaft, however, is rotated 180 degrees, the distance from the center of the cam shaft 59 and the individual cam surfaces will be maximized and the orifice will be opened a maximum extent in all areas. Since the end cams are normally arranged to have the maximum distance at this point between the center of the cam shaft and the cam surface, the outer portions of the wiping die will be opened up a maximum amount when the cam shaft is at this 180° position. Rotation of the cam shaft an intermediate amount or degree between the minimum and maximum will provide various intermediate openings of the slot of the wiping die. Thus by machining a cam shaft in various configurations and then moving or rotating such cam shaft to a series of predetermined positions to take advantage of these configurations, a regular sequence of adjustments of the die can be made. Such adjustments may be made for various operating conditions. For example, if it is desired to operate the line with a relatively great differential between the opening of the coating die orifice in the center and the opening of the coating die orifice at the sides of the die or the extremities of the die in order to maximize the suppression of edge buildup, the cam may be rotated to the maximum differential position. However, if for some reason coating buildup is significantly less in another operation, the cam may be rotated to a less extreme position.

Alternatively, if the coating conditions tend to change as the operation of the line continues, the stepping motor may be operated progressively to turn or rotate the cam shaft and apply different openings to the coating die orifices to adjust for continuously varying conditions. While for illustration the use of a cam shaft arrangement has been shown in which the contour of the die opening slot is relatively or differentially opened more at the ends of the die as the overall die slot is increased in opening width particularly to compensate for increasing edge buildup, it will be understood that the cam shaft arrangement of the invention can be made with a relative contour which will compensate for various other changes in coating conditions and changes depending upon the operation.

In Figure 3, the arrangement shown in Figures 1 and 2 is shown from the outside of the die facing towards the die orifice. A series of increasing cam diameters across the face of the wiping die from the center may be seen and it will

be noted that the opening of the slot orifice 29 at the bottom of the die is greater at the ends. The lower ends of the push rods or adjustment rods 31 may be seen through the slot opening or slot orifice 29 as viewed in Figure 3. The push rods or adjustment rods 31, although visible in Figure 3, have a very limited diameter in an actual installation so that they do not seriously interfere with the flow of gas from the slot orifice of the wiping die. In order to minimize any interference with such flow, it is desirable that the adjustment rods 31 be positioned back as far as possible from the opening in the slot orifice as shown in Figure 1. Other designs may bring the push rods even farther away from the slot opening.

Figure 5 is similar to Figure 3, but shows an alternative embodiment of the invention in which there are two separate cam shafts each provided with separate stepping motors 49a and 49b. It is frequently found that the coating operation has become unequal in that one edge of the coated strip or sheet has a heavier coating than the other edge. In such case, it may be desirable to differentially adjust the coating die openings on opposite edges of the strip. The arrangement shown in Figure 5 allows such independent adjustment of the die openings adjacent the two edges. In this manner, if there is a heavier edge buildup on one adjacent edge of the strip for one reason or another, the coating die can be opened more adjacent that edge to allow more for adjustment of the coating on that side by applying a heavier or more vigorous blast of coating wiping gas on that side. It will be understood that in the apparatus of Figure 5, a series of cams on each cam shaft will have different maximum diameters, usually based largely upon having a lesser/maximum on that portion of the cam which is to be used in the center of the die and a greater/maximum diameter on that portion of the cam shaft which is to be mounted near the edges of the coating die. Rather than having a generally curved configuration, therefore, which will provide first a maximum opening, decreasing to a minimum opening near the center of the die and then back to a maximum opening near the other end of the die, each individual cam shaft will have merely a series of diameters which will provide a minimum opening of the die orifices at one end of the cam shaft and a maximum opening at the other end when the cam shaft is turned to its maximum differential extent. As indicated above, this particular sequence is merely illustrative of a frequently used contour for the die opening and various changeable contours can be provided for. As in the arrangement shown in Figures 1, 2, 3 and 4, the cam shafts in Figure 5 may be adjusted either manually by crank means or preferably by stepping motors as shown. Where an automatic control system is used to control the operation of the stepping motors, it will obviously be necessary to incorporate a somewhat more sophisticated control means for maintaining the relative rotation of the cam shafts at a desired proportion. When there are two contiguous cam shafts, it will usually be found desirable to have the minimum height of the cams uniform completely around the two closest adjacent cams so that when these two ends are placed next to each other, the adjustment of the adjacent portions of the lips of the die will be the same regardless of what relative position the adjustment of the two cam shafts take. For convenience in illustration, the camber of the slot opening 29 is shown in Figure 5 uniform across its width.

Figure 6 shows a still further alternative arrangement of the invention which provides not just two (2) separate cam shafts, but three (3) separate cam shafts, 43a, 43b and 43c, each operated by a separate stepping motor 49a, 49b and 49c. As will be understood, this arrangement provides certain advantages of flexibility of the coating line, but also has increased complexity and may be worthwhile only in certain specific lines where complete flexibility is particularly important. The cams and slot opening are again for convenience shown uniform and, in fact, the variations in an actual installation may be so small as to be scarcely detectable with the naked eye.

While the arrangement shown in Figures 1, 2, 3 and 4 and their variations shown in Figures 5 and 6 are very effective and easily implemented, the adjustment rods extending through the plenum chamber of the coating die do introduce a minimum of turbulence and possible variations in the gas wiping jet issuing from the slot in the gas wiping die.

Fig. 7 shows an alternative arrangement for a wiping die in which the cam shaft 43 and cams 41 are journaled in bearings, not shown, on structural brackets 63 attached to or constituting extensions of the side walls 13 of the coating die, see, for example, Fig. 8. The cam shaft 43 and structural brackets 63 are mounted below the wiping die in a position such that the cam surfaces bear against the underside of the lower lip 21 of the wiping die. The stiff structural brackets 63 hold the cam surfaces 39 tightly against the bottom portion of the flexible lower lip 21 of the wiping die so that as the relative elevation of the cam surfaces changes with respect to each other as the cam shaft rotates, the flexible lip may be pressed more or less inwardly to partially close the gap of the slot orifice 29. In the embodiment shown in Figure 7, it will be understood that the flexible lower lip 21 is arranged to have its normal flexing in an outward direction so that such flexing will be opposed by the surfaces 39 of the cams 41. The upper lip 17 is arranged essentially in the same position as in the other die shown in the Figures 1 to 4. It is preferable to have a cover 65 mounted over the cam shaft 43 and cams 41 to prevent them from being splashed by hot metal from the molten coating bath located under the wiping dies. Obviously, if molten metal splashed upon the cam surfaces, it would change, at least temporarily, the critical machining of such surfaces and interfere with accurate operation and biasing of the lower lip 21 of the wiping die 11.

Figure 8 is a longitudinal view of the wiping die shown in Figure 7 viewed in the direction of the orifice slot 29 and showing the cam shaft 43 and the various cams 41 arranged under the main structure of the wiping die. In Figure 8, the cover 65 for the cam shaft arrangement has been removed in order to better show the cam arrangement. It will be noted that, since the cam shaft is positioned beneath the lower lip, there is absolutely no impediment within the plenum chamber 15 which might interfere with even egress of the wiping gas originally derived from the manifolds 14 from plenum chamber 15 through the slot orifice 29. The arrangement of a stepping motor 49 at the end of the wiping die is shown in Figure 8 in a position to operate the cam shaft 43. An outwardly increasing camber of the die opening 29 is shown in Figure 8.

Figure 9 shows a still further embodiment of the invention in which the cam shaft 43 and cams 41 are positioned directly against the flexible lower lip in a somewhat similar manner to that shown in Figure 7 except that the position of the cams is above the lip 21 rather than below the lip 21. It will be understood that the permanent biasing of the lip 21 will, in the case of Figure 9, be toward the upper lip 17 rather than away from it as in Figure 7. Preferably, a smoothly contoured cover 67 is provided within the interior of the plenum chamber 15 of the wiping die shown in Figure 9. Such smoothly contoured cover prevents the inevitable hump occasioned by the presence of the fairly sturdy and substantial cam shaft 43 and cams 41 mounted thereupon from interfering with smooth flow of gas from the plenum chamber 15 through the slot orifice 29. Since the cam shaft 43 and cams 41 are maintained completely within the interior of the wiping die structure, they are in a fairly clean, non-contaminated atmosphere and it is, therefore, not necessary that a tight fit be maintained between the cover and the flexible lower lip 21. This allows the lip 21 to be easily flexed without interference from the cover. Such cover 67 is, as indicated above, present not so much as a protective cover to shield the cams 41 and cam shaft 43, but to attain a smooth flow of gas across the cover which gas might otherwise be forced into turbulence by passage past the uneven surfaces of the cams. It will be understood that both the size of the cam shaft shift and the height of the cover 67 has been exagerated in Figure 9.

Figure 10 shows a longitudinal outside view of the wiping die shown in Figure 9. It will be noted in Figure 10 that the slot orifice does not appear constricted by the presence of adjustment rods or other extraneous mechanical devices which might interfere with the smooth flow of wiping gas from the orifice.

Figure 11 shows a still further alternative embodiment of the invention in which the flexible lip is the upper lip 17, and such lip is biased from the inside by means of a rotatable cam arrangement. As in Figures 7 and 9, the cam shaft 43 and cams 41 supported upon such shaft are supported in turn upon a structural bracket 69 which is attached securely to the end of the upper side wall 13. In Figure 11, the flexible lip 17 will be permanently biased inwardly toward the plenum chamber and the cams 41 will serve to press such lip 17 outwardly away from the plenum chamber and also away from the slot orifice 29 so that said slot orifice is maintained open to allow wiping gas to pass therethrough in a thin sheet which serves to wipe the surface of the strip or sheet passing up from a coating bath past the end of the wiping die 11. Both the structural bracket 69 and the cam shaft 43, as well as the cams 41 attached thereto, are preferably protected by cover 71 which, as seen in Figure 11, is securely attached to the inside of the sidewall 13 of the coating die and extends downwardly over the cam assembly to generally protect the cam assembly from the contents of the plenum chamber 15. A space or clearance 73 is provided, however, between the end of the cover 71 and the inside surface of the flexible upper lip 17 to allow clearance for movement of the flexible lip 17. As in the previous embodiments, flexible lip 17 is biased so that it normally flexes itself in a direction opposite to the direction in which it is forced outwardly by the cam surfaces. While some of the wiping gas will get into the cam chamber behind the cover 71, no harm will be done since the gas, even in the case of steam, is clean and unpolluted. As in the previous embodiments in Figures 7 and 9, it will be seen in Figure 11 that the cam arrangement is substantially out of line with the slot orifice so that neither the cams nor the cover over the cams interferes in any way with the gas exiting from the slot orifice 29. Figure 12 is a front view of the coating die of Figure 11 showing the unobstructed die orifice 29 and clean appearance similar to Figure 10.

It will be understood in Figures 7, 9 and 11 that while the cam means are shown in the form of a single cam, usually rotated by a stepping motor mounted at one end of the die, that double or multiple cams can be used such as shown in Figures 5 and 6.

Figure 13 shows a diagrammatic sketch of a coating apparatus making use of the preferred wiping dies of the invention as shown in Figures 1 through 4. In Figure 13, a coating pot 81 for a hot-dip-coating-type metal such as aluminum, zinc or aluminum-zinc, shown as a pool of molten coating metal 83 in the pot 81, is arranged with a sinker roll 85 held at a predetermined depth within the molten metal 83 and a stabilizer roll 86 just below the surface of the molten metal. A metal strip such as a steel strip 87 passes into the hot metal through the surface after having passed over guide rolls 89, 91 and 93. The guide rolls 89 and 91 are contained within a muffle furnace 95 where the strip is heated, usually in a reducing atmosphere, prior to passing into the molten metal 83. A pair of gas wiping dies 97 and 99, which as indicated above, are substantially identical to those shown diagrammatically in Figures 1 through 4 are supported upon structural support members 101 and 103 upon which they are pivoted at 102 and 104 at a predetermined height above the hot metal bath. The steel strip 87 passes upwardly from the sinker roll 85 past the stabilizer roll 86 and between the gas wiping dies 97 and 99 in a position such that each side of the strip will be wiped by a preheated pressurized gas curtain issuing from the slot orifice of each wiping die. The wiping dies 97 and 99 are both provided with cam means 107 and 109 acting through push rod means 111 and 113 to bias the lower lips of the wiping dies 97 and 99 to provide a differential thickness curtain of gas to wipe the surface of the strip 87 in order to establish a desired thickness of coating upon such surface. The wiping dies 97 and 99 are shown partially broken away to reveal the push rod means 111 and 113 extending vertically inside.

The gas curtain issuing from the slot orifices of the gas wiping dies serves to wipe back excess coating into the coating bath 83. The gas for the wiping dies 97 and 99 is provided through headers 115 and 117 which are supplied with the gas through any suitable source. An electrical stepping motor is provided in conjunction with each coating die 97 and 99 to control the rotation of the cam means 107 and 109. Meanwhile, a main computer control means 121 is

supplied to control the wiping of the strip or sheet automatically. The computer control means 121 is, in itself, controlled from a console 123 which may provide, through manual manipulation, input data indicating what thickness of coating is to be applied to the surface of the strip or sheet. The main computer control is provided with a number of sensors 125, 127 and 129 to detect respectively, the temperature of the strip issuing from the muffle furnace 95 and passing through the snout or hood 96, the temperature of the hot metal bath 83, the thickness of coating on the strip issuing from the bath on both sides of the strip, the temperature detector on the one side of the strip being denoted as detector 129A and the detector on the other side of the strip being denoted as detector 129B. A further detector, again with one detector on each side of the strip, is a coating thickness detector pair 131A and 131B provided above the wiping dies. The two detectors 131A and 131B detect the final coating thickness after the strip has passed through the coating detectors and preferably after the coating has solidified upon the surface of the strip, although this is not strictly necessary. Each one of these detectors is connected to the main computer control by a suitable signal line.

A control line passes also from the computer control 121, to each of the headers 115 and 117 feeding gas to the coating dies as well as to the stepping motors 119 which control each of the cam means. These control lines serve to automatically position the cam means to open or close the slot orifice or wiping orifices of each wiping die to the best differential opening across the face of the die for the particular coating conditions. They also control the amount of gas passing to the coating dies through the headers by means usually of a butterfly valve in the headers. These additional control features are not shown, as they are conventional in the art.

Figures 14, 15 amd 16 show for comparison longitudinal views of forms of cam shafts 43 having either integral cams or separate cams 41 rigidly secured to its surface similar to those shown in the previous views. In Figure 14 the cam shaft is shown by itself with a series of differentially proportioned cams equally spaced along the shaft. The overall camber is shown generally convex rather than concave as shown in the other illustrations to illustrate that various contours of the cam shaft may be used for various control functions. It can be seen in Figure 14 that the top of the cams upon the cam shaft has a substantially parallel series of cam surfaces whereas the bottom of the cam shaft, i.e. 180° from the parallel series of cam surfaces, has a generally convex arrangement of cooperating cam surfaces which define, as shown, a convex shape, which, it will be understood, could also be concave and might more usually be concave in outline. The cam arrangement shown in Figure 14 is designed especially for use with the dies shown in the previous figures where only either a push or adjustment rod bears directly upon the flexible lip which is ultimately moved by the cams or, alternatively, the cam surfaces bear directly upon the surface of the flexible lip of the coating die. It will be understood that various configurations and combinations of cams may be used together to obtain various arrangements of the cam surfaces and contours of the ultimate flexible die surfaces.

Figure 15 shows a modified type of cam in which the cam shaft itself provides essentially the surface of the various cams of the various sections. This is a substantially solid cam arrangement which, it will be noticed, has essentially the same overall outline of cam surfaces as in Figure 14.

One disadvantage of the arrangement shown in Figure 15 is that surfaces of the cams are inclined at the same angle as the overall change between the cam positions This is a disadvantage because of the inclined point of contact with other mechanical means which may tend to be detrimentally displaced to the side, particularly in the operation of adjustment rods such as shown in Figures 1 through 4. However, this disadvantage can be obviated by providing a cam shaft such as shown in Figure 16. In the cam shaft shown in Figure 16, each of the cam locations for operation of a push rod is provided with a uniform surface parallel to the central axis of the cam shaft so that there are, in fact, "flat," although upwardly curved, cam surfaces 61 for the push rods to bear against. It will be seen that Figures 14 and 16 are substantially equivalent to each other with the exception that the excess metal between the cam sections has been removed in Figure 14 to make a lighter, but not necessarily stronger or cheaper structure.

Various cam outlines may also be used. For example, a normal cam outline having a progressively increasing distance between the center of the cam shaft and the edge of the cam surface from one portion to another is shown in Figure 4. Another possible arrangement is shown in Figure 17 in which instead of the maximum distance between the center of the cam shaft and the surface of the cam, i.e. the highest uniform section, being located at 180° from the portion having the lowest uniform section, the distance of the cam surface from the center of the cam shaft instead increases from the minimum distance steadily as the cam turns until the maximum distance between the two points is found at a location of about 300 or more degrees about the cam shaft progressing in one direction. The distance of the cam surface from the center of the cam shaft then decreases precipitiously to bring it back to the minimum or lowest uniform section. The arrangement shown in Figure 17 provides a wider range of attainable adjustments over a cam shaft having the same diameter as the cam shaft arrangement shown in Figure 4. In other words, in Figure 4, the increase in size of the cam shaft occurs over one-half of the distance about the cam shaft, while in Figure 17 the same increase in distance occurs over more than three-quarters of the circumference of the cam or cam shaft allowing basically a more gradual increase which will give finer control with a less precise movement of the cam shaft. The lowest cam portion in Figure 17 is at 61A while the maximum cam diameter is at 61B fairly close by.

Other arrangements are also possible such as, for example, that shown in Figure 18 where the cam surface progresses in a series of steps from lesser to greater distances between the center of the cam shaft and the surface of the cams. As seen in Figure 18, the series of steps 133 provide longer areas, for example 133A and 133B, of more or

less uniform cam action elevation and push rod action. This arrangement also has advantages in obtaining increased preciseness of movement with a less precise prime mover. In other words, a stepping motor or other movement providing means does not have to be as precise in operation to arrive at a given elevation on the cam surface. Instead, certain predetermined, desirable surface elevations are provided already machined on the surface, which the stepping motor or other motive unit need merely reach fairly imprecisely and which will then be held for a significant distance on the cam as the cam shaft turns so that there is less danger that an imprecise opening of the die lips may be attained by an anomaly in the operation of the motive means. Other possible variations of the cam surfaces to operate the cam of the invention will occur to those skilled in the art.

Figure 19 is a plot showing schematically the coating gauge or thickness of a lengthy strip or sheet passing through a coating bath where the strip or sheet is cooler than the bath temperature. Plot A is for thickness of the coating on one edge of the sheet and plot C is for the thickness of the coating on the other edge of the sheet, while plot B is the thickness of the coating in the center of the sheet. The gauge of the coating thickness are plotted on the abscissa of the graph in relative terms, i.e. an increase in coating thickness is shown by increase in the position of the graph for each coating, such positions being plotable according to the index marks on the abscissa at the left and the right of the graph. The index marks, however, do not have any absolute values other than that the marks are 1000th of an inch apart. Consequently, if the strip coating increases by 1000th of an inch, or one mil, the elevation of the plot will rise from one index mark to the next. The three plots, A, B and C, for different portions of the strip, consequently do not indicate that the coating is thicker on A than on C, but only show the relative increase in the coating from one end of the strip at the left of the plot to the other end of the strip at the right of the plot.

It may be seen in Figure 19 that the center of the strip tended to become more thickly coated, but only to a relatively minor extent, while the edges of the strip A and C were more subject to an increase in coating thickness due to heavy edge coating effect which became relatively more pronounced as the temperature of the bath decreased due to the cooling of the strip entering into the bath causing more material to adhere to the strip surface, basically because the molten coating material becomes slightly more viscous with decreasing temperature.

Figure 20 shows the same type of plot as in Figure 19. In the case of Figure 20, plots X and Z plot the relative thickness of coating on the edges of a strip or on the surface of the strip near the edges, while the plot X indicates the thickness of the coating in the center of the strip. The coating line in operation, plotted in Figure 20, is an illustration of typical results to be expected from a line such as shown in Figure 13 when equipped with a means such as the cam arrangement shown in the drawings to gradually increase the opening of the gas orifice and the gas wiping dies, particularly near the edges of the dies as the coating process proceeds from one end to the other strip being coated. It will be seen that the predetermined camber of the cam surfaces has effectively counteracted the progressively increasing viscosity of the coating by opening the gas wiping die's orifices sufficiently to counteract such increasing viscosity by wiping additional coating from the surface of the strip. The control system 121, shown in Figure 13, through detection of the temperature of the strip and of the bath material operates the stepping motors which turn the cam surfaces at a rate which will maintain both the temperature of the bath material more constant and at the same time, compensates for the increasing viscosity of the molten bath material by increasing the gas blast issuing from the slot orifices of the wiping dies. Since essentially the same series of increases tend to occur in each coating bath subjected to this phenomenon, a cam which will correct for this type of changes can be fairly easily designed.

As will be recognized, if the relative increase in the cam surfaces of the cam rod shown in either Figures 14, 15 or 16, are carefully calculated beforehand, and the rapidity of change of the stepping motor is also carefully orchestrated by a computer means or even, alternatively, by manual means, the continuous compensation demonstrated by Figure 20 for a slow and undesirable increase in the amount of coating on a strip can be easily compensated for. It will be recognized that if manual turning of the cams are provided, that the compensation will be somewhat stepwise, since very fine adjustments will not be practical. However, three to four adjustments of the cam rotation during the run through of a strip will successfully even out the coating to a considerable extent. Naturally, however, it is very desirable to have a computer run the stepping motors. Alternatively, the motors can be run manually, again, however, with the somewhat stepwise adjustment which this provides. A more uniformly coated strip on the average, however, will still result.

It will also be recognized, that a coating line making use of the cam rod adjustments of the present invention will normally have available a series of cam rods which may be easily substituted for each other, depending upon the operation of the line. For example, a given line may well have a master cam rod which will take care of most changes on a line and allow the line operators to compensate particularly over a period for heavy edge buildup and the like. However, at the same time, other specialized cam rods may be produced and kept available at the site to compensate for specialized conditions or to provide specialized adjustment for the openings in the coating knives.

While the present invention has been described at some length and with some particularlity with regard to several embodiments, it is not intended that the invention be limited to any such particulars or embodiments, but it is to be construed broadly with reference to the appended claims so as to provide the broadest possible interpretation of such claims in view of the prior art and thereby to effectively encompass the intended scope of the invention.

Claims

1. An adjustable die for smoothing and wiping liquid coating material on flat elongated material moving past said die using a fluid wiping medium issuing from said die comprising:

   (a) a die body (11) encompassing a plenum chamber (15) and an elongated orifice along one side for egress of said fluid wiping medium,
   (b) means for supplying pressurized fluid wiping medium to said plenum chamber,
   (c) a pair of fluid confining members (17, 21) on each side of the elongated orifice (29) for defining the opening between said fluid confining members and therefore the conformation and/or dimensions of any stream of fluid wiping medium passing through the orifice,
   (d) at least one of said fluid confining members being resiliently biasable toward or away from the other of said pair of fluid confining members,
   (e) said resiliently biasable confining member being in at least indirect physical contact with at least two different contour variable position cam surfaces (39) arranged and constructed to bias the resilient fluid confining member at two different points in line with the elongated orifice in directions which will redefine the conformation and/or dimensions of the elongated orifice and therefore the stream of any fluid wiping medium passing through the orifice. and
   (f) said variable position cam surface being adjustable with respect to its position by means of a movement engendering means.

2. An adjustable wiping die in accordance with claim 1 wherein the pair of fluid confining members comprise integrally relisient lip means (17, 21) on the wiping die.

3. An adjustable wiping die in accordance with claim 2 wherein there are a plurality of differentially contoured variable position cam surfaces (39) in at least indirect contact with the resilient lip means (17, 21).

4. An adjustable wiping die in accordance with claim 3 wherein the plurality of variable position cam surfaces (39) are provided upon a rotatable cam shaft (43) rotatable by the movement engendering means.

5. An adjustable wiping die in accordance with claim 4 wherein the variable position cam surfaces (39) are in indirect contact with said resilient lip means (17, 21) through a plurality of independent intermediate biasing members (31).

6. An adjustable wiping die in accordance with claim 5 wherein the plurality of independent intermediate biasing members comprise independently movable push rod means (31) extending between the variable position cam surfaces and the resilient lip means.

7. An adjustable wiping die in accordance with claim 4 wherein the variable position cam surfaces (39) are in direct contact with the resilient lip means to bias said lip means.

8. An adjustable wiping die in accordance with claim 7 wherein the variable position cam surfaces (39) are defined by substantially adjacent cams (41) mounted on a cam shaft (43) or wherein the variable position cam surfaces are defined by a substantially continuous variable conformation cam surface on a rotatable cam member.

9. An adjustable wiping die in accordance with claim 3 wherein the variable position cam surfaces (39) are defined by a variable conformation cam surface positioned along a rotatable cam member which is rotatable by a stepping motor (49), wherein operation of the stepping motor to rotate the rotatable cam member is controlled by a control system in accordance with a predetermined pattern based upon coating operation data provided to the control system.

10. An adjustable wiping die in accordance with claims 8 and 9 wherein there are at least two separate cam shafts (43) for adjusting separate sections of the resilient lip means.

11. An adjustable wiping die in accordance with claim 2 wherein the resilient lip means is permanently biased in a direction opposite to which the variable position cam surface will physically urge the lip means.

12. An apparatus for smoothing and wiping liquid material on a strip by gas wiping comprising:

(a) an elongated plenum chamber (15) connected to manifold means (14, 16) for supplying a wiping gas to said plenum chamber,

(b) a pair of oppositely disposed lips (17, 21) associated with said plenum chamber and defining an elongated gas ejection and wiping orifice (29) on said plenum chamber,

(c) at least one of said oppositely disposed lips having a resilient construction enabling the outer end of said lip to be adjustably positioned with respect to the outer lip to thereby vary the orifice width between the lips,

(d) a plurality of differential cam sufaces (39) provided about a transverse shaft (43) mounted substantially parallel to the orifice between the lips such that the cam surfaces are in at least in direct contact with a surface of said lip having a resilient construction such that rotation of said shaft will differentially alter the contour of said lip and the elongated gas ejection and wiping orifice in a predetermined ratio.

13. An apparatus in accordance with claim 12 wherein natural flexure of the lip is toward the opposite lip and the shaft and the associated cam surfaces are journaled within the plenum chamber adjacent and in effective contact with one side of the flexible lip or, alternatively, wherein natural flexure of the lip is away from the opposite lip and the shaft and associated cam surfaces are located outside of the plenum chamber in at least indirect contact with said lip.

14. An apparatus in accordance with claim 13 additionally incorporating a shield means separating the cam means in contact with said lip from the main portion of the plenum chamber.

15. An apparatus in accordance with claims 13 and 14 wherein the transverse shaft is rotatable by a stepping motor.

16. A method for wiping a coated sheet or strip material with a gas wiping die comprising:

(a) passing the coated material past the wiping die,

(b) adjusting the wiping gas flow through the gas orifice in the die differentially along the extent of the orifice in a predetermined pattern by varying the distance between the lips at differential locations along the lips by a means having a predetermined contour pattern of differential adjustment modes operable in discreet time periods during operation of the coating line for providing predetermined contour openings between the lips.

17. A method in accordance with claim 16 wherein the means having predetermined differential adjustment modes is a rotatable cam arrangement.

18. A method in accordance with claim 16 or 17 wherein a series of predetermined contour openings between the lips is provided by a cam shaft having a plurality of differential cam surfaces associated with it and with a plurality of discreet cam patterns providing different contours to the lip openings in a time-related sequence.

19. A method in accordance with claim 16 or 17 wherein the cam shaft is provided with a plurality of smoothly changing cam patterns which effectively blend into each other to provide a sequence of time-related lip openings blending into each other.

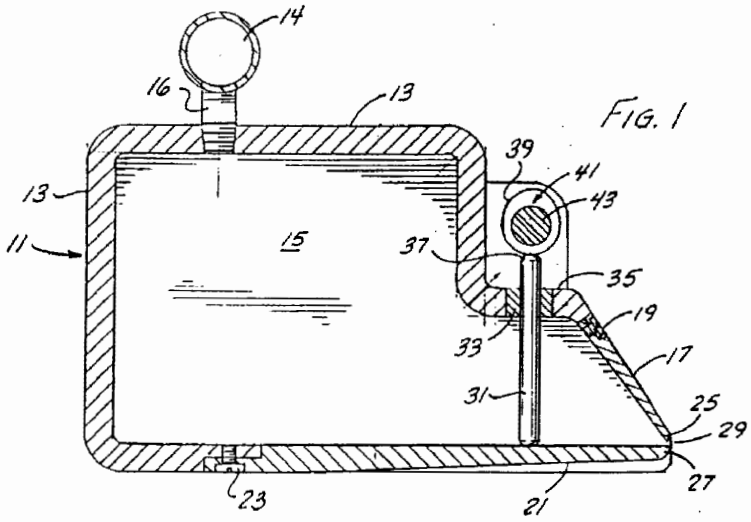
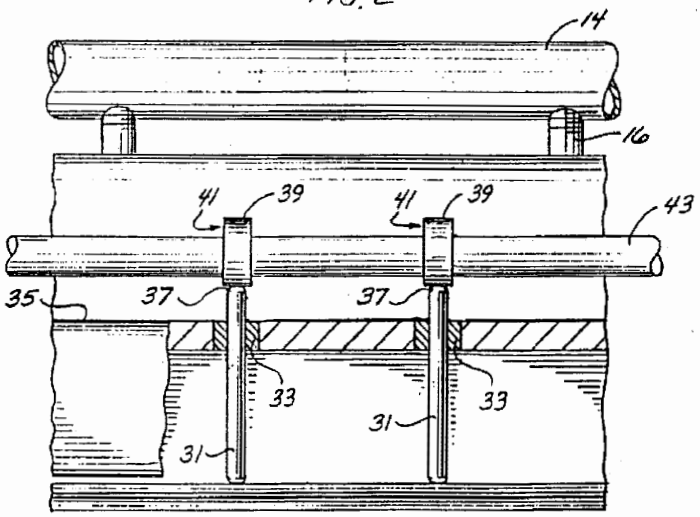

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FIG. 1

FIG. 2


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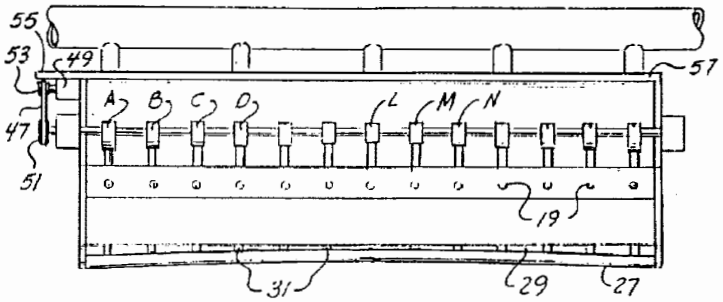


FIG. 3

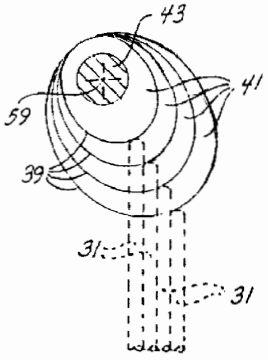


FIG. 4

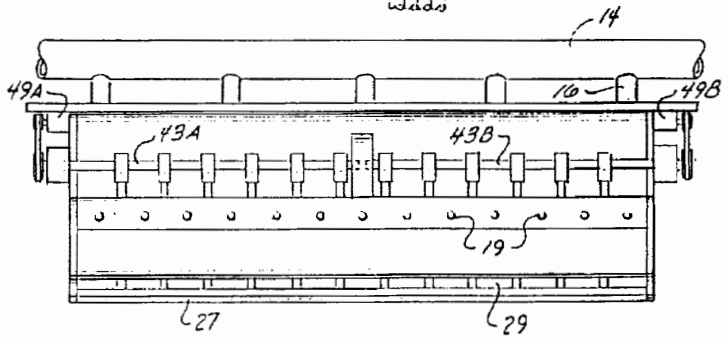


FIG. 5

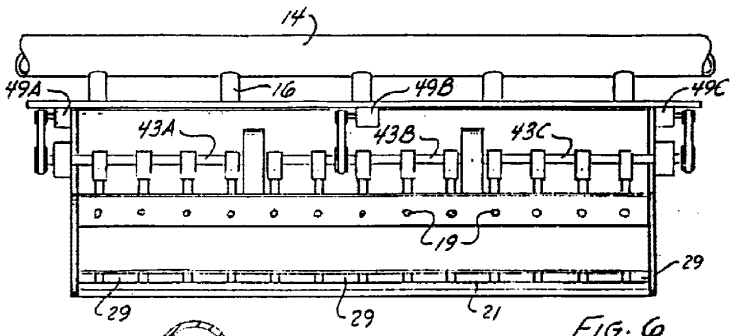


FIG. 6

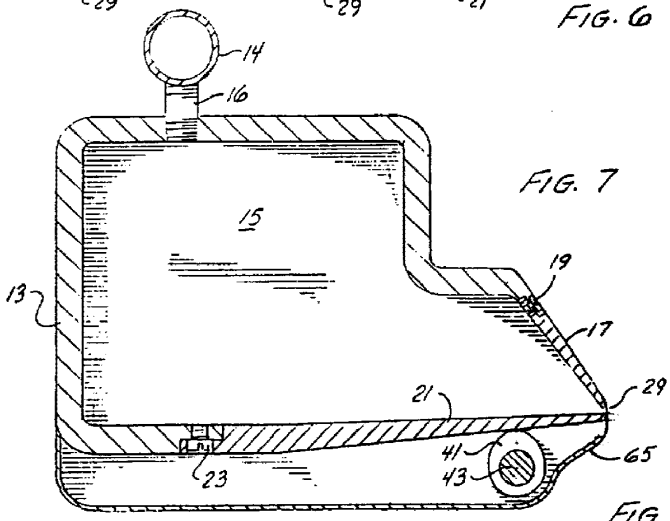


FIG. 7

FIG. 8

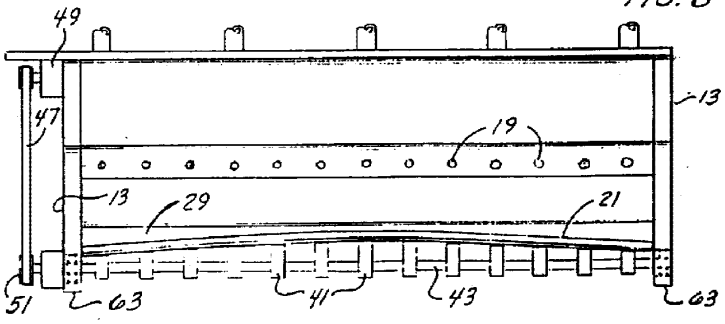
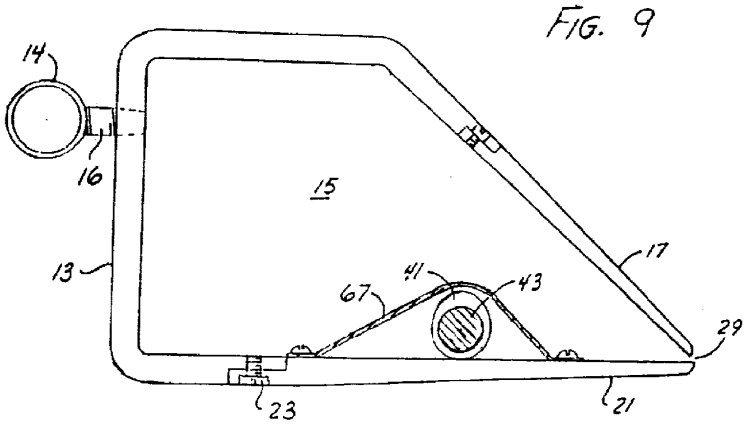


FIG. 9



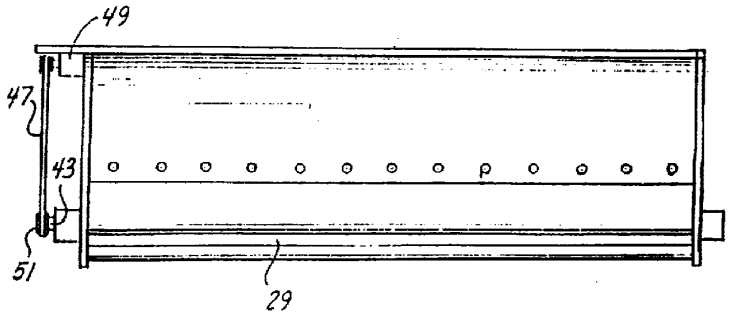


FIG. 10

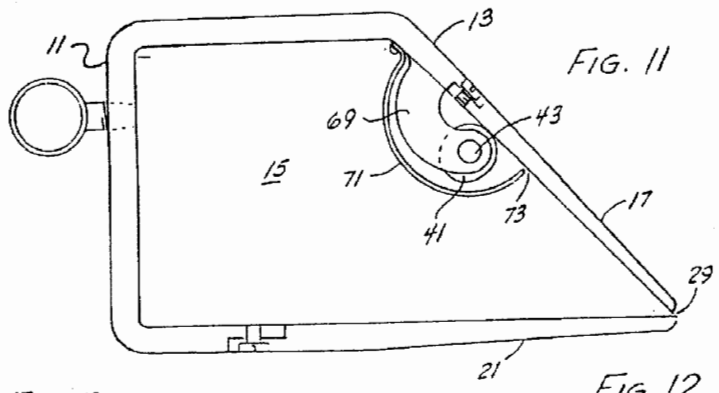


FIG. 11

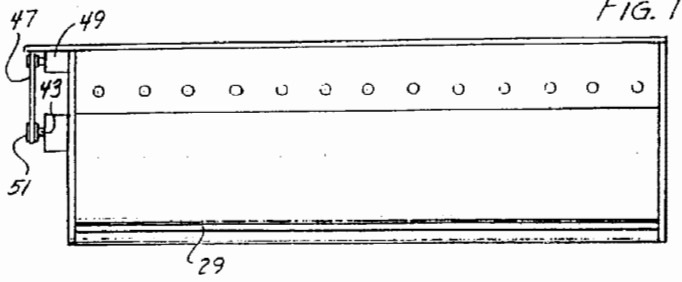


FIG. 12

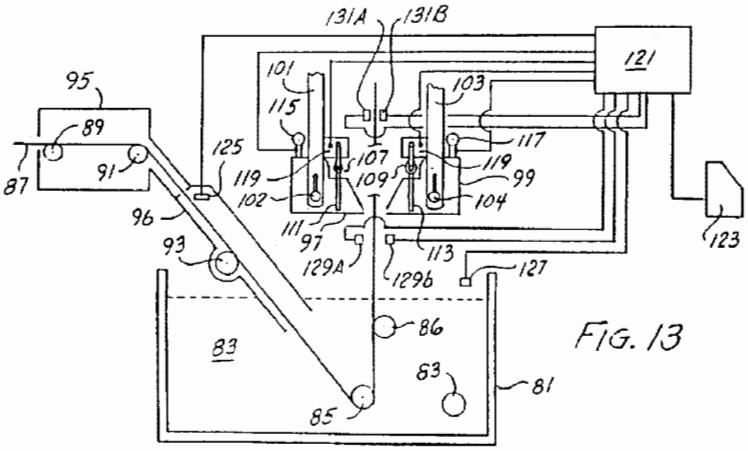


FIG. 13

FIG. 14

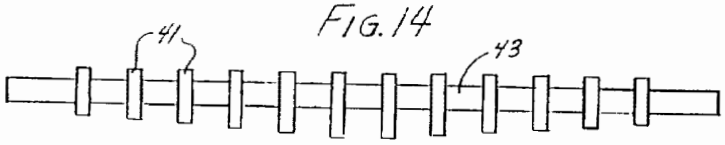


FIG. 15

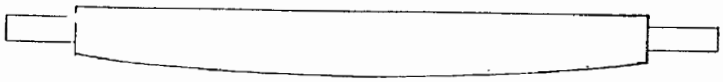


FIG. 16

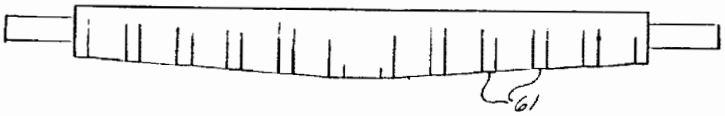


FIG. 17

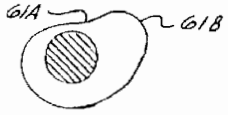


FIG. 18

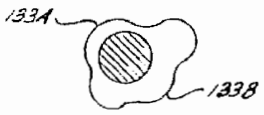


FIG. 19

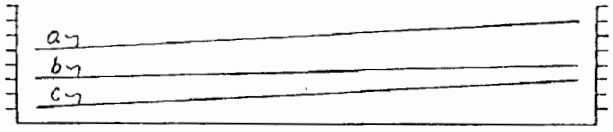
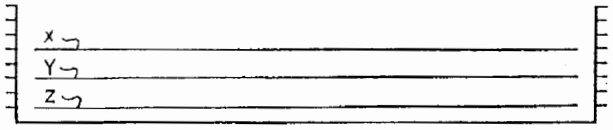


FIG. 20



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 0948

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 17, no. 373 (C-1083) 14 July 1993 & JP-A-05 059 514 (NISSHIN STEEL) 9 March 1993 * abstract *	1-6, 11-13, 16,17	C23C2/20
X	EP-A-0 566 497 (CLECIM) * page 4, column 6, line 59 - page 5, column 7, line 11; claims 1-15; figures 2-4 *	16	
A	* page 5, column 8, line 24 - line 30 *	1-6, 9-13, 17-19	
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 180 (C-0935) 30 April 1992 & JP-A-04 021 752 (KAWASAKI STEEL CORP) 24 January 1992 * abstract *	1,16	
A	FR-A-2 136 041 (DEMAG) * claims 1-9; figures 1-4 *	16	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A,D	FR-A-2 090 313 (ITALSIDER) * claims; figures 1,2 *	16	C23C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 November 1994	Elsen, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 063 314 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.12.2000 Bulletin 2000/52

(21) Application number: **00112814.9**

(22) Date of filing: **16.06.2000**

(51) Int. Cl.[7]: **C23C 2/00**, C23C 2/14, C23C 2/20

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **24.06.1999 JP 17773299**

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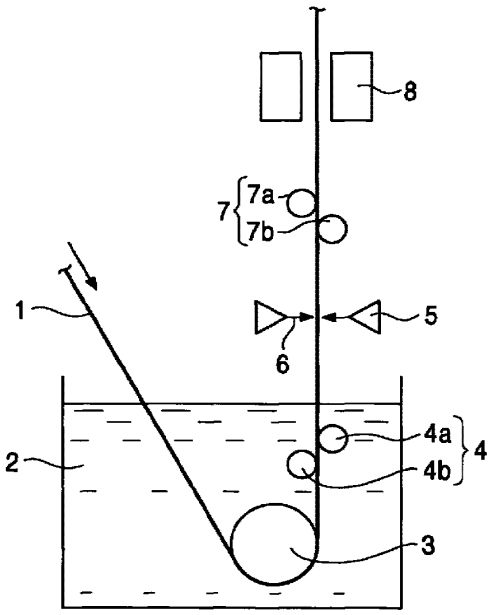
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(54) Method of manufacturing hot dip coated metal strip

(57) A method of manufacturing a hot dip coated metal strip includes the steps of depositing a molten metal coating solution on the surfaces of the metal strip by continuously dipping the metal strip in a coating bath, lifting the metal strip at a constant speed while supporting it with a pair of upper and lower support rolls for clamping the surfaces of the metal strip in the coating bath, adjusting the coating weights of the molten metal deposited on the surfaces of the metal strip by wiping the molten metal with gases from gas wiping nozzles disposed above the surface of the coating bath, and advancing the metal strip while supporting it with a pair of upper and lower touch rolls for clamping the surfaces thereof, wherein the metal strip is advanced by setting the distance L between the upper support roll disposed in the coating bath and the lower touch roll disposed outside the coating bath within the range determined by a formula $L \leq 80 \times T \times W^2/V$, where L: distance between the upper support roll in the coating bath and the lower touch roll outside the coating bath (mm), V: line speed of the metal strip (m/min),
T: tension imposed on the metal strip (kgf/mm^2), and W: target coating weight per one side of the metal strip (g/m^2). According to the invention, the stable quality of the metal strip can be obtained by reducing the variation of the coasting weights of the molten metal deposited on the surfaces of the metal strip by reducing the variation of the coating weights of the molten metal deposited on the surfaces of the metal strip at all times regardless of the change of the operating conditions under which continuous hot dip galvanizing operation is carried out. Further, a coating cost can be greatly reduced by preventing the excessive deposition of the molten metal.

FIG. 2



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a method of manufacturing a hot dip coated metal strip. More particularly, the present invention relates to a method of manufacturing a hot dip coated metal strip having a coating layer of a uniform thickness by reducing the vibration of the metal strip which is lifted from a hot dip coating bath and travels vertically at an approximately constant speed.

2. Description of the Related Art

[0002] In general, hot dip galvanizing is applied to the surfaces of a steel strip using a continuous hot dip galvanizing apparatus (also referred to as a line) as described below.

[0003] First, as shown in Fig. 2, a steel strip 1 as a material to be coated is introduced into a hot dip galvanizing bath 2, the direction of travel of the steel strip 1 is diverted upward by a sink roll 3 disposed in the galvanizing bath 2, the crossbow of the steel strip 1 is corrected by a pair of upper and lower support rolls 4 disposed in the galvanizing bath 2 so as to clamp both the surfaces of the steel strip 1, and then the steel strip 1 is lifted vertically from the galvanizing bath 2. During that time, molten zinc is deposited on the surfaces of the steel strip 1. A gas 6 (referred to as a wiping gas) is blown onto the surfaces of the steel strip 1, on which the molten zinc has been deposited and which travels upward, through nozzles 5 (referred to as wiping nozzles because they wipe off the coated metal) so that the amount of the molten metal deposited on the steel strip 1 is adjusted to a desired amount (so that the molten metal can be uniformly deposited on the entire surface of the steel strip 1). A pair of touch rolls 7, which clamp the surfaces of the steel strip 1 similarly to the support rolls 4, are disposed above the wiping nozzles 5 to stabilize the travel of the steel strip 1. The steel strip 1, which has passed through the touch rolls 7, may be subjected to an alloying treatment by travelling through an alloying furnace 8 disposed above the touch rolls 7 so that the coating layer thereof is alloyed when necessary.

[0004] By the way, recently, it has become very important to stably manufacture at high speed a hot dip galvanized steel strip which has a low coating weight (referred to as light coating). In accordance with the reduced coating weight, there has been required a technology for manufacturing a hot dip galvanized steel strip while preventing the vibration thereof due to an increase in the pressure of the wiping gas 6, and the like. This is because the coating weight of the molten zinc deposited on the surfaces of the steel strip is greatly varied by an increase in the vibration of the steel strip and the quality of a product is thereby deteriorated.

[0005] Ordinarily, when the hot dip coated steel strip 1, which has a particularly low coating weight (coating weight per one side is 45 g/m^2 or less), is manufactured at a high speed, the steel strip 1 is vibrated at the position where the wiping nozzles 5 are disposed in a direction vertical to the surfaces thereof in a total amplitude of vibration of 1 - 2 mm at all times.

[0006] Since wiping cannot be smoothly carried out when this vibration occurs, at present, the standard deviation of the variation of the coating weights on the surfaces of a steel strip σ is set to a large value of 2 - 4 g/m^2 (σ = 2 - 4 g/m^2) with respect to the coating weight per one side of 45 g/m^2. However, since it is generally required by customers to guarantee the lower limit of the coating weight, when the guarantee for the lower limit is kept, molten zinc is excessively deposited. This means that a large amount of zinc is wastefully consumed from the view point of manufacturers.

[0007] When a hot dip galvannealed steel strip is manufactured, the large variation of the coating weight directly leads to the variation of the coating weight of hot dip galvannealing. Thus, when the steel strip 1 is manufactured, the coating is often undesirably exfoliated in a powder state (referred to as powdering) from a portion of the steel strip 1 where zinc is thickly deposited; moreover,a defect such as uneven alloying, and the like is liable to occur in the manufacture of the steel strip 1.

[0008] Technologies for preventing the vibration have been vigorously developed and many of them have been published. For example, Japanese Unexamined Patent Application Publications Nos. 5-320847 and 5-078806 disclose technologies for disposing a static pressure pad to maintain the pressure of a gas which is blown to wiping nozzles at a constant pressure. Further, Japanese Unexamined Patent Application Publication No. 6-322503 discloses a technology for separately disposing nozzles for blowing a shield gas above wiping nozzles and disposing gas shield plates between the shield gas blowing nozzles and the wiping nozzles.

[0009] However, the technologies for preventing the vibration of a steel strip by means of the static pressure pad or by blowing another gas are not in practical use because high power must be specially provided to generate a desired pressure and flow rate of gas as well as the effect of the technologies is lowered when the steel strip has a relatively large thickness.

[0010] Further, Japanese Unexamined Patent Application Publications Nos. 52-113330, 6-179956 and 6-287736 disclose technologies for preventing the vibration of a steel strip using magnetic force or electromagnetic force. However, these technologies are not yet in practical use because not only do they separately require an expensive magnetic force generator and operation is made complex but also the effect of the technologies is lowered in a steel strip having a relatively large thickness.

SUMMARY OF THE INVENTION

[0011] In view of the above circumstances, an object of the present invention is to provide a method of manufacturing a hot dip coated metal strip which can provide the metal strip with stable quality by reducing the variation of the coating weight of molten metal to be deposited on the surfaces of the metal strip even if operating conditions of hot dip coating are changed as well as which can greatly lower a coating cost by preventing the excessive deposition of the molten metal.

[0012] To achieve the above object, the inventors examined the influences of tension of a traveling metal strip, target coating weight, linear speed of the metal strip, pressure of a wiping gas, distance between a touch roll disposed above wiping nozzles and a support roll disposed in a bath, and the like on the vibration of the metal strip at a gas wiping position in many test operations. Then, the inventors have completed the present invention based on a knowledge discovered from the analysis of data obtained in the examination that the vibration of a metal strip can be greatly reduced when operation is carried out by setting the distance between the touch roll and the support roll disposed in the bath within a certain range.

[0013] That is, according to the present invention, there is provided a method of manufacturing a hot dip coated metal strip which includes the steps of depositing molten metal on the surfaces of the metal strip by continuously dipping the metal strip in a hot dip coating bath, lifting the metal strip at a constant speed while supporting it with a pair of upper and lower support rolls for clamping the surfaces of the metal strip in the coating bath, adjusting the coating weights of the molten metal deposited on the surfaces of the metal strip by wiping the molten metal with gases from gas wiping nozzles disposed above the surface of the coating bath, and advancing the metal strip while supporting it with a pair of upper and lower touch rolls disposed outside the coating bath for clamping the surfaces thereof, wherein the metal strip is advanced by setting the distance L between the upper support roll disposed in the coating bath and the lower touch roll disposed outside the coating bath within the range determined by the following formula:

$$L \leq 80 \times T \times W^2/V$$

in which,

L: distance between the upper support roll in the coating bath and the lower touch roll outside the coating bath (mm);
V: linear speed of the metal strip (m/min);
T: tension imposed on the metal strip (kgf/mm^2); and
W: target coating weight per one side of the metal strip (g/m^2)

[0014] Furthermore, according to the present invention, it is preferable that the metal strip be composed of a steel strip and that the molten metal coating solution in the hot dip coating bath be molten zinc. Still further, it is preferable that the metal strip be subjected to an alloying treatment downstream of the upper touch roll.

[0015] According to the present invention, the total amplitude of vibration of the metal strip having the molten metal deposited on the surfaces thereof is greatly reduced at gas wiping positions as compared with a conventional total amplitude of vibration, and coating weights can be smoothly and ideally adjusted. As a result, a metal strip having molten metal deposited on all surfaces thereof can be stably manufactured with a uniform coating weight.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a view showing how support rolls and touch rolls are disposed within and outside a bath, respectively, and how a steel strip is vibrated;
Fig. 2 is a view showing an ordinary continuous hot dip galvanizing apparatus;
Fig. 3 is a graph showing the relationship between a distance L between an upper support roll in the bath and a lower touch roll outside the bath and a total amplitude of vibration of a steel strip;
Fig. 4 is a graph showing the relationship between a pressure of a gas ejected from gas wiping nozzles and a total

amplitude of vibration of a steel strip;

Fig. 5 is a graph showing the relationship between tension of a steel strip and a total amplitude of vibration thereof;

Fig. 6 is a graph showing the relationship between a pressure of a gas ejected from the gas wiping nozzles and a coating weight per one side of a steel strip;

Fig. 7 is a graph showing the relationship between the linear speed of a steel strip and a coating weight per one side thereof;

Fig. 8 is a graph showing the relationship between a total amplitude of vibration of a steel strip and variation of a coating weight per one side thereof;

Fig. 9 is a graph comparing variation of a coating weight in a conventional coating method and that in the method of the present invention;

Fig. 10 is a graph comparing an amount of consumption of metal in the conventional coating method and that in the method of the present invention; and

Fig. 11 is a graph comparing a ratio of occurrence of a defective product due to powdering in the conventional coating method and that in the method of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0017] The inventors carried out various test operations using the continuous hot dip galvanizing apparatus shown in Fig. 2 and described above. At that time, the support rolls 4 and the touch rolls 7 are arranged as pairs of upper and lower rolls, respectively as shown in Figs. 1 and 2. In the figures, each upper roll is denoted by "a" and each lower roll is denoted by "b".

[0018] A distance L (reference numeral 10, units of mm) was measured between an upper support roll 4a and a lower touch roll 7b in parallel with the pass line 9 of the steel strip 1. Further, a total amplitude of vibration B (reference numeral 11, units of mm) of the steel strip 1 was measured by measuring with a range finder distances between the surfaces of the steel strip 1 and the front edges of the wiping nozzles (hereinafter, simply referred to as nozzles) 5 perpendicular to the pass line 9.

[0019] First, the inventors examined the influence of the distance L between the upper support roll 4a disposed in the bath and the lower touch roll 7b on the total amplitude of vibration B of the steel strip 1 when tension of the steel strip 1 was set to 1.5 kgf/mm^2 and a line speed thereof was set to 90 m/min. As a result, the relationship shown in Fig. 3 was found. That is, the total amplitude of vibration was reduced by a decrease in the distance L whenever a coating weight per one side was 30 g/m^2 and 45 g/m^2. The relationship is represented by the following formula (1).

$$B \propto L \tag{1}$$

[0020] Furthermore, the inventors paid attention to the pressure p of a wiping gas 6 and the tension T of the steel strip 1 as factors which influenced the total amplitude of vibration B of the steel strip 1 and tested them. Fig. 4 shows the result of measurement of the pressure p and the total amplitude of vibration B of the steel strip when the distance L was set to 1000 mm and the distance between the front edges of the nozzles and the surfaces of the steel strip was set to about 6 - 8 mm. Furthermore, Fig. 5 shows the result of measurement of the total amplitude of vibration B of the steel strip 1 when the tension T was variously changed.

[0021] It can be seen from Figs. 4 and 5 that the total amplitude of vibration B of the steel strip 1 is approximately in proportion to the gas pressure p of the nozzles and approximately in inverse proportion to the tension T of the steel strip 1. This relationship can be expressed simply by a formula (2).

$$B \propto P/T \tag{2}$$

[0022] Further, the relationship among the gas pressure of the nozzles, the line speed of the steel strip 1 and the coating weight thereof was examined.

[0023] Fig. 6 shows the relationship between the gas pressure p and the coating weight per one side of the steel strip 1 when the distance between the front edges of the nozzles 5 and the steel strip 1 was set to 6 - 8 mm and the line speed of the steel strip 1 was set to 90 m/min and the gas pressure p was variously changed. In this case, the coating weight per one side is approximately in proportion to the inverse square root of the pressure P. In contrast, Fig. 7 shows the relationship between the line speed of the steel strip 1 and the coating weight per one side when the distance between the front edges of the nozzles and the steel strip 1 was set to about 6 - 8 mm, the pressure P was kept constant and the line speed was variously changed. As a result, it can be seen that the coating weight per one side is approximately in proportion to the square root of the line speed of the steel strip 1.

[0024] Therefore, the following formula (3) will be established, where the coating weight per one side is represented by W (g/m^2), the line speed of the steel strip 1 is represented by V (m/min) and the gas pressure P is represented by P

(kgf/cm^2).

$$P \propto V/W^2 \quad (3)$$

[0025] Note that the coating weight per one side W was measured with a coating weight meter and shows the value of the coating weight per one side of the steel strip 1. Further, while the relationship between the line speed of the steel strip 1 and the total amplitude of vibration B thereof was examined with the other conditions kept constant in the test, the total amplitude of vibration B of the steel strip 1 was almost entirely uninfluenced by the line speed.

[0026] Thus, the inventors have found that the following formula will be established by arranging the formulas (1), (2), and (3) obtained in the above tests.

$$B \propto L \times V/(T \times W^2) \quad (4)$$

[0027] Next, the expression $L \times V/(T \times W^2)$, which was referred to as a vibration coefficient, was used to arrange test data.

[0028] The inventors thereafter examined the relationship between the total amplitude of vibration B of the steel strip 1 and the variation of the coating weight (evaluation was carried out based on the standard deviation $\sigma(g/m^2)$ of the coating weight). Conventionally, the variation of the coating weight is evaluated on both sides of a steel strip and Japanese Industrial Standards (JIS) also employs so-called "both side guarantee" which evaluates the variation based on both side total coating weight of steel strip. The applicant discloses a both side coating technology in Japanese Unexamined Patent Application Publication No. 10-306356.

[0029] In the variation of the both side total coating weight, when the steel strip 1 approaches one of the wiping nozzles 5 by vibration, the coating weight of the side of the steel strip 1 near to the nozzle is reduced, whereas the coating weight of the side thereof far from the nozzle is increased. However, a "both side total coating weight" which is obtained by adding the coating weights of both the sides of the steel strip 1 does not greatly vary in many cases, and thus the standard deviation σ is made to a small value. Therefore, the "both side guarantee" is used for convenience in technology, and the deviation of the coating weight must be naturally evaluated based on the coating weight per one side from the view point of coating characteristics, an anti-powdering property and the like. As a natural result, automobile manufactures recently require "one side guarantee" beyond the stipulation of JIS.

[0030] Thus, when the inventors reviewed coating weights used in their company at present on the basis of one side, it was found that the standard deviation σ of them was about 2 - 3 g/m^2. Thus, we intended to establish an operating method of coating for obtaining a standard deviation σ smaller than the above value, specifically, a standard deviation σ of 1.5 g/m^2or less. As a result, the inventors have found that the operating method can be established when a total amplitude of vibration B of a steel strip is set to 0.5 mm or less regardless of the change of the operating conditions in coating as shown in Fig. 8. When many tests were carried out to stably minimize the total amplitude of vibration, it was found that the vibration coefficient should satisfy the following formula.

$$L \times V/(T \times W^2) \leq 80$$

The present invention has been completed by employing this condition. That is, the steel strip 1 is advanced with the upper limit of the distance L between the upper support roll 4a and the lower touch roll 7b which is set to satisfy the following formula.

$$L \leq 80 \times V/(T \times W^2)$$

[0031] Furthermore, it is even better to set the upper limit to satisfy $L \leq 60 \times V/(T \times W^2)$.

[0032] Note that the lower limit of the distance L is not particularly critical in the present invention. In an actual coating apparatus, however, the upper support roll 4a ordinarily has a diameter of about 250 mmØ, each support roll has an immersion depth of about 150 - 200 mm at the center thereof, a height of each wiping nozzle 5 above the bath is about 150 - 600 mm, and a distance of at least about 300 mm is necessary from each wiping nozzle 5 to the lower touch roll 7b above the bath from a view point of the structure of the coating apparatus. As a result, in practice the lower limit of the distance L is expected to be about 600 mm.

[0033] Furthermore, it is preferable to move the touch roll 7b to actually change the distance L. This is because it is easier to move the lower touch roll 7b than to move the upper support roll 4a disposed in the bath from the view point of the structure of the coating apparatus.

Example

[0034] A cold rolled steel strip 1 having a thickness of 0.65 - 0.90 mm was galvanized by the continuous hot dip galvanizing apparatus shown in Fig. 2.

[0035] At that time, operation was carried out using the method of manufacturing a hot dip coated metal strip according to the present invention in which restriction is imposed on the setting of the distance between the above rolls (examples of the present invention) and by a conventional method in which no restriction is imposed thereon (comparative examples). A coating weight was measured on-line while advancing the steel strip 1. The measurement was performed by a fluorescent X-ray coating weight meter (not shown) disposed above the steel strip 1 in travel so as to face downward. Accordingly, the variation σ of the measured coating weights represents the variation thereof on one side of the steel strip 1. Furthermore, the pressure of a wiping gas used under the conditions of the respective examples is a value measured on the side of the steel strip 1 where the coating weight was measured.

[0036] Table 1 shows the operating conditions and the result of the measurements collectively. It is apparent from Table 1 that in the specimens Nos. 1 - 18, which were manufactured by the manufacturing method according to the present invention, the total amplitudes of vibration of the steel strip 1 are 0.5 mm or less because $L \times V/(T \times W^2) \leq 80$ is satisfied therein. As a result, the variation σ of the coating weights is made to 1.5 g/m^2 or less in all the examples (refer to Fig. 9). This suggests that a target value of the coating weight can more closely approach a lower limit value in the operation and the consumption of metal can be greatly reduced thereby. Fig. 10 shows the comparison of an amount of coating metal actually consumed in the conventional manufacturing method with that actually consumed in the manufacturing method according to the present invention. When the consumption in the conventional manufacturing method is represented by 100%, the consumption in the manufacturing method of the present invention is about 90%. This means that the consumption of the coating metal can be greatly reduced.

[0037] On the other hand, in the specimens Nos. 19 - 29 manufactured by the conventional manufacturing method, the steel strip 1 has a large total amplitude of vibration and the variation σ of the coating weights thereof is 2.0 g/m^2 or more.

Table 1

	No.	Thickness (mm)	Width (mm)	Line Speed (m/min)	Tension (kg/mm²)	Coating Weight per One Side (g/m²)	Pressure of Wiping Gas (kg/cm²)	L (mm)	(V×L)/(T×W²)	Total Amplitude of Vibration (mm)	Variation of coating weights σ(g/m²)
Example of the Invention	1	0.7	1200	60	2.0	31	0.58	800	25	0.19	0.25
	2	0.7	1200	60	1.5	30	0.58	800	36	0.23	0.31
	3	0.7	1200	60	1.0	43	0.28	800	26	0.25	0.30
	4	0.7	1200	57	2.0	32	0.58	1000	28	0.22	0.35
	5	0.75	1150	58	1.5	30	0.58	1000	43	0.30	0.55
	6	0.75	1150	60	1.5	45	0.25	1000	20	0.20	0.23
	7	0.75	1150	60	2.0	28	0.58	1200	46	0.27	0.50
	8	0.75	1150	62	1.5	33	0.58	1200	46	0.33	0.60
	9	0.75	1150	60	1.5	31	0.58	1200	50	0.40	1.05
	10	0.65	1350	90	2.0	30	0.92	800	16	0.26	0.25
	11	0.65	1350	90	2.0	47	0.44	800	16	0.13	0.23
	12	0.65	1350	92	2.0	57	0.23	800	11	0.10	0.20
	13	0.85	1150	122	2.0	32	1.22	800	48	0.35	0.51
	14	0.85	1150	120	2.0	43	0.54	800	26	0.20	0.30
	15	0.85	1150	119	2.0	58	0.32	800	14	0.12	0.20
	16	0.85	1150	120	2.0	35	1.08	1200	59	0.44	1.35
	17	0.85	1150	122	2.0	45	0.55	1200	36	0.25	0.51
	18	0.85	1150	122	2.0	55	0.31	1200	24	0.15	0.30
	19	0.85	1150	120	1.5	35	0.60	1000	65	0.47	1.41
	20	0.85	1150	120	1.5	35	0.60	1200	78	0.50	1.50
Comparative Example	19	0.72	1300	60	1.0	32	0.63	1500	88	0.60	1.9
	20	0.7	1550	60	1.0	31	0.48	1500	94	0.62	1.8
	21	0.7	1550	58	1.3	30	0.59	1800	89	0.55	1.8
	22	0.7	1550	90	1.0	30	0.92	1500	150	1.05	4.0
	23	0.7	1550	90	1.1	35	0.65	1500	100	0.70	2.0
	24	0.67	1050	90	1.5	30	0.88	1500	100	0.65	1.8
	25	0.67	1050	92	1.0	45	0.43	200	91	0.58	1.6
	26	0.9	1450	122	1.0	32	1.13	1500	178	1.35	6.0
	27	0.9	1450	120	1.0	43	0.60	1500	97	0.70	2.2
	28	0.9	1450	120	1.5	35	0.96	1300	85	0.55	1.8
	29	0.9	1450	122	1.5	30	1.22	1300	117	0.70	2.1

[0038] Next, a so-called "hot dip galvanized steel strip" was manufacturing by disposing an alloying furnace 8 above the touch rolls 7 in Fig. 2 and by heating the steel strip 1 on which molten zinc was deposited in the alloying furnace 8 so that the Fe content in the zinc coating layer of the steel strip 1 was made to 8 - 13 wt%. Then, an anti-powdering property, which was one of important characteristics of quality, of the steel strip 1 was examined. Powdering is a defect wherein a deposited coating layer is exfoliated in a powder state from a portion of a hot dip galvanized steel sheet, which detracts from the intimate contact property of the coating during press forming thereof. When this phenomenon occurs during press forming, the powder of the coating falls between a press die and the steel sheet to thereby cause a defect of irregularity to the steel sheet. Thus, it is desired that no powdering occurs.

[0039] Operation was carried out paying attention to the powdering under the conditions of a target coating weight per one side set to 45 - 55 g/m^2, a line speed of the steel strip 1 set to 100 m/min - 150 m/min, and a tension of the steel

strip 1 set to 1.5 kgf/mm^2 - 2.0 kgf/mm^2. Table 2 shows examples of operating conditions other than the above operating conditions and the result of the operation collectively. Note that the anti-powdering property was evaluated by a known method of putting an adhesive tape on the coating layer of a specimen sampled from a hot dip galvanized steel strip under pressure, peeling off the adhesive tape after the specimen was bent 90° and returned to its original state and then measuring an amount of exfoliation of the coated layer with a fluorescent X-ray. That is, the anti-powdering property is represented by the number of counts, which is counted with the X-ray, of zinc contained in the exfoliated coating layer. Usually, when the number of counts is 1500 or less, no defect due to powdering occurs at an actual press forming. However, when the number of counts exceeds 1500, a defect due to powdering often occurs.

[0040] It is apparent from Table 2 that since the variation of a coating weight can be greatly reduced according to the method of the present invention, the number of counts is stable at a low value, whereby the hot dip galvanized steel strip 1 excellent in the anti-powdering property can be stably manufactured. In contrast, in the conventional method, there was made a product in which the number of counts was increased and made to 1500 or more at some portions and in which the defect due to powdering was liable arise often when the product was processed. This is because a coating weight greatly varied in the product. Fig. 11 shows a ratio of occurrence of defective products after they were press formed. It is apparent from Fig. 11 that almost no defective products are made by the method of the present invention.

[0041] In the above examples, the steel strip was used as a metal strip and the molten zinc was used as molten metal. However, it is needless to say that the present invention is by no means limited thereto and is applicable to other kinds of metal strip and to molten metal other than molten zinc.

Table 2

	Experiment No.	Thickness (mm)	Width (mm)	L (mm)	Total Amplitude of Vibration (mm)	Variation of coating weights σ(g/m^2)	Average Density of Fe in Coating Layer (%)	Number of Counts of Powdering (Count/Sec) *
Example of the Invention	1	0.75	1200	800	0.21	0.25	11.0	400-870
	2	0.75	1200	800	0.24	0.31	11.3	500-950
	3	0.75	1200	800	0.22	0.30	12.5	350-750
	4	0.75	1200	1000	0.40	1.05	12.7	370-1200
	5	0.75	1200	1000	0.29	0.55	10.9	450-850
	6	0.80	1550	800	0.31	0.43	11.8	480-720
	7	0.80	1550	800	0.25	0.50	11.3	500-950
	8	0.80	1550	800	0.35	0.60	12.2	430-830
	9	0.80	1550	800	0.38	1.02	10.7	500-1350
	10	0.80	1550	800	0.27	0.23	10.8	350-730
Comparative Example	11	0.75	1250	1500	0.65	2.02	11.3	430-1950
	12	0.75	1250	1500	0.60	1.90	10.8	520-1750
	13	0.75	1250	1500	0.85	3.50	11.5	480-1550
	14	0.75	1250	1500	1.02	4.20	12.0	550-2500
	15	0.75	1250	1500	0.88	4.00	11.4	450-2550
	16	0.86	1500	1600	0.95	3.60	11.8	580-1950
	17	0.86	1500	1600	1.20	5.20	10.7	550-3200
	18	0.86	1500	1600	1.10	4.30	10.5	650-2900
	19	0.86	1500	1600	0.92	3.75	11.2	800-2300
	20	0.86	1500	1600	0.98	3.80	12.4	600-2050

*: Showing Maximum and Minimum Measured Values

As described above, a metal strip having molten metal deposited on all surfaces thereof at a uniform coating weight can be manufactured by the present invention. As a result, it is possible to more closely approach a lower target coating weight during a coating operation, whereby the consumption of coating metal can be greatly reduced as compared with a conventional consumption.

Claims

1. A method of manufacturing a hot dip coated metal strip, comprising the steps of:

dipping a metal strip in a hot dip coating bath to continuously deposit molten metal on surfaces of the metal strip;
conveying the metal strip at a substantially constant speed while supporting said strip with a pair of upper and lower support rolls that clamp the surfaces of the metal strip in the coating bath;
adjusting a coating weight of the molten metal deposited on the surfaces of the metal strip by wiping the molten metal with gases from gas wiping nozzles disposed above a surface of the coating bath; and
advancing the metal strip while supporting it with a pair of upper and lower touch rolls disposed outside the coating bath for clamping the surfaces thereof,
wherein the metal strip is advanced by setting the distance L between the upper support roll disposed in the coating bath and the lower touch roll disposed outside the coating bath within the range determined by the following formula

$$L \leq 80 \times T \times W^2/V$$

wherein,

L: distance between the upper support roll in the coating bath and the lower touch roll outside the coating bath (mm);
V: line speed of the metal strip (m/min);
T: tension imposed on the metal strip (kgf/mm^2); and
W: target coating weight per one side of the metal strip (g/m^2).

2. The method according to claim 1, wherein said metal strip is composed of a steel strip and said hot dip coating bath is filled with molten zinc.

3. The method according to claim 1, wherein said metal strip is subjected to an alloying treatment downstream of said upper touch roll.

4. A method of manufacturing a hot dip coated metal strip, comprising the steps of:

conveying a metal strip through a hot dip coating bath to continuously deposit molten metal on surfaces of the metal strip;
supporting said metal strip with a pair of support rolls submerged in the coating bath;
blowing gas on said metal strip as it emerges from said coating bath with gas wiping nozzles disposed above a surface of the coating bath, thereby to adjust a coating weight of molten metal on said strip; and
further conveying the metal strip while supporting it with a pair of touch rolls disposed outside the coating bath, wherein a distance L between an upper support roll disposed in the coating bath and a lower touch roll disposed outside the coating bath is maintained according to the following formula

$$L \leq 80 \times T \times W^2/V$$

wherein,

L: distance between the upper support roll in the coating bath and the lower touch roll outside the coating bath (mm);
V: line speed of the metal strip (m/min);
T: tension imposed on the metal strip (kgf/mm^2); and
W: target coating weight per one side of the metal strip (g/m^2).

5. The method according to claim 4, wherein said metal strip is composed of a steel strip and said hot dip coating bath is filled with molten zinc.

6. The method according to claim 4, wherein said metal strip is subjected to an alloying treatment downstream of said upper touch roll.

FIG. 1

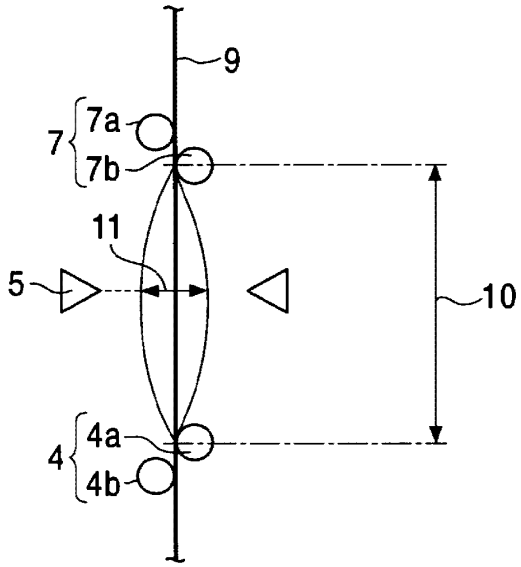


FIG. 2

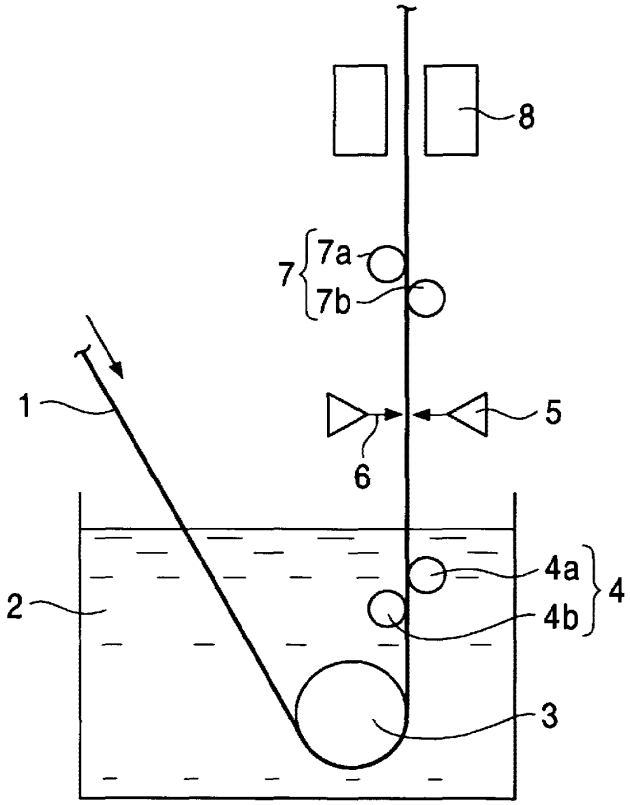


FIG. 3

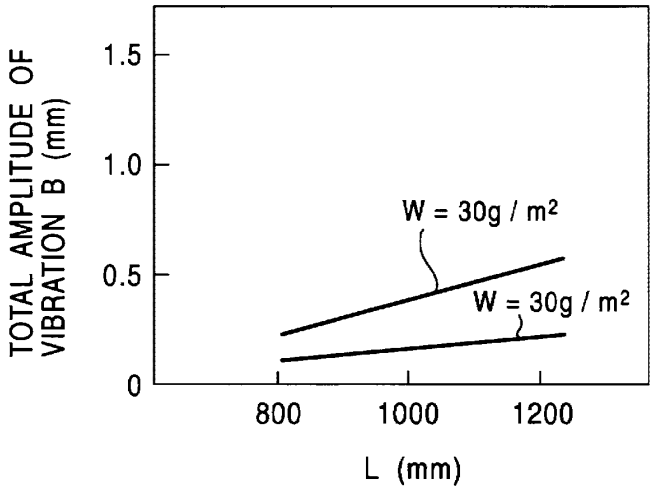

TOTAL AMPLITUDE OF VIBRATION B (mm)
1.5
1.0
0.5
0
W = 30g / m²
W = 30g / m²
800
1000
1200
L (mm)

FIG. 4

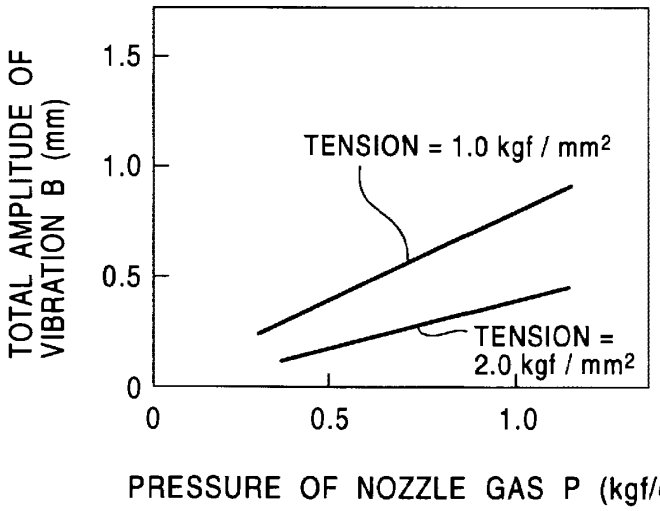

TOTAL AMPLITUDE OF VIBRATION B (mm)
1.5
1.0
0.5
0
TENSION = 1.0 kgf / mm²
TENSION = 2.0 kgf / mm²
0
0.5
1.0
PRESSURE OF NOZZLE GAS P (kgf/cm²)

FIG. 5

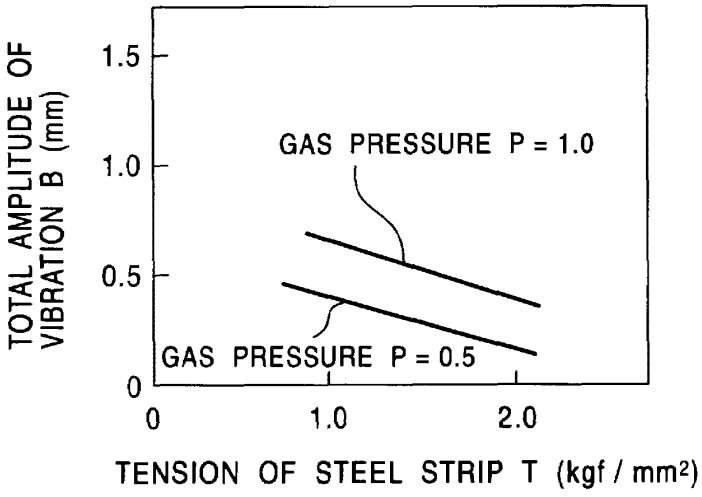

TOTAL AMPLITUDE OF VIBRATION B (mm)
1.5
1.0
0.5
0
GAS PRESSURE P = 1.0
GAS PRESSURE P = 0.5
0
1.0
2.0
TENSION OF STEEL STRIP T (kgf / mm²)

FIG. 6

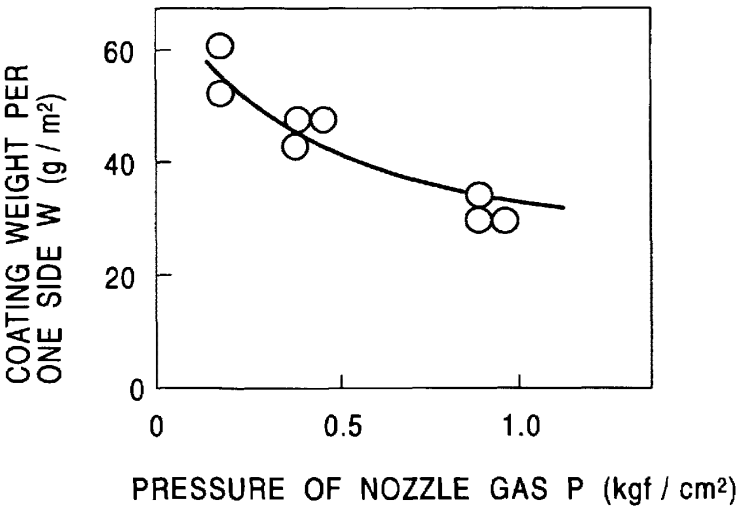

COATING WEIGHT PER ONE SIDE W (g / m²)
60
40
20
0
0
0.5
1.0
PRESSURE OF NOZZLE GAS P (kgf / cm²)

FIG. 7

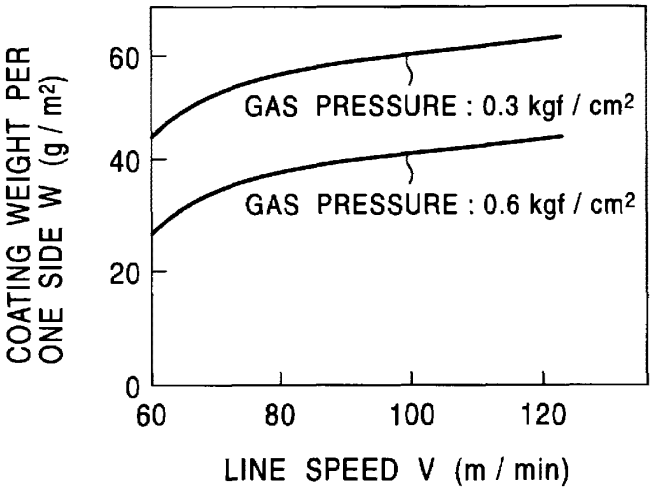

COATING WEIGHT PER ONE SIDE W (g / m²)
60
40
20
0
GAS PRESSURE : 0.3 kgf / cm²
GAS PRESSURE : 0.6 kgf / cm²
60
80
100
120
LINE SPEED V (m / min)

FIG. 8

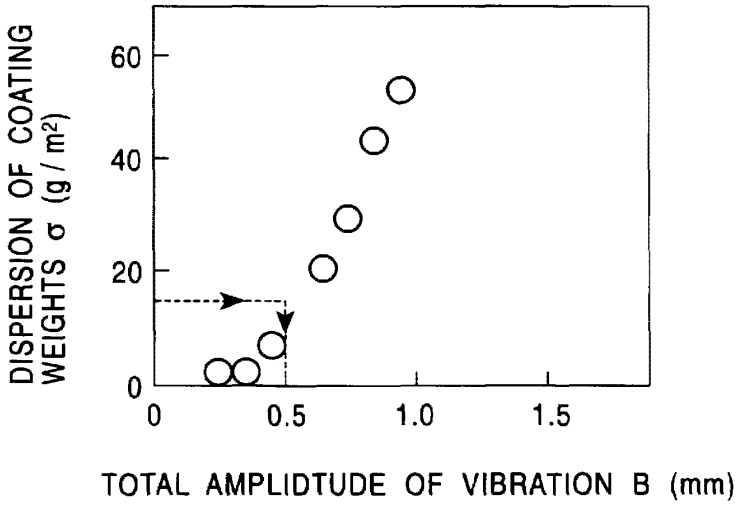

DISPERSION OF COATING WEIGHTS σ (g / m²)
60
40
20
0
0
0.5
1.0
1.5
TOTAL AMPLIDTUDE OF VIBRATION B (mm)

FIG. 9

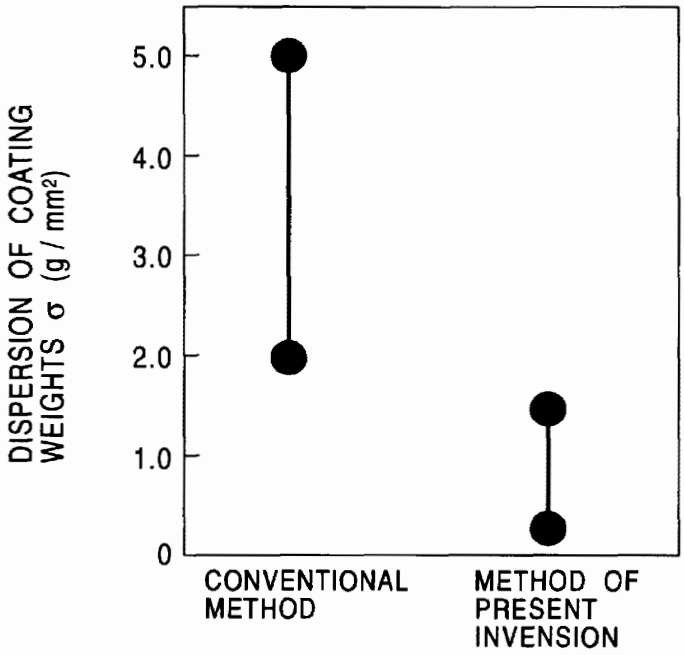

DISPERSION OF COATING WEIGHTS σ (g / mm²)
5.0
4.0
3.0
2.0
1.0
0
CONVENTIONAL METHOD
METHOD OF PRESENT INVENSION

FIG. 10

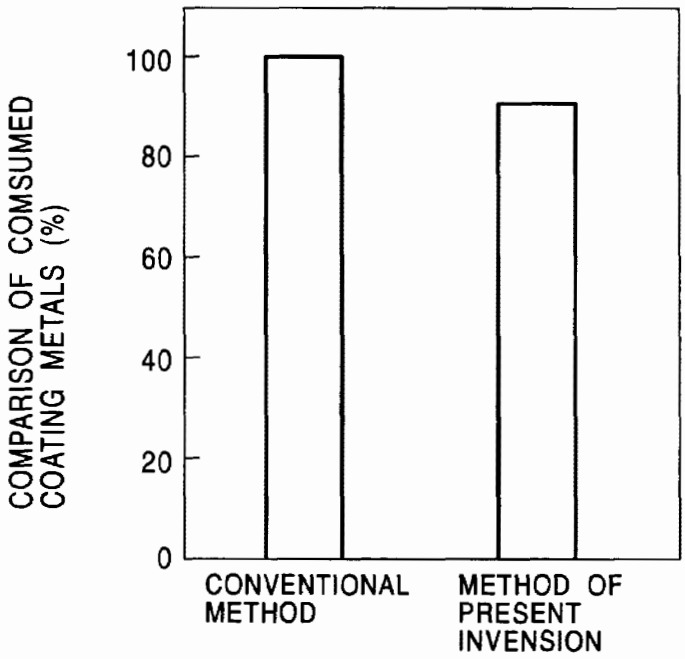
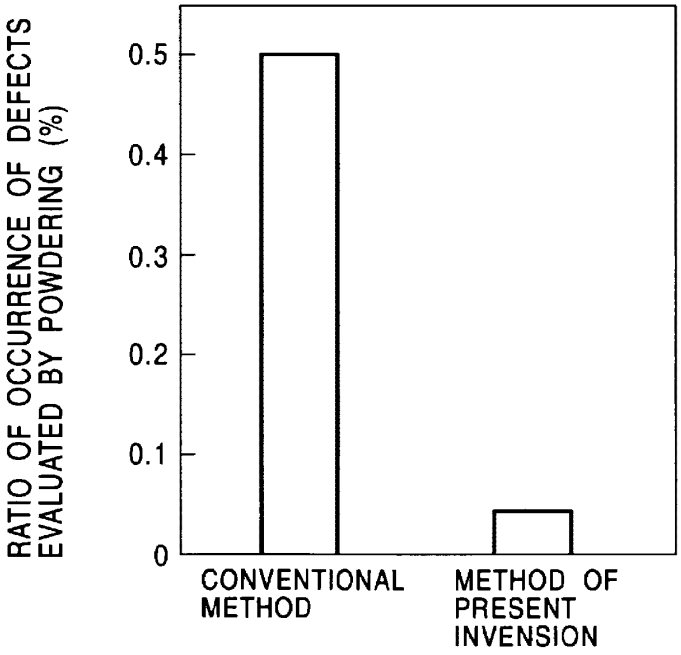

COMPARISON OF COMSUMED COATING METALS (%)
100
80
60
40
20
0
CONVENTIONAL METHOD
METHOD OF PRESENT INVENSION

FIG. 11


RATIO OF OCCURRENCE OF DEFECTS EVALUATED BY POWDERING (%)
0.5
0.4
0.3
0.2
0.1
0
CONVENTIONAL METHOD
METHOD OF PRESENT INVENSION

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 11 2814

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 12, 25 December 1997 (1997-12-25) & JP 09 202955 A (KAWASAKI STEEL CORP), 5 August 1997 (1997-08-05) * abstract *		C23C2/00 C23C2/14 C23C2/20
A	PATENT ABSTRACTS OF JAPAN vol. 009, no. 222 (C-302), 9 September 1985 (1985-09-09) & JP 60 082653 A (KAWASAKI SEITETSU KK;OTHERS: 01), 10 May 1985 (1985-05-10) * abstract *		
A	PATENT ABSTRACTS OF JAPAN vol. 012, no. 219 (C-506), 22 June 1988 (1988-06-22) & JP 63 014847 A (KAWASAKI STEEL CORP), 22 January 1988 (1988-01-22) * abstract *		TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 September 2000	Elsen, D

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 11 2814

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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21-09-2000

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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CLAIMS FR2720079A1

CLAIMS

1.

- A method of hot-dipped coating of a part, in particular of a strip, of steel containing at least 0.1% by weight of manganese, in particular of stainless and / or alloy steel in which the strip is prepared before coating following a sequence of treatments carried out under a controlled atmosphere then the strip is dipped in a bath of aluminum or molten aluminum alloy, characterized in that the atmospheres of said treatments are all non-reducing.

2.

- Method according to claim 1 characterized in that the hydrogen concentrations in the atmospheres of said treatments are all less than or equal to 4%.

3.

- Method according to claim 1 or 2 characterized in that said treatments are heat treatments.

4.

- Method according to claim 3 characterized in that, when said sequence of treatments comprises heating and cooling, the heating and cooling atmospheres contain more than 96% nitrogen.

Espacenet

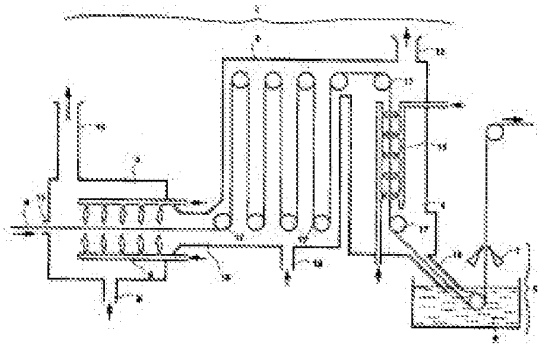
Bibliographic data: FR2720079 (A1) — 1995-11-24

Hot dip coating steel with aluminium (alloy)

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Classification:	**- international:** ***C23C2/02; C23C2/12;*** (IPC1-7): C23C2/02; C23C2/12; C23C2/40 **- cooperative:** **C23C2/02 (EP); C23C2/12 (EP)**
Application number:	FR19940006239 19940519
Priority number(s):	FR19940006239 19940519
Also published as:	FR2720079 (B1) AT158823 (T) DE69500797 (T2) EP0698671 (A1) EP0698671 (B1) more

Abstract of FR2720079 (A1)

A steel strip containing at least 0.1 wt.% Mn is pretreated prior to hot dip coating with Al or Al alloy. During the pretreatments which consist of cleaning, heat treatment and cooling, the atmosphere is maintained as completely non-reducing. Coating esp. stainless and alloy steels. By avoiding the use of hydrogen containing atmospheres, the process becomes more economic and the security of the process is improved.



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DESCRIPTION FR2720079A1

The present invention relates to a process for coating aluminum or aluminum alloys by hot dipping a part, in particular of a strip, made of steel containing at least 0.1% by weight of manganese, in particular stainless steel and / or alloy.

In general, in order to carry out a metal coating by dipping a steel part, the part to be coated is prepared and it is dipped in a coating bath, that is to say here a bath of molten metal.

The preparation of said part generally comprises a certain number of successive treatments.

Thus, for example, to prepare said part, its surface is cleaned, it is heated, then it is cooled.The cleaning of the surface can be carried out in particular by chemical degreasing treatment, by heat treatment called preheating, or even by physical treatment. intended to recrystallize the steel that makes up the part; it is thus carried out for a period and according to a determining temperature profile for the mechanical properties of said part.

The cooling is intended to bring the temperature of the room to a temperature close to that of the bath of molten metal; it is generally carried out under a jet of cold gas.

When the coating is aluminum-based and the parts to be coated are made of stainless steel and / or alloy, in particular containing at least 0.1% manganese, it is known how to prepare the part, in particular the last ones. stages such as heating and cooling, under a reducing atmosphere, in particular containing hydrogen.

Indeed, the part to be coated has on the surface traces of oxides of the alloying elements of said stainless steel and / or alloy; the cleaning treatment, in particular when carried out by preheating, further oxidizes said surface; it is known that these oxides, and in particular the chromium oxides, can prevent the molten metal of the bath from properly wetting the surface of the strip at the time of quenching, which is detrimental to the quality of the coating obtained, in particular at the level of its adherence to the piece and its geometric homogeneity.

This arrangement concerning the atmosphere of the preparation treatments is therefore useful for reducing the oxides of the alloying elements of steel, in particular chromium, which are found on the surface of the part to be coated and for significantly improving the quality of the coating. quenching, especially in terms of its adhesion to the part and its geometric homogeneity.

Thus, it is known to use hydrogen in high proportions in the cooling and heating atmosphere to reduce, at the surface of the part to be coated, the oxides initially present or which were formed during the previous treatments of the preparation; but the use of hydrogen has serious economic and safety drawbacks.

French patent n02 664 617 filed on 07/16/90 in the names of the companies SOLLAC and UGINE SA describes such a process and has the advantage, compared with the processes of the prior art, of avoiding the use of atmospheres reducing agents containing high proportions of hydrogen, during the preparation of a part to be coated, in particular during cooling.

This document describes a preparation process for the dipping aluminum coating of a stainless steel strip in which said strip is preheated in a non-oxidizing atmosphere at a temperature lower than in the prior art, said strip is heated. in a non-oxidizing atmosphere, which may be reducing and contain hydrogen, and said strip is cooled in a non-reactive atmosphere, such as nitrogen, and which may contain hydrogen.

Thus, thanks to a lower temperature and a non-oxidizing atmosphere during preheating, the formation of oxides at the surface of the strip is limited and the subsequent treatments can advantageously be carried out under less reducing atmospheres, therefore containing less hydrogen than those commonly used previously, while obtaining an aluminum coating of good quality, in particular of good adhesion and good homogeneity.

However, in this process, the counterpart of the lower temperature and the non-oxidizing atmosphere of the preheating can be a reduction in the quality of cleaning, in particular when bodies fouling the surface of the part, in particular fatty substances, do not. are not completely decomposed under these new preheating conditions.

It may also be necessary to extend the duration of the preheating treatment in order to obtain a sufficient quality of the cleaning, but this extension of the duration of the treatment is detrimental to the productivity.

Furthermore, in particular for heating and cooling treatments, it is often necessary to use hydrogen, although obviously in smaller proportions than before; the drawbacks linked to the use of hydrogen, and which relate to the safety and cost of the installations, have therefore not been completely eliminated.

The object of the invention is to avoid the use of hydrogen during the preparation of a part, in particular of a strip, made of stainless steel and / or alloy containing at least 0.1% of manganese for a coating with hardened aluminum or aluminum alloys.

The object of the invention is also to facilitate the carrying out of the preparation treatments of such a strip, and in particular to ensure both the quality of the cleaning and the productivity.

To this end, the invention relates to a process for coating aluminum or aluminum alloy by hot dipping a part, in particular a strip, made of steel containing at least 0.1% by weight. manganese, in particular stainless steel and / or alloy in which the strip is prepared before coating according to a sequence of treatments carried out under a controlled atmosphere then the strip is dipped in a bath of aluminum or molten aluminum alloy, characterized in that said atmospheres are all non-reducing.

The process according to the invention may include one or more of the following characteristics - the hydrogen concentrations in the atmospheres of said treatments are all less than or equal to 4%, - said treatments are heat treatments, - when said sequence of treatments comprises heating and On cooling, the heating and cooling atmospheres contain more than 96% nitrogen.

The invention will now be described in more detail with reference to the appended figure, which shows a schematic view of an installation for preparing and an installation for continuously dipping a metal strip.

As shown in the single Figure, the continuous preparation installation designated as a whole by the reference 1 comprises - a preheating furnace 2, - a heat treatment furnace 3, - a cooling chamber 4, Said preparation installation is installed upstream of a dip coating installation designated as a whole by the reference 5; it comprises tape support rollers 17 distributed throughout the installation and which define the tape path.

The dip coating plant 5 is known in itself and will not be described here in detail; in a conventional manner, it comprises a soaking container containing the coating bath 6, composed of aluminum or of molten aluminum alloy, and spin ejectors 7.

The preheating furnace 2 is a direct flame furnace comprising an air inlet 8, burner ramps 9 arranged on either side of the strip path, and a chimney 10 for evacuating the gases, in particular combustion. ; the preheating furnace 2 also comprises a strip inlet 11 and a strip outlet 12 opening directly into the heat treatment furnace 3.

The heat treatment furnace 3 has radiant tubes and a controlled atmosphere, in particular by a treatment gas inlet 13; its outlet opens directly into the cooling chamber 4.

The cooling chamber 4 is provided with cooling gas ejector ramps 14 arranged on either side of the strip path, the ejectors of which are oriented towards the strip path; the cooling chamber 4 is also provided with a gas discharge chimney 15 and opens out via a strip outlet channel 16 below the level of the free surface of the liquid metal 6 of the coating installation 5.

The preparation installation also comprises means for measuring the temperature of the atmosphere and of the strip, means for measuring the dew points and for controlling the humidity level, which are installed in the preheating furnace 2, the heat treatment furnace 3, and the cooling chamber 4; these means are known in themselves and are not shown here.

The cooling gas ejector ramps 14 and the treatment gas inlet 13 are connected to gas supply means which are not shown here.

In order to proceed with the dip coating of a strip B of stainless steel and / or alloy containing at least 0.1% manganese, said strip is prepared according to the following sequence - said strip is preheated between the burner ramps 9 of the preheating

furnace 2 supplied in excess of at least 2% of fuel relative to the stoichiometric combustion conditions in a non-oxidizing atmosphere, the temperature of which is generally between 8000C and 13000C; in this way, the temperature of the strip at the outlet of the preheating oven 2 is higher than the decomposition temperature of the bodies fouling the surface of the strip, in particular of the fatty substances, and generally between 4000C and 7000C; the surface of said strip is then cleaned.

- Said strip is heat treated in the heat treatment furnace 3 for a time sufficient for the measured temperature of said strip at the outlet of the heat treatment furnace 3 to be greater than the recrystallization temperature of the stainless and / or alloy steel of the strip, that is to say generally between 7500C and 9500C, and to obtain the required mechanical properties of the strip; the temperature of the atmosphere of the heat treatment furnace is therefore established between 8500C and 10000C and, moreover, its dew point between -450C and -250C.

Said heat treatment is carried out under a non-reducing atmosphere, by means of the gas supply means, a non-reducing treatment gas, here nitrogen containing less than 0.1% hydrogen, is injected into the heat treatment furnace 3 through the gas inlet 13 at a flow rate such that said furnace 3 is in overpressure with respect to the preheating furnace 2 and to the cooling chamber 4.

Without departing from the invention, it is possible to use nitrogen containing 4% hydrogen as the treatment gas; even at these concentrations, the use of hydrogen does in fact present no drawback with regard to the safety and the cost of the installations.

- Said strip is cooled between the cooling gas ejector ramps 14 in the cooling chamber 4 under a non-reducing atmosphere; thanks to the gas supply means, the ramps 14 are in fact supplied with non-reducing cooling gas, here nitrogen at ambient temperature containing less than 0.1% of hydrogen, at a flow rate such as the measured temperature of the strip at the outlet of said chamber 4 is close to that of the molten metal bath 6, ie generally between 6700C and 7000C; the dew point is set between -300C and -150C.

The cooling and, in part, treatment gases are discharged through the exhaust chimney 15; The other part of the treatment gases is discharged through the exhaust chimney 10 of the preheating furnace 2.

The strip emerges from the preparation installation 1 through the outlet channel 16 of the cooling chamber 4 and therefore immediately soaks in the bath of liquid metal 6 of the coating installation 5.

Thus, during the preparation of the strip for the coating, since there is no upper limit temperature for preheating, it is advantageously possible to proceed at a higher temperature to ensure both the quality of cleaning and good productivity.
.

Thus also, when preparing the strip for coating, the use of hydrogen and the drawbacks associated with its use, in terms of safety and costs, are completely avoided.

The conduct of the strip preparation treatments for dip coating is greatly facilitated.

After the strip has been prepared, the strip is then dip coated according to a method known per se which is not described here in detail; in particular, the wiper ejectors 7 are adjusted to obtain the desired coating thickness, for example approximately twenty micrometers.

The Applicant has surprisingly observed that, while the strip preparation treatments were all carried out in the absence of hydrogen and in a non-reducing atmosphere, the aluminum or aluminum alloy coating produced by dipping according to methods known from elsewhere exhibit good geometric homogeneity and good adhesion to the strip B of stainless steel and / or alloy provided that said steel contains at least 0.1% manganese; this result is all the more surprising since the preparation conditions are neither able to completely prevent the formation of oxides, nor even to reduce them at the surface of the strip.

Example 1: An alloy steel strip with a thickness of 1 mm is taken, the manganese content of which is 0.178%.

The other alloying elements are in particular: Si: 0.37% - Cr 0.84% - Al: 0.9% - Ti: 0.32% - Nb: 0.21%.

Using the installation described above, the invention is carried out under the following preparation and coating conditions :. Preheating furnace 2: - strip temperature at the furnace outlet: 6500C.

Heating furnace 3 - strip temperature at the furnace outlet: 8500 C.

- composition of the atmosphere: Nitrogen.

- dew point: -300C.

Cooling chamber 4 - strip temperature at the chamber outlet: 6800C.

- composition of the atmosphere: Nitrogen.

- dew point: -250C.

Coating bath 6 - composition: Al: 87.6% - Si: 9.1% - Fe: 3.3%.

- immersion time: 3 s.

The spin ejectors 7 are adjusted to load the strip of approximately 120 g / m2 on the double side with a coating which has the following composition: Al: 86.8% - Si: 6% - Fe: 7.2%.

The adhesion and the thickness homogeneity of the coating are then measured by the following methods - Standardized adhesion test ASTM No. A 463 488: the method consists of folding at 1800 ° C. a sample of coated strip to a diameter corresponding to two times the thickness of the sample; the test is positive if no chipping of the coating can be detected after bending.

The adhesion tests carried out on samples of the strip, thus prepared and coated according to the invention, are positive.

- Coating thickness or load measurement according to ASTM standard nOA 428-99: the method is based on measuring the weight of several samples before and after chemical stripping of the coating.

The load measurements carried out on three samples of the strip, thus prepared and coated according to the invention, give results 120 g / m2; 123 g / m2; 121 g / m2 ... and correspond to good homogeneity.

Example 2: A 1.4 mm thick F17T stainless steel strip is taken, the manganese content of which is 0.45%.

The other alloying elements are in particular: Cr: 17.7% - Si 0.44% - Ti: 0.29% - Nb: 0.62%.

Using the installation described above, the invention is carried out under the same preparation and coating conditions as in Example 1.

The spin ejectors 7 are adjusted to load the strip of approximately 120 g / m2 on the double side with a coating which has the following composition: Al: 86.8% - Si: 6% - Fe: 7.2%.

The adhesion and the thickness homogeneity of the coating are then measured by the same methods as in Example 1 - The adhesion tests carried out on samples of the strip, thus prepared and coated according to the invention, are positive.

- The load measurements carried out on three samples of the strip, thus prepared and coated according to the invention, give results 122 g / m2; 124 g / m2; 121 g / m2 ... and correspond to good homogeneity.

(19) RÉPUBLIQUE FRANÇAISE

INSTITUT NATIONAL
DE LA PROPRIÉTÉ INDUSTRIELLE

PARIS

(11) N° de publication : **2 720 079**
(à n'utiliser que pour les commandes de reproduction)

(21) N° d'enregistrement national : **94 06239**

(51) Int Cl[6] : C 23 C 2/02, 2/12, 2/40

(12) DEMANDE DE BREVET D'INVENTION A1

(22) **Date de dépôt** : 19.05.94.

(30) **Priorité** :

(43) **Date de la mise à disposition du public de la demande** : 24.11.95 Bulletin 95/47.

(56) **Liste des documents cités dans le rapport de recherche préliminaire** : *Se reporter à la fin du présent fascicule.*

(60) **Références à d'autres documents nationaux apparentés** :

(71) **Demandeur(s)** : *SOLLAC Société anonyme* — FR.

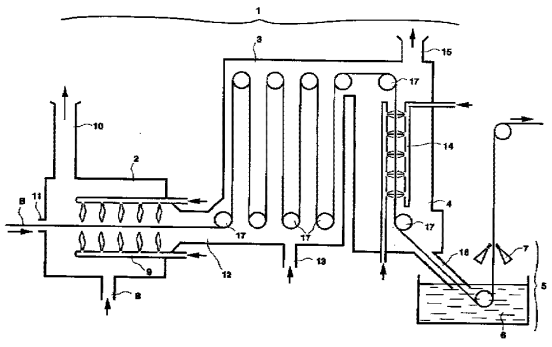
(72) **Inventeur(s)** : Godin Jean-Pierre et Guesdon Philippe.

(73) **Titulaire(s)** :

(74) **Mandataire** : Techmetal Promotion.

(54) Procédé de revêtement d'aluminium par trempe à chaud d'une pièce, notamment d'une bande, en acier contenant au moins 0,1 % en poids de manganèse, notamment en acier inoxydable et/ou allié.

(57) Dans ce procédé, on prépare la bande avant le revêtement suivant une séquence de traitements sous atmosphères toutes non réductrices puis on trempe la bande dans un bain d'aluminium ou d'alliage d'aluminium fondu. Simplification et sécurité de la préparation pour le revêtement au trempé.



FR 2 720 079 - A1

La présente invention est relative à un procédé de revêtement d'aluminium ou d'alliages d'aluminium par trempé à chaud d'une pièce, notamment d'une bande, en acier contenant au moins 0,1% en poids de manganèse, notamment en acier inoxydable et/ou allié.

D'une manière générale, pour procéder à un revêtement métallique au trempé d'une pièce en acier, on prépare la pièce à revêtir et on la trempe dans un bain de revêtement, c'est à dire ici un bain de métal fondu.

La préparation de ladite pièce comporte généralement un certain nombre de traitements successifs.

Ainsi par exemple, pour préparer ladite pièce, on nettoie sa surface, on la chauffe , puis on la refroidit .

Le nettoyage de la surface peut être notamment réalisé par traitement chimique de dégraisssage, par traitement thermique appelé préchauffage, voire par traitement physique .

Le chauffage est destiné à recristalliser l'acier qui compose la pièce ; il est ainsi effectué pendant une durée et selon un profil de température déterminant pour les propriétés mécaniques de ladite pièce.

Le refroidissement est destiné à ramener la température de la pièce à une température proche de celle du bain de métal fondu ; elle est généralement conduite sous jet de gaz froid.

Lorsque le revêtement est à base d'aluminium et que les pièces à revêtir sont en acier inoxydable et/ou allié, notamment contenant au moins 0,1 % de manganèse, il est connu de réaliser la préparation de la pièce, en particulier les dernières étapes comme le chauffage et le refroidissement, sous une atmosphère réductrice, notamment contenant de l'hydrogène.

En effet, la pièce à revêtir présente en surface des traces d'oxydes des éléments d'alliages dudit acier inoxydable et/ou allié ; le traitement de nettoyage, en particulier lorsqu'il est réalisé par préchauffage, oxyde encore davantage ladite surface ; il est connu que ces oxydes, et en particulier les oxydes de chrome, peuvent empêcher le métal fondu du bain de mouiller convenablement la surface de la bande au moment du trempé, ce qui est préjudiciable à la qualité du revêtement obtenu, notamment au niveau de son adhérence à la pièce et de son homogénéité géométrique.

Cette disposition concernant l'atmosphère des traitements de préparation est donc utile pour réduire les oxydes des éléments d'alliages de l'acier, notamment de chrome, qui se trouvent à la surface de la pièce à revêtir et pour améliorer sensiblement la qualité du revêtement au trempé, notamment au niveau de son adhérence à la pièce et de son homogénéité géométrique.

Ainsi, il est connu d'utiliser de l'hydrogène en fortes proportions dans l'atmosphère de refroidissement et de chauffage pour réduire, à la surface de la pièce à revêtir, les oxydes initialement présents ou qui se sont formés lors des traitements précédents de la préparation ; mais l'utilisation d'hydrogène présente de graves inconvénients économiques et de sécurité.

Le brevet français n°2 664 617 déposé le 16/07/90 aux noms des Sociétés SOLLAC et UGINE S.A. décrit un tel procédé et présente l'avantage, par rapport aux procédés de l'art antérieur, d'éviter l'utilisation d'atmosphères réductrices contenant de fortes proportions d'hydrogène, lors de la préparation d'une pièce à revêtir, en particulier au moment du refroidissement.

Ce document décrit un procédé de préparation pour le revêtement d'aluminium au trempé d'une bande d'acier inoxydable dans lequel on préchauffe ladite bande dans une atmosphère non oxydante à une température plus basse que dans l'art antérieur, on chauffe ladite bande dans une atmosphère non oxydante, pouvant être réductrice et contenir de l'hydrogène, et on refroidit ladite bande dans une atmosphère non réactive, comme de l'azote, et pouvant contenir de l'hydrogène.

Ainsi, grâce à une température plus basse et une atmosphère non oxydante au préchauffage, on limite la formation d'oxydes à la surface de la bande et on peut avantageusement effectuer les traitements ultérieurs sous des atmosphères moins réductrices, donc contenant moins d'hydrogène que celles couramment utilisées auparavant, tout en obtenant un revêtement d'aluminium de bonne qualité, en particulier de bonne adhérence et de bonne homogénéité.

Néanmoins, dans ce procédé, la contrepartie de la température plus basse et de l'atmosphère non oxydante du préchauffage peut être une diminution de la qualité du nettoyage, en particulier lorsque des corps encrassant la surface de la pièce, notamment des corps gras, ne sont pas totalement décomposés dans ces nouvelles conditions de préchauffage.

Il peut être également nécessaire de prolonger la durée du traitement de préchauffage pour obtenir une qualité suffisante du nettoyage, mais cet allongement de la durée du traitement est préjudiciable à la productivité.

Par ailleurs, notamment pour les traitements de chauffage et de refroidissement, il reste souvent nécessaire d'utiliser de l'hydrogène, bien qu'évidemment en plus faibles proportions qu'auparavant ; on n'a donc pas totalement supprimé les inconvénients lié à l'utilisation d'hydrogène, et qui concernent la sécurité et le coût des installations.

L'invention a pour but d'éviter l'utilisation d'hydrogène lors de la préparation d'une pièce, notamment d'une bande, en acier inoxydable et/ou allié contenant au moins 0,1 % de manganèse pour un revêtement au trempé d'aluminium ou d'alliages d'aluminium.

L'invention a également pour but de faciliter la conduite des traitements de préparation d'une telle bande, et en particulier d'assurer à la fois la qualité du nettoyage et la productivité.

A cet effet, l'invention a pour objet un procédé de revêtement d'aluminium ou d'alliage d'aluminium par trempé à chaud d'une pièce, notamment d'une bande, en acier contenant au moins 0,1% en poids de manganèse, notamment en acier inoxydable et/ou allié dans lequel on prépare la bande avant le revêtement suivant une séquence de traitements effectués sous atmosphère contrôlée puis on trempe la bande dans un bain d'aluminium ou d'alliage d'aluminium fondu, caractérisé en ce que lesdites atmosphères sont toutes non réductrices.

Le procédé suivant l'invention peut comporter une ou plusieurs des caractéristiques suivantes :

- les concentrations en hydrogène des atmosphères desdits traitements sont toutes inférieures ou égales à 4 %,
- lesdits traitements sont des traitements thermiques,
- lorsque ladite séquence de traitements comporte un chauffage et un refroidissement, les atmosphères de chauffage et de refroidissement contiennent plus de 96 % d'azote.

L'invention va maintenant être décrite plus en détail en regard de la figure annexée , qui représente une vue schématique d'une installation de préparation et d'une installation de revêtement au trempé en continu d'une bande métallique.

Comme représenté à la Figure unique, l'installation de préparation en continu désignée dans son ensemble par la référence 1 comprend :

- un four de préchauffage 2,
- un four de traitement thermique 3,
- une chambre de refroidissement 4,

Ladite installation de préparation est installée en amont d'une installation de revêtement au trempé désignée dans son ensemble par la référence 5 ; elle comporte des rouleaux-support de bande 17 répartis dans toute l'installation et qui définissent le chemin de bande.

L'installation de revêtement au trempé 5 est connue par elle-même et ne sera pas décrite ici en détail ; d'une manière classique, elle comporte un récipient de trempage contenant le bain 6 de revêtement, composé d'aluminium ou d'alliage d'aluminium en fusion, et des éjecteurs d'essorage 7.

Le four de préchauffage 2 est un four à flamme directe comportant une entrée d'air 8, des rampes de brûleurs 9 disposées de part et d'autre du chemin de bande, et une cheminée 10 d'évacuation des gaz, en particulier de combustion ; le four de préchauffage 2 comporte encore une entrée de bande 11 et une sortie de bande 12 débouchant directement dans le four de traitement thermique 3.

Le four de traitement thermique 3 est à tubes radiants et à atmosphère contrôlée, en particulier par une entrée de gaz de traitement 13 ; sa sortie débouche directement dans la chambre de refroidissement 4.

La chambre de refroidissement 4 est dotée de rampes d'éjecteurs de gaz de refroidissement 14 disposées de part et d'autre du chemin de bande, dont les éjecteurs sont orientés vers le chemin de bande ; la chambre de refroidissement 4 est également dotée d'une cheminée d'évacuation des gaz 15 et débouche par un canal de sortie de bande 16 sous le niveau de la surface libre du métal liquide 6 de l'installation de revêtement 5.

L'installation de préparation comporte également des moyens de mesure de température de l'atmosphère et de la bande, des moyens de mesure des points de rosée et de contrôle du taux d'humidité, qui sont installés dans le four de préchauffage 2, le four de traitement thermique 3, et la chambre de refroidissement 4 ; ces moyens sont connus en eux-mêmes et ne sont pas représentés ici.

Les rampes d'éjecteurs de gaz de refroidissement 14 et l'entrée de gaz de traitement 13 sont reliés à des moyens d'alimentation en gaz qui ne sont pas représentés ici.

Afin de procéder au revêtement au trempé d'une bande B d'acier inoxydable et/ou allié contenant au moins 0,1% de manganèse , on prépare ladite bande selon la séquence suivante :

- on préchauffe ladite bande entre les rampes de brûleurs 9 du four de préchauffage 2 alimenté en excès d'au moins 2 % de carburant par rapport aux conditions stoechiométriques de combustion dans une atmosphère non oxydante dont la température est généralement située entre 800°C et 1300°C ; de cette manière, la température de la bande à la sortie du four de préchauffage 2 est supérieure à la température de décomposition des corps encrassant la surface de la bande, notamment des corps gras, et généralement située entre 400°C et 700°C ; la surface de ladite bande est alors nettoyée.

- on traite thermiquement ladite bande dans le four de traitement thermique 3 pendant une durée suffisante pour que la température mesurée de ladite bande à la sortie du four de traitement thermique 3 soit supérieure à la température de recristallisation de l'acier inoxydable et/ou allié de la bande, c'est à dire en général comprise entre 750°C et 950°C, et pour obtenir les propriétés mécaniques requises de la bande ; on établit donc la température de l'atmosphère du four de traitement thermique entre 850°C et 1000°C et, par ailleurs, son point de rosée entre -45°C et -25°C.

On effectue ledit traitement thermique sous une atmosphère non réductrice ; grâce au moyen d'alimentation en gaz, on injecte dans le four de traitement thermique 3 par l'entrée de gaz 13 un gaz de traitement non réducteur, ici de l'azote contenant moins de 0,1% d'hydrogène, à un débit tel que ledit four 3 soit en surpression par rapport au four de préchauffage 2 et à la chambre de refroidissement 4.

Sans se départir de l'invention, il est possible d'utiliser comme gaz de traitement de l'azote contenant 4% d'hydrogène ; même à ces concentrations, l'utilisation d'hydrogène ne présente en effet aucun inconvénient quant à la sécurité et au coût des installations.

- on refroidit ladite bande entre les rampes d'éjecteurs de gaz de refroidissement 14 dans la chambre de refroidissement 4 sous une atmosphère non réductrice ; grâce aux moyens d'alimentation en gaz, on

alimente en effet les rampes 14 en gaz de refroidissement non réducteur, ici de l'azote à température ambiante contenant moins de 0,1% d'hydrogène, à un débit tel que la température mesurée de la bande à la sortie de ladite chambre 4 soit proche de celle du bain de métal fondu 6, c'est à dire en général comprise entre 670°C et 700°C ; on règle le point de rosée entre -30°C et -15°C.

Les gaz de refroidissement et, en partie, de traitement s'évacuent par la cheminée d'évacuation 15 ; l'autre partie des gaz de traitement s'évacue par la cheminée d'évacuation 10 du four de préchauffage 2.

La bande ressort de l'installation de préparation 1 par le canal de sortie 16 de la chambre de refroidissement 4 et trempe donc immédiatement dans le bain de métal liquide 6 de l'installation de revêtement 5.

Ainsi, lors de la préparation de la bande pour le revêtement, puisqu'il n'y a pas de température limite supérieure de préchauffage, on peut avantageusement procéder à une température plus élevée pour assurer à la fois la qualité du nettoyage et une bonne productivité.

Ainsi également, lors de la préparation de la bande pour le revêtement, on évite totalement l'utilisation d'hydrogène et les inconvénients liés à son utilisation, aux plans de la sécurité et des coûts.

La conduite des traitements de préparation de la bande pour le revêtement au trempé est largement facilitée.

Après la préparation de la bande, on procède ensuite au revêtement au trempé de la bande selon un procédé connu en lui-même qui n'est pas décrit ici en détail ; on règle en particulier les éjecteurs d'essorage 7 pour obtenir l'épaisseur de revêtement souhaitée, par exemple de environ vingt micromètres.

La Demanderesse a constaté avec surprise que, alors que les traitements de préparation de la bande ont tous été conduits en l'absence d'hydrogène et en atmosphère non réductrice, le revêtement d'aluminium ou d'alliage d'aluminium réalisé au trempé selon des méthodes connues par ailleurs présente une bonne homogénéité géométrique et une bonne adhérence sur la bande B d'acier inoxydable et/ou allié à condition que ledit acier contienne au moins 0,1 % de manganèse ; ce résultat est d'autant plus surprenant que les conditions de préparation ne sont aptes ni à empêcher totalement la formation d'oxydes, ni même à les réduire à la surface de la bande.

Exemple 1 :

On prend un bande d'acier allié d'épaisseur 1 mm dont la teneur en manganèse est de 0,178 %.

Les autres éléments d'alliage sont notamment : Si : 0,37 % - Cr : 0,84 % - Al : 0,9 % - Ti : 0,32 % - Nb : 0,21 %.

En utilisant l'installation décrite ci-dessus, on procède selon l'invention dans les conditions suivantes de préparation et de revêtement :

. Four de préchauffage 2 :

- température de bande en sortie de four : 650°C.

. Four de chauffage 3 :

- température de bande en sortie de four : 850°C.
- composition de l'atmosphère : Azote.
- point de rosée : -30°C.

. Chambre de refroidissement 4 :

- température de bande en sortie de chambre : 680°C.
- composition de l'atmosphère : Azote.
- point de rosée : -25°C.

. Bain de revêtement 6 :

- composition : Al : 87,6 % - Si : 9,1 % - Fe : 3,3 %.
- durée d'immersion : 3 s.

On règle les éjecteurs d'essorage 7 pour charger la bande de 120 g/m2 environ en double face d'un revêtement qui présente la composition suivante : Al : 86,8 % - Si : 6 % - Fe : 7,2 %.

On mesure ensuite l'adhérence et l'homogénéité en épaisseur du revêtement par les méthodes suivantes :

- Test d'adhérence normalisé ASTM n° A 463 488 : la méthode consiste au pliage à 180°C d'un échantillon de bande revêtue selon un diamètre correspondant à deux fois l'épaisseur de l'échantillon ; le test est positif si aucun écaillage du revêtement ne peut être décelé après pliage.

Les tests d'adhérence effectués sur des échantillons de la bande, ainsi préparée et revêtue selon l'invention, sont positifs.

- Mesure d'épaisseur ou de charge de revêtement selon la norme ASTM n°A 428-99 : la méthode est basée sur la mesure de poids de plusieurs échantillons avant et après décapage chimique du revêtement.

Les mesures de charge effectuées sur trois échantillons de la bande, ainsi préparée et revêtue selon l'invention, donnent comme

résultats : 120 g/m2 ; 123 g/m2 ; 121 g/m2 ... et correspondent à une bonne homogénéité.

Exemple 2 :

On prend un bande d'acier inoxydable F17T d'épaisseur 1,4 mm dont la teneur en manganèse est de 0,45 %.

Les autres éléments d'alliage sont notamment : Cr : 17,7 % - Si : 0,44 % - Ti : 0,29 % - Nb : 0,62 %.

En utilisant l'installation décrite ci-dessus, on procède selon l'invention dans les mêmes conditions de préparation et de revêtement que dans l'exemple 1.

On règle les éjecteurs d'essorage 7 pour charger la bande de 120 g/m2 environ en double face d'un revêtement qui présente la composition suivante : Al : 86,8 % - Si : 6 % - Fe : 7,2 %.

On mesure ensuite l'adhérence et l'homogénéité en épaisseur du revêtement par les mêmes méthodes que dans l'exemple 1 :

- Les tests d'adhérence effectués sur des échantillons de la bande, ainsi préparée et revêtue selon l'invention, sont positifs.
- Les mesures de charge effectuées sur trois échantillons de la bande, ainsi préparée et revêtue selon l'invention, donnent comme résultats : 122 g/m2 ; 124 g/m2 ; 121 g/m2 ... et correspondent à une bonne homogénéité.

REVENDICATIONS

1.- Procédé de revêtement par trempé à chaud d'une pièce, notamment d'une bande, en acier contenant au moins 0,1% en poids de manganèse, notamment en acier inoxydable et/ou allié dans lequel on prépare la bande avant le revêtement suivant une séquence de traitements effectués sous atmosphère contrôlée puis on trempe la bande dans un bain d'aluminium ou d'alliage d'aluminium fondu, caractérisé en ce que les atmosphères desdits traitements sont toutes non réductrices.

2.- Procédé selon la revendication 1 caractérisé en ce que les concentrations en hydrogène des atmosphères desdits traitements sont toutes inférieures ou égales à 4 %.

3.- Procédé selon la revendication 1 ou 2 caractérisé en ce que lesdits traitements sont des traitements thermiques.

4.- Procédé selon la revendication 3 caractérisé en ce que, lorsque ladite séquence de traitements comporte un chauffage et un refroidissement, les atmosphères de chauffage et de refroidissement contiennent plus de 96 % d'azote.

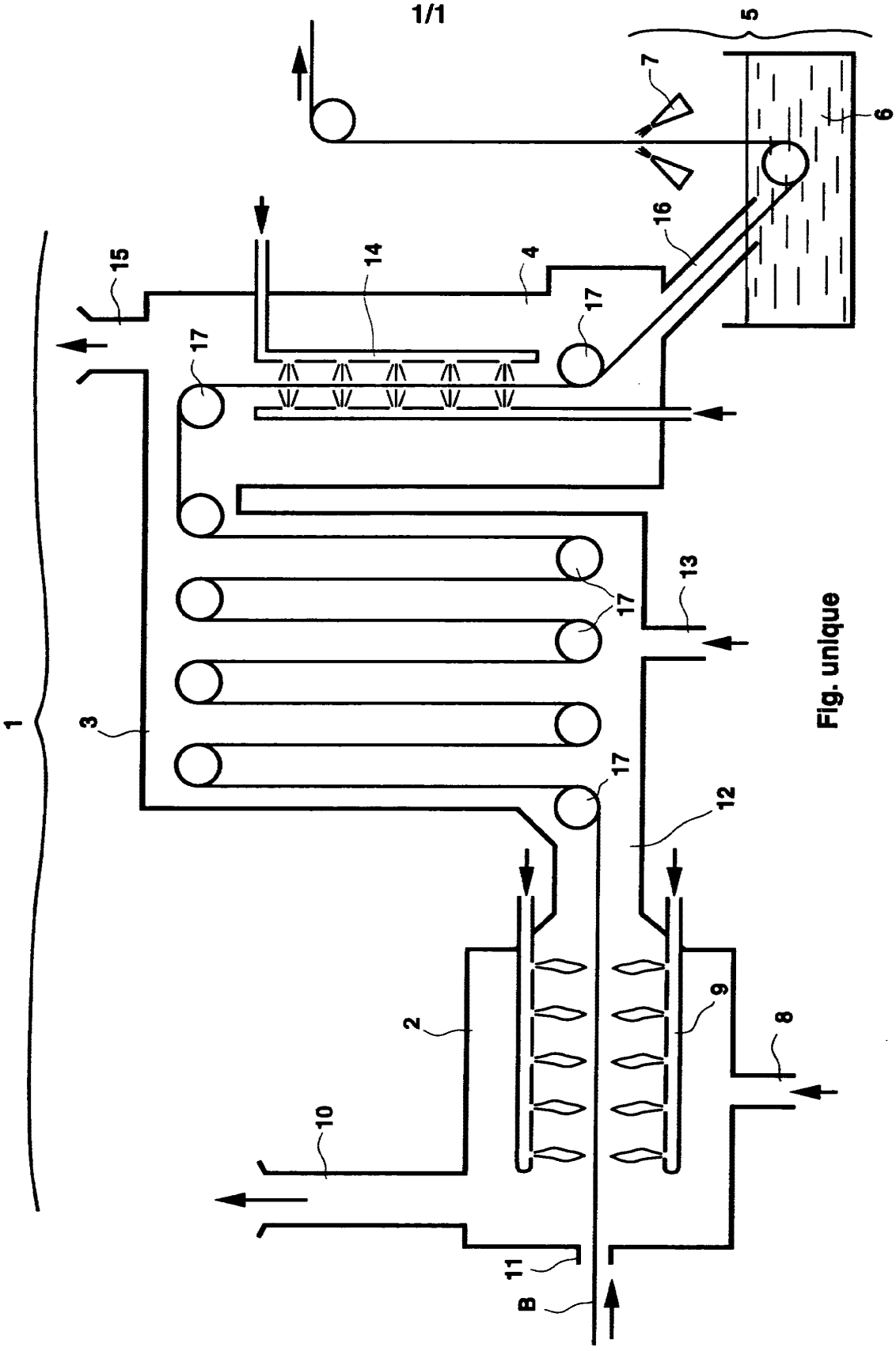


Fig. unique

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RAPPORT DE RECHERCHE PRELIMINAIRE

établi sur la base des dernières revendications déposées avant le commencement de la recherche

2720079

N° d'enregistrement national

FA 499504
FR 9406239

DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie	Citation du document avec indication, en cas de besoin, des parties pertinentes	Revendication concernée de la demande examinée
A	AU-B-24 455 (JOHN LYSAGHT) * page 6, ligne 30 - ligne 33 * * page 8, ligne 24 - ligne 31; revendications 1,7; figures 1,4 *	1-4
A	FR-A-2 086 302 (N.V. BEKAERT) * page 4, ligne 1 - ligne 16 * * page 5, ligne 23 - ligne 27; revendications 1-3 *	1-4
A	GB-A-676 198 (MICHEL ALFERIEFF) *document entier*	1-4
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 17 (C-675) 16 Janvier 1990 & JP-A-01 259 153 (NIPPON STEEL CORP) 16 Octobre 1989 * abrégé *	1-4
A	PATENT ABSTRACTS OF JAPAN vol. 5, no. 106 (C-062) 10 Juillet 1981 & JP-A-56 047 554 (NISSHIN STEEL) 30 Avril 1981 * abrégé *	1-4
A,D	EP-A-0 467 749 (SOLLAC) * revendications 1,4,12 *	1-4
A	US-A-4 210 097 (FRED BYRD)	
A	GB-A-2 001 105 (ARMCO STEEL CORPORATION)	
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 5 (C-260) 10 Janvier 1985 & JP-A-59 157 266 (KAWASAKI SEITETSU) 6 Septembre 1984 * abrégé *	

DOMAINES TECHNIQUES RECHERCHES (Int.Cl.5)

C23C

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Date d'achèvement de la recherche	Examinateur
29 Décembre 1994	Elsen, D

EPO FORM 1503 03.82 (P0C13)

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(12) PATENT ABRIDGMENT (11) Document No. AU-B-39425/89
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 622697

(54) Title
HOT DIP ALUMINUM COATED CHROMIUM ALLOY STEEL

International Patent Classification(s)
(51)[4] **C23C 002/02 C23C 002/12**

(21) Application No. : **39425/89** (22) Application Date : **08.08.89**

(43) Publication Date : **08.02.90**

(44) Publication Date of Accepted Application : **16.04.92**

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(56) Prior Art Documents
AU 592437 72930/87 C23C 2/12

(57) Claim

1. A method of continuous hot dip coating a steel strip with aluminium, comprising the steps of:

heating a ferritic chromium alloy steel strip to a temperature no greater than about 650°C by direct combustion of fuel and air wherein the gaseous products of said combustion have no free oxygen,

further heating said strip to a temperature of at least about 830°C,

cooling said strip to a temperature no less than the melting point of an aluminium coating metal,

passing said strip through a protective atmosphere having at least about 95% by volume hydrogen,

dipping said strip into a molten bath of said coating metal to deposit a coating layer on said strip,

said coating layer being substantially free of uncoated areas and tightly adherent to said strip.

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S & F Ref: 103460

FORM 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Class Int Class

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

Name and Address of Applicant: AK MANAGEMENT CORPORATION ~~Armco Inc.~~
680 Curtis Street
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UNITED STATES OF AMERICA



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Level 33 St Martins Tower, 31 Market Street
Sydney, New South Wales, 2000, Australia

Complete Specification for the invention entitled:

Hot Dip Aluminum ~~Coated~~ Coated Chromium Alloy Steel

The following statement is a full description of this invention, including the best method of performing it known to me/us



5845/4

ABSTRACT OF THE DISCLOSURE

Continuous hot dip aluminum coated ferritic chromium alloy steel strip. Strip is cleaned by heating to a temperature no greater than about 650°C in a direct fired furnace. The cleaned strip is further heated in a protective atmosphere containing at least 95% by volume hydrogen, cooled in the protective hydrogen atmosphere to near or slightly above the melting point of an aluminum coating metal, and passed into a bath of the aluminum coating metal. The low direct fired furnace cleaning temperature and hydrogen protective atmosphere provides good wetting of a chromium alloy steel surface to prevent uncoated areas or pin holes in the aluminum coated layer.

HOT DIP ALUMINUM COATED CHROMIUM ALLOY STEEL

BACKGROUND OF THE INVENTION

This invention relates to a continuously hot dipped metallic coated ferritic chromium alloy ferrous base strip and a process to enhance the wetting of the strip surface with molten aluminum.

Hot dip aluminum coated steel exhibits a high corrosion resistance to salt and finds various applications in automotive exhaust systems and combustion equipment. In recent years, exhaust system requirements have increased with respect to durability and aesthetics. For this reason, there has become a need to increase high temperature oxidation resistance and salt corrosion resistance by replacing aluminum coated low carbon or low alloy steels with aluminum coated chromium alloy steels. For high temperature oxidation, at least part of the aluminum coating layer can be diffused into the iron base by the heat during use to form an Fe-Al alloy layer. If uncoated areas are present in the aluminum coating layer, accelerated oxidation leading to a perforation of the base metal may result if the Fe-Al alloy is not continuously formed on the base metal. For lower

temperatures, the aluminum coating layer acts as a barrier protection for atmospheric conditions and as a cathodic coating in high salt environments. Again, if uncoated areas are present, accelerated corrosion may occur leading to failure of the coated structure.

It is well known to hot dip metallic coat low carbon steel strip without a flux by subjecting the strip to a preliminary treatment which provides a clean surface free of oil, dirt and iron oxide which is readily wettable by the coating metal. One type of preliminary in-line anneal treatment for low carbon steel is described in U.S. patent 3,320,085 issued to C. A. Turner, Jr. The Turner process, also known as the Selas process, for preparation of low carbon steel strip for hot dip metallic coating includes passing the strip through a direct fired furnace having an atmosphere heated to a temperature of at least 2400°F (1316°C). The atmosphere is formed from the gaseous products of combustion of fuel and air and has no free oxygen. The fuel-air ratio is controlled to provide the necessary reducing characteristics for effecting cleaning of the steel strip. The fuel-air ratio is regulated to provide a slight excess of fuel so that there is no free oxygen but excess combustibles in the form of carbon monoxide and hydrogen. Maintaining a furnace atmosphere of at least 1316°C having at least 3% excess combustibles is reducing to steel up to 1700°F (927°C). Turner teaches his cleaned strip is then passed through a sealed delivery duct having a neutral or protective atmosphere prior to passing the cleaned strip into a coating pot. For coating with molten zinc, Turner teaches heating the strip up to 1000°F (538°C). For coating with molten aluminum, Turner teaches heating the strip within the temperature range of 1250-1300°F (677-704°C) in the direct fired furnace since the atmosphere is still reducing to the steel at these temperatures.

Modern direct fired furnaces include an additional furnace section normally heated with radiant tubes. This furnace section contains the same neutral or reducing protective atmosphere, e.g. 75% nitrogen - 25% hydrogen, as the delivery duct described above.

U.S. patent No. 3,925,579 issued to C. Flinchum et al describes an in-line pretreatment for hot dip aluminum coating low alloy steel strip to enhance wettability by the coating metal. The steel contains one or more of up to 5% chromium, up to 3% aluminum, up to 2% silicon and up to 1% titanium, all percentages by weight. The strip is heated to a temperature above 1100°F (593°C) in an atmosphere oxidizing to iron to form a surface oxide layer, further treated under conditions which reduce the iron oxide whereby the surface layer is reduced to a pure iron matrix containing a uniform dispersion of oxides of the alloying elements.

The problems associated with nonwetting of aluminum coatings onto ferritic chromium alloy steel are also well known. Hot dip aluminum coatings have poor ~~wetability~~ wettability to ferritic chromium alloy steel base metals and normally have uncoated or bare spots in the aluminum coating layer. By poor adherence is meant flaking or crazing of the coating during bending the strip. To overcome the adherence problem, some have proposed heat treating the aluminum coated steel to anchor the coating layer to the base metal. Others lightly reroll the coated chromium alloy steel to bond the aluminum coating. Finally, those concerned about uncoated spots have generally avoided continuous hot dip coating. Rather, batch type hot dip coating or spray coating processes have been used. For example, after a

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chromium alloy steel article has been fabricated, it is dipped for an extended period of time within an aluminum coating bath to form a very thick coating layer.

U.S. patent 4,675,214 issued to F. M. Kilbane et al, incorporated herein by reference, proposes a solution for enhancing the wetting of ferritic chromium alloy steel strip continuously coated with hot dip aluminum coatings. The Kilbane process includes cleaning a ferritic chromium alloy steel and passing the cleaned steel through a protective hydrogen atmosphere substantially void of nitrogen prior to entry of the steel into an aluminum coating bath. This process resulted in improved wetting of ferritic chromium alloy steel so long as the steel was not cleaned by heating to an elevated temperature in a direct fired furnace. According to Turner, a direct fired furnace having an atmosphere with at least 3% combustibles heated to 2400°F (1316°C) is reducing to steel up to 1700°F (927°C). Nevertheless, heating ferritic chromium alloy steel at temperatures about 1250°F (677°C) and above in a direct fired furnace whose atmosphere has no free oxygen and subsequently passing the steel through a protective atmosphere of substantially pure hydrogen immediately prior to hot dip coating with aluminum still had large uncoated areas. Not being bound by theory, it is believed a direct fired furnace atmosphere having no free oxygen does have significant oxidizing potential due to the presence of water and apparently is oxidizing to the chromium contained in a chromium alloy ferrous strip. The chromium oxide formed on the surface of the strip apparently is not removed sufficiently by the protective hydrogen atmosphere prior to entry into the coating bath thereby preventing complete wetting of the strip surface.

BRIEF SUMMARY OF THE INVENTION

The invention relates to a continuous hot dip aluminum coated ferritic chromium alloy steel strip heated in a direct fired furnace by the combustion of fuel and air wherein the gaseous products of combustion have no free oxygen. The surface of the strip is heated to a temperature sufficient to remove oil, dirt, iron oxide, and the like but below a temperature causing excessive oxidation of chromium in the strip base metal. The strip is further heated in another furnace portion and is cooled, if necessary, to near or slightly above the melting point of an aluminum coating metal. The strip is then passed through a protective atmosphere of at least 95% by volume hydrogen and then into a molten bath of the aluminum coating metal to deposit a layer of the coating metal on the strip.

It is a principal object of this invention to form hot dip aluminum coated ferritic chromium alloy steels having enhanced wetting by the coating metal.

It is another object of the invention to form a hot dip aluminum coating on a chromium alloy steel strip cleaned in a direct fired furnace.

It is a further object of the invention to form a hot dip aluminum coating on a deep drawing chromium alloy steel strip that is annealed in-line on the coating line.

According to a broad form of the invention, there is provided a method of continuous hot dip coating a steel strip with aluminium, comprising the steps of:

heating a ferritic chromium alloy steel strip to a temperature no greater than about 650°C by direct combustion of fuel and air wherein the gaseous products of said combustion have no free oxygen, further heating said strip to a temperature of at least about 830°C,

cooling said strip to a temperature no less than the melting point of an aluminum coating metal,

passing said strip through a protective atmosphere having at least about 95% by volume hydrogen,

dipping said strip into a molten bath of said coating metal to deposit a coating layer on said strip,

said coating layer being substantially free of uncoated areas and tightly adherent to said strip.

The invention is directed to an improvement in or modification of the invention disclosed and claimed in Australian Patent No. 592437.

One feature of the invention is to clean a ferritic chromium alloy steel strip having enhanced wetting by an aluminium coating by heating the strip in a direct fired furnace on an aluminum coating line below a temperature creating excessive oxidation of chromium contained in the strip.

Another feature of the invention is to further heat the cleaned chromium alloy steel strip to a fully annealed condition in another furnace portion having a protective atmosphere containing at least about 95% by volume hydrogen.

Another feature of the invention is to supply less than 80% of the total thermal energy required to fully anneal the deep drawing ferritic chromium alloy steel strip in the direct fired furnace of the aluminum coating line.

Another feature of the invention is to maintain the cleaned chromium alloy steel strip in a protective atmosphere containing at least about 95% by volume hydrogen, less than 200 ppm oxygen, and having a dew point less than +40°F (+4°C) until the cleaned strip is passed into the aluminum coating metal.

Another feature of the invention is to fully anneal and cool the

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heated chromium alloy steel strip in a protective atmosphere containing at least 95% by volume hydrogen having a dew point no greater than 0°F (-18°C), passing the strip through a snout containing a protective atmosphere containing at least 97% by volume hydrogen having a dew point no greater than -20°F (-29°C), and then dip the strip into the aluminum coating metal.



KEH/342f

Advantages of the invention are elimination of uncoated areas and improved adherence to ferritic chromium alloy steel strip cleaned in a direct fired furnace and continuously hot dip coated with aluminum.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic view of a ferrous base strip being processed through a hot dip aluminum coating line incorporating the present invention;

FIG. 2 is a partial schematic view of the coating line of FIG. 1 showing an entry snout and coating pot.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, reference numeral 10 denotes a coil of steel with strip 11 passing therefrom and around rollers 12, 13 and 14 before entering the top of first furnace section 15. First furnace section 15 is a direct fired type heated by the combustion of fuel and air. The ratio of fuel and air is in a proportion so that the gaseous products of combustion have no free oxygen and preferably at least 3% by volume excess combustibles. The atmosphere in furnace 15 is heated preferably to greater than 2400°F (1316°C) and strip 11 maintained at sufficient speed so that the strip surface temperature is not excessively oxidizing to chromium while removing surface contaminants such as rolling mill oil films, dirt, iron oxide, and the like. Except for a brief period of time as explained in detail later, the strip

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should not be heated to a temperature above about 1200°F (649°C) and ~~preferrably~~ Preferably not above about 1150°F (621°C) while in furnace 15.

The second section of the furnace denoted by numeral 16 may be of a radiant tube type. The temperature of strip 11 is further heated to at least about the melting point of an aluminum coating metal, i.e. 1200°F (649°C), and up to about 1750°F (955°C) reaching a maximum temperature at about point 18. A protective atmosphere including at least about 95% by volume hydrogen preferably is maintained in furnace section 16 as well as succeeding sections of the furnace described below.

Sections 20 and 22 of the furnace are cooling zones. Strip 11 passes from furnace portion 22, over turndown roller 24, through snout 26 and into coating pot 28 containing molten aluminum. The strip remains in the coating pot a very short time, i.e. 2-5 seconds. Strip 11 containing a layer of coating metal on both sides is vertically withdrawn from coating pot 28. The coating layers are solidified and the coated strip is passed around turning roller 32 and coiled for storage or further processing as a coil 34. As noted above, furnace sections 20, 22 and 26 contain the protective hydrogen atmosphere.

Referring now to FIG. 2, snout 26 is protected from the atmosphere by having its lower or exit end 26a submerged below surface 44 of aluminum coating metal 42. Suitably mounted for rotation are pot rollers 36 and 38 and stabilizer roller 40. The weight of coating metal 42 remaining on strip 11 as it is withdrawn from coating pot 28 is controlled by finishing means such as jet knives 30. Strip 11 is cooled to a temperature near or slightly above the melting point of the aluminum coating metal in furnace portions 20, 22

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and 26 before entering coating pot 28. This temperature may be as low as 1150°F (620°C) for aluminum alloy coating metals, e.g. Type 1 containing about 10% by weight silicon, to as high as about 1350°F (732°C) for commercially pure aluminum coating metal, e.g. Type 2.

The apparatus shown in FIG. 2 is for two-side coating using air finishing. As will be understood by those skilled in the art, finishing using a sealed enclosure containing a nonoxidizing atmosphere may also be used.

Hydrogen gas of commercial purity may be introduced into the furnace sections through inlets 27 in snout 26 ~~preferrably~~ preferably to achieve a protective hydrogen atmosphere containing less than about 200 ppm oxygen and having a dew point no greater than +40°F (+4°C). Depending upon factors such as hydrogen flow rate and furnace volume, additional hydrogen inlets may be required in furnace sections 16, 20 and 22.

Ferritic chromium alloy steels as defined herein include iron based magnetic materials characterized by a body centered cubic structure and having about .5 weight % or more chromium. For example, the present invention has particular usefulness for hot dip aluminum coated ferritic stainless steel having up to about 35% by weight chromium and is used in automotive exhaust applications including heavy gauge engine exhaust pipes having thicknesses of 1.2 mm or more, foil having thicknesses less than .25 mm cold reduced from aluminized strip used as catalyst supports for catalytic converters, and fully annealed strip deeply drawn into parts requiring light weight aluminum coatings, e.g. no greater than 185 gm/m^2 total both sides, such as manifolds, muffler parts, catalytic converters,

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resonators, and the like. By full annealing is meant the strip is heated to at least about 830°C in furnace 16 and will have at least about 25% elongation as measured in a tensile test.Type 409 ferritic stainless steel is particularly preferred as the starting material for the present invention. This steel has a nominal composition of about 11% by weight chromium, about 0.5% by weight silicon, and remainder essentially iron. More broadly, a ferritic steel containing from about 10.0% to about 14.5% by weight chromium, about 0.1% to 1.0% by weight silicon, and remainder essentially iron, is preferred.

The following are nonlimiting examples illustrating the invention:

Example 1

A 1.02 mm thick by 122 cm wide Type 409 stainless steel strip was coated with pure molten aluminum coating (Type 2) at a temperature of 699-704°C using the coating line in FIGS. 1 and 2. Hydrogen of commercial purity was flowed at a rate of about 380 m^3/hr into snout 26 and an atmosphere of 75% by volume nitrogen and 25% by volume hydrogen was maintained in furnace portion 16. The dew point of the pure protective hydrogen atmosphere in snout 26 was initially +48°F (+9°C). The fuel to air ratio in direct fired furnace portion 15 was controlled to have about 5% by volume excess combustibles. For various strip speeds and temperatures, the following visual observations were made:

Sample	Speed (m/min)	DFF(°C)*	RT(°C)**	Oxide***	Coating Condition
A	37	760	917	Dark Blue	random un-coated areas
B	46	704	917	Light Blue	random un-coated areas
C	55	649	871	Gold	uncoated strip edge only
D	37	649	871	Gold	good coating

* Strip temperature in furnace portion 15.

** Strip temperature in furnace portion 16

*** Surface appearance as strip 11 passed from furnace 15

As demonstrated above, a ferritic chromium alloy steel is oxidized when heated to a temperature of at least 649°C in an atmosphere of combustion products having no free oxygen. The dew point of the hydrogen atmosphere in snout 26 increased to a maximum of about +58°F (+14°C) as a result of at least some of the iron and/or chromium oxide being reduced to metal and water by the hydrogen atmosphere. Samples A and B heated to at least 704°C in the direct fired furnace were excessively oxidized and not properly wetted by the aluminum coating metal. The amount of oxidation to the strip when heated to 649°C in the direct fired furnace was marginally excessive as demonstrated by poor coating wetting along one edge of

Sample C. Using a very dry protective hydrogen atmosphere, e.g. dew point no greater than 0°F (-19°C), throughout furnace portions 16, 20, 22 and snout 26 probably would have sufficiently removed the oxide on Sample C to result in better wetting of the aluminum coating metal. Contrary to conventional wisdom for low carbon steel, ferritic chromium steel is readily oxidized in an atmosphere having no free oxygen and excess combustibles when heated to at least 649°C.

Example 2

A 1.64 mm thick by 94 cm wide coil of Type 409 stainless steel was coated with 183 gm/m^2 of Type 2 aluminum (total both sides) under similar conditions to that of Example 1 except the pure protective hydrogen atmosphere also was maintained in furnace portion 16 and cooling zones 20, 22. Prior to passing this coil through the coating line, the dew point of the hydrogen atmosphere in snout 26 was -9°F (-23°C). The following coating observations were made for various strip temperatures:

Sample	DFF(°C)	RT(°C)	Coating Appearance
A	817	908	poor, frequent uncoated spots
B	620	841	good, infrequent uncoated spots

Example 3

Three coils of Type 409 stainless steel were processed and coated with 137 gm/m^2 Type 2 aluminum (total both sides) under similar conditions as in Example 2 except the dew point of the hydrogen atmosphere in snout 26 was -50°F (-46°C) and the dew point in radiant tube furnace portion 16 was -4°F (-20°C). The following coating observations were made for various strip temperatures:

Sample	Thickness (mm)	Width (cm)	DFF (°C)	RT (°C)	Coating Appearance
A	1.4	117	676	892	Some uncoated spots
B	1.3	91	677	902	Scattered uncoated spots esp.10 cm from one edge
C	1.4	76	604	871	No uncoated spots

As clearly demonstrated in Examples 1-3, heating the strip to temperatures of at least 676°C in the direct fired furnace caused excessive oxidation of the strip. Using a very dry protective hydrogen atmosphere throughout the furnace portions 16, 20, 22 and snout 26 did not sufficiently remove the oxides to achieve good coating metal wetting. On the other hand, heating the strip to no greater than about 650°C in the direct fired furnace and further heating the strip to temperatures greater than about 830°C in the radiant tube furnace resulted in adherent aluminum coatings having minimal uncoated areas on a fully annealed strip capable of being deeply drawn without flaking or crazing the coating.

Example 4

A 1.08 mm thick by 76 cm wide Type 409 stainless steel coil was also successfully continuously hot dip coated with 119 gm/m^2 (total both sides) of an aluminum alloy (Type 1) containing 9% by weight silicon. Operating conditions were the same as in Example 2. The strip was heated to about 627°C in furnace portion 15 and to 829°C in furnace portion 16. Very few uncoated areas were observed.

Examples 5-10

Examples 5 through 10 are for .38 mm thick by 12.7 cm wide strip for ferritic, low carbon, titanium stabilized steels containing 2.01, 4.22 and 5.99% by weight chromium. These samples were continuously hot dip aluminum coated (Type 2) on a laboratory coating line similar to that shown in FIGS. 1 and 2 and under conditions similar to those for Example 2. Weights of coating were not measured.

No.	% Cr	Speed (m/min)	DFF* (°C)	% H_2**	Condition
5	2.01	7.6	1204	25	Poor Coating
6	4.22	12.2	1093	25	Poor Coating
7	5.99	12.2	1193	25	Poor Coating
8	2.01	9.1	1227	100	Very good coating

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	No.	% Cr	Speed (m/min)	DFF* (°C)	% H_2**	Condition
5	9	4.22	9.1	1238	100	Good coating
	10	5.99	9.1	--	100	Good coating

* Furnace Zone temperatures

** Hydrogen content in protective atmosphere

While strip temperatures out of the direct fired furnace were not measured, the data clearly supports the use of a 100% by volume hydrogen atmosphere in all areas of the furnace except the direct fired portion. Since the chromium content was lowered in Examples 5-10 from previous examples (11% by weight), it is reasonable to expect less dependence on direct fired furnace strip exit temperature with the lower chromium alloys (2, 4, 6% by weight). In other words, there would be less oxidation potential with less chromium content.

As noted above, a direct fired atmosphere of the gaseous products of combustion of fuel and air having no free oxygen is oxidizing to ferritic chromium alloy steel at about 1200°F (649°C). Accordingly, the strip temperature in direct fired furnace 15 should not exceed this temperature, particularly for ferritic stainless steel having chromium content of 10% by weight or more. Preferably, this strip cleaning temperature should not exceed about 1150°F (621°C). Nevertheless, the strip temperature on occasion will exceed 649°C resulting from strip width and/or gauge changes. Brief exclusions, i.e. less than 10 minutes of temperature about or slightly above 649°C, can be tolerated by carefully controlling the protective

atmosphere conditions throughout furnace portion 16, cooling zones 20, 22 and snout 26. By maintaining a protective atmosphere containing at least about 95% by volume hydrogen in furnace portion 16, cooling zones 20, 22 and snout 26, minimal oxidation of strip 11 in furnace portion 15 can be removed. In this regard, we have determined it to be especially beneficial to maintain extremely low dew points in the protective hydrogen atmosphere to compensate for water formation as iron and/or chromium oxide is reduced by hydrogen in the protective atmosphere. Preferably, the protective atmosphere in snout 26 contains at least 97% by volume hydrogen and the dew point should not exceed about -20°F (-29°C). A dew point of 0°F (-18°C) preferably should be maintained in furnace portion 16 and cooling zones 20, 22.

As disclosed in U.S. patent 4,675,214, the reactivity of the aluminum coating metal increases at elevated temperatures. Accordingly, maintaining the aluminum coating at 1280-1320°F (693-716°C) also helps to remove any residual surface oxide not removed by the protective atmosphere. However, removal of oxide from the strip surface while submerged in the aluminum coating metal bath is undesirable because the reduced oxide forms aluminum oxide (dross) on the surface of the coating bath. Aluminum oxide can also cause uncoated areas by attachment as fragments to the strip as it emerges from the coating pot preventing metallurgical bonding of the aluminum coating metal to the steel strip.

The teachings of the present invention are especially important when high strip temperatures, e.g greater than 830°C, are required for full annealing to produce deep drawing strip for high formability products. For

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high temperature annealing for low carbon steel strip, up to about 90% of the total heat input to the strip is accomplished in the direct fired portion of the furnace. The tables below show the percent of total thermal content achieved in the direct fired furnace portion for low carbon steel (prior art) and for ferritic chromium alloy steel (invention).

Prior Art

t(mm)	w(cm)	t X w	s(mpm)	T_1(°C)	T_2(°C)	MW/Hr. To T_1	MW/Hr. To T_2	% T_2*
.81	76	62	95	760	857	3.9	4.4	88.4
1.40	76	106	64	749	857	4.4	5.0	87.0
1.75	86	151	43	760	857	4.3	4.9	88.4
				Invention				
.81	76	62	64	624	831	2.1	2.9	74.5
1.40	76	106	40	628	832	2.3	3.1	74.8
1.75	86	151	33	631	849	2.8	3.8	73.6

t = strip thickness

w = strip width

s = strip speed through furnace

T_1 = strip temperature in direct fired furnace

T_2 = strip temperature in radiant tube heated furnace

* = % total thermal content

As demonstrated above, nearly 90% of total thermal content for fully annealed low carbon steel is achieved in the direct fired portion of the furnace while less than 80% of total thermal content for fully annealed hot dip aluminum coated chromium alloy steel can be achieved in the direct fired portion of the furnace if excessive oxidation is to be avoided. In other words, for fully annealed strip of the invention, the maximum allowed direct fired furnace strip temperature must be less than that necessary to provide at least 80% of total thermal input.

Various modifications can be made to the invention without departing from the spirit and scope of it so long as the chromium alloy steel strip is not heated to a temperature excessively oxidizing to the strip in a direct fired furnace and is passed through a protective atmosphere containing at least about 95% by volume hydrogen prior to entry into the coating metal bath. For example, the hydrogen atmosphere can be used throughout any heating and cooling portions of the coating line between the direct fired furnace and the coating pot delivery duct. The coating metal can include pure aluminum and aluminum base alloys. The coating metal weight may be controlled by finishing in air or a sealed enclosure. Therefore, the limits of the invention should be determined from the appended claims.

The claims defining the invention are as follows:

1. A method of continuous hot dip coating a steel strip with aluminium, comprising the steps of:

heating a ferritic chromium alloy steel strip to a temperature no greater than about 650°C by direct combustion of fuel and air wherein the gaseous products of said combustion have no free oxygen,

further heating said strip to a temperature of at least about 830°C,

cooling said strip to a temperature no less than the melting point of an aluminium coating metal,

passing said strip through a protective atmosphere having at least about 95% by volume hydrogen,

dipping said strip into a molten bath of said coating metal to deposit a coating layer on said strip,

said coating layer being substantially free of uncoated areas and tightly adherent to said strip.

2. The method of claim 1 wherein said strip is heated to no greater than about 621°C by said direct combustion of fuel and air.

3. The method of claim 1 or claim 2 wherein said strip is further heated to a temperature of 845°C to 955°C in said atmosphere.

4. The method of any one of claims 1 to 3 wherein said strip is cooled in said atmosphere.

5. The method of any one of claims 1 to 4 wherein said atmosphere has less than about 200 ppm oxygen and a dew point of less than about +4°C.

6. The method of any one of claims 1 to 5 wherein said coating metal is substantially pure aluminum.

7. The method of any one of claims 1 to 6 wherein said strip includes at least 10% by weight chromium.

8. A method of continuous hot dip coating a steel strip with aluminium, which method is as defined in claim 1 and substantially as herein described with reference to any one of Sample D of Example 1, Sample B of Example 2, Sample C of Example 3, or Example 4.

9. A method of continuous hot dip coating a steel strip with

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aluminium, which method is as defined in claim 1 and substantially as herein described with reference to Figures 1 and 2.

10. A coated steel strip when prepared by the method of any one of claims 1 to 9.

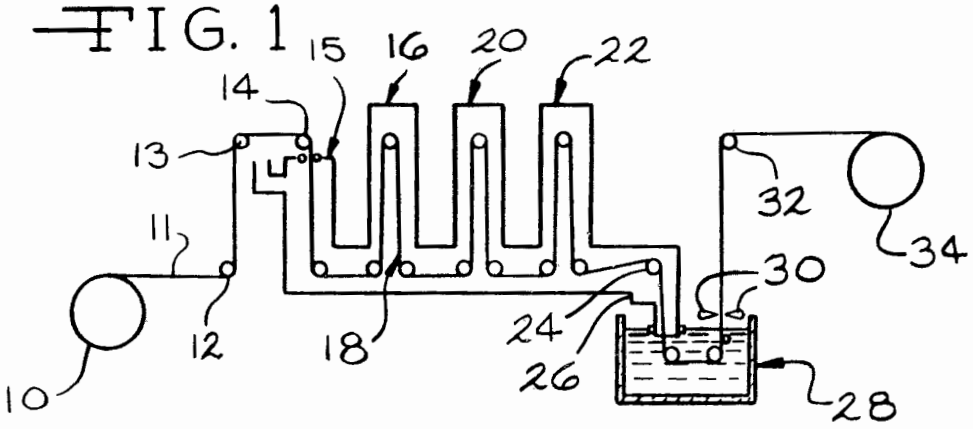
DATED this FIFTH day of FEBRUARY 1992
A K Management Corporation

Patent Attorneys for the Applicant
SPRUSON & FERGUSON

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FIG. 1


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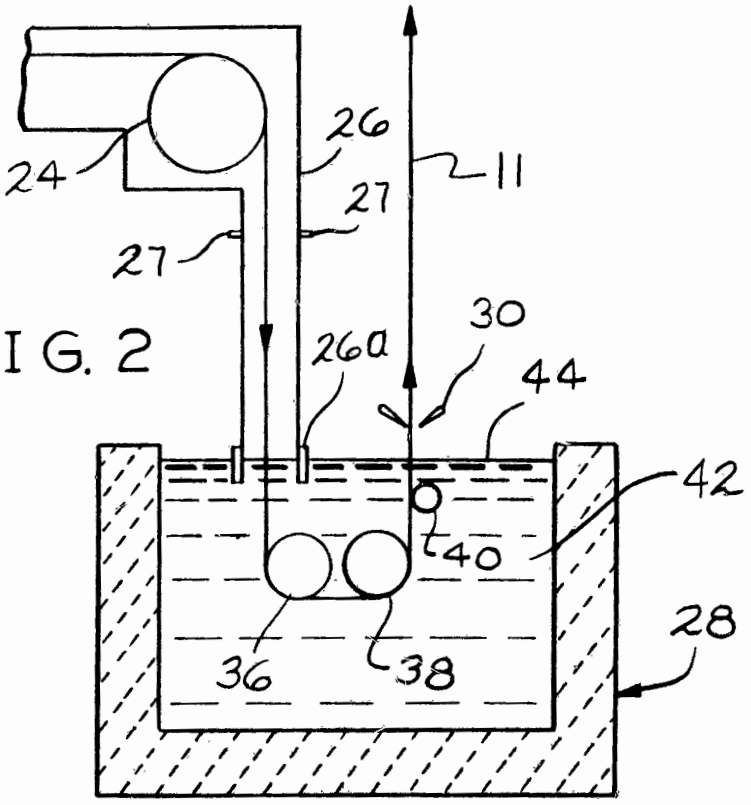

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FIG. 2

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CLAIMS JPH08144037A

1.

In a method for producing a molten aluminum-zinc alloy plated steel sheet in which spangles are suppressed, which is performed after hot-dip plating and immediately before solidification of the hot-dip plating layer, the surface temperature distribution of the steel sheet in the longitudinal direction is measured and refined after hot-dip plating. Supgle suppression, which is characterized by determining the treatment point, measuring the change in the amount of plating adhesion in the width direction, and overcooling the thickened region where the amount of adhesion is larger than the average value prior to the miniaturization treatment. A method for manufacturing a hot-dip aluminum-zinc alloy plated steel sheet.

2.

On the hot-dip galvanizing bath outlet side, a surface temperature measuring means in the longitudinal direction of the hot-dip galvanized steel sheet, a plating adhesion amount measuring means for measuring the plating adhesion amount in the plate width direction, and a region designated as a thickening area by the plating adhesion amount measuring means. A cooling means capable of selectively overcooling, a movable micronization treatment means provided downstream of the cooling means, and the cooling means and the cooling means based on the temperature distribution of the steel plate in the longitudinal direction and the amount of plating adhered in the plate width direction. An apparatus for producing a hot-dip aluminum-zinc alloy plated steel sheet in which spangles are suppressed, which comprises an arithmetic apparatus for controlling the micronization processing means.

3.

The molten aluminum according to claim 2, further comprising a heating means and another cooling means for the plated steel sheet upstream of the cooling means on the hot-dip galvanizing bath side, and these heating means and the cooling means are also controlled by the arithmetic unit. -Zinc alloy plated steel sheet manufacturing equipment.

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DESCRIPTION JPH08144037A

[0001]

INDUSTRIAL APPLICABILITY The present invention relates to a method for producing a molten aluminum-zinc alloy plated steel sheet and a method for producing a molten aluminum-zinc alloy plated steel sheet in which a so-called spangle pattern appearing on the surface of the molten aluminum-zinc alloy plated steel sheet is suppressed.

[0002]

[Conventional Technology] Hot-dip aluminum-zinc alloy-plated steel sheet represented by 55% Al-Zn alloy-plated steel sheet (hereinafter referred to as hot-dip Al-Zn alloy-plated steel sheet or simply Al-Zn alloy-plated steel sheet) is a hot-dip galvanized steel sheet. Since it has significantly better corrosion resistance, its use in building materials such as roofing materials is expanding.

[0003]

Al-Zn alloy plated steel sheets are generally manufactured using a continuous hot dip galvanizing line.

Therefore, after being annealed in the line by the Zenzimir method or the non-oxidizing furnace method, which is the mainstream in the continuous hot-dip galvanizing line, plating is performed. Specifically, after preheating while removing dirt (oils and fats, etc.) on the surface of the plating original plate in an oxidizing furnace or non-oxidizing furnace of a continuous hot-dip galvanizing line, a reduction furnace maintained in an H2-N2 mixed gas atmosphere. The surface is activated and annealed at. Next, the original plate was cooled to a temperature suitable for molten Al-Zn alloy plating, then passed through a plating bath to perform Al-Zn alloy plating, and the amount of plating adhered was adjusted by a wiping nozzle on the plating bath outlet side and cooled. After winding the plated steel sheet.

[0004]

On the surface of the molten Al-Zn alloy plated steel sheet produced in this way, a flower-shaped pattern called spangle spots (hereinafter, simply referred to as spangle) is generated, and the plated surface is uneven along the pattern. There is. When spangles become coarse, the appearance of the product deteriorates and the commercial value decreases. Further, for example, when it is used as a base material for a coated steel sheet, there is an inconvenience that a uniform coated surface cannot be secured. Therefore, there is a strong demand for a molten Al---Zn alloy plated steel sheet having a uniform and beautiful surface appearance in which spangle patterns are suppressed.

[0005]

As a method of suppressing (miniaturizing) the spangle pattern of a molten Al-Zn alloy plated steel sheet, a method of spraying air or a chemical solution after plating to quench the steel sheet (Japanese Patent Laid-Open No. 60-162763) has a higher

melting point than the plated metal. A method of spraying and cooling fine metal powder (Japanese Patent Laid-Open No. 59-170271) has been proposed so far. Further, a method of spraying a metal oxide powder as a spangle miniaturization treatment for hot-dip zinc alloy plating and hot-dip aluminum plating is also known (Japanese Patent Laid-Open No. 63-157849). It is most effective to suppress spangles by performing these miniaturization treatments immediately before the hot-dip galvanizing layer solidifies, that is, when the plating layer is at a temperature slightly higher than the melting point.

[0006]

However, even if molten Al---Zn alloy plating is performed by applying these miniaturization treatment methods, spangles often remain in the plated products. This is often due to the non-uniform adhesion of the Al---Zn alloy plating layer before the miniaturization treatment, or the non-uniform cooling in the plate width direction. For example, after hot-dip galvanizing, when the plating layer is miniaturized at a temperature considerably higher than the melting point of the Al---Zn alloy, the plated surface exhibits a pit-like rough skin appearance. On the contrary, if the miniaturization treatment time is too late and the plating layer is already solidified before that, the spangle cannot be sufficiently miniaturized.

[0007]

Regarding the cooling control for suppressing the spangle pattern, although it is an example of hot dip galvanizing, the following method has been proposed so far. A method of locally heating the edge portion of a steel plate in order to correct the deviation of the temperature distribution in the width direction of the molten zinc layer (Japanese Patent Laid-Open No. 48-84038), the width direction of the steel strip before and after the zinc powder spraying position. The temperature distribution of the steel strip is measured, and from the measured temperature distribution in the width direction, the line position where the temperature of the steel strip is slightly higher than the solidification temperature of zinc over the entire width is calculated, and the appropriate zinc powder spraying position is determined. Method for determining (Japanese Unexamined Patent Publication No. 1-30547), thermometers are arranged before and after the spangle refining processing device, and heating and cooling means are arranged in front of the spangle cooling device, and the two directions are the longitudinal direction and the width direction. A method for obtaining an appropriate temperature distribution by measuring a dimensional temperature distribution and changing the heating / cooling method and the position of a spangle micronization treatment device (Japanese Patent Laid-Open No. 2-298248).

[0008]

In both of the methods and methods, the surface temperature of the plated steel sheet is measured to determine the miniaturization treatment point (cooling timing) so that the miniaturization treatment can be performed immediately before the hot-dip galvanized layer solidifies. These methods can also be sufficiently applied to suppress spangles in molten Al---Zn alloy plated steel sheets.

[0009]

However, even if the cooling control method after plating as described above is applied to molten Al-Zn alloy plating, the finally obtained Al-Zn alloy plated steel sheet can be obtained. It has been experienced that unwanted spangles remain on the surface, especially in specific areas in the width direction. That is, the determination of an appropriate cooling time and the uniform cooling in the width direction by the conventional measurement of the surface temperature distribution of the steel sheet are not perfect for suppressing spangles.

[0010]

Therefore, an object of the present invention is to provide a method and a manufacturing apparatus for a molten Al---Zn alloy plated steel sheet capable of reliably suppressing spangles. Specifically, a technology that can surely eliminate the residual or generation of spangles that may occur even if the steel sheet temperature is properly controlled and the appropriate cooling time is determined during hot-dip Al-Zn alloy plating. To develop.

[0011]

PROBLEM TO BE SOLVED: To investigate the cause of spangle residue on a molten Al---Zn alloy plated steel sheet even if the cooling time is appropriately determined as described above. As a result, the final product may have a rough spangle

shape due to reheating, or spangle may occur locally. The cause is that the amount of Al—Zn alloy adhered is non-uniform in the plate width direction. It was clarified that this is because the amount of latent heat is large in the portion where the amount of Al—Zn alloy adhered is large in the plate width direction, and therefore the amount of reheat is also large, and solidification is partially delayed.

[0012]

If solidification is delayed in a part of the plate width direction due to such non-uniform reheating, the plating layer temperature is still fine in the part where solidification is delayed even if spangle miniaturization treatment is performed at an appropriate time thereafter. It is too expensive for the conversion process, and spangles will remain even after the miniaturization process. Therefore, in order to reliably obtain a molten Al—Zn alloy-plated steel sheet in which spangles are suppressed throughout the plate width direction, it is necessary to consider reheat in addition to determining an appropriate cooling time.

[0013]

Thus, the present invention measures the amount of Al-Zn alloy adhering to the steel sheet in the plate width direction when producing the molten Al-Zn alloy plated steel sheet in which spangles are suppressed by the micronization treatment, and the plate width direction. By overcooling only the portion where the amount of adhesion is large, it is a basic feature that uniform cooling of the Al—Zn alloy from immediately before the freezing point is possible over the entire width in the plate width direction during the miniaturization process.

[0014]

That is, the gist of the present invention is a method for producing a hot-dip Al—Zn alloy-plated steel sheet in which spangles are suppressed, in which a micronization treatment is performed after hot-dip plating and immediately before solidification of the hot-dip plating layer. The surface temperature distribution of the steel sheet is measured to determine the point of micronization, and the change in the amount of plating adhesion in the width direction is measured to overcool the thickened area where the amount of adhesion is larger than the average value prior to the miniaturization. This is a method for producing a hot-dip Al—Zn alloy-plated steel sheet in which spangles are suppressed.

[0015]

Here, supercooling means that the degree of cooling is stronger than that of cooling of other parts in the width direction (that is, the part where the amount of adhesion is below the average), but specifically, consideration is given to reheating. Therefore, the cooling is performed so as to be 1 to 5 ° C lower than the cooling temperature required for the target temperature when the other parts reach the miniaturization processing device.

[0016]

From another aspect, the present invention presents the hot-dip galvanized steel sheet with a surface temperature measuring means in the longitudinal direction, a plating adhesion amount measuring means for measuring the plating adhesion amount in the plate width direction, and the plating adhesion. A cooling means capable of selectively overcooling a region designated as a thickened region by a quantity measuring means, a movable micronization processing means provided downstream of the cooling means, and a steel plate temperature distribution and a plate width in the longitudinal direction. It is an apparatus for producing a hot-dip Al—Zn alloy-plated steel sheet in which spangles are suppressed, which comprises an arithmetic apparatus for controlling the cooling means and the micronization processing means based on the amount of plating adhesion in the direction.

[0017]

In a preferred embodiment, the manufacturing apparatus further includes a heating means for the plated steel sheet and another cooling means upstream of the cooling means on the hot-dip galvanizing bath side, and these heating means and cooling means are also the arithmetic unit. Is controlled by.

[0018]

[Action] As described above, even in the conventional method for manufacturing a molten Al-Zn alloy plated steel sheet in which spangles are suppressed, heating, cooling, and miniaturization treatment points are performed so that the miniaturization treatment is performed immediately before solidification of the plating layer. It is in control.

However, conventionally, these controls have been performed by paying attention only to the width direction of the hot-dip galvanized steel sheet or only the temperature distribution in the width direction and the longitudinal direction.

[0019]

For example, FIG. 2 shows a hot-dip galvanizing apparatus for carrying out the above method.

This device includes a burner box 4 for heating, a cooler box 5 for cooling, a radiation thermometer 6 for two-dimensional temperature measurement, a miniaturization processing device 7, and an arithmetic device 8.

Note that 1 is a hot-dip galvanized bath, 2 is a steel plate, 3 is a wiping nozzle, and 9 is a plated steel plate.

The temperature of the plated steel sheet 9 that has exited the hot-dip galvanized bath 1 is measured in the width direction and the longitudinal direction by the two-dimensional temperature measuring device 6, and the heating means 4 or the heating means 4 or The temperature of the steel sheet is controlled by heating or cooling by the cooling means 5.

These measurement, heating, and cooling data are sent to the arithmetic unit 8, and the miniaturization processing device is moved to a position where the entire width of the plate is slightly higher than the solidification temperature, and the miniaturization processing is performed.

[0020]

On the other hand, in the present invention, attention is paid to the fact that the adhesion amount of the hot-dip galvanized steel sheet is non-uniform in the width direction, and for spangles, the reheat in the thickened region where the adhesion amount is larger than the average value is other. It was found that this large reheat, which is larger than the part, affects the spangle. It is presumed that the reason why the amount of hot-dip galvanized varies in the width direction is that the shape of the steel sheet passing between the gas injection nozzles is unstable.

[0021]

In order to prevent the generation of spangles due to this reheating, in the present invention, prior to the miniaturization process, a thickened region in the width direction of the plated steel sheet is detected, and the region is particularly supercooled to be fine. The effect of reheating before and after the conversion process is minimized. The degree of supercooling at this time is determined in relation to the degree of thickening, but if the temperature of the thickening region at the time of miniaturization processing is cooled to be the same as the temperature of other parts. Good. That is, since the amount of reheat generated between the cooling and the miniaturization process is proportional to the amount of plating adhesion, supercooling is performed so as to offset it. Specifically, as described above, the cooling may be performed so as to be 1 to 5 ° C lower than the cooling temperature required for the target temperature at the time of reaching the miniaturization processing apparatus in other parts.

[0022]

Therefore, as shown in FIG. 1, the hot-dip Al—Zn alloy-plated steel sheet manufacturing apparatus of the present invention is capable of partially overcooling in the width direction as compared with the conventional hot-dip galvanizing apparatus shown in FIG. Means (eg, second cooler box 10) and hot-dip galvanizing amount measuring means 11 in the width direction may be attached.

[0023]

Thus, according to the present invention, since only the portion having a large amount of plating adhesion (thickening region) in the width direction is selectively overcooled and then the miniaturization treatment is performed, the plating surface temperature is the width of the steel sheet during the miniaturization treatment. Since it is substantially uniform over the entire width in the direction, the miniaturization treatment effect can be uniformly achieved over the entire width, and a molten Al—Zn alloy plated steel sheet in which spangles are uniformly

suppressed in the width direction can be obtained. it can.

[0024]

On the other hand, in the past, since the degree of cooling is not changed in the width direction, the amount of heat recovery in the thickening region becomes large, and the miniaturization treatment is performed at a temperature higher than the optimum temperature, so that the effect of the miniaturization treatment is sufficient. However, spangles occur and spangles remain in the thickening area.

[0025]

The cooling means for supercooling may be the same as the conventional cooling means, but must be capable of changing the degree of cooling in the width direction.

In addition, there are no restrictions on the means of micronization, and powders with a higher melting point than air, air-water (gas in which minute water droplets are mixed), chemicals, and Al-Zn alloy, which is the material to be plated (eg, zinc powder, metal). It can be carried out using a medium that has been used conventionally, such as oxide powder).

[0026]

[Example] FIG. 1 is a schematic explanatory view of an apparatus for manufacturing a molten Al—Zn alloy plated steel sheet according to the present invention.

Hereinafter, examples of the present invention will be described with reference to this figure.

[0027]

In the apparatus of the present invention shown in FIG. 1, similarly to the conventional apparatus shown in FIG. 2, the steel plate 2 immersed in the molten Al—Zn alloy plating bath 1 is subjected to predetermined plating by the wiping nozzle 3 when it is pulled up from the bath. it is adjusted to the amount of adhesion.

Next, the temperature of the steel sheet is adjusted by heating the steel sheet with the burner box 4 or cooling it in the first cooler box 5 so that the micronization treatment is performed immediately before the molten Al—Zn alloy plating layer solidifies. This adjustment of the steel sheet temperature is not essential, but by adjusting the steel sheet temperature to be almost constant by heating or cooling in this way, the fluctuation range of the position of the miniaturization processing device 7 becomes small, and the miniaturization processing point can be controlled. It is preferable to adjust the temperature because it is easy.

[0028]

The temperature distribution in the longitudinal direction of the steel sheet 2 is monitored by the radiation thermometer 6, and based on this, the degree of heating or cooling for adjusting the temperature of the steel sheet is determined. In order to know the possibility of partial solidification in the width direction, it is preferable to monitor not only the longitudinal direction of the plated steel sheet but also the temperature distribution in the width direction at the same time with the radiation thermometer 6. Then, all of these heating, cooling, and temperature distribution data are sent to the arithmetic unit 8, and the position of the miniaturization processing device 7, that is, the miniaturization processing point is determined by this arithmetic unit. The miniaturization processing device 7 is movable, that is, it can be moved by moving up and down along the plate passing line according to the position where the molten Al-Zn alloy plating layer solidifies, and this device is a molten Al-Zn alloy plating layer. The required amount of movement is determined by the command of the arithmetic unit 8 so as to come to the point immediately before solidification.

[0029]

The hot-dip galvanizing apparatus of the present invention includes a means 11 for measuring the amount of plating adhesion in the width direction of the hot-dip galvanized steel sheet 9. The amount of plating adhered can be quickly measured by an analytical means such as fluorescent X-ray. The measurement result of the plating

adhesion amount measuring means is sent to the arithmetic unit 8 to detect a thick basis weight region in which the adhesion amount is larger than the average adhesion amount in the width direction. Then, based on the result, the second cooler box 10 provided on the upstream side of the miniaturization processing device 7 and capable of changing the degree of cooling in the width direction is operated. Therefore, the position of the adhesion amount measuring means 11 may be any point between the wiping nozzle 3 and the second cier box 10, but is preferably immediately after the wiping nozzle 3.

[0030]

The second cooler box is specifically 1 to 5 ° C from the target temperature so as to offset the excessive amount of reheat for the thickened region detected based on the measurement result of the adhesion amount measuring means 11. C The hot-dip galvanized layer is cooled by changing the degree of cooling in the width direction so as to supercool to a low temperature. This cooling can be performed by partially cooling only the thickening area (not cooling the other parts) or by making the cooling degree of the thickening area stronger than the cooling degree of the other parts. For example, the second cooler box 10 can consist of a large number of spray nozzles, one in each of a large number of areas evenly partitioned (eg, 1 to 50 mm wide) along the width direction of the steel sheet. In that case, the cooling medium (eg, air, air, water, chemical solution) is sprayed onto the plated steel plate only from the spray nozzle of the section designated as the thickening area, or the amount of the cooling medium sprayed from the spray nozzle of the section is changed. By increasing the amount of spraying in the section of the above, it is possible to overcool the thickened area.

[0031]

After selectively supercooling the thickening region in this way, the plating layer miniaturization processing apparatus is performed. The miniaturization processing apparatus 7 is an apparatus for producing a steel sheet in which spangles are suppressed by spraying an appropriate medium such as air, brackish water, a chemical solution, or a metal powder onto the hot-dip galvanized layer immediately before solidification and uniformly quenching the layer. Is.

[0032]

As described above, the position of the micronization processing device 7 is the steel plate temperature distribution measured by the radiation thermometer 6, the heating or cooling of the plated steel sheet by the burner box 4 or the first cooler box 5, and further the second cooler box 10. The data regarding the cooling of the steel sheet by the above is sent to the arithmetic unit 8 to determine that the molten Al—Zn alloy plating layer is unsolidified over the entire width and is at the position immediately before solidification. Then, based on the command from the arithmetic unit 8, the miniaturization processing device 7 is moved up and down along the plate line (that is, moved in the same direction as the steel plate traveling direction or in the opposite direction) to solidify the hot-dip galvanized layer. Set to the previous position.

[0033]

In the past, the effect of reheat due to the uneven amount of plating adhering in the width direction was ignored, so in the thickened area, miniaturization treatment is performed in a state of insufficient cooling due to reheating, and even after the miniaturization treatment, this is performed. The plated surface has spangles remaining in the area. On the other hand, according to the present invention, since only the thickening region is supercooled upstream of the miniaturization processing apparatus, a relatively large reheat that occurs in this region while the plated steel plate advances to the miniaturization processing apparatus. It is offset by supercooling, and a local temperature rise (insufficient cooling) in the thickening region is avoided, so that the miniaturization treatment can be uniformly performed at the optimum temperature over the entire width in the plate width direction. As a result, the effect of the miniaturization treatment is uniformly exhibited over the entire width, and a plated surface in which spangles are uniformly suppressed in the plate width direction can be obtained. Since the hot-dip galvanized steel sheet is usually double-sided plated, the controlled plating method according to the present invention described above is independently performed on both sides of each side. However, in the case of single-sided plating, or when only one side needs to be a beautiful surface, the

above-mentioned controlled plating method of the present invention may be applied to only one side.

[0034]

3 (a) and 3 (b) schematically explain the formation of a thickened region and supercooling of a molten Al—Zn alloy-plated steel sheet obtained by using the apparatus according to the present invention shown in FIG. .. In the illustrated example, the plate thickness is 0.5 mm, the plate width is 1219 mm, and the target plating adhesion amount is 90 g / m2 per side. The adhesion amount distribution of the molten Al—Zn alloy plating layer in the plate width direction measured by the plating adhesion amount measuring means 11 is as shown in FIG. 3 (a), and two thickening regions were detected. On the other hand, as shown in FIG. 1B, the second cooler box 10 includes 12 water spray nozzles A to L arranged at equal distances in the plate width direction. That is, it can be evenly divided into 12 sections in the width direction, and each section can be supercooled. In the illustrated example, only the thickening area is selectively supercooled by operating only the spray nozzles C and I located at the positions corresponding to the detected thickening area to spray the cooling water, and then fine. The conversion process was performed.

[0035]

The plated appearance of the molten Al-Zn alloy-plated steel sheet finally obtained after the miniaturization treatment, especially the spangle pattern, was observed by dividing the plate width direction into 12 sections corresponding to the nozzle positions A to L. However, spangles were sufficiently suppressed. On the other hand, for comparison, when the same molten Al—Zn alloy plated steel sheet was manufactured without operating the above second cooler box at all (thus, without selective supercooling in the width direction), the plate width was obtained. In the section corresponding to the thickening area in the direction (that is, the section corresponding to the nozzle positions C and I), a visually recognizable spangle pattern remained, and the suppression of spangle was insufficient.

[0036]

INDUSTRIAL APPLICABILITY As described above, when a molten Al—Zn alloy-plated steel sheet in which spangles are suppressed is produced by performing a micronization treatment immediately before solidification of a hot-dip galvanized layer, melting in the plate width direction is performed according to the present invention. By measuring the change in the amount of plating adhesion and selectively overcooling only the thickened area where the amount of plating adhesion is large, a beautiful plated surface in which spangles are suppressed uniformly over the entire width in the plate width direction can be obtained. As a result, even when a painted steel sheet is used, it can be painted uniformly, and the painted appearance is improved.

[0037]

A brief description of the drawing

[0038]

FIG. 1 is a schematic explanatory view of an apparatus for manufacturing a molten Al—Zn alloy plated steel sheet in which spangles are suppressed according to the present invention.

[0039]

FIG. 2 is a schematic explanatory view of a conventional similar device.

[0040]

3 Fig. 3 (a) and 3 (b) show the formation and supercooling of the thickened region of the molten Al—Zn alloy plated steel sheet obtained by using the apparatus according to the present invention shown in FIG.

1, respectively. It is a figure to explain.

[0041]

Code description

[0042]

1: Hot-dip galvanized bath 2: Steel plate 3: Wiping nozzle 4: Burner box 5: First cooler box 6: Radiation thermometer 7: Miniaturization processing device 8: Computing device 9: Hot-dip galvanized steel sheet 10: Second cooler box 11: Plate width direction plating adhesion amount measuring means

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CLAIMS JPH08144037A

1.

In a method for producing a molten aluminum-zinc alloy plated steel sheet in which spangles are suppressed, which is performed after hot-dip plating and immediately before solidification of the hot-dip plating layer, the surface temperature distribution of the steel sheet in the longitudinal direction is measured and refined after hot-dip plating. Supgle suppression, which is characterized by determining the treatment point, measuring the change in the amount of plating adhesion in the width direction, and overcooling the thickened region where the amount of adhesion is larger than the average value prior to the miniaturization treatment. A method for manufacturing a hot-dip aluminum-zinc alloy plated steel sheet.

2.

On the hot-dip galvanizing bath outlet side, a surface temperature measuring means in the longitudinal direction of the hot-dip galvanized steel sheet, a plating adhesion amount measuring means for measuring the plating adhesion amount in the plate width direction, and a region designated as a thickening area by the plating adhesion amount measuring means. A cooling means capable of selectively overcooling, a movable micronization treatment means provided downstream of the cooling means, and the cooling means and the cooling means based on the temperature distribution of the steel plate in the longitudinal direction and the amount of plating adhered in the plate width direction. An apparatus for producing a hot-dip aluminum-zinc alloy plated steel sheet in which spangles are suppressed, which comprises an arithmetic apparatus for controlling the micronization processing means.

3.

The molten aluminum according to claim 2, further comprising a heating means and another cooling means for the plated steel sheet upstream of the cooling means on the hot-dip galvanizing bath side, and these heating means and the cooling means are also controlled by the arithmetic unit. -Zinc alloy plated steel sheet manufacturing equipment.

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開平8－144037

(43)公開日　平成８年(1996)６月４日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｃ２３Ｃ　2/26				
2/06				
2/12				

審査請求　未請求　請求項の数３　ＯＬ　（全　６　頁）

(21)出願番号　特願平6－283766

(22)出願日　平成６年(1994)11月17日

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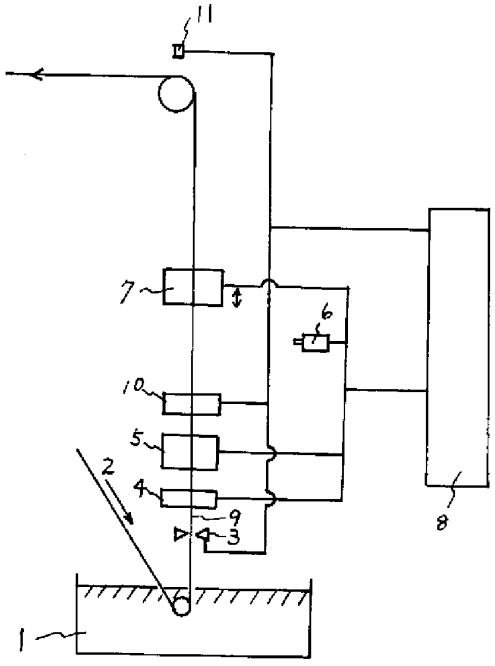
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(54)【発明の名称】　溶融アルミニウム－亜鉛合金メッキ鋼板の製法及び装置

(57)【要約】

【構成】　溶融メッキ浴１でメッキ後、メッキ層の凝固直前に７で微細化処理する、スパングルの抑制された溶融アルミニウム－亜鉛合金メッキ鋼板の製造において、溶融メッキ鋼板９の長手方向の鋼板表面温度分布を６で計測し、この温度分布および４、５での加熱、冷却のデータを演算装置８で処理して微細化処理地点を決定する。さらに、幅方向におけるメッキ付着量の変化を11で計測し、平均値より付着量の大きい厚目付け領域を、微細化処理に先立って冷却手段10で過冷却する。

【効果】　厚目付け領域での復熱に起因するスパングルの発生がなく、均一にスパングルが抑制された溶融Al－Zn合金メッキ鋼板が得られる。



【特許請求の範囲】
【請求項１】　溶融メッキ後、溶融メッキ層の凝固直前に微細化処理を行う、スパングルの抑制された溶融アルミニウム－亜鉛合金メッキ鋼板の製造方法において、溶融メッキ後に長手方向の鋼板表面温度分布を計測して微細化処理地点を決定するとともに、幅方向におけるメッキ付着量の変化を計測し、平均値より付着量の大きい厚目付け領域を、微細化処理に先立って過冷却することを特徴とする、スパングルの抑制された溶融アルミニウム－亜鉛合金メッキ鋼板の製造方法。
【請求項２】　溶融メッキ浴出側に、溶融メッキ鋼板の長手方向の表面温度計測手段、板幅方向のメッキ付着量を計測するメッキ付着量計測手段、該メッキ付着量計測手段によって厚目付け領域とされた領域を選択的に過冷却することのできる冷却手段、該冷却手段の下流に設けた可動型の微細化処理手段、および長手方向の鋼板温度分布および板幅方向のメッキ付着量に基づいて該冷却手段および該微細化処理手段を制御する演算装置を備えた、スパングルの抑制された溶融アルミニウム－亜鉛合金メッキ鋼板の製造装置。
【請求項３】　溶融メッキ浴出側の前記冷却手段より上流に、メッキ鋼板の加熱手段および別の冷却手段をさらに備え、これらの加熱手段および冷却手段も前記演算装置により制御される、請求項２記載の溶融アルミニウム－亜鉛合金メッキ鋼板の製造装置。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、溶融アルミニウム－亜鉛合金メッキ鋼板の表面に現れる、いわゆるスパングル模様が抑制された、溶融アルミニウム－亜鉛合金メッキ鋼板の製造方法および製造方法に関する。
【０００２】
【従来の技術】55%Al－Zn合金メッキ鋼板で代表される溶融アルミニウム－亜鉛合金メッキ鋼板（以下、溶融Al－Zn合金メッキ鋼板または単にAl－Zn合金メッキ鋼板という）は、溶融亜鉛メッキ鋼板より耐食性が著しく優れていることから、特に屋根材などの建材への利用が拡大している。
【０００３】Al－Zn合金メッキ鋼板は、一般に連続溶融亜鉛メッキラインを利用して製造される。従って、連続溶融亜鉛メッキラインで主流となっている、ゼンジミアー方式または無酸化炉方式によりライン内焼鈍を受けた後、メッキが施されることになる。具体的には、連続式溶融メッキラインの酸化炉または無酸化炉でメッキ原板表面の汚れ（油脂分など）を除去しながら予熱を行った後、H_2-N_2 混合ガス雰囲気に保持された還元炉にて表面の活性化および焼鈍を行う。次いで、原板を溶融Al－Zn合金メッキに適した温度に冷却した後、メッキ浴を通過させてAl－Zn合金メッキを施し、メッキ浴出側でワイピングノズルによりメッキ付着量を調整し、冷却した後メッキ鋼板を巻取る。
【０００４】このようにして製造された溶融Al－Zn合金メッキ鋼板の表面には、スパングル斑（以下、単にスパングルという）と称する華状の模様が生成し、その模様に沿ってメッキ表面に凹凸を生じている。スパングルが粗大化すると、製品としての見栄えが悪くなり、商品価値が低下する。さらに、例えば、塗装鋼板用母材とした場合に均一な塗装仕上り表面が確保できないといった不都合もある。そのため、スパングル模様が抑制された、一様で美麗な表面外観を有する溶融Al－Zn合金メッキ鋼板に対する要求が強い。
【０００５】溶融Al－Zn合金メッキ鋼板のスパングル模様を抑制（微細化）する方法として、メッキ後に空気や薬液を噴霧して急冷する方法（特開昭60－162763号公報）、メッキ金属より高い融点を有する金属微粉末を吹付けて冷却する方法（特開昭59-170271号公報）等がこれまでに提案された。また、溶融亜鉛合金メッキおよび溶融アルミニウムメッキのスパングル微細化処理として、金属酸化物粉末を吹付ける方法も知られている（特開昭63－157849号公報）。これらの微細化処理は、溶融メッキ層の凝固直前、即ち、メッキ層が融点よりわずかに高温にある時期に行うことがスパングル抑制に最も効果的である。
【０００６】しかし、これらの微細化処理方法を適用して溶融Al－Zn合金メッキを行っても、メッキ製品にスパングルが残ることが多い。この原因は、微細化処理前のAl－Zn合金メッキ層の付着量不均一に基づくか、或いはこの冷却が板幅方向に不均一である場合が多い。例えば、溶融メッキ後、Al－Zn合金の融点よりもかなり高温時にメッキ層が微細化処理されると、メッキ表面がピット状の肌荒れ外観を呈する。逆に、微細化処理時期が遅すぎて、その前に既にメッキ層が凝固していると、スパングルを十分に微細化することはできない。
【０００７】スパングル模様の抑制のための冷却制御に関しては、溶融亜鉛メッキの例ではあるが、次の方法がこれまでに提案されている。
溶融亜鉛層の幅方向における温度分布の偏差を修正するために、鋼板の端縁部分を局部加熱する方法（特開昭48－84038 号公報）、
亜鉛粉吹付け位置の前後における鋼帯幅方向の温度分布を測定し、測定された幅方向温度分布から、該鋼帯の温度が全幅に亘って亜鉛の凝固温度より僅かに高くなるライン位置を算出し、適切な亜鉛粉の吹付け位置を決定する方法（特開平１－306547号公報）、
スパングル微細化処理装置の前後に温度計を配置し、さらにスパングル冷却装置の前に加熱、冷却手段を配して、長手方向と幅方向の二次元温度分布を測定し、加熱冷却方法とスパングル微細化処理装置の位置を変更することにより、適切な温度分布を得る方法（特開平２－298248号公報）。

【０００８】およびの方法はいずれも、溶融メッキ層の凝固直前に微細化処理を行うことができるように、メッキ鋼板表面温度を測定して微細化処理地点（冷却時期）を決定するものである。これらの方法はAl－Zn合金メッキ鋼板のスパングル抑制にも十分に適用できる。

【０００９】

【発明が解決しようとする課題】しかし、上記～のようなメッキ後の冷却の制御方法を、溶融Al－Zn合金メッキに適用しても、最終的に得られたAl－Zn合金メッキ鋼板の表面、特に板幅方向の特定領域に、望ましくないスパングルが残ることが経験されてきた。即ち、従来の鋼板表面温度分布の測定による適切な冷却時期の決定や幅方向の冷却均一化は、スパングルの抑制にとって万全ではない。

【００１０】よって本発明の目的は、スパングルを確実に抑制することのできる溶融Al－Zn合金メッキ鋼板の製造方法と製造装置を提供することである。具体的には、溶融Al－Zn合金メッキ時に、鋼板温度の適正な管理や適切な冷却時期の決定を行っても生じることがある、スパングルの残留または発生を確実に解消することのできる技術を開発することである。

【００１１】

【課題を解決するための手段】本発明者らは、上述のように適切に冷却時期を決定しても溶融Al－Zn合金メッキ鋼板にスパングル残りが見られる原因について検討した。その結果、復熱により最終製品では粗いスパングル状になるか、局部的にスパングルが発生する場合があること、その原因としては、Al－Zn合金付着量が板幅方向に不均一であるため、板幅方向でAl－Zn合金付着量の多い部分が潜熱の量が大きく、従って復熱量も多くなり、部分的に凝固が遅れるからであること、を究明した。

【００１２】このような不均一な復熱により板幅方向の一部で凝固が遅れると、その後にスパングル微細化処理を適切な時期に行ったとしても、凝固が遅れた部分では、メッキ層温度がなお微細化処理には高すぎ、微細化処理してもスパングルが残ることになる。従って、スパングルが板幅方向の全体にわたって抑制された溶融Al－Zn合金メッキ鋼板を確実に得るためには、適切な冷却時期の決定に加えて、復熱に対する配慮が必要である。

【００１３】かくして、本発明は、微細化処理によりスパングルの抑制された溶融Al－Zn合金メッキ鋼板を製造する際に、鋼板に付着したAl－Zn合金の板幅方向の付着量を測定し、板幅方向で付着量の多い部分のみを過冷却することにより、微細化処理時に板幅方向の全幅に亘ってAl－Zn合金の凝固点直前からの均一冷却を可能にすることを基本的特徴とする。

【００１４】即ち、本発明の要旨とするところは、溶融メッキ後、溶融メッキ層の凝固直前に微細化処理を行う、スパングルの抑制された溶融Al－Zn合金メッキ鋼板の製造方法において、溶融メッキ後に長手方向の鋼板表面温度分布を計測して微細化処理地点を決定するとともに、幅方向におけるメッキ付着量の変化を計測し、平均値より付着量の大きい厚目付け領域を、微細化処理に先立って過冷却することを特徴とする、スパングルの抑制された溶融Al－Zn合金メッキ鋼板の製造方法である。

【００１５】なお、ここで、過冷却とは、幅方向の他の部分（即ち、付着量が平均以下の部分）の冷却より冷却度を強めることを意味するが、具体的には、復熱に配慮して、他の部分の微細化処理装置到達時の目標温度に必要な冷却温度より１～５℃低くなるように冷却することである。

【００１６】また、別の面からは、本発明は、溶融メッキ浴出側に、溶融メッキ鋼板の長手方向の表面温度計測手段、板幅方向のメッキ付着量を計測するメッキ付着量計測手段、該メッキ付着量計測手段によって厚目付け領域とされた領域を選択的に過冷却することのできる冷却手段、該冷却手段の下流に設けた可動型の微細化処理手段、および長手方向の鋼板温度分布および板幅方向のメッキ付着量に基づいて該冷却手段および該微細化処理手段を制御する演算装置を備えた、スパングルの抑制された溶融Al－Zn合金メッキ鋼板の製造装置である。

【００１７】好適態様にあっては、この製造装置は、溶融メッキ浴出側の前記冷却手段より上流に、メッキ鋼板の加熱手段および別の冷却手段をさらに備え、これらの加熱手段および冷却手段も前記演算装置により制御される。

【００１８】

【作用】前述したように、従来のスパングルが抑制された溶融Al－Zn合金メッキ鋼板の製造方法においても、微細化処理をメッキ層の凝固直前で行うように加熱、冷却、微細化処理地点の制御を行っている。しかし、従来は、溶融メッキ鋼板の幅方向のみ、或いは幅方向と長手方向の温度分布だけに注目して、これらの制御を行っていた。

【００１９】例えば、上記の方法を実施するための溶融メッキ装置を図２に示す。この装置は、加熱用のバーナーボックス４、冷却用のクーラーボックス５、二次元温度測定用の放射温度計６、微細化処理装置７、および演算装置８を備えている。なお、１は溶融メッキ浴、２は鋼板、３はワイピングノズル、９はメッキ鋼板である。溶融メッキ浴１を出たメッキ鋼板９は、二次元温度測定装置６で幅方向と長手方向の温度が測定され、溶融メッキ層が凝固する直前に微細化処理を受けるように、加熱手段４または冷却手段５による加熱または冷却により鋼板温度を制御する。これらの測定、加熱、冷却のデータが演算装置８に送られ、板幅の全幅が凝固温度よりわずかに高温にある位置に微細化処理装置を移動させ、微細化処理を行う。

【００２０】これに対して、本発明では、溶融メッキ鋼

板の付着量が幅方向に不均一であることに着目し、スパングルに対しては、付着量が平均値より大きい厚目付け領域における復熱が他の部分より大きく、この大きな復熱がスパングルに影響することを究明したのである。溶融メッキの付着量が幅方向で変動する理由としては、気体噴射ノズル間を通過する鋼板の形状不安定等によるものと推測される。

【００２１】この復熱によるスパングルの発生を防止するために、本発明にあっては、微細化処理に先立って、メッキ鋼板の幅方向における厚目付け領域を検知し、その領域を特に過冷却して、微細化処理前後の復熱の影響を可及的に小とするのである。この時の過冷却の程度は、厚目付けの程度との関係で決定されるが、微細化処理時点での厚目付け領域の温度が、他の部分の温度と同じようになるように冷却すればよい。即ち、冷却から微細化処理までの間に起こる復熱の量はメッキ付着量に比例するので、それを相殺するように過冷却する。具体的には、前述したように、他の部分における微細化処理装置到達時の目標温度に必要な冷却温度より１～５℃低温になるように冷却すればよい。

【００２２】従って、本発明の溶融Al－Zn合金メッキ鋼板製造装置は、図１に示すように、図２に示した従来の溶融メッキ装置に対して、さらに幅方向の部分的な過冷却が可能な冷却手段（例、第二クーラーボックス10）と幅方向の溶融メッキ付着量計測手段11を付設すればよい。

【００２３】かくして、本発明によれば、幅方向においてメッキ付着量の多い部分（厚目付け領域）だけを選択的に過冷却してから微細化処理を行うため、微細化処理時にはメッキ表面温度が鋼板の幅方向の全幅にわたって実質的に均一になっているので、微細化処理効果を全幅にわたって均一に達成することができ、幅方向で均一にスパングルが抑制された溶融Al－Zn合金メッキ鋼板を得ることができる。

【００２４】これに対し、従来は、幅方向で冷却の程度を変化させないため、厚目付け領域での復熱量が大きくなり、適温より高温で微細化処理を受けることになって、微細化処理の効果が十分に得られず、スパングルの発生が起こって、厚目付け領域にスパングルが残る。

【００２５】過冷却のための冷却手段は、従来の冷却手段と同様でよいが、幅方向の冷却度の変化が可能なものでなければならない。また、微細化処理手段も制限がなく、空気、気水（微小水滴が混合状態となった気体）、薬液、被メッキ材であるAl－Zn合金より高融点の粉末（例、亜鉛粉末、金属酸化物粉末など）など、従来より用いてきた媒体を用いて実施することができる。

【００２６】

【実施例】図１は、本発明にかかる溶融Al－Zn合金メッキ鋼板の製造装置の概略説明図である。以下、この図に基づき、本発明の実施例について説明する。

【００２７】図１に示す本発明の装置においても、図２に示す従来装置と同様に、溶融Al－Zn合金メッキ浴１に浸漬された鋼板２は、浴から引き上げられると、ワイピングノズル３によって所定のメッキ付着量に調整される。次いで、溶融Al－Zn合金メッキ層が凝固する直前に微細化処理を行うように、鋼板をバーナーボックス４によって加熱するか、或いは第１クーラーボックス５において冷却することによって鋼板温度の調整を行う。この鋼板温度の調整は必須ではないが、このように加熱または冷却により鋼板温度をほぼ一定に調整することで、微細化処理装置７の位置の変動幅が小さくなり、微細化処理地点の制御が容易となるので、この温度調整を行うことが好ましい。

【００２８】鋼板２の長手方向の温度分布は放射温度計６によって監視されており、それに基づいて上記の鋼板温度の調整のための加熱または冷却の程度が決定される。なお、幅方向の部分的な凝固の可能性を知るために、放射温度計６によってメッキ鋼板の長手方向だけでなく、幅方向の温度分布も同時に監視することが好ましい。そして、これらの加熱、冷却、および温度分布のデータはいずれも演算装置８に送られ、この演算装置によって微細化処理装置７の位置、つまり微細化処理地点が決定される。微細化処理装置７は可動型、即ち、溶融Al－Zn合金メッキ層が凝固する位置に応じて、通板ラインに沿った昇降により移動可能であり、この装置が溶融Al－Zn合金メッキ層の凝固直前の地点にくるように、必要な移動量が演算装置８の指令によって決定される。

【００２９】本発明の溶融メッキ装置は、溶融メッキ鋼板９の幅方向のメッキ付着量の計測手段11を備えている。メッキ付着量は、蛍光Ｘ線などの分析手段により迅速に測定できる。このメッキ付着量計測手段の測定結果を演算装置８に送って、幅方向において平均付着量より付着量の大きい厚目付け領域を検出する。そして、その結果に基づいて、微細化処理装置７の上流側に設けた、幅方向に冷却度を変化させることができる第２クーラーボックス10を作動させる。従って、付着量計測手段11の位置は、ワイピングノズル３と第２クラーボックス10の間の任意の地点でよいが、好ましくはワイピングノズル３の直後である。

【００３０】第２クーラーボックスは、付着量計測手段11の測定結果に基づいて検出された厚目付け領域に対しては、その過大な復熱量を相殺するように、具体的には目標温度より１～５℃低い温度に過冷却するように、幅方向に冷却度を変化させて、溶融メッキ層の冷却を行う。この冷却は、厚目付け領域のみを部分的に冷却する（他の部分は冷却しない）か、或いは厚目付け領域の冷却度を他の部分の冷却度より強めることによって行うことができる。例えば、第２クーラーボックス10は、鋼板の幅方向に沿って均等に区画された（例、１～50㎜幅）多数の領域に１個づつ設置された多数のスプレーノズル

から構成することができる。その場合、厚目付け領域とされた区画のスプレーノズルだけから冷却媒体（例、空気、気水、薬液）をメッキ鋼板に吹付けるか、或いはその区画のスプレーノズルの冷却媒体の吹付け量を他の区画での吹付け量より増大させることにより、厚目付け領域の過冷却を行うことができる。

【００３１】このようにして厚目付け領域を選択的に過冷却してから、メッキ層の微細化処理装置を行う。微細化処理装置７は、凝固直前の溶融メッキ層に空気、気水、薬液、金属粉末などの適当な媒体を噴霧して、均一に急冷することにより、スパングルの抑制された鋼板を製造する装置である。

【００３２】微細化処理装置７の位置は、前述したように、放射温度計６により測定された鋼板温度分布、バーナーボックス４もしくは第１クーラーボックス５によるメッキ鋼板の加熱もしくは冷却、さらには第２クーラーボックス10による鋼板の冷却、に関するデータを演算装置８に送って、溶融Al－Zn合金メッキ層が全幅にわたって未凝固で、かつ凝固する直前の位置にくるように決定する。そして、この演算装置８からの指令に基づいて、微細化処理装置７を通板ラインに沿って昇降（即ち、鋼板進行方向と同方向または逆方法に移動）させて、上記の溶融メッキ層凝固直前の位置にセットする。

【００３３】従来は、幅方向における不均一なメッキ付着量による復熱の影響を無視していたため、厚目付け領域では復熱による冷却不足の状態で微細化処理を受けることになり、微細化処理後もこの領域にスパングルが残ったメッキ表面となる。これに対し、本発明によれば、厚目付け領域のみを微細化処理装置の上流で過冷却するため、微細化処理装置までメッキ鋼板が進行する間にこの領域において起こる相対的に大きな復熱が過冷却により相殺され、厚目付け領域における局部的な温度上昇（冷却不足）が避けられので、板幅方向の全幅にわたって均一に最適温度で微細化処理を受けさせることが可能となる。その結果、微細化処理の効果が全幅にわたって均一に発揮され、板幅方向に一様にスパングルが抑制されたメッキ表面が得られる。なお、溶融メッキ鋼板は、通常は両面メッキであるから、以上に説明した本発明にかかる制御されたメッキ方法を片面づつ独立して両面に対して行う。但し、片面メッキの場合、或いは１面だけを美麗な表面にすればよい場合には、片面のみに対して上記の本発明の制御されたメッキ方法を適用してもよい。

【００３４】図３(a) および(b) に、図１に示す本発明にかかる装置を使用して得た溶融Al－Zn合金メッキ鋼板の厚目付け領域の形成および過冷却の様子を図式的に説明する。図示例では、板厚は0.5 ㎜、板幅は1219 ㎜ 、目標のメッキ付着量は片面当たり90 g/㎡ である。メッキ付着量計測手段11で測定された板幅方向の溶融Al－Zn合金メッキ層の付着量分布は、図３(a) に示す通りであり、二箇所の厚目付け領域、が検出された。一方、第２クーラーボックス10は、図１(b) に示すように、板幅方向に均等な距離で配置された12個の水スプレーノズルＡ～Ｌを備えている。即ち、幅方向に12区画に均等分割して、各区画ごとに過冷却することができる。図示例では、検出された厚目付け領域、に対応する位置にあるスプレーノズルＣ、Ｉだけを作動させて冷却水をスプレーすることにより、厚目付け領域だけを選択的に過冷却してから、微細化処理を行った。

【００３５】微細化処理後に最終的に得られた溶融Al－Zn合金メッキ鋼板のメッキ外観、特にスパングル模様について、板幅方向をノズル位置Ａ～Ｌに対応する12区画に分けて観察したが、いずれの区画もスパングルが十分に抑制されていた。一方、比較のために、上記の第２クーラーボックスを全く作動させずに（従って、幅方向における選択的過冷却を行わずに）、同様溶融Al－Zn合金メッキ鋼板を製造したところ、板幅方向における厚目付け領域、に対応する区画（即ち、ノズル位置Ｃ、Ｉに対応する区画）では、目視ではっきり認識できるスパングル模様が残っており、スパングルの抑制が不十分であった。

【００３６】

【発明の効果】以上に説明したごとく、溶融メッキ層の凝固直前に微細化処理を行ってスパングルの抑制された溶融Al－Zn合金メッキ鋼板を製造する際、本発明に従って、板幅方向の溶融メッキ付着量の変化を測定し、メッキ付着量の多い厚目付け領域のみを選択的に過冷却することにより、板幅方向に均一に全幅にわたってスパングルが抑制された、美麗なメッキ表面が得られる。それにより、塗装鋼板にした場合にも均一に塗装でき、塗装外観が向上する。

【図面の簡単な説明】

【図１】本発明にかかる、スパングルの抑制された溶融Al－Zn合金メッキ鋼板の製造装置の概略説明図である。

【図２】従来の同様の装置の概略説明図である。

【図３】図３（a)、(b）は、それぞれ、図１に示す本発明にかかる装置を使用して得た溶融Al－Zn合金メッキ鋼板の厚目付け領域の形成および過冷却の様子を図式的に説明する図である。

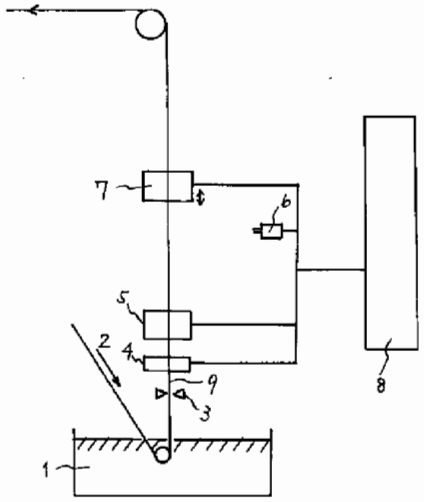
【符号の説明】

１：溶融メッキ浴
２：鋼板
３：ワイピングノズル
４：バーナーボックス
５：第１クーラーボックス
６：放射温度計
７：微細化処理装置
８：演算装置
９：溶融メッキ鋼板
10：第２クーラーボックス

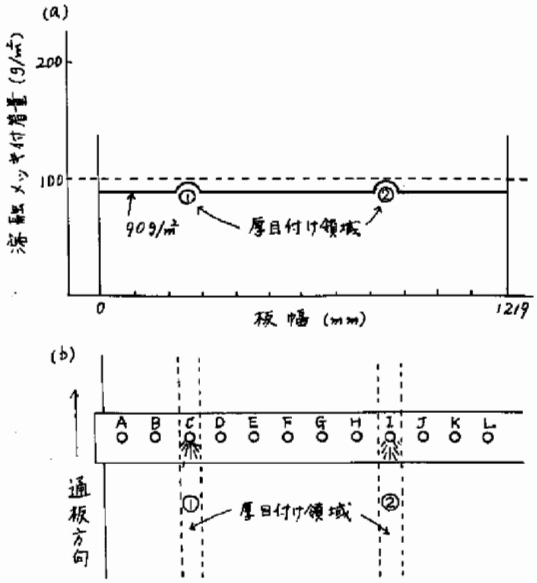
11：板幅方向メッキ付着量計測手段

【図１】

【図２】



【図３】



```
ERROR: undefined
OFFENDING COMMAND: eexec

STACK:

/quit
-dictionary-
-mark-
```

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/413,799	Filing Date 05/16/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	01/08/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/NICOLE LOVE HENSLEY/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637

23280 7590 07/10/2020

Davidson, Davidson & Kappel, LLC
589 8th Avenue
16th Floor
New York, NY 10018

EXAMINER	
SCHLEIS, DANIEL J	

ART UNIT	PAPER NUMBER
1784	

NOTIFICATION DATE	DELIVERY MODE
07/10/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ddk@ddkpatent.com

Office Action Summary	Application No. 16/413,799	Applicant(s) DRILLET et al.	
	Examiner Daniel J Schleis	Art Unit 1784	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 04/08/2020.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 48-77 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 48-77 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date 07/08/2019 and 01/06/2020.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

In view of the amendments to the claims, the 35 U.S.C. 112 rejections directed to the claims are withdrawn. New rejections directed to the claims are set forth below and were necessitated by these amendments.

Information Disclosure Statement

The information disclosure statements (IDS) submitted on 8 July 2019 and 6 January 2020 were considered by the examiner.

Claim Rejections - 35 USC § 102 / § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made

> to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under pre-AIA 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under pre-AIA 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of pre-AIA 35 U.S.C. 103(c) and potential pre-AIA 35 U.S.C. 102(e), (f) or (g) prior art under pre-AIA 35 U.S.C. 103(a).

Claims 48-50 and 54-77 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent Number 6,296,805 (Laurent).

In regards to independent claims 48, 68, and 71 and dependent claims 49, 50, 54-67, 69-70, and 72-77, Laurent is directed to a coated, hot- and cold-rolled steel sheet comprising a very

high resistance after thermal treatment. (1:6-8) The sheet is provided with an aluminum-based coating, for example by dipping in a bath containing, in addition, from 8% to 11% silicon, from 2% to 4% iron, the sheet having a high mechanical resistance after thermal treatment and a high resistance to corrosion, as well as a good capacity for painting and gluing. (2:37-45) The aluminum-based layer is provided in a thickness of about 20 microns. (3:38-44)

Laurent teaches a composition for the steel that completely falls within or overlaps the teachings within the instant application and set forth within the claims. Laurent teaches:

	Claim 50	Claim 51	Laurent (1:47-64)
Carbon	0.15-0.5	0.2-0.5	0.15-0.5
Manganese	0.5-3	0.8-1.5	0.5-3
Silicon	0.1-0.5	0.1-0.35	0.1-0.5
Chromium	0.01-1	0.01-1	0.01-1
Titanium	<0.2	<0.1	<0.2
Aluminum	<0.1	<0.1	<0.1
Phosphorous	<0.1	<0.05	<0.1
Sulfur	<0.05	<0.03	<0.05
Boron	0.0005-0.08	0.0005-0.01	0.0005-0.08
Iron	Balance	Balance	Balance

Diffusion of the iron in the coating will be initiated at high temperature, thus there will be better cohesion between the coating and steel in the sheet. (3:26-37) After the shaping of a casting the coating is subjected to an increase in temperature to an excess of 5° C/second. (3:26-29)

Thermal treatment of the metal sheet consists in a heating at a temperature between Ac1, starting temperature of austenitic formation, for example 750° C and 1200° C, in a furnace, for a period which depends on the temperature to be reached and the thickness of the casting sheet. (3:61-65) For a completely martensitic structure, and for steel having the composition of the

example, the speed of cooling should be in excess of the critical speed of hardening, which is 27° C / second for an austenitizing at 900° C for five minutes, wherein the sheet has a thickness of approximately 1 mm. (4:4-9)

This process appears to be identical or substantially identical to the process set forth in the specification of the instant application, which produces the claimed product. The instant application sets forth that the aluminum hot-dip coating is precisely controlled to fall within a range equal to 20 and 33 microns. (¶46-47 of Specification) The favorable layer disposition is obtained when aluminum- or aluminum alloy pre-coated steel sheets, whose thickness range from, e.g. 07 to 3 mm, are heated for 3 to 13 minutes in a furnace heated to a temperature of 880 to 940° C. (¶58 of Specification) The heating rate is between 4 and 12° C/second for producing a favorable alloyed layer disposition. (¶59 of Specification)

The Instant Application sets forth that the Al-Si coating has 8 to 11% silicon, from 2 to 4% iron, and the remainder being aluminum or aluminum alloy. (¶67 of Specification) The Typical composition of Al-Si coating is Al-9.3% silicon-2.8%Fe. (¶67 of Specification) The inventive coatings, however, are not limited to these compositions. (¶67 of Specification)

It appears that the thickness of the aluminum hot-dip coating, the composition of the hot-dip aluminum coating, the thickness of the steel sheet, the time and temperature of the heating within the furnace, and the heating rates in Laurent are identical or substantially identical to those set forth in the specification of the instant application. Applicant teaches that the heating rate and temperature lead to the favorable layer disposition. (See ¶58 and ¶59 of Specification) Laurent further sets forth the composition of the steel that falls within the teachings of the instant application and result in the claimed structure.

Where the claimed and prior art products are identical or substantially identical, or are produced by identical or substantially identical processes, the Office can require an applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of the claimed product. Whether the rejection is based on "inherency" under 35 USC 102, on "prima facie obviousness" under 35 USC 103, jointly or alternatively, the burden of proof is the same, and its fairness is evidenced by the Office's inability to manufacture products or to obtain and compare prior art products.

Consequently, absent a showing to the contrary, it appears that the properties of the product in the prior art necessarily or inherently possesses the characteristics of the claimed product, including the presence of the four claimed layers, the resulting thickness of the overall coating and its respective layers, and the quasi-continuous nature of the layers.

As to claims 54 and 55, Laurent teaches in the preferred embodiment that the titanium content with respect to the nitrogen content is in excess of 3.42. [2:11-14]

Claim Rejections - 35 USC § 103

Claims 51-53 is/are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Laurent

As to claim 51, Laurent sets forth compositional ranges that overlap the claimed compositional ranges.

	Claim 51	Laurent (1:47-64)
Carbon	0.2-0.5	0.15-0.5
Manganese	0.8-1.5	0.5-3

Silicon	0.1-0.35	0.1-0.5
Chromium	0.01-1	0.01-1
Titanium	<0.1	<0.2
Aluminum	<0.1	<0.1
Phosphorous	<0.05	<0.1
Sulfur	<0.03	<0.05
Boron	0.0005-0.01	0.0005-0.08
Iron	Balance	Balance

As to claims 52 and 53, Laurent teaches that the sulfur content of the preferred embodiment has a sulfur content of less than 0.03%. (1:65-2:10) This range taught by Laurent overlaps the claimed range.

Response to Arguments

Applicant's arguments with respect to the claims have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel J Schleis whose telephone number is (571)270-5636. The examiner can normally be reached on 10 AM to 4 PM Monday through Friday.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Humera Sheikh can be reached on (571) 272-0604. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair.

Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Daniel J. Schleis
Primary Examiner
Art Unit 1784

/Daniel J. Schleis/
Primary Examiner, Art Unit 1784

Notice of References Cited	Application/Control No. 16/413,799	Applicant(s)/Patent Under Reexamination DRILLET et al.	
	Examiner Daniel J Schleis	Art Unit 1784	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-6296805-B1	10-2001	Laurent; Jean-Pierre	C21D8/0278	148/531
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
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	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/413,799	DRILLET et al.
	Examiner	Art Unit
	Daniel J Schleis	1784

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor Name Search	07/08/2019	Schleis
Assignee Name Search	07/08/2019	Schleis
Reviewed Global Dossier	07/08/2019	Schleis
Non-Patent Literature Search - Google Scholar	07/08/2019	Schleis
EAST Text Search - See Search History	07/08/2019	Schleis
Reviewed File Wrappers of Other Applications in Patent Family	07/08/2019	Schleis
Reviewed Global Dossier	07/06/2020	Schleis
Reviewed File Wrappers, including search histories- in Patent Family	07/06/2020	Schleis
Non-Patent Literature Search - Google Scholar	07/06/2020	Schleis
EAST Text Search - See Search History	07/06/2020	Schleis

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/413,799	DRILLET et al.
	Examiner	Art Unit
	Daniel J Schleis	1784

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	13	((PASCAL) near2 (DRILLET)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 09:51
S2	8	((DOMINIQUE) near2 (SPEHNER)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 09:51
S3	11	((RONALD) near2 (KEFFERSTEIN)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 09:51
S4	0	("2013/0029172").URPN.	USPAT	OR	ON	2013/02/26 09:51
S5	9	("20030152796" | "3240269" | "5023113" | "6296805" | "6815087" | "7137201" | "7217331" | "7503116").PN. OR ("8307680").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 09:51
S6	4	("20030152796" | "5023113" | "6296805" | "7137201").PN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:05
S7	9	("4891274" | "5133815" | "5178688" | "5656102").PN. OR ("6296805").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:37
S8	4	("3214820" | "6197132" | "6296805").PN. OR ("7708843").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:40
S9	16	("20010042393" | "20070082214" | "20070163685" | "20090242086" | "20090308499" | "20110006491" | "20110165436" | "4546051" | "6017643" | "6093498" | "6296805" | "6298905" | "6564604" | "6815087" | "7137201" | "7867344").PN. OR ("8066829").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:40
S10	1	("2003/0152796").URPN.	USPAT	OR	ON	2013/02/26 10:43
S11	17	("1423747" | "3240269" | "4657717" | "4921159" | "5056209" | "6337471").PN. OR ("7137201").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:45
S12	10	("3632453" | "3664293" | "4751957" | "4891274" | "5518772" | "5529816").PN. OR ("6017643").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:47

S13	195	(("5209860") or ("8066829") or ("8066829") or ("8307680") or ("20110006491") or ("20110165436") or ("20110214475") or ("20120064362") or ("20130029172") or ("6564604") or ("20010042393") or ("20120118437") or ("4846986") or ("20120085467") or ("20080261058") or ("4601766") or ("5248528") or ("5456953") or ("5568914") or ("5830290") or ("20040118482") or ("5287983") or ("4880481") or ("4344342") or ("4963400") or ("4999241") or ("5342672") or ("5792180") or ("6070444") or ("4353765") or ("5982073") or ("6129790") or ("6165595") or ("3798406") or ("4033918") or ("4311755") or ("4488862") or ("4508755") or ("4514264") or ("4525177") or ("4551085") or ("4554765") or ("4585519") or ("4842887") or ("4994517") or ("5273369") or ("5389452") or ("5538576") or ("5542978") or ("5639510") or ("5697715") or ("5729616") or ("5801128") or ("5837314") or ("5869160") or ("6020026") or ("6019923") or ("6251514") or ("6258425") or ("6262513") or ("6309748") or ("6340397") or ("6342108") or ("20020014181") or ("20090025836") or ("20090048127") or ("4374168") or ("4309951") or ("5810332") or ("5795661") or ("8349098") or ("20020160235") or ("20020166606") or ("20100294400") or ("20110056594") or ("20110056594") or ("20120085466") or ("5981089") or ("6197125") or ("4793867") or ("4941930") or ("4980241") or ("5238506") or ("5405427") or ("5939144") or ("6090873") or ("6241393") or ("3859239") or ("3850684") or ("3850647") or ("4316751") or ("4347085") or ("4401719") or ("4402994") or ("4533606") or ("4592958") or ("4867853") or ("5232619") or ("5242506") or ("5290362") or ("5332776") or ("5466280") or ("5608028") or ("5643474") or ("5700551") or ("5743536") or	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/26 10:54

		("5783622") or ("5786098") or ("5851659") or ("5863640") or ("5890852") or ("5955201") or ("6001494") or ("6042949") or ("6083613") or ("6194088") or ("6197436") or ("6284059") or ("6329456") or ("6410626") or ("7533713") or ("8025965") or ("8025965") or ("20030150308") or ("20040129346") or ("20040216860") or ("20070209555") or ("20080090093") or ("20100175794") or ("20110300407") or ("20100199872") or ("4793218") or ("5584845") or ("5759304") or ("6463779") or ("7703820") or ("7926180") or ("7926180") or ("20070045384") or ("20070051434") or ("20090058111") or ("20100187291")).PN. or (("20110247467") or ("4384011") or ("5960930") or ("6120604") or ("4863650") or ("4926792") or ("4942061") or ("4035528") or ("4342418") or ("4355059") or ("4490129") or ("4611610") or ("4818570") or ("4925213") or ("5300362") or ("5728474") or ("5809628") or ("5820954") or ("6037053") or ("6132864") or ("6403192") or ("8042484") or ("20080000417") or ("20080305358") or ("20090220815") or ("20120074106") or ("20120152410") or ("4486172") or ("4537588") or ("4844327") or ("4925518") or ("7955413") or ("4283225") or ("4302515") or ("4314661") or ("4316572") or ("4358325") or ("4480016") or ("4801072") or ("4853047") or ("5018259") or ("5271318") or ("5533423") or ("5622674") or ("5660443") or ("5926516") or ("6554919") or ("6986536") or ("RE40736") or ("7955413") or ("20010049956") or ("20050285416") or ("20050285417") or ("20080257110") or ("20090173129") or ("20110266724") or ("20120120561") or ("4251549")).PN.				
S14	0	("2012/0085466").URPN.	USPAT	OR	ON	2013/02/26 10:55
S15	0	("2012/0085467").URPN.	USPAT	OR	ON	2013/02/26 10:55

S16	0	("2011/0214475").URPN.	USPAT	OR	ON	2013/02/26 10:55
S17	1	("2011/0165436").URPN.	USPAT	OR	ON	2013/02/26 10:56
S18	1	("2011/0006491").URPN.	USPAT	OR	ON	2013/02/26 10:56
S19	8,085	((428/601,600,602,653) or (420/104,120,121,126) or (148/531,535,534,537,635,653) or (72/364,342.1,47) or (280/1)).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/26 11:01
S20	2,517	S19 and (steel ferrous) same (aluminum aluminium al)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/02/26 11:02
S21	304	S20 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/02/26 11:03
S22	14	("20020068189" | "20020104876" | "20030012977" | "20030207769" | "20040028939" | "3195991" | "4957822" | "4973523" | "5112416" | "5362574" | "5384205" | "5470666" | "7074496").PN. OR ("8053087").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 12:13
S23	8,085	((428/601,600,602,653) or (420/104,120,121,126) or (148/531,535,534,537,635,653) or (72/364,342.1,47) or (280/1)).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/26 12:33
S24	286	S23 and (carbon c) same (manganese Mn) same (Silicon si) same (Chromium Cr) same (titanium ti) same (aluminum al) same (Phosphorus P) same (Sulfur Sulphur S) same (Boron B)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/02/26 12:33
S25	59	S24 and (aluminum aluminium al) near5 (pre-coat$4 precoat$4 layer coat$5)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/02/26 12:35
S26	0	("2010/0294400").URPN.	USPAT	OR	ON	2013/02/26 12:36
S27	2	("2001/0001049").URPN.	USPAT	OR	ON	2013/02/26 12:40
S28	8,224	((428/601,600,602,653) or (420/104,120,121,126) or	US-PGPUB; USPAT; USOCR	OR	OFF	2013/09/19 16:58

		(148/531,535,534,537,635,653) or (72/364,342.1,47) or (280/1)).CCLS.				
S29	456	S28 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/09/19 16:58
S30	4	S29 and (strain near3 ratio)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/09/19 16:59
S31	36	S28 and (strain near3 ratio)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/09/19 16:59
S32	16	("20060134451" | "20070113936" | "20070166565" | "20070246509" | "20090020276" | "20090165901" | "20100101688" | "20100112370" | "20100183897" | "20110014494" | "20110240280" | "20110287276" | "20110287277" | "5037707" | "6019939" | "7387844").PN. OR ("8247082").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 16:59
S33	0	("2010/0084057").URPN.	USPAT	OR	ON	2013/09/19 16:59
S34	13	("4673551" | "4906534" | "5037707" | "5100048").PN. OR ("6019939").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:00
S35	4	("2010/0112370").URPN.	USPAT	OR	ON	2013/09/19 17:00
S36	0	("2009/0252641").URPN.	USPAT	OR	ON	2013/09/19 17:00
S37	4	("4985196" | "4990545" | "5139832" | "6084849").PN. OR ("7060140").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:00
S38	15	("4196025" | "4309886" | "4793869" | "5507677" | "5509842" | "5618401" | "5625251" | "5629051" | "5646478").PN. OR ("5871851").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:01
S39	9	("4601766" | "5019191" | "5871851").PN. OR ("6129992").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:01
S40	4	("3795971" | "4455352" | "4956025").PN. OR ("5529644").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:01

S45	40	(("20010042393") or ("8127449") or ("7137201") or ("7708843") or ("20070163683") or ("20070175040") or ("3240269") or ("7503116") or ("7217331")).PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	OFF	2017/03/10 08:29
S46	10	(("20010042393") or ("8127449") or ("7137201") or ("7708843") or ("20070163683") or ("20070175040") or ("3240269") or ("7503116") or ("7217331")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/03/10 08:43
S47	4	("3214820" | "6197132" | "6296805").PN. OR ("7708843").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2017/03/10 08:48
S48	8,872	((428/601,600,602,653) or (420/104,120,121,126) or (148/531,535,534,537,635,653) or (72/364,342.1,47) or (280/1)).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/07/08 10:56
S49	540	S48 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/07/08 10:56
S50	13,610	(C21D9/46 or C23C2/12 or C23C2/40 or C23C2/26 or B32B15/012 or Y10T428/12389 or Y10T428/12396 or Y10T428/12757).cpc.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/07/08 10:58
S51	977	S50 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/07/08 11:00
S52	2	S51 and (strain near3 ratio)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/07/08 11:02
S53	15,184	(C21D9/46 or C23C2/12 or C23C2/40 or C23C2/26 or B32B15/012 or Y10T428/12389 or Y10T428/12396 or Y10T428/12757).cpc.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2020/07/06 12:06
S54	1,089	S53 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2020/07/06 12:06

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S41	5,246	(C21D9/46 B32B15/012 C23C2/12 C23C2/26 C23C2/40 Y10T428/12389 Y10T428/12396 Y10T428/12757).cpc.	US-PGPUB; USPAT	OR	ON	2016/12/02 11:46
S42	1,776	S41 and (aluminum aluminium al) near5 (pre-coat$4 precoat$4 layer coat$5)	US-PGPUB; USPAT	OR	ON	2016/12/02 11:46
S43	888	S41 and ((aluminum aluminium al) near5 (pre-coat$4 precoat$4 layer coat$5)).clm.	US-PGPUB; USPAT	OR	ON	2016/12/02 11:46
S44	136	S43 and ((interdiffusion intermediate intermetallic superficial) near3 layer).clm.	US-PGPUB; USPAT	OR	ON	2016/12/02 11:47
S55	7,654	(C21D9/46 B32B15/012 C23C2/12 C23C2/26 C23C2/40 Y10T428/12389 Y10T428/12396 Y10T428/12757).cpc.	US-PGPUB; USPAT	OR	ON	2020/07/06 11:17
S56	1,342	S55 and ((aluminum aluminium al) near5 (pre-coat$4 precoat$4 layer coat$5)).clm.	US-PGPUB; USPAT	OR	ON	2020/07/06 11:17
S57	202	S56 and ((interdiffusion intermediate intermetallic superficial) near3 layer).clm.	US-PGPUB; USPAT	OR	ON	2020/07/06 11:17

7/6/2020 12:08:38 PM
C:\Users\dschleis\Documents\EAST\Workspaces\16413799.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16413799
Filing Date	2019-05-16
First Named Inventor	Drillet
Art Unit	1784
Examiner Name	TBD
Attorney Docket Number	20631.1028CON5

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7867344	B2	2011-01-11	Kusumi et al.	
	2					

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	1	20040238080	A1	2004-12-02	Vandeputte et al.	

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	1	2004106573	WO	A1	2004-12-09	SUMITOMO METAL IND	See English translation	
	2	2833504	FR	A1	2003-06-20	Laurent et al.	See English translation	

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	3	1013785	FR	B1	2006-10-25	Laurent	See English translation	
	4	2006051543	JP	A	2006-02-23	Kusumi et al.	See English machine translation, also e.g. US 7867344	

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	Mahesh C. Somani, et al., "Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process," ISIJ International, 2001, Volume 41, Issue 4, Pages 361-367 ("Somani")	
	2	Declaration of Mel Desart, dated April 16, 2019, relating to attached "High Strength Steels for Automotive Safety Parts," SAE Technical Paper 2001-01-0078. 2001, by Cornette, D., Hourman, T., Hudin, O., Laurent, J., and Reynaert, A."	
	3	Declaration Dr. Michael Miles, dated June 28, 2019 as filed in IPR2019-01275, US Patent No. 9,708,683	
	4	Declaration of Mel Desart, dated May 30, 2019, relating to attached "High Strength Steels for Automotive Safety Parts," SAE 2001 Transactions Journal of Materials & Manufacturing-V110-5, by Corneae, D., Hourman, T., Hudin, 0., Laurent, J., and Reynaert, A."	
	5	Declaration of Dr. Michael L. Knott dated April 22, 2019 realting to attached Somani (Mahesh C. Somani, et al., "Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process," ISIJ International, 2001, Volume 41, Issue 4, Pages 361-367 ("Somani")) from University of Michigan's Art, Architecture, and Engineering Library's Technical Services Department	
	6	Publication History from SAE Mobilus, dated May 30, 2019 for Cornette et al., "High Strength Steels for Automotive Safety Parts" SAE Technical Paper Series 2001-01-0078, March 24 001, ISSN: 0148-7191	
	7	Fekete, J., Stibich, A., and Shi, M., "A Comparison of the Response of HSLA and Dual Phase Sheet Steel in Dynamic Crush," SAE Technical Paper 2001-01-3101, 2001	

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	8	Robert R. Mayer, "Theoretical Effects of Hydroforming on Crashworthiness of Straight Sections," ASME International Mechanical Engineering Congress and Exposition, Applied Mechanics (2004):591-603	
	9	Publication History from ISIJ International for "Mahesh C. Somani, et al., "Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process," ISIJ International, 2001, Volume 41, Issue 4, Pages 361-367 ("Somani")"	
	10	Webster's New Twentieth Century Dictionary (2nd ed. 1964), published by The World Publishing Company	
	11	Random House Webster's Unabridged Dictionary (2nd ed. 1998), Random House New York	
	12	ASM Materials Engineering Dictionary, ASM INternational, The Materials Information Society, 1992	
	13	Dictionary of Materials and Manufacturing, Nichols Publishing: New York, 1990	
	14	McGraw-Hill Dictionary of Scientific and Technical Terms, Sixth Edition, 2003	
	15	Certified Translation of "alliation" and "alliage"	
	16	Ahindra Ghosh, "Secondary Steelmaking, Principles and Applications" (2001), CRC Press	
	17	Åkerström, P. et al., "Material parameter estimation for boron steel from simultaneous cooling and compression experiments," Modelling and Simulation in Materials Science and Engineering. 2005, Vol.13, No.8, p.1291	
	18	ASTM Dictionaly of Engineering Science & Technology, ASTM International 2005	

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	19	Chambers Dictionary of Science and Technology, Tenth edition, 1999
	20	Webster's Third New International Dictionary of the English Language Unabridged, 2003
	21	Engels, H. et al., "Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels." – p. 135-50 ("Engels"), published in Liewald, M. (Ed.). "New developments in sheet metal forming": Frankfurt a.M.: MATINFO, Werkstoff-Informationsges (2006)
	22	Declaration of Marcel Thoms of University of Stuttgart dated June 7, 2019 relating to attached "Engels, H. et al., "Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels." – p. 135-50 ("Engels"), published in Liewald, M. (Ed.). "New developments in sheet metal forming": Frankfurt a.M.: MATINFO, Werkstoff-Informationsges (2006)"
	23	Certified translation of "Stahl"
	24	Preliminary Opinion issued on June 19, 2019 in opposition proceedings of European Patent Application 06842403.5

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Examiner Signature	/Daniel J. Schleis/	Date Considered	07/06/2020

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	Art Unit	1784
	Examiner Name	TBD
	Attorney Docket Number	20631.1028CON5

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jennifer L. O'Connell/	Date (YYYY-MM-DD)	2019-07-08
Name/Print	Jennifer L. O'Connell	Registration Number	57392

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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	Examiner Name	Schleis
	Attorney Docket Number	20631.1028CON5

	1	"Continuously hot-dip coated strip and sheet of strucutral steels - Technical delivery conditions," European Standard EN 10326, July 2004, NON-EN 10326	

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	Art Unit	1784
	Examiner Name	Schleis
	Attorney Docket Number	20631.1028CON5

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/williamcgehris/	Date (YYYY-MM-DD)	2020-01-06
Name/Print	William C. Gehris	Registration Number	38156

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /DJS/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /DJS/

Electronic Acknowledgement Receipt

EFS ID:	39098953
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	Cary S. Kappel
Filer Authorized By:	
Attorney Docket Number:	20631.1028CON5
Receipt Date:	08-APR-2020
Filing Date:	16-MAY-2019
Time Stamp:	14:22:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Response to Election / Restriction Filed	206311028con5DraftResOA_8apr20.pdf	96232 ba0d4d97e6223b03c50665effadbcf2cc0942a4f	no	9

Warnings:

Information:	
Total Files Size (in bytes):	96232

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Application of:	ARCELORMITTAL
Inventor(s):	Drillet et al.
Application No.:	16/413,799
Filed:	May 16, 2019
Attorney Docket No.:	20631.1028CON5
Confirmation No.:	7637
Examiner:	Daniel J. Schleis
Title:	Coated Steel Strips, Coated Stamped Products and Methods

Submitted electronically via EFS-WEB April 8, 2020

RESPONSE TO OFFICE ACTION

Dear Sir or Madam:

In response to the Office Action dated March 2, 2020, please re-consider the above-identified patent application based on the following:

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1 to 47 (canceled).

Claim 48 (currently amended): A precoated steel ~~hot stamped~~ product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean iron composition,

(b) an intermediate layer having a second mean iron composition different from the first mean iron composition,

(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron composition being higher than the second mean iron composition; and

(d) a superficial layer having a fourth mean iron composition different from the third mean iron composition,

wherein the coating has a thickness greater than 30 micrometers.

Claim 49 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the layers (c) and (d) are quasi continuous by occupying at least 90% of a level corresponding to each of the layers (c) and (d) and wherein less than 10% of layer (c) is present at an extreme surface of the product.

Claim 50 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the base steel includes the following components by weight based on total weight:

0.15%<carbon<0.5%;

0.5%<manganese<3%;

0.1%<silicon<0.5%;

0.01%<chromium<1%;

titanium<0.2%;

aluminum<0.1%;

phosphorus<0.1%;

sulfur<0.05%;

0.0005%<boron<0.08%;

and further comprises iron and impurities inherent in processing.

Claim 51 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the base steel comprises the following components by weight based on total weight:

0.20%<carbon<0.5%;

0.8%<manganese<1.5%;

0.1%<silicon<0.35%;

0.01%<chromium<1%;

titanium<0.1%;

aluminum<0.1%;

phosphorus<0.05%;

sulfur<0.03%;

0.0005%<boron<0.01%;

and further comprises iron and impurities inherent in processing.

Claim 52 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the base steel comprises 20 ppm or less of sulfur.

Claim 53 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 49 wherein the base steel comprises 20 ppm or less of sulfur.

Claim 54 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 55 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 49 wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 56 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the layer (a) has a thickness less than 15 micrometers.

Claim 57 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the layer (a) has a thickness less than 10 micrometers.

Claim 58 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the interdiffusion layer comprises the following components by weight based on total weight: 86 to 95% Fe, 4 to10% Al, and 0 to 5% Si.

Claim 59 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 60 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 61 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 62 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 58 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 63 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 62 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 64 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 63 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 65 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the interdiffusion layer has a thickness of from 1 micron to 15 microns.

Claim 66 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the first mean iron composition is 90 percent, the second mean iron composition is 43 percent, the third mean iron composition is 63 percent and the fourth mean iron composition is 45 percent.

Claim 67 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 48 wherein the fourth mean iron composition is lower than the third mean iron composition.

Claim 68 (currently amended): A precoated steel ~~hot stamped~~ product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean iron composition,

(b) an intermediate layer having a second mean iron composition different from the first mean iron composition,

(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron concentration being higher than the second mean iron composition, and

(d) a superficial layer having a fourth mean iron composition different from the first, second and third mean iron compositions,

wherein the coating has a thickness greater than 30 micrometers.

Claim 69 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 68 wherein the fourth mean iron composition is lower than the third mean iron composition.

Claim 70 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 69 wherein the fourth mean iron composition is higher than the second mean iron composition.

Claim 71 (currently amended): A precoated steel ~~hot stamped~~ product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean aluminum composition,

(b) an intermediate layer having a second mean aluminum composition different from the first mean aluminum composition,

(c) an intermetallic layer having a third mean aluminum composition different from the first and second mean aluminum compositions, and

(d) a superficial layer having a fourth mean aluminum composition different from the first, second and third mean aluminum compositions, the second mean aluminum composition being greater than the third mean aluminum composition;

wherein the coating has a thickness greater than 30 micrometers.

Claim 72 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 71 wherein the fourth mean aluminum composition is less than the second mean aluminum composition.

Claim 73 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 71 wherein the layer (a) has a thickness less than 15 micrometers.

Claim 74 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 71 wherein the interdiffusion layer comprises the following components by weight based on total weight: 86 to 95% Fe, 4 to10% Al, and 0 to 5% Si.

Claim 75 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 71 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 76 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 71 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 77 (currently amended): The precoated steel ~~hot stamped~~ product as recited in claim 71 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

REMARKS

Claims 48 to 77 are pending. In the Office Action dated March 3, 2020, the Examiner issued a restriction requirement alleging that claims 48-77 were directed to a non-elected invention. According to the Examiner, original claims 25-47 were directed to "a precoated steel product" (Group I), and previously submitted claims 48 to 77 were directed to "a coated hot stamped product" (Group II). Claims 48 to 77 have been amended to be directed to constructively elected invention (I) "a precoated steel product".

In the Office Action dated July 11, 2019, previously pending Claims 25 to 47 were rejected under 35 U.S.C. l 12(b) as being indefinite. These claims were canceled in favor of new claims 48-77 which were subject to the restriction requirement addressed above. Claims 48-77 are herein amended to recite "a precoated steel product". It is respectfully submitted that currently amended claims 48-77 address the Examiner's concern that, in prior claims 25-47, the layer structure was not positively claimed as part of the precoated steel product. It is respectfully submitted that claims 48-77 comply with 35 U.S.C. l 12.

Applicant further notes that claims 48-77 recite mean composition features finding support for example at 0049 to 0057 and 0122 to 0126. The independent claims remove the claim limitation of "layer (a) has a thickness less than 15 micrometers" found at the specification at 0057, but add certain mean composition features, namely in claims 48 and 68 of "an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron concentration being higher than the second mean iron composition" and in claim 71 of "the second mean aluminum composition being greater than the third mean aluminum composition." These again find support for example at 0049 to 0057 and 0122 to 0126. Applicants would like to note that during previous prosecution of related U.S. Patent No. 9,708,683, the claim limitation of the layer (a) having a thickness less than 15 micrometers was at issue in the issuance of those claims. While Applicant has now removed that limitation in the independent claims in the present application (though it remains in some dependent claims), it is noted that Takagi U.S. 2004/0009366 states at 0035 that: "Thickness of aluminum coating layer: 10~20 μm." While this is the thickness of the aluminum coating before heat treatment in Takagi, there is simply no indication that the Takagi heat treatment process

would increase this coating layer to meet the claim limitation of the present independent claims of claims 48, 68 and 71 of "wherein the coating has a thickness greater than 30 micrometers." Nor, if Takagi were so modified, is there any indication that the layer compositions as claimed in claims 48, 68 and 71 would be attained.

Applicant also notes that for the related U.S. 9,708,683 patent a petition for inter partes review has been filed and invites the Examiner to review the papers filed in that proceeding.

The present claims are respectfully submitted as patentable over all of the prior art at issue.

It is respectfully submitted that the application is in condition for allowance and applicants respectfully request such action

If any fees are deemed to be due at this time, the Assistant Commissioner is authorized to charge payment of the same to Deposit Account No. 50-0552.

Respectfully submitted,
DAVIDSON, DAVIDSON & KAPPEL, LLC

By: /Cary Kappel/
Cary Kappel, Reg. No. 36,561

Davidson, Davidson & Kappel, LLC
589 Eighth Ave, 22nd Floor
New York, New York 10018

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/413,799	Filing Date 05/16/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	04/08/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/TONYA Q MCBRIDE/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637

23280 7590 03/02/2020

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589 8th Avenue
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EXAMINER	
SCHLEIS, DANIEL J	

ART UNIT	PAPER NUMBER
1784	

NOTIFICATION DATE	DELIVERY MODE
03/02/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ddk@ddkpatent.com

DETAILED ACTION

4. (Continued)

The amendment filed on 25 November 2019 canceling all claims drawn to the elected invention and presenting only claims drawn to a non-elected invention is non-responsive (MPEP § 821.03) and has not been entered. The remaining claims are not readable on the elected invention.

The inventions are independent or distinct, each from the other because:

Newly submitted claims 48-77 directed to an invention that is independent or distinct from the invention originally claimed for the following reasons:

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Original Claims 25-47, drawn to a precoated steel product, classified in B32B 15/012.

II. Amended Claims 48-77, drawn to a coated hot stamped product, classified in C21D 9/46.

Inventions I and II are related as mutually exclusive species in an intermediate-final product relationship. Distinctness is proven for claims in this relationship if the intermediate product is useful to make other than the final product, and the species are patentably distinct (MPEP § 806.05(j)). In the instant case, the intermediate product is deemed to be useful as a product that has not been stamped, for example as a sheet panel that is not stamped (e.g. simply a panel for a structure that is attached to the structure and is in sheet form) and the inventions are deemed patentably distinct because there is nothing of record to show them to be obvious variants.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution

on the merits. Accordingly, claims 48-77 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Since the above-mentioned amendment appears to be a bona fide attempt to reply, applicant is given a TIME PERIOD of TWO MONTHS from the mailing date of this notice within which to supply the omission or correction in order to avoid abandonment. EXTENSIONS OF THIS TIME PERIOD UNDER 37 CFR 1.136(a) ARE AVAILABLE.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel J Schleis whose telephone number is (571)270-5636. The examiner can normally be reached on 10 AM to 4 PM Monday through Friday.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Humera Sheikh can be reached on (571) 272-0604. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR

system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Daniel J. Schleis
Primary Examiner
Art Unit 1784

/Daniel J. Schleis/
Primary Examiner, Art Unit 1784

Notice of Non-Compliant Amendment (37 CFR 1.121)	Application No. 16/413,799	Applicant(s) DRILLET et al.	
	Examiner Daniel J Schleis	Art Unit 1784	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

The amendment document filed on 11/25/2019 is considered non-compliant because it has failed to meet the requirements of 37 CFR 1.121 or 1.4. In order for the amendment document to be compliant, correction of the following item(s) is required.

THE FOLLOWING MARKED (X) ITEM(S) CAUSE THE AMENDMENT DOCUMENT TO BE NON-COMPLIANT:

- ☐ 1. Amendments to the specification:
  - ☐ A. Amended paragraph(s) do not include markings.
  - ☐ B. New paragraph(s) should not be underlined.
  - ☐ C. Other _____ .
- ☐ 2. Abstract:
  - ☐ A.Not presented on a separate sheet. 37 CFR 1.72.
  - ☐ B.Other _____ .
- ☐ 3. Amendments to the drawings:
  - ☐ A. The drawings are not properly identified in the top margin as "Replacement Sheet", "New Sheet", or "Annotated Sheet" as required by 37 CFR 1.121(d).
  - ☐ B. The practice of submitting proposed drawing correction has been eliminated. Replacement drawings showing amended figures, without markings, in compliance with 37 CFR 1.84 are required.
  - ☐ C. Other _____ .
- ☑ 4. Amendments to the claims:
  - ☐ A. A complete listing of all of the claims is not present.
  - ☐ B. The listing of claims does not include the text of all pending claims (including withdrawn claims)
  - ☐ C. Each claim has not been provided with the proper status identifier, and as such, the individual status of each claim cannot be identified. Note: the status of every claim must be indicated after its claim number by using one of the following status identifiers: (Original), (Currently amended), (Canceled), (Previously presented), (New), (Not entered), (Withdrawn) and (Withdrawn-currently amended).
  - ☐ D. The claims of this amendment paper have not been presented in ascending numerical order.
  - ☑ E. Other: See Continuation .
- ☐ 5. Other (e.g., the amendment is unsigned or not signed in accordance with 37 CFR 1.4):

_____

For further explanation of the amendment format required by 37 CFR 1.121, see MPEP § 714.

TIME PERIODS FOR FILING A REPLY TO THIS NOTICE:

1. Applicant is given **no new time period if the non-compliant amendment is an** after-final amendment or an amendment filed after allowance. If applicant wishes to resubmit the non-compliant after-final amendment with corrections, the **entire corrected amendment** must be resubmitted.

2. Applicant is given **two months** from the mail date of this notice to supply the correction, if the non-compliant amendment is one of the following: a preliminary amendment, a non-final amendment (including a submission for a request for continued examination (RCE) under 37 CFR 1.114), a supplemental amendment filed within a suspension period under 37 CFR 1.103(a) or (c), and an amendment filed in response to a *Quayle* action. If any of above boxes 1. to 4. are checked, the correction required is only the **corrected section** of the non-compliant amendment in compliance with 37 CFR 1.121.

   Extensions of time are available under 37 CFR 1.136(a) only if the non-compliant amendment is a non-final amendment or an amendment filed in response to a *Quayle* action.

   Failure to timely respond to this notice will result in:
   Abandonment of the application if the non-compliant amendment is a non-final amendment or an amendment filed in response to a *Quayle* action; or
   Non-entry of the amendment if the non-compliant amendment is a preliminary amendment or supplemental amendment.

/Daniel J. Schleis/ Primary Examiner, Art Unit 1784	

Notice of Non-Compliant Amendment (37 CFR 1.121)

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16413799
Filing Date	2019-05-16
First Named Inventor	Drillet
Art Unit	1784
Examiner Name	Schleis
Attorney Docket Number	20631.1028CON5

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16413799
	Filing Date	2019-05-16
	First Named Inventor	Drillet
	Art Unit	1784
	Examiner Name	Schleis
	Attorney Docket Number	20631.1028CON5

	1	"Continuously hot-dip coated strip and sheet of strucutral steels - Technical delivery conditions," European Standard EN 10326, July 2004, NON-EN 10326

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16413799
	Filing Date	2019-05-16
	First Named Inventor	Drillet
	Art Unit	1784
	Examiner Name	Schleis
	Attorney Docket Number	20631.1028CON5

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/williamcgehris/	Date (YYYY-MM-DD)	2020-01-06
Name/Print	William C. Gehris	Registration Number	38156

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	16413799
Filing Date:	16-May-2019
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Filer:	William C. Gehris/Simon Steiner
Attorney Docket Number:	20631.1028CON5

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	240	240
		Total in USD ($)		**240**

Electronic Acknowledgement Receipt	
EFS ID:	38216106
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	William C. Gehris/Simon Steiner
Filer Authorized By:	William C. Gehris
Attorney Docket Number:	20631.1028CON5
Receipt Date:	06-JAN-2020
Filing Date:	16-MAY-2019
Time Stamp:	17:26:42
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$240
RAM confirmation Number	E202016H28254356
Deposit Account	500552
Authorized User	Simon Steiner
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	D82.PDF	1631436 839d121c824780631dfa1011f8cfe1aa30a04c1d	no	25
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	IDSJan2020.PDF	1035293 324d04b63c1a1b8162227db0b46e679f95a2eae1	no	4
Warnings:					
Information:					
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
3	Fee Worksheet (SB06)	fee-info.pdf	30685 466ece7855b87c09211353b78ab80d3c8f85895c	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2697414		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Application of:	ARCELORMITTAL
Inventor(s):	Drillet et al.
Application No.:	16/413,799
Filed:	May 16, 2019
Attorney Docket No.:	20631.1028CON5
Confirmation No.:	7637
Examiner:	Daniel J. Schleis
Title:	Coated Steel Strips, Coated Stamped Products and Methods

Submitted electronically via EFS-WEB November 25, 2019

RESPONSE TO OFFICE ACTION

Dear Sir or Madam:

In response to the Office Action dated July 11, 2019, please re-consider the above-identified patent application based on the following:

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1 to 47 (canceled).

Claim 48 (new): A coated steel hot stamped product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean iron composition,

(b) an intermediate layer having a second mean iron composition different from the first mean iron composition,

(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron composition being higher than the second mean iron composition; and

(d) a superficial layer having a fourth mean iron composition different from the third mean iron composition,

wherein the coating has a thickness greater than 30 micrometers.

Claim 49 (new): The coated steel hot stamped product as recited in claim 48 wherein the layers (c) and (d) are quasi continuous by occupying at least 90% of a level corresponding to each of the layers (c) and (d) and wherein less than 10% of layer (c) is present at an extreme surface of the product.

Claim 50 (new): The coated steel hot stamped product as recited in claim 48 wherein the base steel includes the following components by weight based on total weight:

0.15%<carbon<0.5%;

0.5%<manganese<3%;

0.1%<silicon<0.5%;

0.01%<chromium<1%;

titanium<0.2%;

aluminum<0.1%;

phosphorus<0.1%;

sulfur<0.05%;

0.0005%<boron<0.08%;

and further comprises iron and impurities inherent in processing.

Claim 51 (new): The coated steel hot stamped product as recited in claim 48 wherein the base steel comprises the following components by weight based on total weight:

0.20%<carbon<0.5%;

0.8%<manganese<1.5%;

0.1%<silicon<0.35%;

0.01%<chromium<1%;

titanium<0.1%;

aluminum<0.1%;

phosphorus<0.05%;

sulfur<0.03%;

0.0005%<boron<0.01%;

and further comprises iron and impurities inherent in processing.

Claim 52 (new): The coated steel hot stamped product as recited in claim 48 wherein the base steel comprises 20 ppm or less of sulfur.

Claim 53 (new): The coated steel hot stamped product as recited in claim 49 wherein the base steel comprises 20 ppm or less of sulfur.

Claim 54 (new): The coated steel hot stamped product as recited in claim 48 wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 55 (new): The coated steel hot stamped product as recited in claim 49 wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 56 (new): The coated steel hot stamped product as recited in claim 48 wherein the layer (a) has a thickness less than 15 micrometers.

Claim 57 (new): The coated steel hot stamped product as recited in claim 48 wherein the layer (a) has a thickness less than 10 micrometers.

Claim 58 (new): The coated steel hot stamped product as recited in claim 48 wherein the interdiffusion layer comprises the following components by weight based on total weight: 86 to 95% Fe, 4 to10% Al, and 0 to 5% Si.

Claim 59 (new): The coated steel hot stamped product as recited in claim 48 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 60 (new): The coated steel hot stamped product as recited in claim 48 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 61 (new): The coated steel hot stamped product as recited in claim 48 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 62 (new): The coated steel hot stamped product as recited in claim 58 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 63 (new): The coated steel hot stamped product as recited in claim 62 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 64 (new): The coated steel hot stamped product as recited in claim 63 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 65 (new): The coated steel hot stamped product as recited in claim 48 wherein the interdiffusion layer has a thickness of from 1 micron to 15 microns.

Claim 66 (new): The coated steel hot stamped product as recited in claim 48 wherein the first mean iron composition is 90 percent, the second mean iron composition is 43 percent, the third mean iron composition is 63 percent and the fourth mean iron composition is 45 percent.

Claim 67 (new): The coated steel hot stamped product as recited in claim 48 wherein the fourth mean iron composition is lower than the third mean iron composition.

Claim 68 (new): A coated steel hot stamped product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean iron composition,

(b) an intermediate layer having a second mean iron composition different from the first mean iron composition,

(c) an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron concentration being higher than the second mean iron composition, and

(d) a superficial layer having a fourth mean iron composition different from the first, second and third mean iron compositions,

wherein the coating has a thickness greater than 30 micrometers.

Claim 69 (new): The coated steel hot stamped product as recited in claim 68 wherein the fourth mean iron composition is lower than the third mean iron composition.

Claim 70 (new): The coated steel hot stamped product as recited in claim 69 wherein the fourth mean iron composition is higher than the second mean iron composition.

Claim 71 (new): A coated steel hot stamped product comprising:

a strip of base steel having a first side and a second side; and

a coating on at least one of the first side of the strip of base steel and the second side of the strip of base steel, wherein the coating results from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating, and wherein the coating includes, proceeding from the base steel outwards:

(a) an interdiffusion layer having a first mean aluminum composition,

(b) an intermediate layer having a second mean aluminum composition different from the first mean aluminum composition,

(c) an intermetallic layer having a third mean aluminum composition different from the first and second mean aluminum compositions, and

(d) a superficial layer having a fourth mean aluminum composition different from the first, second and third mean aluminum compositions, the second mean aluminum composition being greater than the third mean aluminum composition;

wherein the coating has a thickness greater than 30 micrometers.

Claim 72 (new): The coated steel hot stamped product as recited in claim 71 wherein the fourth mean aluminum composition is less than the second mean aluminum composition.

Claim 73 (new): The coated steel hot stamped product as recited in claim 71 wherein the layer (a) has a thickness less than 15 micrometers.

Claim 74 (new): The coated steel hot stamped product as recited in claim 71 wherein the interdiffusion layer comprises the following components by weight based on total weight: 86 to 95% Fe, 4 to10% Al, and 0 to 5% Si.

Claim 75 (new): The coated steel hot stamped product as recited in claim 71 wherein the intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

Claim 76 (new): The coated steel hot stamped product as recited in claim 71 wherein the intermetallic layer comprises the following components by weight based on total weight: 62 to 67% Fe, 30 to 34% Al, and 2 to 6% Si.

Claim 77 (new): The coated steel hot stamped product as recited in claim 71 wherein the superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

REMARKS

Claims 25 to 47 are pending. Claims 25 to 47 were rejected under 35 U.S.C. 112(b) as being indefinite.

Claims 25 to 47 have been canceled without prejudice and claims 48 to 77 added. Support for the new claims is found in the original claims and at 0049 to 0057 and 0122 to 0126 for example.

Reconsideration of the application as amended is respectfully requested.

Rejections under 35 U.S.C. § 112

Claims 25 to 47 were rejected under 35 U.S.C. 112(b) as being indefinite.

Claims 25 to 47 have been canceled in favor of new claims that now recite ***a coated steel hot stamped product*** as described, support being found at 0049 to 0057 and 0122 to 0126 for example. These claims thus address the Examiner's concern regarding the layer structure not being in the precoated product. Claims directed to the precoating features have been removed without prejudice.

In view of the above, withdrawal of the rejection under 35 U.S.C. § 112 to claims 25 to 47 is respectfully requested.

New Claims

The new claims recite mean composition features finding support for example at 0049 to 0057 and 0122 to 0126. The new independent claims remove the claim limitation of "layer (a) has a thickness less than 15 micrometers" found at the specification at 0057, but add certain mean composition features, namely in claims 48 and 68 of "an intermetallic layer having a third mean iron composition different from the first and second mean iron compositions, the third mean iron concentration being higher than the second mean iron composition" and in claim 71 of "the second mean aluminum composition being greater than the third mean aluminum composition." These again find support for example at 0049 to 0057 and 0122 to 0126.

Applicants would like to note that during previous prosecution of related U.S. Patent No. 9,708,683, the claim limitation of the layer (a) having a thickness less than 15 micrometers was at issue in the issuance of those claims. While Applicant has now removed that limitation in the independent claims in the present application (though it remains in some dependent claims), it is

noted that Takagi U.S. 2004/0009366 states at 0035 that: "Thickness of aluminum coating layer: 10~20 μm." While this is the thickness of the aluminum coating before heat treatment in Takagi, there is simply no indication that the Takagi heat treatment process would increase this coating layer to meet the claim limitation of the present independent claims of claims 48, 68 and 71 of "wherein the coating has a thickness greater than 30 micrometers." Nor, if Takagi were so modified, is there any indication that the layer compositions as claimed in claims 48, 68 and 71 would be attained.

Applicant also notes that for the related U.S. 9,708,683 patent a petition for *inter partes* review has been filed and invites the Examiner to review the papers filed in that proceeding. The present claims are respectfully submitted as patentable over all of the prior art at issue.

CONCLUSION

It is respectfully submitted that the application is in condition for allowance and applicants respectfully request such action.

If any fees are deemed to be due at this time, the Assistant Commissioner is authorized to charge payment of the same to Deposit Account No. 50-0552.

Respectfully submitted,
DAVIDSON, DAVIDSON & KAPPEL, LLC

By:_____
William C. Gehris, Reg. No. 38,156

Davidson, Davidson & Kappel, LLC
589 Eighth Ave, 16th Floor
New York, New York 10018

PTO/AIA/22 (03-13)
Approved for use through 11/30/2020. OMB 0651-0031
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)

Docket Number (Optional): 20631.1028CON5

Application Number	Filed
16413799	05/16/2019

For: Coated Steel Strips, Coated Stamped Products and Methods

Art Unit	Examiner
1784	SCHLEIS, DANIEL J

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

		Fee	Small Entity Fee	Micro Entity Fee	
☑	One month (37 CFR 1.17(a)(1))	$200	$100	$50	$ 200
☐	Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$
☐	Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$
☐	Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
☐	Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☑ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 500552.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 38156.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/williamcgehris/ — Signature

11/25/2019 — Date

William C. Gehris — Typed or printed name

2127361940 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☐ * Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	16413799
Filing Date:	16-May-2019
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Filer:	William C. Gehris/Simon Steiner
Attorney Docket Number:	20631.1028CON5

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	1251	1	200	200
Miscellaneous:				
		Total in USD ($)		**200**

Electronic Acknowledgement Receipt	
EFS ID:	37855584
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	William C. Gehris/Simon Steiner
Filer Authorized By:	William C. Gehris
Attorney Docket Number:	20631.1028CON5
Receipt Date:	25-NOV-2019
Filing Date:	16-MAY-2019
Time Stamp:	18:27:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$200
RAM confirmation Number	E2019AOI28031197
Deposit Account	500552
Authorized User	Simon Steiner
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		206311028con5DraftResOA_12nov19-WG.pdf	275127 0afa95c64c56ef9b7d0c23c93cbdccf321623008	yes	9

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Claims	2	7
Applicant Arguments/Remarks Made in an Amendment	8	9

Warnings:

Information:

2	Extension of Time	extension.PDF	145664 eef024e7512727b6561d635943426bfe9cf45de7	no	2

Warnings:

Information:

3	Fee Worksheet (SB06)	fee-info.pdf	30725 f172b4f526ddf7960028c56c28b2af7aceee3d27	no	2

Warnings:

Information:

Total Files Size (in bytes):	451516

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/413,799	Filing Date 05/16/2019	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	11/25/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 24	= 6		x $100 =	600
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	600

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/JAMES W TUNSTALL/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5

CONFIRMATION NO. 7637

23280
Davidson, Davidson & Kappel, LLC
589 8th Avenue
16th Floor
New York, NY 10018

PUBLICATION NOTICE



Title: Coated Steel Strips, Coated Stamped Products and Methods

Publication No.US-2019-0271056-A1
Publication Date:09/05/2019

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637

23280 7590 07/11/2019

Davidson, Davidson & Kappel, LLC
589 8th Avenue
16th Floor
New York, NY 10018

EXAMINER	
SCHLEIS, DANIEL J	

ART UNIT	PAPER NUMBER
1784	

NOTIFICATION DATE	DELIVERY MODE
07/11/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ddk@ddkpatent.com

Office Action Summary	**Application No.** 16/413,799	**Applicant(s)** DRILLET et al.	
	Examiner Daniel J Schleis	**Art Unit** 1784	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 05/16/19.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 25-47 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 25-47 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 05/16/19 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date 06/04/19 and 06/04/19.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

Information Disclosure Statement

The information disclosure statements (IDS) submitted on 4 June 2019 were considered by the examiner.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 25-47 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Claim 25 is directed to a precoated steel product having a precoating with "a controlled thickness to create a precoated steel strip heat treatable to form a coating" having an interdiffusion layer, intermediate layer, intermetallic layer, and a superficial layer wherein the coating has a thickness greater than 30 micrometers and the interdiffusion layer is less than 15 micrometers. It is unclear as to the precoating that would meet these limitations.

It is noted that the layers of the interdiffusion layer, intermediate layer, intermetallic layer, and superficial layer are not defined by the claims. It is not clear what distinguishes each of these respective layers.

Additionally, the claimed product is not the product having the layers set forth in the instant application. Rather, it must merely be capable of forming such layers. The method of producing the resulting product is not limited beyond that precoated steel strip is heat treatable. It is unclear what structure of the precoating is necessary in order to achieve these claimed layers within a final product. For example, it is unclear if it is an issue of a thickness of the layers, directed to a structure of a precoating based on a particular deposition method or processing conditions, or some other type of factor.

Therefore, the metes and bounds of the instant claims cannot be determined. It is unclear what precoating product would or would not fall within the scope of the instant claims. For the purposes of examination, the Office is unable to determine the scope of these claims.

Claims 26-47 depend from claim 25 and incorporate the limitations therein. Therefore these claims are rejected for the reasons set forth above in regards to claim 25.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel J Schleis whose telephone number is (571)270-5636. The examiner can normally be reached on 10 AM to 4 PM Monday through Friday.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is

encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Humera Sheikh can be reached on (571) 272-0604. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Daniel J. Schleis
Primary Examiner
Art Unit 1784

/Daniel J. Schleis/
Primary Examiner, Art Unit 1784

Notice of References Cited	Application/Control No. 16/413,799	Applicant(s)/Patent Under Reexamination DRILLET et al.	
	Examiner Daniel J Schleis	Art Unit 1784	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9708683-B2	07-2017	Drillet; Pascal	B32B15/012	1/1
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/413,799	DRILLET et al.
	Examiner	Art Unit
	Daniel J Schleis	1784

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor Name Search	07/08/2019	Schleis
Assignee Name Search	07/08/2019	Schleis
Reviewed Global Dossier	07/08/2019	Schleis
Non-Patent Literature Search - Google Scholar	07/08/2019	Schleis
EAST Text Search - See Search History	07/08/2019	Schleis
Reviewed File Wrappers of Other Applications in Patent Family	07/08/2019	Schleis

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	13	((PASCAL) near2 (DRILLET)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 09:51
S2	8	((DOMINIQUE) near2 (SPEHNER)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 09:51
S3	11	((RONALD) near2 (KEFFERSTEIN)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 09:51
S4	0	("2013/0029172").URPN.	USPAT	OR	ON	2013/02/26 09:51
S5	9	("20030152796" | "3240269" | "5023113" | "6296805" | "6815087" | "7137201" | "7217331" | "7503116").PN. OR ("8307680").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 09:51
S6	4	("20030152796" | "5023113" | "6296805" | "7137201").PN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:05
S7	9	("4891274" | "5133815" | "5178688" | "5656102").PN. OR ("6296805").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:37
S8	4	("3214820" | "6197132" | "6296805").PN. OR ("7708843").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:40
S9	16	("20010042393" | "20070082214" | "20070163685" | "20090242086" | "20090308499" | "20110006491" | "20110165436" | "4546051" | "6017643" | "6093498" | "6296805" | "6298905" | "6564604" | "6815087" | "7137201" | "7867344").PN. OR ("8066829").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:40
S10	1	("2003/0152796").URPN.	USPAT	OR	ON	2013/02/26 10:43
S11	17	("1423747" | "3240269" | "4657717" | "4921159" | "5056209" | "6337471").PN. OR ("7137201").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:45
S12	10	("3632453" | "3664293" | "4751957" | "4891274" | "5518772" | "5529816").PN. OR ("6017643").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 10:47
S13	195	(("5209860") or ("8066829") or	US-	OR	OFF	2013/02/26

		("8066829") or ("8307680") or ("20110006491") or ("20110165436") or ("20110214475") or ("20120064362") or ("20130029172") or ("6564604") or ("20010042393") or ("20120118437") or ("4846986") or ("20120085467") or ("20080261058") or ("4601766") or ("5248528") or ("5456953") or ("5568914") or ("5830290") or ("20040118482") or ("5287983") or ("4880481") or ("4344342") or ("4963400") or ("4999241") or ("5342672") or ("5792180") or ("6070444") or ("4353765") or ("5982073") or ("6129790") or ("6165595") or ("3798406") or ("4033918") or ("4311755") or ("4488862") or ("4508755") or ("4514264") or ("4525177") or ("4551085") or ("4554765") or ("4585519") or ("4842887") or ("4994517") or ("5273369") or ("5389452") or ("5538576") or ("5542978") or ("5639510") or ("5697715") or ("5729616") or ("5801128") or ("5837314") or ("5869160") or ("6020026") or ("6019923") or ("6251514") or ("6258425") or ("6262513") or ("6309748") or ("6340397") or ("6342108") or ("20020014181") or ("20090025836") or ("20090048127") or ("4374168") or ("4309951") or ("5810332") or ("5795661") or ("8349098") or ("20020160235") or ("20020166606") or ("20100294400") or ("20110056594") or ("20110056594") or ("20120085466") or ("5981089") or ("6197125") or ("4793867") or ("4941930") or ("4980241") or ("5238506") or ("5405427") or ("5939144") or ("6090873") or ("6241393") or ("3859239") or ("3850684") or ("3850647") or ("4316751") or ("4347085") or ("4401719") or ("4402994") or ("4533606") or ("4592958") or ("4867853") or ("5232619") or ("5242506") or ("5290362") or ("5332776") or ("5466280") or ("5608028") or ("5643474") or ("5700551") or ("5743536") or ("5783622") or ("5786098") or ("5851659") or ("5863640") or ("5890852") or ("5955201") or ("6001494") or ("6042949") or ("6083613") or ("6194088") or ("6197436") or ("6284059") or ("6329456") or ("6410626") or ("7533713") or ("8025965") or ("8025965") or ("20030150308") or ("20040129346") or ("20040216860") or ("20070209555") or ("20080090093") or ("20100175794") or ("20110300407") or	PGPUB; USPAT; USOCR			10:54

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S14	0	("2012/0085466").URPN.	USPAT	OR	ON	2013/02/26 10:55
S15	0	("2012/0085467").URPN.	USPAT	OR	ON	2013/02/26 10:55
S16	0	("2011/0214475").URPN.	USPAT	OR	ON	2013/02/26 10:55
S17	1	("2011/0165436").URPN.	USPAT	OR	ON	2013/02/26 10:56
S18	1	("2011/0006491").URPN.	USPAT	OR	ON	2013/02/26 10:56
S19	8085	((428/601,600,602,653) or (420/104,120,121,126) or (148/531,535,534,537,635,653) or (72/364,342.1,47) or (280/1)).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/26 11:01
S20	2517	S19 and (steel ferrous) same (aluminum aluminium al)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/02/26 11:02
S21	304	S20 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/02/26 11:03

S22	14	("20020068189" | "20020104876" | "20030012977" | "20030207769" | "20040028939" | "3195991" | "4957822" | "4973523" | "5112416" | "5362574" | "5384205" | "5470666" | "7074496").PN. OR ("8053087").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/02/26 12:13
S23	8085	((428/601,600,602,653) or (420/104,120,121,126) or (148/531,535,534,537,635,653) or (72/364,342.1,47) or (280/1)).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/02/26 12:33
S24	286	S23 and (carbon c) same (manganese Mn) same (Silicon si) same (Chromium Cr) same (titanium ti) same (aluminum al) same (Phosphorus P) same (Sulfur Sulphur S) same (Boron B)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/02/26 12:33
S25	59	S24 and (aluminum aluminium al) near5 (pre-coat$4 precoat$4 layer coat$5)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/02/26 12:35
S26	0	("2010/0294400").URPN.	USPAT	OR	ON	2013/02/26 12:36
S27	2	("2001/0001049").URPN.	USPAT	OR	ON	2013/02/26 12:40
S28	8224	((428/601,600,602,653) or (420/104,120,121,126) or (148/531,535,534,537,635,653) or (72/364,342.1,47) or (280/1)).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/09/19 16:58
S29	456	S28 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/09/19 16:58
S30	4	S29 and (strain near3 ratio)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/09/19 16:59
S31	36	S28 and (strain near3 ratio)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2013/09/19 16:59
S32	16	("20060134451" | "20070113936" | "20070166565" | "20070246509" | "20090020276" | "20090165901" | "20100101688" | "20100112370" | "20100183897" | "20110014494" | "20110240280" | "20110287276" | "20110287277" | "5037707" | "6019939" | "7387844").PN. OR ("8247082").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 16:59
S33	0	("2010/0084057").URPN.	USPAT	OR	ON	2013/09/19 16:59
S34	13	("4673551" | "4906534" | "5037707" | "5100048").PN. OR ("6019939").URPN.	US-PGPUB;	OR	ON	2013/09/19 17:00

			USPAT; USOCR			
S35	4	("2010/0112370").URPN.	USPAT	OR	ON	2013/09/19 17:00
S36	0	("2009/0252641").URPN.	USPAT	OR	ON	2013/09/19 17:00
S37	4	("4985196" | "4990545" | "5139832" | "6084849").PN. OR ("7060140").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:00
S38	15	("4196025" | "4309886" | "4793869" | "5507677" | "5509842" | "5618401" | "5625251" | "5629051" | "5646478").PN. OR ("5871851").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:01
S39	9	("4601766" | "5019191" | "5871851").PN. OR ("6129992").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:01
S40	4	("3795971" | "4455352" | "4956025").PN. OR ("5529644").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2013/09/19 17:01
S45	40	(("20010042393") or ("8127449") or ("7137201") or ("7708843") or ("20070163683") or ("20070175040") or ("3240269") or ("7503116") or ("7217331")).PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	OFF	2017/03/10 08:29
S46	10	(("20010042393") or ("8127449") or ("7137201") or ("7708843") or ("20070163683") or ("20070175040") or ("3240269") or ("7503116") or ("7217331")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/03/10 08:43
S47	4	("3214820" | "6197132" | "6296805").PN. OR ("7708843").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2017/03/10 08:48
S48	8872	((428/601,600,602,653) or (420/104,120,121,126) or (148/531,535,534,537,635,653) or (72/364,342.1,47) or (280/1)).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/07/08 10:56
S49	540	S48 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/07/08 10:56
S50	13610	(C21D9/46 or C23C2/12 or C23C2/40 or C23C2/26 or B32B15/012 or Y10T428/12389 or Y10T428/12396 or Y10T428/12757).cpc.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/07/08 10:58
S51	977	S50 and (interdiffusion intermediate intermetallic superficial) near3 layer	US-PGPUB; USPAT; USOCR; EPO; JPO;	OR	ON	2019/07/08 11:00

			DERWENT			
S52	2	S51 and (strain near3 ratio)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/07/08 11:02

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S41	5246	(C21D9/46 B32B15/012 C23C2/12 C23C2/26 C23C2/40 Y10T428/12389 Y10T428/12396 Y10T428/12757).cpc.	US-PGPUB; USPAT	OR	ON	2016/12/02 11:46
S42	1776	S41 and (aluminum aluminium al) near5 (pre-coat$4 precoat$4 layer coat$5)	US-PGPUB; USPAT	OR	ON	2016/12/02 11:46
S43	888	S41 and ((aluminum aluminium al) near5 (pre-coat$4 precoat$4 layer coat$5)).clm.	US-PGPUB; USPAT	OR	ON	2016/12/02 11:46
S44	136	S43 and ((interdiffusion intermediate intermetallic superficial) near3 layer).clm.	US-PGPUB; USPAT	OR	ON	2016/12/02 11:47

7/8/2019 11:55:42 AM
C:\Users\dschleis\Documents\EAST\Workspaces\16413799.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16413799
Filing Date	2016-05-16
First Named Inventor	Drillet
Art Unit	
Examiner Name	
Attorney Docket Number	20631.1028CON5

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6296805	B1	2001-10-02	Laurent et al.	
	2	7559998	B2	2009-07-14	Nishibata et al.	
	3	8307680		2012-11-13	Drillet et al.	
	4	9708683		2017-07-18	Drillet et al.	
	5	8127449	B2	2012-03-06	Bayer et al.	
	6	7137201		2006-11-21	Brodt et al.	
	7	7708843		2010-05-04	Laurent et al.	
	8	3240269		1966-03-15	Thomas	

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	9	7503116		2009-03-17	Machrowicz et al.	
	10	7217331		2007-03-15	Jambu et al.	
	11	6296805		2001-10-02	Laurent et al.	
	12	6815087		2004-11-09	Takagi et al.	
	13	5023113		1991-06-11	Boston et al.	
	14	7137201		2006-11-21	Brodt et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20080283156	A1	2008-11-20	Laurent et al.	
	2	20070163683	A1	2007-07-19	Schiessl	
	3	20010042393	A1	2001-11-22	Kefferstein et al.	

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	4	20110056594	A1	2011-03-10	Macherey et al.	
	5	20070175040		2007-08-02	Bayer et al.	
	6	20040009366		2004-01-15	Takagi et al.	
	7	20030152796		2003-08-14	Clancy et al.	

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	1	3290199	EP	A1	2018-03-07	Drillet	In English	
	2	2758571	FR	A	1998-07-24	Lorraine	See English Abstract and EPO machine translation	
	3	2006097593	WO	A	2006-09-21	Laurent	See US 2008/0283156	
	4	102004007071	DE	A1	2005-09-08	Audi AG	See US 2007/0163683	
	5	2242863	EP	B1	2014-01-08	ArcelorMIttal France	In English	

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	6	2005078144	WO	A1	2005-08-25	Audi AG	See US 2007/163683	
	7	2833504	FR	A1	2003-06-20	Usinor	See English Abstract and EPO machine translation	
	8	1013785	EP	A1	2000-06-28	Lorraine Laminage	See English Abstract and EPO machine translation	
	9	2012048841	WO	A1	2012-04-19	Tata Steel IJMUIDEN B. V.	In English	
	10	2012028224	WO	A1	2012-03-08	Tata Steel IJMUIDEN B. V.	In English	
	11	1380666	EP	A1	2004-01-14	NISSAN MOTOR	In English	
	12	3290200	EP	A1	2018-03-07	Drillet	In English	
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	14	2040556	RU	C1	1995-07-25	CHEREPOVETS METALL KOM	See English Abstract and EPO machine translation	
	15	1531604	CN	A	2004-09-22	Nippon Steel	See WO02/103073A2	
	16	02103073	WO	A2	2002-12-27	Nippon Steel Corporation	In English	

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	17	3931251	JP		2007-06-13	Laurent	See US 6296805	
	18	2005009642	WO		2005-02-03	Bayer	See US 8127449	
	19	2006529002	JP		2003-12-28		See US 8127449	
	20	H11156293	JP		1999-06-15	Kada	See English Abstract and EPO machine translation	
	21	2002178069	JP		2002-06-25	Brodt	See US 7137201	
	22	2008537977	JP		2008-10-02		See US 7708843	
	23	2787735	FR		2000-06-30	Lorraine Laminage	See English Abstract and EPO machine translation	
	24	2007522345	JP		2007-08-09		See US 20070163683	
	25	1829813	CN		2006-09-06	Sumitomo Metal Ind	See US 7559998	
	26	0356783	EP		1990-05-07	Armco Inc.	In English	
	27	1472068	CN	A	2004-02-04	Nissan Motor	See US6815087	

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	28	720079	FR		1995-11-24	FR DE FILETAGE INDESSERRABLE D	See English Abstract and EPO machine translation	
	29	1297906	FR		1962-07-06	BEAUJEU-DUMONTEL GASTON	See EPO machine translation	
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	1	Raviere et al, Hot Stamping Experiment and Numerical Simulation of Pre-coated USIBOR1500 Quenchable Steels, SAE 2003-01-2859, 2003	
	2	Merklein, M et al., "Einflussgrößen im Presshärteprozess" Tagungsband 4. Chemnitzer Karosseriekolloquium, November 2005, ISSN: 3-937524-33-9, see English translation	
	3	Forschungsvereinigung Stahlanwendungen e. V., "Forschung für die Praxis P644 - Auslegung des Prozessfensters für die Blechumformung höchstfester Vergütungsstähle bei erhöhten Temperaturen" Düsseldorf: Verlags und Vertriebsgesellschaft mbH, 2006, ISBN: 3-937567-42-9, see partial English translation	
	4	Usinor Auto Groupe website, Product Description, USIBOR Heattreatable manganese-boron steel, bare or precoated 1/3, http://www.usinorauto.com/v_anglaise/produits/fiches/ a_usibor3.htm, Feb. 21, 2003	
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	6	Usinor Auto Groupe website, Product Description, USIBOR Heattreatable manganese-boron steel, bare or precoated 3/3, http://www.usinorauto.com/v_anglaise/produits/fiches/ a_usibor3.htm, Apr. 29, 2002	

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	Filing Date	2016-05-16
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	Art Unit	
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	Attorney Docket Number	20631.1028CON5

	7	Altan, 'Hot-stamping boron-alloyed steels for automotive parts - Part II: Microstructure, material strength changes during hot stamping', Stamping Journal, January 2007	
	8	Merklein M.: "Neuere Entwicklungen zur Umformung höchstfester Stahlwerkstoffe," EFB-Kolloquium 2005, see English translation	
	9	Roll et al.: "Prozesskette zum Warmumformen von Blechen," Tagungsband SFU Leichtbau durch Umformtechnik, September 2005, see English translation	
	10	Laurent J.-P. "Hot formed Pre-coated boron steels: A solution of the resistance-formability's dilemma" - 1st European Conference of Experts, 10/14/2003	
	11	Garcia Aranda L., Ravier P., Chastel Y., "Hot stamping of quenchable steels - Material data and process simulations", IDDRG conference, 2003	
	12	Merklein M., "Characterisation of the Flow Properties of the Quenchenable Ultra High Strength Steel 22MnB5", Annals of the CIRP Vol. 55/1/2006	
	13	Turetta A., Testing material formability in hot stamping operations, 2006	
	14	Babbit M., "Some Highlights on New Steel Products for Automotive Use," steel research international Col. 77, issue 9 to 10, Dec. 13, 2016	
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	Attorney Docket Number	20631.1028CON5

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	21	Grothe, "Dubbel - Taschenbuch für den Maschinenbau" Berlin Heidelberg: Springer, 2005, Ed. 21. Auflage, ISBN: 3-540-22142-5 see English translation
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	23	Hein, Kefferstein and Dahan, 'Hot Stamping of USIBOR 1500 P: Part and Process Analysis Based on Numerical Simulation', in: Liewald (eds), New Developments in Sheet Metal Forming, 2006, in English and English partial translations
	24	Cornette et al., "High Strength Steels for Automotive Safety Parts" SAE Technical Paper Series 2001-01-0078, March 2001, ISSN: 0148-7191
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	29	Preliminary Opinion of the European Patent Office Board of Appeal on EP 2 242 863 B1, dated July 3, 2018	
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	42	Application report: Examination of body components with AlSi coating systems, Application No.: 18041806a-S2001 by TAZ GmbH, August 27, 2018, see English translation	
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	Attorney Docket Number	20631.1028CON5

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Examiner Signature	/Daniel J. Schleis/	Date Considered	07/08/2019

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	Examiner Name	
	Attorney Docket Number	20631.1028CON5

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jennifer L. O'Connell/	Date (YYYY-MM-DD)	2019-06-04
Name/Print	Jennifer L. O'Connell	Registration Number	57392

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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	13	Volkswagen Aktiengesellschaft, "Fahrzeugdaten" including opinion of Ingineurbuero fuer KfZ-Technik GmbH Nr. 18BS-00988JP, observations of notary and partial translation, August 2018 see partial English translation	
	14	D4A-"Evaluation of the porosity of the coating in a reference range of Fig. 1 of D4 [WO2008/053273]" see English translation	
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	19	Hein, "Press-hardening of Usibor 1500 P : simulation-based component and process analysis", 18 pages, 9./10. May 2006, and translation thereof, 13 pages	
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	21	Zhao:"Analysis and Application of Axle Housing Hot Stamping Process", Forging Machinery, published in March, 2002, including English translation, 8 pages	
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	25	X. Bano, et al., "Heat Treated Boron Steels in the Automobile Industry," 39"' MWSP Conf. Proc., ISS, Vol. XXXV, 1998.

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Signature	/Jennifer L. O'Connell/	Date (YYYY-MM-DD)	2019-06-04
Name/Print	Jennifer L. O'Connell	Registration Number	57392

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	ARCELORMITTAL
Inventor(s):	Drillet et al.
Application No.:	16/412,799
Filed:	May 16, 2019
Examiner:	TBD
Attorney Docket No.:	20631.1028CON5
Confirmation No.:	7637
Title:	Coated Steel Strips, Coated Stamped Products and Methods

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

July 8, 2019

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. § 1.56

Sir:

In accordance with the provisions of 37 C.F.R. § 1.97, Applicants hereby make of record the documents listed on the accompanying Form PTO/SB/08a for consideration by the Examiner in connection with the examination of the above-identified patent application. While the references are being submitted herewith, some or all of the references may not constitute prior art under the U.S. patent laws.

Applicants also respectfully advise the Examiner that some or all of the references were cited on June 28, 2019 in a Petition for *Inter Partes Review* (IPR2019-01275) of U.S. Patent No. 9,708,683, which issued from U.S. Application No. 13/621,015, filed September 15, 2012 and is a parent of the present application.

Applicants also respectfully advise the Examiner of the Opposition Proceedings in European counterpart patent application 06 842 403.5, filed on October 30, 2006, which issued on November 29, 2017 as EP2086755 B1

This Information Disclosure Statement is filed before the mailing date of the First Office Action, thus no fee is believed to be due.

In the event any fee is due or an overpayment is made in connection with this submission, the Commissioner is hereby authorized to charge said deficiency or credit said overpayment to our Deposit Account No. 50-0552.

Respectfully submitted,
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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 013 785 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and notification of the grant of the patent:
10/25/2006 Bulletin 2006/43

(51) Int Cl.:
C23C 2/12 (2006.01) *C23C 2/40* (2006.01)
C23C 2/26 (2006.01)

(21) Application number: **99403227.4**

(22) Date of filing: **12/21/1999**

(54) Process for manufacturing a part from a hot-rolled sheet

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **12/24/1998 FR 9816477**

(43) Date of publication of application:
06/28/2000 Bulletin 2000/26

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- **GIEREK A. E.A.: "Tauchalitieren – Eigenschaften und Einsatzgebiete" V.D.I. ZEITSCHRIFT, vol. 118, no. 8, April 1976 (1976-04), pages 19-22, XP002114744**
- **DATABASE WPI Week 9046 Derwent Publications Ltd., London, GB; AN 347101 XP002114745 "Aluminized steel strip production process – involves cooling and hot rolling under compression to improve adhesion of covering to base" & SU 331 284 A (FRUNZE POLY), 9 January 1991 (1991-01-09)**

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POSCO Exhibit 1012-0001
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Description

[0001] The invention concerns a process for manufacturing a part from a strip of hot-rolled sheet steel.

[0002] Steel sheets having to undergo forming at high temperature or heat treatment are not delivered coated because of resistance of the coating during the heat treatment. The coating is therefore undertaken on the finished part, which requires careful cleaning of surfaces and grooved parts. This cleaning requires the use of acids or bases, recycling and storage of which entail a significant financial expense and present risks for the operators and for the environment. Furthermore, the heat treatment must be undertaken in a controlled environment to avoid any decarburation and oxidation of the steel. Then, in the case of hot forming, the carbon deposit, owing to its abrasive power, damages the forming tools, which reduces the quality of the parts obtained from a dimensional and aesthetic point of view, or requires frequent and costly tool repairs. Lastly, to increase their resistance to corrosion, the parts thus obtained must undergo costly post-treatment, application of which is difficult, even impossible, particularly in the case of parts comprising grooves.

[0003] The aim of the invention is to propose rolled steel sheets of a thickness of 0.2 mm to around 20 mm, coated after hot-rolling, and having to undergo forming, either hot or cold, followed by heat treatment, with the temperature having to be increased without decarburation of the sheet steel, without oxidation of the surface of the said sheet, before, during and after the hot forming or the heat treatment.

[0004] The invention has the purpose of a process for manufacturing a part from a strip of hot-rolled sheet steel and which is characterized in that:

- the rolled sheet is coated with a metal or a metal alloy providing protection of the surface and the steel,
- the temperature of the coated sheet is increased for its forming,
- this creates an alloyed intermetallic compound, providing protection against corrosion, and against decarburation of the steel, it being possible for said intermetallic compound to provide a lubricating function,
- the forming is undertaken by stamping,
- the part formed is cooled so as to confer a high degree of mechanical hardness of the steel and a high degree of superficial hardness of the coating.

[0005] The other features of the invention are:

- the hot-rolled sheet is coated after hot-rolling and pickling,
- the metal or metal alloy coating is made of aluminum or aluminum alloy,
- the intermetallic alloy is a compound principally based on aluminum, iron and silicon,
- the metal or metal alloy coating is hot-dipped,
- the coated sheet is heated to a temperature above 700°C before forming,
- the coated sheet is hot-stamped,
- the stamped part is quench-cooled at a rate above the critical quench rate.

[0006] The invention also concerns a hot-rolled sheet comprising a metal or metal alloy coating deposited on the surface, for the hot manufacture of an intermetallic compound, the intermetallic compound providing protection against corrosion, a barrier against decarburation of the steel sheet, lubrication upon hot forming of the sheet, and on the finished part, after forming and cooling, a high degree of mechanical hardness of the steel and a high degree of superficial hardness of the surface of the said finished part.

[0007] Another feature of the invention is:

- the sheet comprises an aluminum or aluminum alloy surface deposit.

[0008] The invention also concerns the use of the sheet in the hot forming by stamping parts with a high degree of mechanical hardness and a high degree of surface hardness providing very good resistance to abrasion.

The following description will help better understand the invention.

[0009] The process according to the invention consists of coating a hot-rolled steel sheet, for heat treatment or hot forming, with a metal or metal alloy such as aluminum or an aluminum alloy composed for example of aluminum and silicon. The metal or metal alloy coating is chosen to provide protection against corrosion and to withstand a high temperature. Upon heat treatment, or an increase in temperature for forming, the coating forms an alloyed layer presenting a high resistance to corrosion, abrasion, wear and fatigue. The coating does not change the formability properties of the steel, and thus allows a great variety of hot and cold forming.

[0010] After hot-rolling the strip can be pickled and cold-rolled before being coated.

[0011] The rolled steel can be coated, for example, with the following two types of metal alloy:

Alloy no. 1: Si: 9% to 10%; Fe: 2% to 3.5%; Balance: Al and impurities.

Alloy no. 2: Fe: 2% to 4%; Balance: Al and impurities.

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For alloy no. 1 the thickness of the coating is between 5 µm and 100 µm, and preferably between 10 µm and 25 µm. For alloy no. 2 the thickness of the coating is between 15 µm and 100 µm, and preferably between 30 µm and 50 µm.

[0012] For the forming or heat treatment the sheet is heated to a high temperature, preferably between 750°C and 1200°C, in a furnace comprising an atmosphere no longer requiring control owing to the barrier to oxidation formed by the coating. Upon increasing the temperature, the aluminum-based coating transformed into an alloyed layer on the surface comprising various phases depending on the heat treatment and presenting a high degree of hardness that can exceed 600 HV 100g.

[0013] According to the process of the invention, sheets can be produced of a thickness between 0.2 mm and 20 mm, having good forming properties and good resistance to corrosion.

[0014] The sheets delivered coated present a high resistance to corrosion during temperature increases, forming, heat treatments, and upon use of the finished formed parts.

[0015] The presence of the coating during heat treatments or hot forming makes it possible to avoid, in addition to corrosion, decarburation of the base steel. This has an undeniable advantage in the case of hot forming in a stamping press. Indeed, the intermetallic alloy formed avoids the formation of carbon deposit and therefore the wear of tools by the carbon deposit, and due to this lengthens the average life of the said tools. It has been noted that the hot formed intermetallic alloy provides a lubricating function at high temperature. Furthermore, the protective effect against decarburation of the intermetallic alloy enables the use of the furnace at a high temperature exceeding 900°C and having an uncontrolled atmosphere, even for heating times of several hours.

[0016] On leaving the furnace, it is no longer necessary to pickle the part obtained, hence a saving owing to the removal of the pickling bath for the finished parts.

[0017] Owing to the characteristics of the coating after increasing the temperature, the parts obtained have increased resistance to fatigue, wear, abrasion and corrosion. Furthermore, the coating can be welded before and after raising the temperature.

[0018] The sheet steel, through the effect of the quench cooling, provides high mechanical characteristics of the part obtained after forming, the coating transformed into an intermetallic alloy when hot providing, owing to its qualities of lubricant and resistance to friction, an improvement of the forming in the area of the hot stamping.

[0019] In one embodiment, a hot-rolled sheet steel strip is used of the following weight composition:

carbon: 0.15% to 0.25%,
manganese: 0.8% to 1.5%,
silicon: 0.1% to 0.35%,
chromium: 0.01% to 0.2%,
titanium: less than 0.1%,
aluminum: less than 0.1%,
phosphorus: less than 0.05%,
sulfur: less than 0.03%,
boron: 0.0005% to 0.01%,

the sheet strip is coated with a coating of alloy no. 1 or no. 2,
the sheet is austenitized at 950°C before forming and quenching in the tool, with the coating providing a role of lubricant upon forming, in addition to its functions of protection against cold and hot corrosion and against decarburation. Upon quenching, the alloy coating does not hinder the extraction of the heat by the tool and can favor it. After forming and quenching, it is no longer necessary to pickle the part or to protect it, as the base coating provides protection throughout the process.

Claims

1. Process of producing a part from a strip of hot-rolled steel sheet, **characterized in that**:

   - the rolled sheet is coated with an aluminum alloy containing 9 to 10% silicon and 2 to 3.5% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 5 and 100 µm, or with an aluminum alloy containing 2 to 4% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 15 and 100 µm, the coating with the aluminum alloy being carried out by hot-dip coating, immediately after hot-rolling and pickling;
   - the coated sheet is heated to a temperature above 700°C before the forming operation until consequently producing an alloyed intermetallic compound based on aluminum, iron and silicon on the surface, protecting the steel from corrosion and from decarburation, it being possible for said intermetallic compound to provide a lubricating function;
   - the part is hot-stamped; and
   - the formed part is quench-cooled at a rate above the critical quench rate.

2. Hot-rolled steel sheet having a coating consisting of an alloyed intermetallic compound, based on aluminum, iron and silicon, on the surface,

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said coating being obtained by the heat treatment of said sheet precoated with an aluminum alloy containing 9 to 10% silicon and 2 to 3.5% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 5 and 100 μm, or with an aluminum alloy containing 2 to 4% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 15 and 100 μm, said coating thickness between 15 and 100 μm, said coating being deposited by hot-dip coating, immediately after the hot-rolling and pickling, and said heat treatment being carried out at a temperature above 700°C.

3. Part obtained by hot-stamping the sheet according to Claim 2, followed by a quench at a rate above the critical quench rate.

Claims

1. Process of producing a part from a strip of hot-rolled steel sheet, **characterized in that**:

   - the rolled sheet is coated with an aluminum alloy containing 9 to 10% silicon and 2 to 3.5% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 5 and 100 μm, or with an aluminum alloy containing 2 to 4% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 15 and 100 μm, the coating with the aluminum alloy being carried out by hot-dip coating, immediately after hot-rolling and pickling;
   - the coated sheet is heated to a temperature above 700°C before the forming operation until consequently producing an alloyed intermetallic compound based on aluminum, iron and silicon on the surface, protecting the steel from corrosion and from decarburation, it being possible for said intermetallic compound to provide a lubricating function;
   - the part is hot-stamped; and
   - the formed part is quench-cooled at a rate above the critical quench rate.

2. Hot-rolled steel sheet having a coating consisting of an alloyed intermetallic compound, based on aluminum, iron and silicon, on the surface, said coating being obtained by the heat treatment of said sheet precoated with an aluminum alloy containing 9 to 10% silicon and 2 to 3.5% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 5 and 100 μm, or with an aluminum alloy containing 2 to 4% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 15 and 100 μm, said coating thickness between 15 and 100 μm, said coating being deposited by hot-dip coating, immediately after the hot-rolling and pickling, and said heat treatment being carried out at a temperature above 700°C.

3. Part obtained by hot-stamping the sheet according to Claim 2, followed by a quench at a rate above the critical quench rate.

Claims

1. Process of producing a part from a strip of hot-rolled steel sheet, **characterized in that**:

   - the rolled sheet is coated with an aluminum alloy containing 9 to 10% silicon and 2 to 3.5% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 5 and 100 μm, or with an aluminum alloy containing 2 to 4% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 15 and 100 μm, the coating with the aluminum alloy being carried out by hot-dip coating, immediately after hot-rolling and pickling;
   - the coated sheet is heated to a temperature above 700°C before the forming operation until consequently producing an alloyed intermetallic compound based on aluminum, iron and silicon on the surface, protecting the steel from corrosion and from decarburation, it being possible for said intermetallic compound to provide a lubricating function;
   - the part is hot-stamped; and
   - the formed part is quench-cooled at a rate above the critical quench rate.

2. Hot-rolled steel sheet having a coating consisting of an alloyed intermetallic compound, based on aluminum, iron and silicon, on the surface, said coating being obtained by the heat treatment of said sheet precoated with an aluminum alloy containing 9 to 10% silicon and 2 to 3.5% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 5 and 100 μm, or with an aluminum alloy containing 2 to 4% iron, the balance consisting of aluminum and impurities, as a layer having a thickness between 15 and 100 μm, said coating thickness between 15 and 100 μm, said coating being deposited by hot-dip coating, immediately after the hot-rolling and pickling, and said heat

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treatment being carried out at a temperature above 700°C.

3. Part obtained by hot-stamping the sheet according to Claim 2, followed by a quench at a rate above the critical quench rate.

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I, Eve Hecht, declare the following:

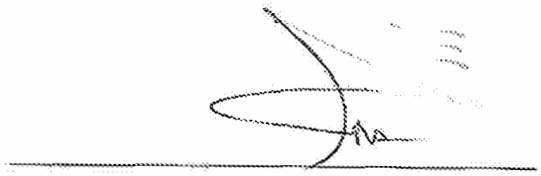
1. I am over 18 years of age and competent to make this declaration.

2. I am a qualified French to English translator as certified by the American Translators Association.

3. I have translated the attached document dated 12/21/1999 in connection with European Patent Application number: 99403227.4.

4. I affirm that the translated text has been translated and edited to the best of my ability and knowledge to accurately reflect the content, meaning, and style of the original text. I hereby certify under penalty of perjury under the laws of the United States of America that the foregoing constitutes, pursuant to my knowledge and belief, a true and correct translation of the original document.

4. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.



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POSCO Exhibit 1012-0006
Filed with Petition for IPR of U.S. Patent No. 9,708,683

(19) Europäisches Patentamt
European Patent Office
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(11) EP 1 013 785 B1

(12) FASCICULE DE BREVET EUROPEEN

(45) Date de publication et mention de la délivrance du brevet:
25.10.2006 Bulletin 2006/43

(51) Int Cl.:
C23C 2/12 *(2006.01)* ***C23C 2/40*** *(2006.01)*
C23C 2/26 *(2006.01)*

(21) Numéro de dépôt: **99403227.4**

(22) Date de dépôt: **21.12.1999**

(54) Procédé de réalisation d'une pièce à partir d'une bande de tôle d'acier laminée à chaud

Herstellungsverfahren für Formteile aus warmgewalztem Stahlblech

Process for manufacturing of a part from a hot-rolled sheet

(84) Etats contractants désignés:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priorité: **24.12.1998 FR 9816477**

(43) Date de publication de la demande:
28.06.2000 Bulletin 2000/26

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- **DATABASE WPI Week 9046 Derwent Publications Ltd., London, GB; AN 347101 XP002114745 "Aluminised steel strip production process - involves cooling and hot rolling under compression to improve adhesion of covering to base" & SU 331 284 A (FRUNZE POLY), 9 janvier 1991 (1991-01-09)**

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EP 1 013 785 B1

Printed by Jouve, 75001 PARIS (FR)

POSCO Exhibit 1011-0001
Filed with Petition for IPR of U.S. Patent No. 9,708,683

Description

[0001] L'invention concerne un procédé de réalisation d'une pièce à partir d'une bande de tôle d'acier laminée à chaud.

[0002] Les tôles en acier devant subir un formage à haute température et ou un traitement thermique ne sont pas livrées revêtues pour des considérations de tenue du revêtement lors du traitement thermique. Le revêtement est donc effectué sur pièce finie ce qui nécessite un nettoyage soigné des surfaces et des parties creuses. Ce nettoyage requiert l'utilisation d'acides et ou de bases dont le recyclage et le stockage sont une charge financière importante et présentent des risques pour les opérateurs et pour l'environnement. De plus, le traitement thermique doit être effectué sous atmosphère contrôlée afin d'éviter toute décarburation et oxydation de l'acier. Ensuite, dans le cas du formage à chaud, la calamine, de par son pouvoir abrasif, endommage les outils de mise en forme, ce qui diminue la qualité des pièces obtenues du point de vue dimensionnel et esthétique, ou oblige à de fréquentes et coûteuses réparations d'outils. Enfin, pour augmenter leur résistance à la corrosion, les pièces ainsi obtenues doivent recevoir un post traitement coûteux dont l'application est difficile, voire impossible, en particulier dans le cas de pièces comportant des creux.

[0003] Le but de l'invention est de proposer des tôles d'acier laminées de 0,2 mm à environ 20 mm d'épaisseur, revêtues après laminage à chaud, et devant subir une mise en forme, soit à chaud, soit à froid suivie d'un traitement thermique, l'élévation de température devant être assurée sans décarburation de l'acier de la tôle, sans oxydation de la surface de ladite tôle, avant, pendant et après la mise en forme à chaud et ou le traitement thermique.

[0004] L'invention a pour objet un procédé de réalisation d'une pièce à partir d'une bande de tôle d'acier laminée à chaud et qui se caractérise en ce que:

- on revêt la tôle laminée d'un métal ou d'un alliage métallique assurant une protection de la surface et de l'acier,
- on soumet la tôle revêtue à une élévation en température pour sa mise en forme,
- on réalise, de ce fait un composé allié intermétallique, en surface, assurant une protection contre la corrosion, contre la décarburation de l'acier, le composé intermétallique pouvant assurer une fonction de lubrification,
- on effectue la mise en forme par emboutissage,
- on refroidit la pièce formée pour conférer des caractéristiques mécaniques de dureté élevées de l'acier et une dureté superficielle élevée du revêtement.

[0005] Les autres caractéristiques de l'invention sont:

- on revêt la tôle laminée à chaud après laminage à chaud et décapage,
- le métal ou l'alliage métallique de revêtement est de l'aluminium ou un alliage d'aluminium.
- l'alliage intermétallique est un composé à base principalement d'aluminium, de fer et de silicium,
- le revêtement de métal ou d'alliage métallique et effectué au trempé à chaud.
- la tôle revêtue est soumise à une élévation de température supérieure à 700°C avant la mise en forme,
- la tôle revêtue est emboutie à chaud.
- la pièce obtenue par emboutissage est refroidie pour subir une trempe, à une vitesse supérieure à la vitesse critique de trempe.

[0006] L'invention concerne également une tôle laminée à chaud comportant un revêtement de métal ou d'alliage métallique déposé en surface, pour la réalisation à chaud d'un composé intermétallique, le composé intermétallique assurant, une protection contre la corrosion, une barrière contre la décarburation de l'acier de la tôle, une lubrification lors de la mise en forme à chaud de la tôle, et sur la pièce finie, après mise en forme et refroidissement, des caractéristiques mécaniques de dureté de l'acier élevées ainsi qu'une dureté superficielle élevée de la surface de ladite pièce finie.

[0007] Une autre caractéristique de l'invention est:

- la tôle comporte un dépôt en surface d'aluminium ou d'un alliage d'aluminium.

[0008] L'invention concerne encore l'utilisation de la tôle dans la mise en forme à chaud par emboutissage de pièces de hautes caractéristiques mécaniques en dureté et de hautes caractéristiques de dureté en surface assurant une très bonne tenue à l'abrasion.

La description qui suit fera bien comprendre l'invention.

[0009] Le procédé selon l'invention consiste à revêtir un acier laminé à chaud, pour traitement thermique et ou formage à chaud, avec un métal ou un alliage métallique tels que de l'aluminium ou un alliage d'aluminium composé par exemple d'aluminium et de silicium. Le revêtement de métal ou d'alliage métallique est choisi de manière à avoir une protection contre la corrosion et de manière à résister à une haute température. Lors d'un traitement thermique, ou d'une élévation de température pour la mise en forme, le revêtement forme une couche alliée présentant une grande résistance à la corrosion, à l'abrasion, à l'usure et à la fatigue. Le revêtement ne modifie pas les propriétés de formabilité de l'acier et autorise ainsi une grande variété de mise en forme à froid et à chaud.

[0010] Après laminage à chaud la bande peut être décapée et laminée à froid avant d'être revêtue.

[0011] On peut revêtir la tôle laminée avec, par exemple, les deux types d'alliage métallique suivants:

Alliage N°1: Si: 9% à 10%; Fe: 2% à 3,5%; Solde: Al et des impuretés.
Alliage N°2: Fe: 2% à 4%; Solde: Al et des impuretés.

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Filed with Petition for IPR of U.S. Patent No. 9,708,683
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Pour l'alliage N°1 l'épaisseur du revêtement est compris entre 5 µm et 100 µm, et de préférence entre 10 µm et 25 µm. Pour l'alliage N°2 l'épaisseur du revêtement est compris entre 15 µm et 100 µm, et de préférence entre 30 µm et 50 µm.

[0012] Pour la mise en forme ou le traitement thermique, la tôle est soumise à une élévation de température comprise de préférence entre 750°C et 1200°C dans un four comportant une atmosphère ne nécessitant plus de contrôle du fait de la barrière à l'oxydation formée par le revêtement. Lors de l'élévation de la température, le revêtement à base d'aluminium se transforme en une couche alliée en surface comportant différentes phases dépendant du traitement en température et présentant une grande dureté pouvant dépasser 600 HV 100g.

[0013] Selon le procédé de l'invention, on peut produire des tôles dont l'épaisseur est comprise entre 0,2 mm et 20 mm, ayant de bonnes propriétés de mise en forme ainsi qu'une bonne résistance à la corrosion.

[0014] Les tôles livrées revêtues, présentent une résistance importante à la corrosion pendant les élévations de température, la mise en forme, les traitements thermiques, et lors de l'utilisation des pièces formées finies.

[0015] La présence du revêtement lors de traitements thermiques ou de formages à chaud permet d'éviter en plus de la corrosion, la décarburation de l'acier de base. Cela à un avantage indéniable dans le cas d'une mise en forme à chaud dans une presse d'emboutissage. En effet, l'alliage intermétallique formé évite, la formation de la calamine, l'usure des outils par la calamine, et permet de ce fait, un allongement de la vie moyenne desdits outils. Il a été remarqué que l'alliage intermétallique formé à chaud, a une fonction de lubrifiant à haute température. De plus, l'effet de protection contre la décarburation de l'alliage intermétallique permet l'usage de four haute température dépassant 900°C ayant une atmosphère non contrôlée, et cela, même pour des temps de chauffe de plusieurs heures.

[0016] En sortie de four, il n'est plus nécessaire de décaper la pièce obtenue, d'où une économie du fait de la suppression du bain de décapage des pièces finies.

[0017] De par les caractéristiques du revêtement après élévation de température, les pièces obtenues ont une résistance accrue à la fatigue, à l'usure, à l'abrasion et à la corrosion. De plus, le revêtement est soudable avant et après élévation de température.

[0018] L'acier de la tôle assure, par effet de trempe au refroidissement, des caractéristiques mécaniques élevées de la pièce obtenue après mise en forme, le revêtement transformé en un alliage intermétallique à chaud assurant pour sa part, du fait de ses qualités de lubrifiant et de résistance aux frottement, une amélioration de la mise en forme, dans le domaine de l'emboutissage à chaud.

[0019] Dans un exemple de réalisation, on utilise une bande de tôle laminée à chaud en acier de composition pondérale suivante:

carbone: 0,15% à 0,25%,
manganèse: 0,8% à 1,5%,
silicium: 0,1% à 0,35%,
chrome: 0,01% à 0,2%,
titane: moins de 0, 1 %,
aluminium: moins de 0,1 %,
phosphore: moins de 0,05%,
soufre: moins de 0,03%,
bore : 0,0005% à 0,01 %,

on revêt la bande de tôle d'un revêtement de type alliage N°1 ou 2,
on austénitise la tôle à 950°C avant formage et trempe dans l'outil, le revêtement assurant un rôle de lubrifiant lors de la mise en forme, en plus de ses fonctions de protection contre la corrosion à froid, à chaud et contre la décarburation. Lors de la trempe, le revêtement allié ne gène pas l'extraction de la chaleur par l'outil et peut la favoriser. Après formage et trempe, il n'est plus nécessaire de décaper la pièce ou de la protéger, le revêtement de base assurant la protection tout au long du procédé.

Revendications

1. Procédé de réalisation d'une pièce à partir d'une bande de tôle d'acier laminée et laminée à chaud, **caractérisée en ce que** :

   - on revêt la tôle laminée d'un alliage d'aluminium comprenant de 9 à 10% de silicium et de 2 à 3,5% de fer, le solde étant constitué d'aluminium et d'impuretés, en une couche d'épaisseur comprise entre 5 et 100 µm, ou d'un alliage à aluminium comprenant de 2 à 4% de fer, le solde étant constitué d'aluminium et d'impuretés, en une couche d'épaisseur comprise entre 15 et 100 µm, le revêtement d'alliage d'aluminium étant effectué au trempé à chaud, immédiatement après laminage à chaud, et décapage,
   - on soumet la tôle revêtue à une élévation en température supérieure à 700°C avant la mise en forme jusqu'à réaliser, de ce fait un composé allié intermétallique à base d'aluminium, de fer et de silicium, en surface, assurant une protection contre la corrosion, contre la décarburation de l'acier, le composé intermétallique pouvant assurer une fonction de lubrification,
   - on emboutit la pièce à chaud,
   - on refroidit la pièce formée par trempe, à une vitesse supérieure à la vitesse critique de trempe.

2. Tôle d'acier laminée à chaud comportant un revêtement constitué d'un composé allié intermétallique à base d'aluminium, de fer et de silicium, en surface,

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ledit revêtement étant obtenu par traitement thermique de ladite tôle préalablement revêtue d'un alliage d'aluminium comprenant de 9 à 10% de silicium et de 2 à 3,5% de fer, le solde étant constitué d'aluminium et d'impuretés, en une couche d'épaisseur comprise entre 5 et 100µm, ou d'un alliage à aluminium comprenant de 2 à 4% de fer, le solde étant constitué d'aluminium et d'impuretés, en une couche d'épaisseur comprise entre 15 et 100 µm, ledit revêtement étant déposé ou trempé à chaud, immédiatement après laminage à chaud, et décapage et ledit traitement thermique étant effectué à une température supérieure à 700°C.

3. Pièce obtenue par emboutissage à chaud de la tôle selon la revendication 2, suivi d'une trempe, à une vitesse supérieure à la vitesse critique de trempe.

Claims

1. Process of producing a part from a strip of a hot-rolled steel sheet, **characterized in that**:

   - the rolled sheet is coated with an aluminium alloy containing 9 to 10% silicon and 2 to 3.5% iron, the balance consisting of aluminium and impurities, as a layer having a thickness between 5 and 100 µm, or with an aluminium alloy containing 2 to 4% iron, the balance consisting of aluminium and impurities, as a layer having a thickness between 15 and 100 µm, the coating with the aluminium alloy being carried out by hot-dip coating, immediately after hot rolling and pickling;
   - the coated sheet is heated to a temperature above 700°C before the forming operation until consequently producing an alloyed intermetallic compound based on aluminium, iron and silicon on the surface, protecting the steel from corrosion and from decarburation, it being possible for said intermetallic compound to provide a lubricating function;
   - the part is hot-stamped; and
   - the formed part is quench-cooled at a rate above the critical quench rate.

2. Hot-rolled steel sheet having a coating consisting of an alloyed intermetallic compound, based on aluminium, iron and silicon, on the surface, said coating being obtained by the heat treatment of said sheet precoated with an aluminium alloy containing 9 to 10% silicon and 2 to 3.5% iron, the balance consisting of aluminium and impurities, as a layer having a thickness between 5 and 100 µm, or with an aluminium alloy containing 2 to 4% iron, the balance consisting of aluminium and impurities, as a layer having a thickness between 15 and 100 µm, said coating being deposited by hot-dip coating, immediately after the hot rolling and pickling, and said heat treatment being carried out at a temperature above 700°C.

3. Part obtained by hot-stamping the sheet according to Claim 2, followed by a quench at a rate above the critical quench rate.

Patentansprüche

1. Verfahren zum Herstellen eines Formteils ausgehend von einem warmgewalzten Stahlblechband, **dadurch gekennzeichnet, dass**:

   - man das gewalzte Blech mit einer Aluminiumlegierung, die 9 bis 10 % Silicium und 2 bis 3,5 % Eisen enthält, wobei der Rest aus Aluminium und Verunreinigungen besteht, in einer Schicht mit einer Stärke zwischen 5 und 100 µm beschichtet oder mit einer Aluminiumlegierung, die 2 bis 4 % Eisen enthält, wobei der Rest aus Aluminium und Verunreinigungen besteht, in einer Schicht mit einer Stärke zwischen 15 und 100 µm, wobei die Beschichtung mit einer Aluminiumlegierung durch Warmhärten unmittelbar nach dem Warmwalzen und Beizen erfolgt,
   - man das beschichtete Blech einer Temperaturerhöhung über 700 °C vor dem Formen unterwirft, bis man **dadurch** eine intermetallische legierte Verbindung auf der Basis von Aluminium, Eisen und Silicium auf der Oberfläche herstellt, die einen Schutz vor Korrosion, Entkohlen des Stahls sicherstellt, wobei die intermetallische Verbindung eine Schmierfunktion sicherstellen kann,
   - man das Formteil warm stanzt,
   - man das durch Härten gebildete Formteil mit einer Geschwindigkeit über der kritischen Härtgeschwindigkeit abkühlt.

2. Warmgewalztes Stahlblech, das eine Beschichtung aufweist, die aus einer legierten intermetallischen Verbindung auf der Basis von Aluminium, Eisen und Silicium auf der Oberfläche besteht, wobei die Beschichtung durch eine Wärmebehandlung des Blechs erzielt wird, das zuvor mit einer Aluminiumlegierung beschichtet wurde, die 9 bis 10 % Silicium und 2 bis 3,5 % Eisen enthält, wobei der Rest aus Aluminium und Verunreinigungen besteht, in einer Schicht mit einer Stärke zwischen 5 und 100 µm, oder mit einer Aluminiumlegierung, die 2 bis 4 % Eisen enthält, wobei der Rest aus Aluminium und Verunreinigungen besteht, in einer Schicht mit einer Stärke zwischen 15 und 100 µm, wobei die Beschichtung durch Warmhärten unmittelbar nach dem Warmwalzen und Beizen erfolgt, und die Wärmebe-

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handlung bei einer Temperatur über 700 °C erfolgt.

3. Formteil, das durch Warmstanzen des Blechs nach Anspruch 2 erzielt wird, gefolgt von einem Härten bei einer Geschwindigkeit, die größer ist als die kritische Härtgeschwindigkeit.

POSCO Exhibit 1011-0005
Filed with Petition for IPR of U.S. Patent No. 9,708,683
646

TRANSLATION

(19) REPUBLIC OF FRANCE

(11) **Publication Number:** ***2,833,504***
(only to be used for reproduction orders)

INSTITUT NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE [NATIONAL INSTITUTE OF INDUSTRIAL PROPERTY]

PARIS

(21) **National registration number:** **01 016185**

(51) Int Cl[7]: **B 21 D 53/26,** C 21 D 8/02, C 22 C 38/32, 38/38

(12) **PATENT APPLICATION** **A1**

(22) **Filing date:** December 14, 2001

(30) **Priority:**

(43) **Date application made available to the public:** 6/20/2003 Bulletin 03/25.

(56) **List of documents cited in the preliminary search report:** *Refer to the end of the present filing*

(60) **References to other related national documents:**

(71) **Applicant(s):** *USINOR Société anonyme* — FR.

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(54) **HOT-FORMING METHOD AND IN PARTICULAR OBTAINING ALL OR PART OF AN AUTOMOTIVE VEHICLE WHEEL.**

(57) Hot-forming method and in particular obtaining all or part of an automotive vehicle wheel, for example a wheel disk, characterized in that in a hot-stamping operation a precoated steel sheet hot-rolled for thermal treatment is used.

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TRANSLATION

2,833,504

Hot-Forming Method and in Particular Obtaining All or Part of an Automotive Vehicle Wheel

The present invention relates to obtaining a part by a hot-forming method and in particular obtaining all or part of an automotive vehicle wheel.

Currently, wheel disks are obtained by cold stamping of a sheet-metal blank or by flow-turning.

In the case of obtaining a wheel disk by stamping of a sheet-metal blank, it is necessary to perform several shaping operations, for which several stamping tools must be made. The number of stamping tools is of order 7, 8 or 9.

The following are the main disadvantages of the indicated present technique:

- Any change of shape requires machining or fabricating 7 to 9 different pairs of tools.
- Any manufacturing change leads to disassembling then assembling and adjusting 7 to 9 tools together with the adjustment of the associated presses.
- All these tools must be stored.
- Because of the fabrication cost of the tools, small runs cannot be made economically.
- It is not possible to make thick parts.

In the case of getting, for example, a wheel disk by flow-turning, productivity is reduced compared to stamping, which limits the manufacturing in large runs.

In the two cases indicated:

- Using stamping or lubricating oil is essential and requires degreasing before painting.
- These oils and the effluents must be stored and treated.

From the perspective of the properties sought:

- The increase of the mechanical properties leads to reduction of the formability, which limits the shape of the wheel disks and generates an increased elastic return, penalizing the dimensional guarantees.
- Increasing the mechanical properties requires the use of more and more powerful presses.
- The temporary protection against corrosion, before painting for example a stamped wheel disk, requires oiling the part and then degreasing it. It is also

necessary to remove the stamping oil before painting, which comes with a cost and an ecological risk.

The goal of the invention is the execution of a part by hot stamping, in one single pass, adhering to the dimensional guarantees, while also having the possibility of getting complex shapes.

The object of the invention is obtaining a part by a hot-forming method and in particular obtaining all or part of an automotive vehicle wheel, for example a wheel disk, characterized in that in a hot-stamping operation a precoated steel sheet hot-rolled for thermal treatment is used.

The other characteristics of the invention are:

- The steel sheet is a precoated hot or cold-rolled steel sheet with the following general composition by weight:

  0.15% < carbon < 0.5%
  0.5% < manganese < 3%
  0.1% < silicon < 0.5%
  0% < chrome < 1%
  Titanium < 0.2%
  Aluminum < 0.1%
  Phosphorus < 0.1%
  Sulfur < 0.05%
  0.0005% < boron < 0.08%

The other characteristics of the invention are:

- The coating is aluminum-based,
- Preferably, the steel sheet is a precoated hot or cold-rolled steel sheet with the following composition by weight:

  0.15% < carbon < 0.5%
  0.8% < manganese < 1.5%
  0.1% < silicon < 0.35%
  0% < chrome < 1%
  Titanium < 0.1%
  Aluminum < 0.1%
  Phosphorus < 0.05%

Sulfur < 0.03%

0.0005% < boron < 0.01%

- In the composition by weight of the sheet, the titanium concentration relative to the nitrogen concentration is greater than 3.42;
- The base composition by weight of the metal bath for coating comprises from 9% to 10% silicon, 2% to 3.5% iron, and the remainder of the bath is composed of aluminum and impurities;
- The base composition by weight of the metal bath for coating comprises from 2% to 4% iron;
- The base composition by weight of the metal bath for coating comprises from 0 to 50% zinc.

The following description will make the invention well understood.

The problem to be solved is to make a part by a hot-forming method and in particular getting all or part of an automotive vehicle wheel like for example a light vehicle or truck wheel disk or a wheel disk and a part of the wheel rim, in a single pass, meeting the dimensional guarantees, while also implementing complex shapes.

From French patent application 98/08793, a coated hot or cold steel sheet and comprising a very high strength after thermal treatment is known. From the French patent application 98/016477, a method for execution of a part from a strip of rolled steel sheet, and in particular hot-rolled, is known.

According to the invention, a particularly significant use of the sheet and of the method presented was demonstrated by getting a part by a hot-shaping method and, in particular, getting all or part of an automotive vehicle wheel, in a single hot-stamping pass, whereas the techniques used to date call for many complex tools and also many shaping operations.

Contrary to known industrial habits, the inventors obtained a wheel disk, in a single pass, by hot stamping a precoated hot-rolled steel sheet, which previously was done in 7 or 8 stamping operations, with the plane of the precut sheet having the following general composition by weight:

0.15% < carbon < 0.5%

0.5% < manganese < 3%

0.1% < silicon < 0.5%

0.01% < chrome < 1%

Titanium < 0.2%

Aluminum < 0.1%

Phosphorus < 0.1%

Sulfur < 0.05%

0.0005% < boron < 0.08%

A notable improvement in fatigue resistance without posing welding problems and having increased corrosion resistance after painting can be obtained by using a precoated steel for thermal treatment.

Further, the method and the steel used allow a notable weight reduction and an increase of the fatigue life. Finally, the resulting wheel disk can be welded and then painted without changes to existing lines.

Preferably the steel for the sheet has the following composition by weight:

0.15% < carbon < 0.5%

0.8% < manganese < 1.5%

0.1% < silicon < 0.35%

0.01% < chrome < 1%

Titanium < 0.1%

Aluminum < 0.1%

Phosphorus < 0.05%

Sulfur < 0.03%

0.0005% < boron < 0.01%

The sheet provides a very high mechanical strength after thermal treatment and the aluminum-based coating provides a high corrosion and fatigue resistance.

In order to get the part, in a single pass, by hot stamping of the coated hot-rolled sheet, it is preferable that the ratio of the titanium concentration to the nitrogen concentration be greater than 3.42.

The base composition by weight of the aluminum-based coating of the coated hot-rolled sheet comprises from 9% to 10% silicon and from 2% to 3.5% iron.

The base composition by weight of the coating of the coated hot-rolled sheet can also comprise from 2% to 4% iron. The base composition by weight of the metal bath comprises from 0 to 50% zinc.

In an implementation example, the steel according to the invention containing 0.231% carbon; 1.145% manganese; 0.020% phosphorus; 0.0038% sulfur; 0.239% silicon; 0.043% aluminum; 0.009% copper; 0.020% nickel; 0.179% chrome; 0.0042% nitrogen; 0.032% titanium; 0.0028% boron; and 0.0051% calcium, in sheet form, is coated with an aluminum-based layer about 25 μm thick before thermal treatment.

The sheet-metal blank is heated in a furnace at a temperature included between 750°C and 1000°C and more generally at a temperature included between 850°C and 950°C for a time that varies depending on the thickness. For a thickness of 2 mm, the sheet-metal blank stays in the furnace for six minutes. The rate of temperature increase is greater than 3°C/s. Because of the coating, it is not necessary to use an inert atmosphere furnace.

During reheating of the sheet-metal blank, the coating alloys with the substrate to form an intermetallic alloy. By interdiffusion, the alloying leads to an increase of the thickness of the layer which, for the treatment specified above, corresponds to a 50% increase.

The hot-sheet-metal blank is next transferred to the cooling tool or not, depending on the production rate, thickness of the sheet and the targeted cooling speed, in order to be shaped. There must not be blank clamping pressure in order to avoid tearing of the sheet due to the low high temperature strength thereof. The deformation speed must be sufficient for avoiding deforming the steel at a temperature below 400°C.

The resulting wheel disk is kept in the tool until reaching a temperature below 200°C and preferably below 100°C in order to meet the dimension guarantees. If the targeted structure for the substrate is a martensitic structure, the average cooling speed from the temperature on leaving the furnace to 400°C must be over 27°C/s. If the average cooling speed is below this value, bainite, ferrite or even pearlite can appear. It is therefore possible to get various structures and therefore various properties depending on the targeted cooling speed. Just the same, the best fatigue results are obtained with a totally martensitic steel structure.

Because of the hot forming, there is no damage to the metallurgical structure. This has a beneficial effect on the fatigue resistance because of the elimination of

internal defects that could serve to initiate fatigue cracks. It is not necessary to add stamping lubricant because the precoating acts as a lubricant.

The resulting part can directly go through the painting cycle. If this is not the case, it is not necessary to apply a temporary corrosion protection because the alloyed layer slows the appearance of corrosion. During the thermal cycle, the coating, alloyed or not, protects the steel from oxidation and decarburization.

The alloy layer made on the part has a hardness gradient. Starting from the extreme layer and moving towards the sheet, the hardness varies from 750HV0.1 to 300HV0.1 at the coating layer-sheet interface, and then increases up to about 500HV0.1 in the sheet, when the structure of the steel is entirely martensitic. It is the layer at 300HV0.1 which, by stopping cracks, gives the part an increased fatigue resistance.

If the steel from the proposed solution is used but not precoated, a significant breakdown of the average fatigue limit is noted, as seen in Table 1 below, principally related to the decarburization of the steel. The proposed solution avoids this phenomenon, because of the presence of the precoating. The alternating reversed-bending fatigue tests show a notable improvement.

Table 1.

Steel	Rp0.2 (MPa) Through	Rm (MPa) Through	Number of validation cycles for the limitation of the fatigue limit (millions of cycles)	Average Fatigue Limit (MPa)
USIDUR 355 comparison example	432	514	1.106	279
USIFORM 800 comparison example	766	872	2.106	388
Result according to the invention, no precoating	980	1490	2. 106	249

Result according to the invention	980	1480	2. 106	439

Compared to the USIDUR 355 sheet, commonly used industrially for implementing wheel disks, the improvement is 40% in life or reduced weight. Compared to the grade indicated, used for wheel disks, the fatigue limit has an improvement of over 12%.

The following are the advantages of obtaining a part by a hot-forming method and in particular obtaining all or part of an automotive vehicle wheel:

- A wheel disk implementation in a single forming pass;
- Because of the significant hot formability, a single tool is needed; it is therefore possible to make parts with complex shapes, in series, economically such as styled wheels;
- A very good dimensional guarantee because there is no elastic return as in the case of cold stamping or flow-turning;
- The high mechanical properties after tempering in the stamping tool allow significant weight reduction;
- The precoating provides an enhanced guarantee against corrosion and wear;
- An increased formability during heating of the sheet-metal blank allows hot forming of thicknesses that usually could only be formed by flow-turning;
- The deformation can take place during the hot austenitic phase, without damage, which guarantees a better fatigue resistance by elimination of internal defects generally created during hot deformation;
- Because of the precoating, there is no need to lubricate the sheet during the hot forming, thus eliminating the degreasing step before painting;
- Because of the coating, there is no need to apply temporary corrosion protection on the parts awaiting painting;
- Unlike zinc-based coatings, the thermally untreated precoating does not degrade the fatigue resistance and even increases it;
- The impact behavior is improved by the use of the selected steel type;
- The thermally treated precoating does not need specific welding material and precautions.

Other parts can benefit from this production method. Specifically, the fatigue-sized suspension parts can be indicated such as: control arms, tie rods, etc.

CLAIMS

1. A hot-forming method and in particular obtaining all or part of an automotive vehicle wheel, for example a wheel disk, characterized in that in a hot-stamping operation a precoated steel sheet hot or cold rolled for thermal treatment is used.

2. The method according to claim 1, characterized in that the steel sheet is a precoated hot-rolled steel sheet with the following general composition by weight:

   0.15% < carbon < 0.5%
   0.5% < manganese < 3%
   0.1% < silicon < 0.5%
   0% < chrome < 1%
   Titanium < 0.2%
   Aluminum < 0.1%
   Phosphorus < 0.1%
   Sulfur < 0.05%
   0.0005% < boron < 0.08%

3. The method according to claim 1, characterized in that the coating is aluminum-based.

4. The method according to claim 1, characterized in that preferably, the steel sheet is a precoated hot or cold-rolled steel sheet with the following composition by weight:

   0.15% < carbon < 0.5%
   0.8% < manganese < 1.5%
   0.1% < silicon < 0.35%
   0.01% < chrome < 1%
   Titanium < 0.1%
   Aluminum < 0.1%

Phosphorus < 0.05%

Sulfur < 0.03%

0.0005% < boron < 0.01%

5. The method according to claim 1, characterized in that in the composition by weight of the sheet, the titanium concentration relative to the nitrogen concentration is greater than 3.42.

6. The method according to claim 1, characterized in that the base composition by weight of the metal bath for coating comprises from 9% to 10% silicon, 2% to 3.5% iron, and the remainder of the bath is composed of aluminum and impurities.

7. The method according to claim 1, characterized in that the base composition by weight of the metal bath for coating comprises from 2% to 4% iron.

8. The method according to claim 1, characterized in that the base composition by weight of the metal bath for coating comprises from 0 to 50% zinc.

TRANSLATION

2,833,504

[logo]

INSTITUT NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE [NATIONAL INSTITUTE OF INDUSTRIAL PROPERTY]

PRELIMINARY SEARCH REPORT

prepared on the basis of the latest claims filed before beginning the search

NATIONAL REGISTRATION NUMBER

FA 611824
FR 0116185

	DOCUMENTS FOUND TO BE PERTINENT	Claims relevant to the examined application	Classification assigned to the invention by INPI
Category	Document citations with indication of the pertinent parts if necessary		
D,X	FR 2 780 984 A (LORRAINE LAMINAGE) 14 janvier 2000 (2000-01-14) * le document en entier * ---	1-8	B21D53/26 C21D8/02 C22C38/32 C22C38/38
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			B21D

	Date search completed:	Examiner
	August 14, 2002	Peeters, L

CATEGORY OF THE DOCUMENTS CITED		
X: particularly pertinent on its own Y: particularly relevant in combination with another document in the same category A: pertinent to the background of at least one claim or general technology background O: un-written disclosure P: document insert		T: theory or principal underlying the invention E: patent document having a date earlier than the filling date and which had only been published on the filling date or on a later date D: cited in the application L: cited for other reasons ..... &: member of the same family; corresponding document

ATTACHMENT TO THE PRELIMINARY SEARCH REPORT CONCERNING THE FRENCH PATENT APPLICATION NUM.: FR 0116185 FA 611824

The present attachment indicates the members of the patent family concerning the patent documents cited in the preliminary group search report given above.
The said members are contained in the computer file of the European Patent Office as of August 14, 2002.
The information provided is given for information and does not incur the responsibility of the European Patent Office, or the French Authority.

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US 4,397,345 A	09-08-1983	None	

For complete information concerning this attachment: see Official Journal of the European Patent Office, number 12/82

DECLARATION OF BRUCE D. POPP

I, Bruce D. Popp, declare the following:

1. I am over 18 years of age and competent to make this declaration.

2. I am a qualified French to English translator as certified by the American Translators Association.

3. I have translated the attached patent application bearing Publication No. 2,833,504 and a filing date of December 14, 2001, regarding "Hot-forming method and in particular obtaining all or part of an automotive vehicle wheel."

4. I affirm that the translated text has been translated and edited to the best of my ability and knowledge to accurately reflect the content, meaning, and style of the original text. I hereby certify under penalty of perjury under the laws of the United States of America that the foregoing constitutes, pursuant to my knowledge and belief, a true and correct translation of the original document.

5. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.



Bruce D. Popp

Dated and signed on May 10, 2019.

(19) RÉPUBLIQUE FRANÇAISE

INSTITUT NATIONAL
DE LA PROPRIÉTÉ INDUSTRIELLE

PARIS

(11) **N° de publication :** **2 833 504**
(à n'utiliser que pour les commandes de reproduction)

(21) **N° d'enregistrement national :** **01 16185**

(51) Int Cl[7] : **B 21 D 53/26,** C 21 D 8/02, C 22 C 38/32, 38/38

(12) DEMANDE DE BREVET D'INVENTION A1

(22) **Date de dépôt :** 14.12.01.

(30) **Priorité :**

(43) **Date de mise à la disposition du public de la demande :** 20.06.03 Bulletin 03/25.

(56) **Liste des documents cités dans le rapport de recherche préliminaire :** *Se reporter à la fin du présent fascicule*

(60) **Références à d'autres documents nationaux apparentés :**

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(74) **Mandataire(s) :**

(54) PROCEDE DE MISE EN FORME A CHAUD ET NOTAMMENT L'OBTENTION DE TOUT OU PARTIE D'UNE ROUE DE VEHICULE AUTOMOBILE.

(57) Procédé de mise en forme à chaud et notamment, obtention de tout ou partie d'une roue de véhicule automobile comme par exemple un voile de roue, caractérisé en ce qu'on utilise, dans une opération d'emboutissage à chaud, une tôle d'acier laminée à chaud pour traitement thermique pré revêtu.

FR 2 833 504 - A1

POSCO Exhibit 1010-0014
Filed with Petition for IPR of U.S. Patent No. 9,708,683

Procédé de mise en forme à chaud et notamment l'obtention de tout ou partie d'une roue de véhicule automobile.

La présente invention concerne l'obtention d'une pièce par un procédé de mise en forme à chaud et notamment l'obtention de tout ou partie d'une roue de véhicule automobile.

Actuellement, les voiles de roues sont obtenus soit par emboutissage à froid d'un flan de tôle soit par fluotournage.

Dans le cas de l'obtention d'un voile par emboutissage d'un flan de tôle, il est nécessaire de réaliser plusieurs opérations de mise en forme, ce qui impose la réalisation de plusieurs outils d'emboutissage. Le nombre d'outils d'emboutissage est de l'ordre de 7, 8 ou 9.

Les principaux inconvénients de la présente technique citée sont les suivants :

- Tout changement de forme nécessite l'usinage ou la fabrication de 7 à 9 paires d'outils différents.
- Tout changement de fabrication occasionne le démontage puis le montage et le réglage de 7 à 9 outils ainsi que le réglage des presses associées.
- Ces nombreux outils doivent être stockés.
- Le coût de fabrication des outils ne permet pas la réalisation de petites séries de manière économique.
- Il n'est pas possible de réaliser des pièces de forte épaisseur.

Dans le cas de l'obtention, par exemple, d'un voile de roue par fluotournage, la productivité est réduite comparativement à l'emboutissage, ce qui limite la fabrication en grandes séries.

Dans les deux techniques citées :

- L'utilisation d'huile d'emboutissage ou de lubrifiant est impératif et nécessite un dégraissage avant mise en peinture.
- Il faut stocker et traiter ces huiles ainsi que les effluents.

Du point de vue des caractéristiques recherchées :

- L'augmentation des caractéristiques mécaniques entraîne une diminution de la formabilité, ce qui limite la forme des voiles, et génère un retour élastique accru, pénalisant les garanties dimensionnelles.
- L'augmentation des caractéristiques mécaniques impose d'utiliser des presses de plus en plus puissantes.

- La protection temporaire contre la corrosion, avant peinture par exemple d'un voile embouti, nécessite d'huiler la pièce puis de la dégraisser. Il est également nécessaire de retirer l'huile d'emboutissage avant peinture, ce qui comporte un coût et un risque écologique.

Le but de l'invention est la réalisation d'une pièce par emboutissage à chaud, en une seule passe, en respectant les garanties dimensionnelles, tout en ayant la possibilité d'obtenir des formes complexes.

L'invention a pour objet l'obtention d'une pièce par un procédé de mise en forme à chaud et notamment l'obtention de tout ou partie d'une roue de véhicule automobile comme par exemple un voile de roue, caractérisée en ce qu'on utilise, dans une opération d'emboutissage à chaud, une tôle d'acier laminée à chaud pour traitement thermique, pré revêtue.

Les autres caractéristiques de l'invention sont :

- la tôle d'acier est une tôle d'acier laminée à chaud ou à froid pré revêtue de composition générale pondérale suivante :

0,15% < carbone < 0,5%
0,5% < manganèse < 3%
0,1% < silicium < 0,5%
0% < chrome < 1%
titane < 0,2%
aluminium < 0,1%
phosphore < 0,1%
soufre < 0,05%
0,0005% < bore < 0,08%

les autres caractéristiques de l'invention sont :

- le revêtement est à base d'aluminium,
- de préférence, la tôle d'acier est une tôle d'acier laminée à chaud ou à froid pré revêtue de la composition pondérale suivante :

0,15% < carbone < 0,5%
0,8% < manganèse < 1,5%
0,1% < silicium < 0,35%
0% < chrome < 1%
titane < 0,1%
aluminium < 0,1%

phosphore < 0,05%

soufre < 0,03%

0,0005% < bore < 0,01%

- dans la composition pondérale de la tôle, la teneur en titane par rapport à la teneur en azote est supérieure à 3,42,
- le bain métallique du revêtement comprend dans sa composition pondérale de base, de 9% à 10% de silicium, de 2% à 3,5% de fer, le reste du bain étant composé d'aluminium et des impuretés,
- le bain métallique du revêtement comprend dans sa composition pondérale de base de 2% à 4% de fer,
- le bain métallique du revêtement peut contenir dans sa composition pondérale de base, de 0 à 50% de zinc.

La description qui suit fera bien comprendre l'invention.

Le problème posé est de réaliser une pièce par un procédé de mise en forme à chaud et notamment l'obtention de tout ou partie d'une roue de véhicule automobile comme par exemple, un voile de roue de VL ou PL (voiture légère ou poids lourd) ou un voile de roue et une partie de la jante de roue, en une seule passe, en respectant les garanties dimensionnelles, tout en réalisant des formes complexes.

Il est connu de la demande de brevet FR N° 98 08793 une tôle d'acier à chaud et à froid revêtue et comportant une très haute résistance après traitement thermique. Il est également connu de la demande de brevet FR N° 98 16477 un procédé de réalisation d'une pièce à partir d'une bande de tôle d'acier laminée et notamment laminée à chaud.

Selon l'invention, une utilisation particulièrement importante d'une tôle et du procédé présentés a été démontrée, dans l'obtention d'une pièce par un procédé de mise en forme à chaud et, notamment, l'obtention de tout ou partie d'une roue de véhicule automobile, en une seule passe d'emboutissage à chaud, alors que les techniques utilisées à ce jour, demande des outillages nombreux, complexes, ainsi que des opérations nombreuses de mise en forme.

A l'encontre des habitudes industrielles connues, les inventeurs ont obtenu, en une seule passe, par emboutissage à chaud d'une tôle d'acier laminée à chaud pré revêtu, un voile de roue, qui antérieurement, était réalisé en 7 ou 8 opérations d'emboutissage, le plan de tôle prédécoupé ayant la composition pondérale générale suivante :

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0,15% < carbone < 0,5%

0,5% < manganèses < 3%

0,1% < silicium < 0,5%

0,01% < chrome < 1%

titane < 0,2%

aluminium < 0,1%

phosphore < 0,1%

soufre < 0,05%

0,0005% < bore < 0,08%

L'utilisation d'un acier pour traitement thermique pré revêtu permet d'obtenir un gain notable en résistance à la fatigue sans poser de problème de soudage et en présentant une résistance accrue à la corrosion après peinture.

De plus, le procédé et l'acier utilisé permettent un allègement notable et une augmentation de la durée de vie en fatigue. Enfin, le voile obtenu peut être soudé puis peint sans modification des lignes existantes.

De préférence l'acier de la tôle a la composition pondérale suivante :

0,15% < carbone < 0,5%

0,8% < manganèses < 1,5%

0,1% < silicium < 0,35%

0,01% < chrome < 1%

titane < 0,1%

aluminium < 0,1%

phosphore < 0,05%

soufre < 0,03%

0,0005% < bore < 0,01%

la tôle assurant une très haute résistance mécanique après traitement thermique et le revêtement à base d'aluminium assurant une haute tenue à la corrosion et à la fatigue.

Pour l'obtention de la pièce, en une seule passe, par emboutissage à chaud de la tôle laminée à chaud revêtue, il est préférable que la teneur en titane par rapport à la teneur en azote soit supérieure à 3,42.

Le revêtement de la tôle laminée à chaud revêtue, à base d'aluminium, comprend dans sa composition pondérale de base, de 9% à 10% de silicium, de 2% à 3,5% de fer.

Le revêtement de la tôle laminée à chaud revêtue peut également comprendre dans sa composition pondérale de base, de 2% à 4% de fer. Le bain métallique peut contenir dans sa composition pondérale de base de 0 à 50% de zinc.

Dans un exemple de réalisation, l'acier selon l'invention contenant 0,231% de carbone ; 1,145% de manganèse ; 0,020% de phosphore ; 0,0038% de soufre ; 0,239% de silicium ; 0,043% d'aluminium ; 0,009% de cuivre ; 0,020% de nickel ; 0,179% de chrome ; 0.0042% d'azote ; 0.032% de titane ; 0,0028% de bore ; 0,0051% de calcium, sous la forme d'une tôle est revêtue d'une couche à base d'aluminium ayant environ 25 µm d'épaisseur avant traitement thermique.

Le flan de tôle est chauffé dans un four, à une température comprise entre 750°C et 1000°C et plus généralement à une température comprise entre 850°C et 950°C pendant un temps variant en fonction de l'épaisseur. Pour une épaisseur de 2 mm, le flan de tôle séjourne pendant 6 minutes dans le four. La vitesse de montée en température est supérieure à 3°C/s. Du fait du revêtement, il n'est pas nécessaire d'utiliser un four à atmosphère inerte.

Lors du réchauffage du flan de tôle, le revêtement s'allie avec le substrat pour former un alliage intermétallique. L'alliation entraîne, par inter diffusion, une augmentation de l'épaisseur de la couche qui, pour le traitement ci-dessus spécifié, correspond généralement à une augmentation de 50%.

Le flan de tôle chaud est ensuite transféré dans l'outil refroidi ou non, en fonction de la cadence, de l'épaisseur de la tôle et de la vitesse de refroidissement visée, pour être mis en forme. Il ne doit pas y avoir de pression de serre flan afin d'éviter le déchirement de la tôle dû à sa faible résistance à haute température. La vitesse de déformation doit être suffisante pour éviter de déformer l'acier à une température inférieure à 400°C.

Le voile de roue ainsi obtenu est maintenu dans l'outil jusqu'à atteindre une température inférieure à 200°C et de préférence inférieure à 100°C afin de respecter les garanties de dimension. La vitesse de refroidissement moyenne doit être supérieure a 27°C/s, entre la température de sortie du four et 400°C, si la structure visée pour le substrat est une structure martensitique. Si la vitesse moyenne de refroidissement est inférieure à cette valeur, de la bainite, de la ferrite, voire de la perlite peuvent apparaître. Il est ainsi possible d'obtenir différentes structures et donc différentes propriétés en fonction de la vitesse de refroidissement visée. Néanmoins, les meilleurs

résultats en fatigue sont obtenus avec une structure de l'acier, totalement martensitique.

Du fait du formage à chaud, il n'y a pas d'endommagement de la structure métallurgique. Ceci a un effet bénéfique sur la tenue en fatigue du fait de la suppression des défauts internes pouvant servir d'initiation des fissures en fatigue. Il n'est pas nécessaire d'ajouter de lubrifiant d'emboutissage car le pré revêtement fait office de lubrifiant.

La pièce ainsi obtenue peut subir directement le cycle de peinture. Si ce n'est pas le cas, il n'est pas nécessaire d'appliquer une protection temporaire contre la corrosion car la couche alliée ralentit l'apparition de la corrosion. Lors du cycle thermique, le revêtement, alliée ou non, protège l'acier de l'oxydation et de la décarburation.

La couche alliée réalisée sur la pièce présente un gradient de dureté. En partant de la couche extrême et en se déplaçant vers la tôle, la dureté varie de 750HV0,1 à 300 HV0,1 à l'interface couche de revêtement - tôle, puis augmente jusqu'à environ 500HV0,1 dans la tôle, lorsque la structure de l'acier est totalement martensitique. C'est la couche à 300HV0,1 qui, en arrêtant les fissures, confère à la pièce une tenue en fatigue accrue.

Si on utilise l'acier de la solution proposée mais non pré revêtu, on note une dégradation importante de limite d'endurance moyenne, comme matérialisé sur le tableau 1 ci-dessous liée principalement à la décarburation de l'acier. La solution proposée, de part la présence de la pré protection, évite ce phénomène. Les essais de fatigue en flexion plane alternée montre un gain notable.

Tableau 1.

Acier	Rp0.2 (MPa) Travers	Rm (MPa) Travers	Nombre de cycles de validation de la limitation de la limite d'endurance (millions de cycles)	Limite d'endurance Moyenne (MPa)
USIDUR 355 exemple de comparaison	432	514	1. 106	279
USIFORM 800 exemple de comparaison	766	872	2. 106	388
Obtention selon l'invention, non pré revêtue	980	1490	2. 106	249
Obtention selon l'invention	980	1480	2. 106	439

Par rapport à la tôle USIDUR 355, couramment utilisé industriellement pour la réalisation des voiles de roues, le gain est de 40% en durée de vie ou en allègement. Par rapport à la nuance citée, utilisée pour les voiles de roues, la limite d'endurance présente un gain supérieur à 12%.

Les avantages de l'obtention d'une pièce par un procédé de mise en forme à chaud et notamment l'obtention de tout ou partie d'une roue de véhicule automobile sont les suivants :

- une réalisation de voile de roue en une seule passe de formage,
- du fait de la formabilité importante à chaud, un seul outil est nécessaire. il est donc possible de faire des pièces de formes complexes en série de manière économique telles que les roues de style,
- une très bonne garantie dimensionnelle car il n'y a pas de retour élastique comme dans le cas de l'emboutissage à froid ou du fluotournage,
- les caractéristiques mécaniques élevées après trempe dans l'outil d'emboutissage permettent un allègement significatif,
- le pré revêtement assure une garantie accrue à la corrosion et à l'usure,
- une formabilité accrue lors de la chauffe du flan de tôle permet de former à chaud des épaisseurs ne pouvant habituellement être mise en forme que par fluotournage,
- une déformation peut avoir lieu dans la phase austénitique à chaud, sans endommagement, ce qui garantie une meilleure tenue à la fatigue par élimination des défauts internes généralement créés lors d'une déformation à froid,
- du fait du pré revêtement, il est inutile de lubrifier la tôle lors du formage à chaud, supprimant ainsi l'étape de dégraissage avant peinture,
- grâce au revêtement, il est inutile d'appliquer une protection temporaire contre la corrosion sur les pièces en attente de peinture,
- le pré revêtement non traité thermiquement, contrairement aux revêtements à base de zinc, ne dégrade pas la tenue à la fatigue et même l'augmente,
- le comportement aux chocs est renforcé par l'utilisation du type d'acier choisi,
- le pré revêtement traité thermiquement ne nécessite pas de matériel de soudage et de précaution particuliers.

D'autres pièces peuvent bénéficier de cette méthode d'obtention. On peut citer en particulier les pièces de liaison au sol dimensionnées en fatigue telles que : les bras de suspension, bras de roue...

REVENDICATIONS.

1. Procédé de mise en forme à chaud et notamment, obtention de tout ou partie d'une roue de véhicule automobile comme par exemple un voile de roue, caractérisé en ce qu'on utilise, dans une opération d'emboutissage à chaud, une tôle d'acier laminée à chaud ou à froid pour traitement thermique pré revêtu.

2. Procédé selon la revendication 1, caractérisé en ce que la tôle d'acier est une tôle d'acier laminée à chaud pré revêtu de la composition générale pondérale suivante :

0,15% < carbone < 0,5%
0,5% < manganèse < 3%
0,1% < silicium < 0,5%
0% < chrome < 1%
titane < 0,2%
aluminium < 0,1%
phosphore < 0,1%
soufre < 0,05%
0,0005% < bore < 0,08%

3. Procédé selon la revendication 1, caractérisé en ce que le revêtement est à base d'aluminium.

4. Procédé selon la revendication 1, caractérisé en ce que de préférence, la tôle d'acier est une tôle d'acier laminée à chaud ou à froid pré revêtue de la composition pondérale suivante :

0,15% < carbone < 0,5%
0,8% < manganèse < 1,5%
0,1% < silicium < 0,35%
0,01% < chrome < 1%
titane < 0,1%
aluminium < 0,1%
phosphore < 0,05%
soufre < 0,03%
0,0005% < bore < 0,01%

5. Procédé selon la revendication 1, caractérisé en ce que dans la composition pondérale de la tôle, la teneur en titane par rapport à la teneur en azote est supérieure à 3,42.

6. Procédé selon la revendication 1, caractérisé en ce que le bain métallique du revêtement comprend dans sa composition pondérale de base, de 9% à 10% de silicium, de 2% à 3,5% de fer, le reste du bain étant composé d'aluminium et des impuretés.

7. Procédé selon la revendication 1, caractérisé en ce que le bain métallique du revêtement comprend dans sa composition pondérale de base, de 2% à 4% de fer.

8. Procédé selon la revendication 1, caractérisé en ce que le bain métallique du revêtement peut contenir dans sa composition pondérale de base, de 0 à 50% de zinc.

INPI
INSTITUT NATIONAL DE LA PROPRIETE INDUSTRIELLE

2833504

N° d'enregistrement national

FA 611824
FR 0116185

RAPPORT DE RECHERCHE PRÉLIMINAIRE

établi sur la base des dernières revendications déposées avant le commencement de la recherche

DOCUMENTS CONSIDÉRÉS COMME PERTINENTS		Revendication(s) concernée(s)	Classement attribué à l'invention par l'INPI
Catégorie	Citation du document avec indication, en cas de besoin, des parties pertinentes		
D,X	FR 2 780 984 A (LORRAINE LAMINAGE) 14 janvier 2000 (2000-01-14) * le document en entier *	1-8	B21D53/26 C21D8/02 C22C38/32 C22C38/38
D,X	FR 2 787 735 A (LORRAINE LAMINAGE) 30 juin 2000 (2000-06-30) * le document en entier *	1	
A	US 4 397 345 A (RAMARATNAM KRISHNASWAMY ET AL) 9 août 1983 (1983-08-09)		
			DOMAINES TECHNIQUES RECHERCHÉS (Int.CL.7)
			B21D

1

Date d'achèvement de la recherche	Examinateur
14 août 2002	Peeters, L

CATÉGORIE DES DOCUMENTS CITÉS

X : particulièrement pertinent à lui seul
Y : particulièrement pertinent en combinaison avec un autre document de la même catégorie
A : arrière-plan technologique
O : divulgation non-écrite
P : document intercalaire

T : théorie ou principe à la base de l'invention
E : document de brevet bénéficiant d'une date antérieure à la date de dépôt et qui n'a été publié qu'à cette date de dépôt ou qu'à une date postérieure.
D : cité dans la demande
L : cité pour d'autres raisons

& : membre de la même famille, document correspondant

EPO FORM 1503 12.99 (P04C14)

POSCO Exhibit 1010-0024
Filed with Petition for IPR of U.S. Patent No. 9,708,683

ANNEXE AU RAPPORT DE RECHERCHE PRÉLIMINAIRE RELATIF A LA DEMANDE DE BREVET FRANÇAIS NO. FR 0116185 FA 611824

La présente annexe indique les membres de la famille de brevets relatifs aux documents brevets cités dans le rapport de recherche préliminaire visé ci-dessus.
Les dits membres sont contenus au fichier informatique de l'Office européen des brevets à la date du 14-08-2002
Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l'Office européen des brevets, ni de l'Administration française

Document brevet cité au rapport de recherche		Date de publication	Membre(s) de la famille de brevet(s)		Date de publication
FR 2780984	A	14-01-2000	FR	2780984 A1	14-01-2000
			BR	9902712 A	08-03-2000
			EP	0971044 A1	12-01-2000
			JP	2000038640 A	08-02-2000
			US	6296805 B1	02-10-2001
FR 2787735	A	30-06-2000	FR	2787735 A1	30-06-2000
			EP	1013785 A1	28-06-2000
US 4397345	A	09-08-1983	AUCUN		

EPO FORM P0465

Pour tout renseignement concernant cette annexe : voir Journal Officiel de l'Office européen des brevets, No.12/82

[Document Name]Description

[Title of the invention]Hot pressing method for high strength member using steel sheet and hot pressed parts

[Technical field]

[0001]The present invention relates to a hot pressing method and a hot press part for manufacturing a strength member such as a pillar, a door impact beam, a bumper beam, etc. of an automobile using cold rolling, hot rolled steel sheet or Al based or Zn based plated steel sheet.

[Background of the invention]

[0002]In order to reduce the weight of an automobile which comes to an end of global environmental problem, it is necessary to increase the strength of steel plates used in automobiles as high as possible, but as the steel plate is increased in strength, elongation and r value decrease and moldability deteriorates. In order to solve such a problem, Japanese Unexamined Patent Publication No. 2000 (1999) - 234153 discloses a technique in which hot molding is performed and the strength is increased by utilizing heat at that time. In this technique, it is intended to appropriately control a component in steel, heat in a temperature range of ferrite, and increase in strength using precipitation strengthening in this temperature range. In addition, Japanese Patent Application Laid-open No. 87183 (2000) proposes a high-strength steel sheet which has a yield strength at a molding temperature which is much lower than a yield strength at room temperature for the purpose of improving press forming accuracy. However, with such technology, a limit may be in the strength obtained. On the other hand, Japanese Unexamined Patent Publication No. Hei 2000 (1999) - 38640 proposes a technique in which, for the purpose of obtaining higher strength, heat is applied to a high temperature austenite single phase region after molding, and then transformed into a hard phase in a subsequent cooling step.

[0003]However, if heat and rapid cooling is performed after molding, there is a possibility of causing a problem in shape accuracy. As a technique for overcoming this drawback, there is disclosed a technique in which a steel sheet is heated to an austenite single phase region and is then cooled at a rate higher than or equal to a critical cooling rate of martensitic transformation determined by a steel component in a press forming process (SAE, 2001 - 01 0078) and Japanese Unexamined Patent Publication No. Hei 2001 - 181833. In the former document, it is disclosed to use an Al plated steel sheet in order to suppress generation of scale on heating. This pressing step is referred to as hot pressing in the present invention.

[0004]As a prior art relating to a hot press using such a plated steel sheet, there is the following. Japanese Patent Application Laid-open No. 147499 2003 discloses an example in which a steel plate coated with a plating layer made of Fe - Zn alloy is used for hot pressing, and Japanese Unexamined Patent Publication No. Hei 2003 (1999) - 41343 discloses an example in which an Al-based plating steel sheet coated with a plating layer made of Fe - Al alloy is used for hot pressing. Further, as a method of pressing a heated metal plate material using a die and a punch in Japanese Patent Laid-Open No. 2002 282951, an example is disclosed in which a clearance of a mold is

defined from the viewpoint of formability and hardenability.

[Patent document 1]JP 2000-87183A

[Patent document 2]JP 2000-38640A

[Patent document 3]JP 2001-181833A

[Patent document 4]JP 2003-147499A

[Patent document 5]JP 2003-41343A

[Patent document 6]JP 2002-282951A

[Non-patent document1]SAE, 2001 - 01 - 0078

[Disclosure of the invention]

[Problem to be solved by the invention]

[0005]As described above, a high-strength steel sheet used in an automobile or the like has an essential problem of the above mentioned moldability, particularly, a hydrogen embrittlement (sometimes referred to as a placement or delayed fracture) of a high strength material having a strength of more than 1000 MPa.Therefore, when used as a steel sheet for hot pressing, it is important to reduce the amount of hydrogen in a raw material.It is an object of the present invention to solve the above problems and to provide a hot rolling and cold rolled steel sheet which is capable of obtaining a strength of 1200 MPa or more after high temperature molding, and which has extremely little fear of hydrogen embrittlement, and a hot pressing method and a press part using an Al based plated steel sheet or a Zn based plated steel sheet.

[Means for solving the problem]

[0006]In order to solve the above problems, the present inventors have conducted various studies.As a result, it has been found that it is extremely important to control the atmosphere and the temperature at the time of heating to an austenite single phase region before pressing to produce a plated steel sheet for hot pressing excellent in hydrogen embrittlement resistance.In other words, if hydrogen is contained in an atmosphere at the time of heating, it is important to reduce these components because the hydrogen penetrates into the steel plate and the hydrogen possibly enters the steel plate even if moisture is contained.It has also been found that it is important to properly select the clearance of the mold to prevent hydrogen embrittlement.The gist of the present invention based on such knowledge is as follows.

(1) A steel sheet containing a C:0.05~0.5% as a steel component as a steel component, or a steel sheet plated with Al or Zn as a main component is manufactured by a hot pressing method. A hot pressing method of the high strength automobile component the heating temperature before a press being three or more Ac(s) and 1100 degrees C or less, and making hydrogen concentration in a heated atmosphere below into the 6 volume %, and the dew point being 10 degrees C or less.

(2) A hot pressing method for a high strength automobile member according to claim 1, wherein a hydrogen concentration in a heating atmosphere is 1 vol% or less and a dew point is 10 ° C. or less.

(3) The present invention is characterized in that a gap (a clearance) between a die

and a punch is 1.0 to 1.8 times as large as a thickness of a steel material to be used, when a steel sheet is introduced into a press and is molded after heating (1). A hot pressing method according to item 2).
(4) A hot press part comprising the hot press method according to any one of (1) to (3).

[Effect of the invention]

[0007]According to the present invention, a high-strength member can be manufactured by hot pressing using a hot rolling, a cold rolled steel sheet, an Al based plated steel sheet, or a Zn based plated steel sheet, and can be used without hydrogen embrittlement, and its industrial significance is extremely large.

[Best mode for carrying out the invention]

[0008]Next, a limitation of the present invention will be described.As described above, according to the present invention, hot rolling, cold rolled steel sheet, or Al based, Zn based plated steel sheet is heated to 700 ° C. or higher and then hot molded and immediately cooled by a mold and quenched to obtain desired strength, and in the present invention, a steel sheet before heating, press forming is defined.As a steel sheet component, it is necessary to be excellent in hardenability, and for this purpose, it is necessary to have a C content of 0.05% or more, and preferably 0.1% or more.For other elements in the steel, elements such as Si,Mn,Ti,B,Cr,Mo,Al,P,S,N may be added.Si is effective in fatigue characteristics, and is preferably 0.05 to 1% by weight.Since Mn,B,Cr,Mo contributes to improvement in hardenability, when making it contain, it is [below Mn:0.5~3%,B:0.05%] desirable to use less than Cr:2% and less than Mo:0.5%. Ti and Al improve the oxidation resistance of an Al based plated steel sheet, and it is desirable to contain Ti in an amount of 0.5% or less and Al in an amount of 0.1% or less, when contained.

[0009]As the plating type, a steel plate or a steel plate plated with Zn is considered, and when these steel plates are used for hot pressing, formation of iron oxide on the surface can be suppressed and corrosion resistance can be imparted.The composition of Al system plating layer is described first. An Al-based plated steel sheet is currently manufactured for various applications, and the present invention is applicable to these steel sheets.As a configuration of the Al-based plating layer, there is a steel plate containing Al as a main component and preferably containing 3 to 15% of Si in order to suppress generation of an alloy layer during hot-dip Al plating.In addition, Cr,Mg,Ti,Sn or the like is used as an element for further improving corrosion resistance of the plating layer, and it is also possible to add these elements.In this case, it is desirable to contain a Cr:0.1~1%,Mg:0.5~10%,Ti:0.1~1%,Sn:1~5%.In addition, Fe is contained as an impurity in the Al-based plating layer, and this amount is usually 0.05 to 0.5%.In addition, an intermetallic compound such as FeAl3,Fe2Al5,Fe3Al,Fe2Al8Si may be formed on the surface after heating.These phases tend to have a multilayer structure which is typically a 5 layer structure, but these phase structures do not detract from the spirit of the invention.Further, as the composition thereof, Al, Fe is mainly used, and Si is also contained in the Al plating bath when Si is added in an amount of 5 to 10%.The composition of these elements accounts for 90% or more in total.In addition, there may be a small amount of Al that is not alloyed, but a small amount of Al does not affect performance particularly.After heating, an Al-based oxide or a nitride covers the surface, and the amount thereof is not particularly limited.

[0010]Next, a structure of the Zn-based plating layer will be described.The Zn-based

plated steel sheet has various compositions now, and the present invention is applicable to these steel sheets.As a typical structure of the Zn plating layer, the following may be mentioned.Zn - 0.2% Al, Zn - 5% Al - 0.1% Mg, Zn - 5% Al - 0.1% Mg - Misch metal, Zn - 7% Al - 3% Mg, Zn - 11% Al - 3% Mg - 0.1% Si, Zn - 55% Al - 1.6% Si, etc.In addition, there are some which were changed to Zn-10% Fe by heating after plating with Al bath Zn-0.1%. In addition, Cr,Mg,Ti,Sn or the like is used as an element for further improving corrosion resistance of the plating layer, and it is also possible to add these elements.In this case, it is desirable to contain a Cr:0.1~1%,Mg:0.5~10%,Ti:0.1~1%,Sn:1~5%.In addition, a ferrite phase containing ζ, δ 1, Γ, Γ 1, and so on or a ferrite phase in which Zn is dissolved can be formed on the surface after heating.These phases may be distributed in layers or distributed in the form of granules, which does not detract from the spirit of the invention.In addition, as long as Al contains Al, the Fe - Al based compound may be generated.In the case of Zn plating, a Zn based or Al based oxide film is formed after heating, but even if these films are generated, the gist of the present invention is not impaired.

[0011]Although there is no particular limitation on the deposition amount of Al based, Zn based plating, the plating pretreatment, and the post treatment, it is desirable that the plating deposition amount is 50 g / m 2 or more of one side.This is because, as the amount of plating applied increases, an effect of suppressing oxidation at the time of heating, a heating, and a corrosion resistance at the time of forming a molded rear part are improved.As a post-plating treatment, a chromate treatment, a resin coating treatment, or the like may be used for the purpose of primary rust prevention and lubricity, but it is not preferable because the organic resin is lost when heated.In consideration of the 6 valent chromium regulation in recent years, a 3 valent treatment film such as electrolytic chromate is preferred.It is possible to use only an oil coating without applying a chromate film in the case of an Al-based plated steel sheet excellent in corrosion resistance.Specifying the temperature and atmosphere at the time of heating in the present invention, the temperature shall be three or more Ac(s) and 1100 degrees C or less. This is due to the fact that an Ac 3 temperature or higher is required for completely transforming the steel sheet into an austenite single phase region, while an excessively high heating temperature leads to an oxidation of the surface and an active entry of hydrogen into the steel.In addition, when Zn plating is used, it is desirable to set the temperature at 1000 ° C. as an upper limit because Zn is completely evaporated at a temperature of about 910 ° C. and Zn is completely evaporated at a high temperature.More preferably, the upper limit temperature is 920 ° C.The lower limit temperature is preferably 800 ° C.This is because, even when heating is performed at an Ac 3 temperature or higher, the temperature of the steel sheet is lowered during the transfer of the steel sheet from the furnace to the press machine after the heating, and thus, the ferrite may be generated.

[0012]The heating atmosphere has a hydrogen concentration of 6 vol% or less.This is to increase the possibility of hydrogen embrittlement due to intrusion of hydrogen into the steel as described above.A lower limit is not particularly provided, and a lower limit is preferable.More preferably, the amount of hydrogen is 1% or less.It has also been found in the present invention that moisture in the atmosphere can easily enter into the steel as hydrogen.For this reason, it is preferred that the moisture content in the atmosphere is low, and the dew point is measured to measure the water content, but the upper limit of the dew point is set to 10 ° C.In addition, as for the conversion of the dew point and the water content, the following formula is known, and the water content at this time is 1.2 vol%.In particular, when a Zn based plated steel sheet is used, oxygen is contained in an atmosphere, and Zn

oxide tends to be formed on the surface of the steel sheet to suppress evaporation of Zn. For this reason, when a Zn-based plated steel sheet is used, oxygen is preferably contained in an atmosphere of 1 to 21%. In addition, it is necessary to control the hydrogen concentration and the moisture content in a heated atmosphere because of the presence of hydrogen penetration during heating of a steel plate (bare material) without plating.

[Mathematical formula 1]

$$pH2O = \exp\left(-\frac{44016 - 118.774 * Tdp}{8.314 * Tdp}\right)$$

pH2O:水素濃度(体積分率) Tdp:露点(絶対温度)

[0013]The heating method is not particularly limited, and an induction heating, a radiant heating, an induction heating, or the like may be used. In this case, the heating rate is not limited. This of course depends largely on the thickness and shape of the plate. A hot press is characterized in that it cools from an austenite phase to obtain a hardened structure, and, of course, a cooling rate after heating is large. In the present invention, it is necessary to cool at least a critical cooling rate for obtaining a martensitic structure determined by a steel component, but as a guideline, it is desirable that an average cooling temperature from 700 ° C. to 350 ° C. is 15 ° C. / sec or more. It is considered that this cooling rate depends on the steel component, and in a steel having good hardenability, a desired martensite is obtained as a main component even at a cooling rate of about 20 ° C. / sec, and a cooling rate of about 30 ° C. / sec is required depending on the type of steel. While a gap (clearance) between a die and a punch is one of important factors at the time of pressing, in the present invention, this clearance is preferably 1.0 to 1.8 times the thickness of the plate thickness. Since a board cannot flow easily and it will become ironing if clearance is narrow, galling occurs in a steel sheet surface, and it is thought that it may become a starting point of hydrogen embrittlement. When wide, it is in the tendency which becomes that it is hard to be tempered, and strength unevenness arises in parts and it is thought that remaining stress remains and concern of hydrogen embrittlement increases into parts.

[Examples]

[0014]Hereinafter, the present invention will be described in more detail with reference to Examples.
(Example 1)
A cold rolled steel sheet having a steel component shown in Table 1 and having a thickness of 1.4 was heated under various conditions, and then molded by a hat-shaped mold shown in FIG. 1. The clearance was 1.1 times the thickness of the plate. Then, punching of 5 ϕ and 0.5 of clearance (both sides) was performed on the flange portion of the hat at 10 points, and after 7 days, the punched portion was observed by a loupe of 20 times to determine presence / absence of fine cracks. Heating was performed by inserting a sample into an atmosphere controlled electric furnace. A temperature rise time of up to 900 ° C. was approximately 4 minutes, a time from the furnace to the press was approximately 10 seconds, and a press start temperature was approximately 750 ° C. Cooling was performed with a mold, and average cooling speed from 700 ° C. to 350 ° C. was 40 ° C. / sec. Table 2 shows the heating conditions and the presence or absence of microcracks. In addition, when the Vickers hardness was measured at a partial cutting load of 10 kgf after molding, all of the samples were

in the range of Hv:410~510, and the microstructure showed a martensitic structure. After hot pressing, iron oxide was generated on the surfaces of these steel sheets. In No. 8 of Example 1, there were 5 or more microcracks due to the high dew point. In No. 1 and No. 3, since the amount of hydrogen was 1% or more, small cracks occurred.

[0015]

[Table 1]

表 1

符号	C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
A	0.15	0.1	2.1	0.01	0.004	0.03	0.004	0.02	0.4	0.01	0.003
B	0.21	0.2	0.9	0.02	0.005	0.015	0.005	0.01	0.9	0.4	0.004
C	0.27	0.15	0.88	0.01	0.002	0.02	0.004	0.02	0.23	0.5	0.003

[Table 2]

表2

番号	鋼	温度 (℃)	保定時間(分)	加熱雰囲気			微小クラックの発生	
				水素 (vol%)	露点 (℃)	酸素 (vol%)		
1	A	950	1	5	8	0.01	△	本発明例
2	A	900	1	0.1	2	0.3	◎	本発明例
3	B	800	2	2	−10	0.5	○	本発明例
4	B	850	3	0.5	0	21	◎	本発明例
5	C	1000	1	0.1	−30	21	◎	本発明例
6	C	850	5	0.05	2	21	◎	本発明例
7	A	900	10	0.07	6	21	◎	本発明例
8	B	850	8	0.1	13	21	×	比較例
9	B	850	5	0.2	0	21	◎	本発明例
10	C	850	2	0.1	−10	21	◎	本発明例

微小クラックの発生評点

10 点中の微小クラックの個数の合計　◎:0 個、○:1 個、△:5 個未満、×5 個以上

(Example 2)

[0016]Molten Al plating was performed using a cold-rolled steel sheet (thickness of 1.4) as shown in Table 3, which has undergone a conventional hot rolling process and a cold rolling process, as a material. In the hot-dip Al plating, a line of an

oxidation furnace - a reduction furnace flag was used, and a plating amount was adjusted to 80 g / m 2 by a gas wiping method after plating, followed by cooling.At this time, the plating bath composition was Al - 10% Si - 2% Fe, and the bath temperature was 660 ° C.Fe in the bath is unavoidable from plating equipment and strips.The plating appearance was good without non-plating.The molten Al plated steel sheet thus prepared was heated under various conditions and then molded by a hat-shaped mold shown in FIG. 1.The clearance was 1.1 times the thickness of the plate.Then, punching of 5 ϕ and 0.5 of clearance (both sides) was performed on the flange portion of the hat at 10 points, and after 7 days, the punched portion was observed by a loupe of 20 times to determine presence / absence of fine cracks.Heating was performed by inserting a sample into an atmosphere controlled electric furnace.A temperature rise time of up to 900 ° C. was approximately 4 minutes, a time from the furnace to the press was approximately 10 seconds, and a press start temperature was approximately 750 ° C.Cooling was performed with a mold, and average cooling speed from 700 ° C. to 350 ° C. was 40 ° C. / sec.Table 4 shows the heating conditions and the presence or absence of microcracks.In addition, when the Vickers hardness was measured at a partial cutting load of 10 kgf after molding, all of the samples were in the range of Hv:410~510, and the microstructure showed a martensitic structure.After hot pressing, no iron oxide was generated on the surfaces of these steel sheets.

[0017]

[Table 3]

表 3

C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
0.22	0.21	1.20	0.02	0.003	0.027	0.003	0.002	0.18	0.02	0.0018

[Table 4]

表 4

番号	温度 (℃)	保定時間 (分)	加熱雰囲気			微小クラックの発生	
			水素 (vol%)	露点 (℃)	酸素 (vol%)		
1	800	5	0.01	2	0.3	◎	本発明例
2	900	3	0.02	1	0.5	◎	本発明例
3	1000	2	0.1	3	0.8	◎	本発明例
4	1100	2	N.D.	1	1	◎	本発明例
5	900	2	10	0	0.01	×	比較例
6	900	2	4	1	0.01	△	本発明例
7	900	2	1	-1	0.01	◎	本発明例
8	900	2	0.1	15	0.01	×	比較例
9	900	2	0.1	6	0.1	◎	本発明例
10	900	2	0.05	2	0.1	◎	本発明例
11	900	2	2	-20	0.5	○	本発明例
12	900	2	0.01	7	21	◎	本発明例
13	900	2	0.01	1	21	◎	本発明例
14	980	8	0.01	1	21	◎	本発明例
15	1050	5	0.01	1	21	◎	本発明例
16	900	10	5	6	0.06	△	本発明例

微小クラックの発生評点

10 点中の微小クラックの個数の合計　◎:0 個、○:1 個、△:5 個未満、×5 個以上

[0018]As shown in Table 4, the amount of hydrogen that penetrates into the steel varies according to the heating atmosphere and temperature, and the sensitivity to the microcracks changes. In No. 5 with a hydrogen concentration of 10 vol% and No. 8 with a dew point of 15 ° C., 5 or more cracks were observed. As the hydrogen concentration and dew point decreased, the occurrence of cracks was suppressed, but in the case of a No. 6, 11, 16, some cracks occurred.
(Example 3)

[0019]Various Zn based plating was applied using a cold rolled steel sheet having a steel content of 1.4 as shown in Table 5. Table 6 shows the plating type, bath component and bath temperature at this time. Using these Zn based plated steel sheets, a hat molding was performed in the same manner as in Example 1, and the way in which the minute cracks after punching were observed was observed. Table 7 shows the relationship between the heating conditions and the occurrence of cracks. Cooling was performed with a mold, and average cooling speed from 700 ° C. to 350 ° C. was 20 ° C. / sec. When the cross section hardness after molding was measured in the same manner as in Example 1, all of the cross section was located between the Hv:410~510 and the microstructure showed a martensite structure. After hot pressing, no iron oxide was generated on the surfaces of these steel sheets.

[0020]

[Table 5]

表5

符号	C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
A	0.15	0.1	2.1	0.01	0.004	0.03	0.004	0.02	0.4	0.01	0.003
B	0.21	0.2	0.9	0.02	0.005	0.015	0.005	0.01	0.9	0.4	0.004
C	0.27	0.15	0.88	0.01	0.002	0.02	0.004	0.02	0.23	0.5	0.003

[Table 6]

表6

符号	めっき組成	片面付着量(g/m²)	浴温(℃)
GI	Zn-0.2%Al	85	460
GA	Zn-10.5%Fe	70	460
GL	Zn-55%Al-1.6%Si	75	610
GAM	Zn-6%Al-3%Mg	65	420
GAMS	Zn-11%Al-3%Mg-0.1%Si	80	430

[Table 7]

表7

番号	鋼	めっき	温度(℃)	保定時間(分)	加熱雰囲気			微小クラックの発生	
					水素(vol%)	露点(℃)	酸素(vol%)		
1	A	GI	950	1	5	8	0.01	△	本発明例
2	A	GA	900	1	0.1	2	0.3	◎	本発明例
3	B	GL	800	2	2	-10	0.5	○	本発明例
4	B	GAM	850	3	0.5	0	21	◎	本発明例
5	C	GAMS	1000	1	0.1	-30	21	◎	本発明例
6	C	GI	850	5	0.05	2	21	◎	本発明例
7	A	GI	900	10	0.07	6	21	◎	本発明例
8	B	GA	850	8	0.1	13	21	×	比較例
9	B	GA	850	5	0.2	0	21	◎	本発明例
10	C	GL	850	2	0.1	-10	21	◎	本発明例

微小クラックの発生評点

10点中の微小クラックの個数の合計　◎:0個、○:1個、△:5個未満、×5個以上

[0021]In the same manner as in Examples 1 and 2, No. 8 in Table 7 had a high dew point, and thus microcracks occurred. In Nos. 1 and 3, since the amount of hydrogen was larger than 1%, slight cracks occurred slightly. In addition, since the oxygen concentration of Nos. 1 to 3 is low, contamination in the furnace and deterioration of the surface of the steel sheet caused by evaporation of Zn in the furnace were observed.

(Example 4)

[0022]A cold-rolled steel sheet (thickness : 1.4) as shown in Table 8 was used as a material.A part thereof was subjected to hot-dip Al plating or hot-dip Zn plating.In the hot dip plating, a line of an oxidation-free furnace and a reduction furnace was used, and the amount of plating was adjusted by a gas wiping method after plating, and then, the appearance of the cooled plating was good without non-plating.The plating species, bath components, and bath temperature are shown in Table 9.

[0023]

[Table 8]

表 8

C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
0.22	0.21	1.20	0.02	0.003	0.027	0.003	0.002	0.18	0.02	0.0018

[Table 9]

表 9

符号	めっき組成	片面付着量(g/m²)	浴温(℃)
AL	Al-10%Si-2%Fe	80	660
GI	Zn-0.2%Al	85	460
GA	Zn-10.5%Fe	70	460

[0024]The steel sheet thus produced was heated under various conditions and then molded with a hat-shaped mold shown in FIG. 1.The clearance during hot pressing is shown in Table 10.Then, punching of 5 ϕ and 0.5 of clearance (both sides) was performed on the flange portion of the hat at 10 points, and after 7 days, the punched portion was observed by a loupe of 20 times to determine presence / absence of fine cracks.Heating was performed by inserting a sample into an atmosphere controlled electric furnace.A temperature rise time of up to 900 ° C. was approximately 4 minutes, a time from the furnace to the press was approximately 10 seconds, and a press start temperature was approximately 750 ° C.Cooling was performed with a mold, and average cooling speed from 700 ° C. to 350 ° C. was 40 ° C. / sec.Table 10 shows the heating conditions and the presence or absence of microcracks.In addition, when the Vickers hardness was measured at a partial cutting load of 10 kgf after molding, all of the samples were in the range of Hv:410~510, and the microstructure showed a martensitic structure.

[0025]

[Table 10]

表 10

番号	熱間プレスでのクリアランス（板厚比）	めっき種	温度（℃）	保定時間（分）	加熱雰囲気			微小クラックの発生	酸化鉄の発生	
					水素（vol%）	露点（℃）	酸素（vol%）			
1	0.8	冷延	900	3	0.02	1	0.5	×	有り	比較例
2	1.0	冷延	900	3	0.02	1	0.5	◎	有り	本発明例
3	1.1	冷延	900	3	0.02	1	0.5	◎	有り	本発明例
4	1.4	冷延	900	3	0.02	1	0.5	◎	有り	本発明例
5	1.7	冷延	900	3	0.02	1	0.5	○	有り	本発明例
6	1.9	冷延	900	3	0.02	1	0.5	×	有り	比較例
7	0.8	GI	900	10	0.07	6	21	×	無し	比較例
8	1.0	GI	900	10	0.07	6	21	◎	無し	本発明例
9	1.1	GI	900	10	0.07	6	21	◎	無し	本発明例
10	1.4	GI	900	10	0.07	6	21	◎	無し	本発明例
11	1.7	GI	900	10	0.07	6	21	○	無し	本発明例
12	1.9	GI	900	10	0.07	6	21	×	無し	比較例
13	0.8	GA	850	5	0.2	0	21	×	無し	比較例
14	1.0	GA	850	5	0.2	0	21	◎	無し	本発明例
15	1.1	GA	850	5	0.2	0	21	◎	無し	本発明例
16	1.4	GA	850	5	0.2	0	21	◎	無し	本発明例
17	1.7	GA	850	5	0.2	0	21	○	無し	本発明例
18	1.9	GA	850	5	0.2	0	21	×	無し	比較例

微小クラックの発生評点

10 点中の微小クラックの個数の合計　◎:0 個、○:1 個、△:5 個未満、×5 個以上

[0026]In the No.1, 7, 13 of Table 10, since the clearance of the mold during hot pressing was less than or equal to the limit, 5 or more microcracks were observed. In the No.6, 12 , 18 of Table 10, since the clearance of the mold at the time of hot pressing was larger than or equal to the limit, the strength unevenness occurred and residual stress remained in the component, and 5 or more microcracks were recognized. In the No.5, 11, 17, since the clearance of the mold at the time of hot pressing was large, unevenness in strength occurred and residual stress remained in the component, so that slight cracks were generated.

[Brief description of the drawings]

[0027]

FIG. 1 is an external view of a hat-shaped mold used for a working test of an embodiment ;.

(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2006-51543
(P2006-51543A)
(43)公開日　平成18年2月23日(2006.2.23)

(51)Int.Cl.		F I		テーマコード（参考）
B21D 22/20	(2006.01)	B21D 22/20	G	4K037
B21D 22/26	(2006.01)	B21D 22/26	D	
C22C 38/00	(2006.01)	B21D 22/20	H	
C22C 38/38	(2006.01)	C22C 38/00	301S	
C21D 9/46	(2006.01)	C22C 38/00	301T	

審査請求 未請求　請求項の数 4　OL　（全 12 頁）　最終頁に続く

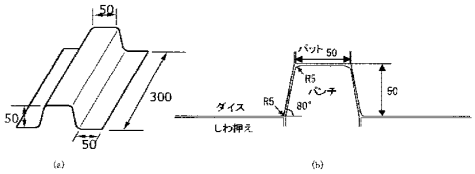
(21)出願番号　特願2005-203748 (P2005-203748)
(22)出願日　平成17年7月13日 (2005.7.13)
(31)優先権主張番号　特願2004-208326 (P2004-208326)
(32)優先日　平成16年7月15日 (2004.7.15)
(33)優先権主張国　日本国 (JP)

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最終頁に続く

(54)【発明の名称】冷延、熱延鋼板もしくはＡｌ系、Ｚｎ系めっき鋼板を使用した高強度自動車部材の熱間プレス方法および熱間プレス部品

(57)【要約】　（修正有）
【課題】高温成形後に１２００ＭＰａ以上の強度を得ることができ、かつ水素脆化の懸念の極めて少ない熱延・冷延鋼板、またAl系めっき鋼板あるいはZn系めっき鋼板を使用した熱間プレス方法および熱間プレス部品を提供する。
【解決手段】鋼成分として質量%でC:0.05~ 0.5%を含有する鋼板、またはAlもしくはZnを主体とするめっきを施した鋼板を使用して自動車部材を熱間プレス法で製造するに際し、プレス前の加熱温度をAc3以上、1100℃以下とし、加熱雰囲気中の水素濃度を6体積%以下、露点を10℃以下とすることを特徴とする高強度自動車部材の熱間プレス方法および熱間プレス部品。
【選択図】図１



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【特許請求の範囲】
【請求項１】
鋼成分として質量%でC:0.05~ 0.5%を含有する鋼板、またはAlもしくはZnを主体とするめっきを施した鋼板を使用して自動車部材を熱間プレス法で製造するに際し、プレス前の加熱温度をAc3以上、1100℃以下とし、加熱雰囲気中の水素濃度を6体積%以下、露点を10℃以下とすることを特徴とする高強度自動車部材の熱間プレス方法。
【請求項２】
加熱雰囲気中の水素濃度が1体積%以下、露点が10℃以下であることを特徴とする請求項１に記載の高強度自動車部材の熱間プレス方法。
【請求項３】
加熱後鋼板をプレス機に導入し、成形する際のダイスとパンチ間の間隙（クリアランス）が使用する鋼材の板厚の1.0~ 1.8倍であることを特徴とする請求項１または請求項２に記載の熱間プレス方法。
【請求項４】
請求項１乃至請求項３のいずれか一項に記載の熱間プレス方法を用いることを特徴とする熱間プレス部品。

【発明の詳細な説明】
【技術分野】
【０００１】
本発明は冷延、熱延鋼板もしくはＡ１系またはZn系めっき鋼板を使用して自動車のピラー、ドアインパクトビーム、バンパービーム等の強度部材を製造する際の熱間プレス方法および熱間プレス部品に関する。
【背景技術】
【０００２】
地球環境問題に端を発する自動車の軽量化のためには、自動車に使用される鋼板をできるだけ高強度化することが必要となるが、一般に鋼板を高強度化していくと伸びやｒ値が低下し、成形性が劣化していく。このような課題を解決するために、温間で成形し、その際の熱を利用して強度上昇を図る技術が、特開２０００－２３４１５３号公報に開示されている。この技術では、鋼中成分を適切に制御し、フェライト温度域で加熱し、この温度域での析出強化を利用して強度を上昇させることを狙っている。
また、特開２０００－８７１８３号公報では、プレス成形精度を向上させる目的で成形温度での降伏強度を常温での降伏強度より大きく低下する高強度鋼板が提案されている。しかしながら、これらの技術では得られる強度に限度がある可能性がある。一方、より高強度を得る目的で、成形後に高温のオーステナイト単相域に加熱し、その後の冷却過程で硬質の相に変態させる技術が特開２０００－３８６４０号公報に提案されている。
【０００３】
しかしながら、成形後に加熱・急速冷却を行うと形状精度に問題が生じる可能性がある。この欠点を克服する技術としては、鋼板をオーステナイト単相域に加熱し、その後プレス成形過程にて鋼成分により決まるマルテンサイト変態の臨界冷却速度以上の冷却速度にて冷却を施す技術が文献（SAE、2001-01-0078）や、特開2001-181833号公報に開示されている。前者の文献においては加熱する際の表面のスケール発生を抑制するためにAlめっき鋼板を使用することが開示されている。このようなプレス工程を本発明においては熱間プレスと呼ぶ。
【０００４】
このようなめっき鋼板を使用した熱間プレスに関する先行技術としては、以下が挙げられる。特開2003-147499号公報において、Fe-Zn合金からなるめっき層で被覆した鋼板を熱間プレスに使用する例が、また特開2003-41343号公報にはFe-Al合金からなるめっき層で

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被覆されたAl系めっき鋼板を熱間プレスに使用する例がそれぞれ開示されている。

また、特開2002-282951号公報にてダイスとパンチを用いて、加熱された金属板材をプレスする方法として、成形性と焼き入れ性の観点で金型のクリアランスを規定した例が開示されている。

【特許文献１】特開2000-87183号公報
【特許文献２】特開2000-38640号公報
【特許文献３】特開2001-181833号公報
【特許文献４】特開2003-147499号公報
【特許文献５】特開2003-41343号公報
【特許文献６】特開2002-282951号公報
【非特許文献１】SAE、2001-01-0078

【発明の開示】
【発明が解決しようとする課題】
【０００５】

このように、自動車等に使用される高強度鋼板は高強度化されるほど上述した成形性の問題や特に１０００ＭＰａを超えるような高強度材においては従来から知られているように水素脆化（置きわれや遅れ破壊と呼ばれることもある）という本質的な課題がある。従って熱間プレス用鋼板として用いられる場合、素材の水素量を下げることが重要となる。

本発明は、上記課題を解決するためになされたものであり、高温成形後に１２００ＭＰａ以上の強度を得ることができ、かつ水素脆化の懸念の極めて少ない熱延・冷延鋼板、またAl系めっき鋼板あるいはZn系めっき鋼板を使用した熱間プレス方法およびプレス部品を提供するものである。

【課題を解決するための手段】
【０００６】

本発明者らは、上記課題を解決するために種々の検討を実施した。その結果、プレス前のオーステナイト単相域に加熱する際の雰囲気及び温度を制御することが耐水素脆性に優れた熱間プレス用めっき鋼板が製造するために極めて重要であることを見出した。つまりこの加熱の際の雰囲気中に水素が含有されているとこの水素が鋼板に侵入し、また水分が含有されていても同様に水素が鋼板に侵入する可能性があることから、これらの成分を少なくすることが重要である。また水素脆化を防止するために金型のクリアランスを適正に選択することが重要であることも見出した。かかる知見に基づく本発明の要旨とするところは下記のとおりである。

（１）鋼成分として質量%でC:0.05~ 0.5%を含有する鋼板、またはAlもしくはZnを主体とするめっきを施した鋼板を使用して自動車部材を熱間プレス法で製造するに際し、プレス前の加熱温度をAc3以上、1100℃以下とし、加熱雰囲気中の水素濃度を6体積%以下、露点を10℃以下とすることを特徴とする高強度自動車部材の熱間プレス方法。

（２）加熱雰囲気中の水素濃度が1体積%以下、露点が10℃以下であることを特徴とする請求項（１）に記載の高強度自動車部材の熱間プレス方法。

（３）加熱後鋼板をプレス機に導入し、成形する際のダイスとパンチ間の間隙（クリアランス）が使用する鋼材の板厚の1.0~ 1.8倍であることを特徴とする請求項（１）または（２）に記載の熱間プレス方法。

（４）（１）乃至（３）のいずれか一に記載の熱間プレス方法を用いることを特徴とする熱間プレス部品。

【発明の効果】
【０００７】

本発明によると、熱延、冷延鋼板、またＡｌ系めっき鋼板あるいはZn系めっき鋼板を使用して熱間プレス工法により高強度部材を製造することができ、なおかつ水素脆化なく使用することが可能となるものであり、その工業的意義は極めて大きい。

【発明を実施するための最良の形態】
【０００８】

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次に本発明の限定理由について説明する。

前述したように、本発明は熱延、冷延鋼板、またはＡｌ系、Zn系めっき鋼板を700℃以上に加熱後、熱間で成形して直ちに金型で冷却、焼入れして所望の強度を得るもので、本発明においては加熱、プレス成形前の鋼板を規定するものとする。鋼板成分としては焼入れ性に優れていることが必要で、このためにはC量0.05%以上が必要であり、望ましくは0.1%以上である。他の鋼中元素については、Si、Mn、Ti、B、Cr、Mo、Al、P、S、N等の元素が添加される場合がある。Siは疲労特性に効果があり含有させる場合は0.05~ 1%とするのが望ましい。Mn、B、Cr、Moは焼入れ性の向上に寄与するので含有させる場合はMn：0.5~ 3%、B：0.05%以下、Cr：2%以下、Mo：0.5%以下とするのが望ましい。Ti、AlはAl系めっき鋼板の耐酸化性を向上させるので含有させる場合はTi：0.5%以下、Al：0.1%以下とするのが望ましい。

【０００９】

めっき種としてはＡｌ系、またはZn系めっきを施した鋼板が考えられ、これらを熱間プレスに用いると、表面の酸化鉄の生成を抑制し、耐食性を付与することが可能となる。

まずAl系めっき層の構成について述べる。現在種々の用途向けにAl系めっき鋼板が製造されており、本発明はこれらの鋼板の適用が可能である。Al系めっき層の構成としては、Alを主成分とし、溶融Alめっき時の合金層の生成を抑制するためにSiを望ましくは3~ 15%含有させた鋼板がある。この他にめっき層の耐食性をより向上させる元素としてCr、Mg、Ti、Sn等があり、これらを添加することも可能である。この際にはCr：0.1~ 1%、Mg：0.5~ 10%、Ti：0.1~ 1%、Sn：1~ 5%含有させるのが望ましい。なおAl系めっき層中にはFeが不純物として含有され、この量は通常0.05~ 0.5%である。

なお、加熱後表面には$FeAl_3$、Fe_2Al_5、Fe_3Al、Fe_2Al_8Si等の金属間化合物が生成し得る。これらの相は代表的には５層構造となる複層構造をとる傾向にあるが、これらの相構造がどのようなものになろうと本願発明の主旨が損なわれるものではない。またその組成としてはAl、Feを主成分とし、Alめっき浴にSiを添加したときにはSiも5~ 10%程度含有される。これらの元素の組成が合計で90%以上を占める。また微量の合金化していないAlが残存することもありうるが、少量であれば特に性能には影響しない。加熱後Al系の酸化物や窒化物が表面を覆うがこれらの量については特に規定しない。

【００１０】

次にZn系めっき層の構成について述べる。Zn系めっき鋼板は現在種々の組成のものが製造されており、本発明はこれらの鋼板の適用が可能である。代表的なZn系めっき層の構成としては、次のようなものが挙げられる。Zn-0.2%Al、Zn-5%Al-0.1%Mg、Zn-5%Al-0.1%Mg-ミッシュメタル、Zn-7%Al-3%Mg、Zn-11%Al-3%Mg-0.1%Si、Zn-55%Al-1.6%Si等。この他にZn-0.1%Al浴でめっきした後に加熱することでZn-10%Feに変化させたようなものもある。この他にめっき層の耐食性をより向上させる元素としてCr、Mg、Ti、Sn等があり、これらを添加することも可能である。この際にはCr：0.1~ 1%、Mg：0.5~ 10%、Ti：0.1~ 1%、Sn：1~ 5%含有させるのが望ましい。

なお、加熱後表面にはζ、δ1、Γ、Γ1相等の金属間化合物やZnを固溶したフェライト相が生成し得る。これらの相は層状に分布したり、あるいは粒状に分布し得るがこれらの相構造がどのようなものになろうと本願発明の主旨が損なわれるものではない。またその組成としてはAlを含有するめっきであれば前記したFe-Al系化合物が生成することもありうる。Zn系めっきの場合、加熱後にZn系、あるいはAl系の酸化膜が生成するがこれらが生成しても本発明の趣旨を損なうものではない。

【００１１】

Al系、Zn系めっきの付着量、めっき前処理、後処理については特に限定するものではないが、めっき付着量は片面50g/m^2以上であることが望ましい。めっき付着量が多いほど、加熱時の酸化抑制効果、加熱、成形後部品にした際の耐食性が向上するためである。めっき後処理として一次防錆、潤滑性を目的としてクロメート処理、樹脂被覆処理等ありうるが、有機樹脂は加熱すると消失してしまうため好ましくない。クロメート処理も近年の6価クロム規制を考慮すると、電解クロメート等の3価の処理皮膜が好ましい。クロメート

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皮膜を付与せず、塗油だけとすることも耐食性に優れたAl系めっき鋼板の場合には可能である。

本発明において加熱時の温度と雰囲気を規定するものであり、その温度はAc3以上、1100℃以下とする。これは鋼板が完全にオーステナイト単相域に変態するためにAc3温度以上が必要であり、一方加熱温度が高すぎると表面が酸化したり、鋼中への水素の侵入が活発になることによる。Zn系めっきを使用する場合にはこれに加えてZnの沸点が約910℃であまり高温ではZnが完全に蒸散して鋼板の酸化が激しくなるために1000℃を上限とすることが望ましい。さらに望ましくは、上限温度920℃である。下限温度は800℃とすることが望ましい。Ac3温度以上に加熱しても加熱後に鋼板を炉から出してプレス機に移送する間に温度が低下してフェライトが生成してしまうことがあるためである。

【００１２】

加熱雰囲気は水素濃度を6体積%以下とする。これは前述したように鋼中に水素が侵入することで水素脆化の懸念を高めるためである。下限は特に設けず、低い方が好ましい。より好ましくは水素量が1%以下である。同様に雰囲気中の水分も容易に鋼中に水素として侵入し得ることを本発明において知見した。このため雰囲気中水分も低い方が好ましく、実用上露点を測定して水分量を測定するが、露点の上限を10℃とする。なお、露点と水分量の換算については下の式が知られ、この時の水分量としては1.2体積%である。特にZn系めっき鋼板を使用するときには雰囲気中に酸素が含有されている方が、鋼板表面にZnの酸化物を形成してZnの蒸発を抑制する傾向にある。このためZn系めっき鋼板を使用するときには雰囲気中に酸素を1~ 21%含有することが好ましい。また、めっき鋼板だけでなく、めっきを施さない鋼板（裸材）についても加熱中の水素侵入があるので加熱雰囲気中の水素濃度と水分量の管理が必要である。

【数１】

$$pH2O = \exp\left(-\frac{44016 - 118.774 * Tdp}{8.314 * Tdp}\right)$$

pH2O:水素濃度(体積分率) Tdp:露点(絶対温度)

【００１３】

加熱方法については特に規定を設けず、ラジアントチューブ等で輻射加熱しても、誘導加熱、通電加熱等を使用してもよい。このときの加熱速度も限定しない。これは当然板厚、形状に大きく依存する。

熱間プレスはオーステナイト相から冷却して焼入組織を得ることに特徴があり、当然加熱後の冷却速度の影響が大きい。本発明においては鋼成分により決まるマルテンサイト組織を得るための臨界冷却速度以上で冷却することが必要となるが、目安として700℃から350℃までの平均冷却温度が15℃/sec以上であることが望ましい。この冷却速度は鋼成分に依存し、焼入れ性の良好な鋼では20℃/sec程度の冷却速度でも所望のマルテンサイトを主体とする組織が得られるし、鋼種によっては30℃/sec程度の冷却速度が必要となると考えられる。

プレス時にはダイスとパンチの間隙（クリアランス）が重要な因子の１つであるが、本発明においてはこのクリアランスが板厚の1.0~ 1.8倍であることが望ましい。クリアランスが狭いと板が流入し難く、しごき加工となるため鋼板表面にカジリが発生し、水素脆化の起点となる可能性があると考えられる。また広いと焼入され難くなる傾向にあり、部品中にて強度むらが生じて部品内に残留応力が残って水素脆化の懸念が高まると考えられる。

【実施例】

【００１４】

次に実施例で本発明をより詳細に説明する。

（実施例１）

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表１に示すような鋼成分を有する板厚1.4mmの冷延鋼板を種々の条件で加熱し、その後第１図に示すハット形状の金型で成形した。クリアランスは板厚の1.1倍とした。その後ハットのフランジ部に5mmφ、クリアランス0.5mm(両側)の打抜きを10点行い、７日経過後に20倍のルーペで打抜き部を観察して微小クラックの有無判定した。加熱は試料を雰囲気制御した電気炉内に挿入することで行った。900℃までの昇温時間はほぼ4分、炉からプレスまでの時間は約10秒で、プレス開始温度は約750℃だった。冷却は金型で行い、700℃から350℃までの平均冷速は40℃/秒であった。加熱条件と微小クラックの有無を表２に示す。なお、ハット成形後一部の切出し荷重10kgfでビッカース硬度を測定したところ、全ての水準においてHv：410~ 510の範囲にあり、組織はマルテンサイト組織を示した。また熱間プレス後にはこれらの鋼板の表面には酸化鉄が発生した。

実施例１のNo.8は露点が高いために微小クラックが5個以上発生した。No.1とNo.3は水素量が1%以上であったため、微小クラックが少量発生した。

【００１５】

【表１】

表１

符号	C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
A	0.15	0.1	2.1	0.01	0.004	0.03	0.004	0.02	0.4	0.01	0.003
B	0.21	0.2	0.9	0.02	0.005	0.015	0.005	0.01	0.9	0.4	0.004
C	0.27	0.15	0.88	0.01	0.002	0.02	0.004	0.02	0.23	0.5	0.003

【表２】

表2

番号	鋼	温度(℃)	保定時間(分)	加熱雰囲気			微小クラックの発生	
				水素(vol%)	露点(℃)	酸素(vol%)		
1	A	950	1	5	8	0.01	△	本発明例
2	A	900	1	0.1	2	0.3	◎	本発明例
3	B	800	2	2	-10	0.5	○	本発明例
4	B	850	3	0.5	0	21	◎	本発明例
5	C	1000	1	0.1	-30	21	◎	本発明例
6	C	850	5	0.05	2	21	◎	本発明例
7	A	900	10	0.07	6	21	◎	本発明例
8	B	850	8	0.1	13	21	×	比較例
9	B	850	5	0.2	0	21	◎	本発明例
10	C	850	2	0.1	-10	21	◎	本発明例

微小クラックの発生評点

10点中の微小クラックの個数の合計　◎:0個、○:1個、△:5個未満、×5個以上

（実施例２）

【００１６】

通常の熱延、冷延工程を経た、表３に示すような鋼成分の冷延鋼板（板厚1.4mm）を材料として溶融Alめっきを行った。溶融Alめっきは無酸化炉－還元炉タイプのラインを使用し、めっき後ガスワイピング法でめっき付着量を片面80g/m^{2}に調節し、その後冷却した。この際のめっき浴組成としてはAl-10%Si-2%Fe、浴温は660℃であった。浴中のFeは

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めっき機器やストリップから供給される不可避のものである。めっき外観は不めっき等なく良好であった。このようにして製造した溶融Alめっき鋼板を種々の条件で加熱し、その後第１図に示すハット形状の金型で成形した。クリアランスは板厚の1.1倍とした。その後ハットのフランジ部に5mmφ、クリアランス0.5mm(両側)の打抜きを10点行い、7日経過後に20倍のルーペで打抜き部を観察して微小クラックの有無判定した。加熱は試料を雰囲気制御した電気炉内に挿入することで行った。900℃までの昇温時間はほぼ4分、炉からプレスまでの時間は約10秒で、プレス開始温度は約750℃だった。冷却は金型で行い、700℃から350℃までの平均冷速は40℃/秒であった。加熱条件と微小クラックの有無を表４に示す。なお、ハット成形後一部の切出し荷重10kgfでビッカース硬度を測定したところ、全ての水準においてHv：410~ 510の範囲にあり、組織はマルテンサイト組織を示した。また熱間プレス後にはこれらの鋼板の表面には酸化鉄が発生しなかった。

【００１７】

【表３】

表3

C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
0.22	0.21	1.20	0.02	0.003	0.027	0.003	0.002	0.18	0.02	0.0018

【表４】

表4

番号	温度 (℃)	保定時間 (分)	加熱雰囲気			微小クラックの発生	
			水素 (vol%)	露点 (℃)	酸素 (vol%)		
1	800	5	0.01	2	0.3	◎	本発明例
2	900	3	0.02	1	0.5	◎	本発明例
3	1000	2	0.1	3	0.8	◎	本発明例
4	1100	2	N.D.	1	1	◎	本発明例
5	900	2	10	0	0.01	×	比較例
6	900	2	4	1	0.01	△	本発明例
7	900	2	1	-1	0.01	◎	本発明例
8	900	2	0.1	15	0.01	×	比較例
9	900	2	0.1	6	0.1	◎	本発明例
10	900	2	0.05	2	0.1	◎	本発明例
11	900	2	2	-20	0.5	○	本発明例
12	900	2	0.01	7	21	◎	本発明例
13	900	2	0.01	1	21	◎	本発明例
14	980	8	0.01	1	21	◎	本発明例
15	1050	5	0.01	1	21	◎	本発明例
16	900	10	5	6	0.06	△	本発明例

微小クラックの発生評点

10点中の微小クラックの個数の合計　◎:0個、○:1個、△:5個未満、×5個以上

【００１８】

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表４に示すように加熱雰囲気及び温度により鋼中に侵入する水素量が変化して微小クラックに対する感受性が変化する。水素濃度が10vol%のNo.５、露点が15℃のNo.８には５個以上のクラック発生が認められた。水素濃度、露点を下げるにつれてクラックの発生は抑制されていくが、No.６、11、16のような場合には若干のクラックが発生した。

（実施例３）

【００１９】

表５に示すような鋼成分を有する板厚1.4mmの冷延鋼板を用いて種々のZn系めっきを施した。このときのめっき種と浴成分、浴温を表６に示す。これらのZn系めっき鋼板を使用して実施例１と同様にハット成形を行い、打抜き加工後の微小クラックの入り方を観察した。この時の加熱条件とクラック発生状況の関係を表７に示す。冷却は金型で行い、700℃から350℃までの平均冷速は20℃/秒であった。実施例１と同様に成形後の断面硬度を測定したところ、全てHv：410~ 510の間にあり、組織もマルテンサイト組織を示した。また熱間プレス後にはこれらの鋼板の表面には酸化鉄が発生しなかった。

【００２０】

【表５】

表５

符号	C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
A	0.15	0.1	2.1	0.01	0.004	0.03	0.004	0.02	0.4	0.01	0.003
B	0.21	0.2	0.9	0.02	0.005	0.015	0.005	0.01	0.9	0.4	0.004
C	0.27	0.15	0.88	0.01	0.002	0.02	0.004	0.02	0.23	0.5	0.003

【表６】

表６

符号	めっき組成	片面付着量(g/m²)	浴温(℃)
GI	Zn-0.2%Al	85	460
GA	Zn-10.5%Fe	70	460
GL	Zn-55%Al-1.6%Si	75	610
GAM	Zn-6%Al-3%Mg	65	420
GAMS	Zn-11%Al-3%Mg-0.1%Si	80	430

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【表７】

表７

番号	鋼	めっき	温度(℃)	保定時間(分)	加熱雰囲気			微小クラックの発生	
					水素(vol%)	露点(℃)	酸素(vol%)		
1	A	GI	950	1	5	8	0.01	△	本発明例
2	A	GA	900	1	0.1	2	0.3	◎	本発明例
3	B	GL	800	2	2	-10	0.5	○	本発明例
4	B	GAM	850	3	0.5	0	21	◎	本発明例
5	C	GAMS	1000	1	0.1	-30	21	◎	本発明例
6	C	GI	850	5	0.05	2	21	◎	本発明例
7	A	GI	900	10	0.07	6	21	◎	本発明例
8	B	GA	850	8	0.1	13	21	×	比較例
9	B	GA	850	5	0.2	0	21	◎	本発明例
10	C	GL	850	2	0.1	-10	21	◎	本発明例

微小クラックの発生評点

10点中の微小クラックの個数の合計　◎:0個、○:1個、△:5個未満、×5個以上

【００２１】

実施例１、２と同様に表７のNo.8は露点が高いために微小クラックが発生した。No.1、３は水素量が1%よりも大きいため、微小クラックが若干発生した。またNo.１～３は酸素濃度が低いために、炉内でのZnの蒸発に伴う炉内の汚れ、鋼板表面の劣化が認められた。

（実施例４）

【００２２】

通常の熱延、冷延工程を経た、表８に示すような鋼成分の冷延鋼板（板厚1.4mm）を材料として用いた。その一部は溶融Alめっき、または溶融Zn系めっきを施した。溶融めっきは無酸化炉－還元炉タイプのラインを使用し、めっき後ガスワイピング法でめっき付着量を調節し、その後冷却しためっき外観は不めっき等なく良好であった。めっき種と浴成分、浴温を表９に示す。

【００２３】

【表８】

表８

C	Si	Mn	P	S	Al	N	Ti	Cr	Mo	B
0.22	0.21	1.20	0.02	0.003	0.027	0.003	0.002	0.18	0.02	0.0018

【表９】

表９

符号	めっき組成	片面付着量(g/m²)	浴温(℃)
AL	Al-10%Si-2%Fe	80	660
GI	Zn-0.2%Al	85	460
GA	Zn-10.5%Fe	70	460

【００２４】

このようにして製造した鋼板を種々の条件で加熱し、その後第１図に示すハット形状の

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金型で成形した。熱間プレス時のクリアランスを表１０に示す。その後ハットのフランジ部に5mmφ、クリアランス0.5mm(両側)の打抜きを10点行い、7日経過後に20倍のルーペで打抜き部を観察して微小クラックの有無判定した。加熱は試料を雰囲気制御した電気炉内に挿入することで行った。900℃までの昇温時間はほぼ4分、炉からプレスまでの時間は約10秒で、プレス開始温度は約750℃だった。冷却は金型で行い、700℃から350℃までの平均冷速は40℃/秒であった。加熱条件と微小クラックの有無を表１０に示す。なお、ハット成形後一部の切出し荷重10kgfでビッカース硬度を測定したところ、全ての水準においてHv：410~ 510の範囲にあり、組織はマルテンサイト組織を示した。

【００２５】

【表１０】

表 10

番号	熱間プレスでのクリアランス（板厚比）	めっき種	温度(℃)	保定時間(分)	加熱雰囲気			微小クラックの発生	酸化鉄の発生	
					水素(vol%)	露点(℃)	酸素(vol%)			
1	0.8	冷延	900	3	0.02	1	0.5	×	有り	比較例
2	1.0	冷延	900	3	0.02	1	0.5	◎	有り	本発明例
3	1.1	冷延	900	3	0.02	1	0.5	◎	有り	本発明例
4	1.4	冷延	900	3	0.02	1	0.5	◎	有り	本発明例
5	1.7	冷延	900	3	0.02	1	0.5	○	有り	本発明例
6	1.9	冷延	900	3	0.02	1	0.5	×	有り	比較例
7	0.8	GI	900	10	0.07	6	21	×	無し	比較例
8	1.0	GI	900	10	0.07	6	21	◎	無し	本発明例
9	1.1	GI	900	10	0.07	6	21	◎	無し	本発明例
10	1.4	GI	900	10	0.07	6	21	◎	無し	本発明例
11	1.7	GI	900	10	0.07	6	21	○	無し	本発明例
12	1.9	GI	900	10	0.07	6	21	×	無し	比較例
13	0.8	GA	850	5	0.2	0	21	×	無し	比較例
14	1.0	GA	850	5	0.2	0	21	◎	無し	本発明例
15	1.1	GA	850	5	0.2	0	21	◎	無し	本発明例
16	1.4	GA	850	5	0.2	0	21	◎	無し	本発明例
17	1.7	GA	850	5	0.2	0	21	○	無し	本発明例
18	1.9	GA	850	5	0.2	0	21	×	無し	比較例

微小クラックの発生評点

10点中の微小クラックの個数の合計　◎:0個、○:1個、△:5個未満、×5個以上

【００２６】

表１０のNo.1、 7、 13は熱間プレス時の金型のクリアランスが制限以下であったため5個以上の微小クラックが認められた。表１０のNo.6、 12 、 18は熱間プレス時の金型のクリアランスが制限以上であったため、強度むらが生じて部品内に残留応力が残って5個以上の微小クラックが認められた。No.5、 11、 17は熱間プレス時の金型のクリアランスが大きめであったため強度むらが生じて部品内に残留応力が残る傾向を示すため、微小クラックが若干発生した。

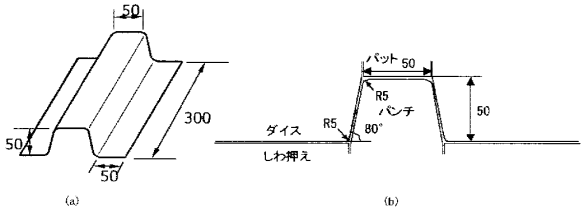
【図面の簡単な説明】

【００２７】

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Filed with Petition for IPR of U.S. Patent No. 9,708,683

【図１】実施例の加工試験に用いるハット形状の金型の外形図である。

【図１】



フロントページの続き

(51)Int.Cl.	FI		テーマコード（参考）
	Ｃ２２Ｃ 38/00	３０１Ｗ	
	Ｃ２２Ｃ 38/38		
	Ｃ２１Ｄ 9/46	Ｇ	
	Ｃ２１Ｄ 9/46	Ｈ	
	Ｃ２１Ｄ 9/46	Ｓ	

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Ｆターム(参考) 4K037 EA01 EA02 EA05 EA06 EA11 EA15 EA16 EA18 EA23 EA25
EA27 EA31 EB06 EB08 EB09

POSCO Exhibit 1023-0012
Filed with Petition for IPR of U.S. Patent No. 9,708,683

TRANSLATION

(12) International Application Disclosed Based on the Patent Cooperation Treaty

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
December 9, 2004 (09.12.2004)

PCT

(10) International Publication No.
WO 2004/106573 A1

(51) International Patent Classifications[7]: C22C 38/00, 38/58, B21D 5/01, 22/20, C21D 1/02

(21) International Application No. : PCT/JP2004/007654

(22) International Application Date: May 27, 2004 (27.05.2004)

(25) Language of International Application: Japanese

(26) Language of International Publication: Japanese

(30) Priority Data:
Patent Application 2003-151106 May 28, 2009 (28.05.2003) JP

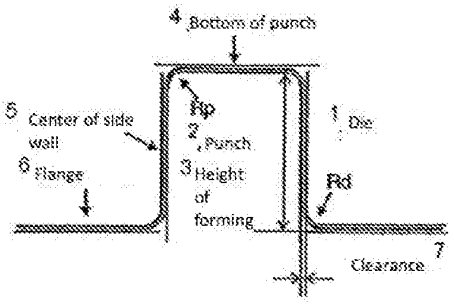
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[Continued]

(54) Title of the Invention: METHOD FOR HOT FORMING AND HOT-FORMED MEMBERS



1...DIE
2...PUNCH
3...HEIGHT OF FORMING
4...BOTTOM OF PUNCH
5...CENTER OF SIDE WALL
6...FLANGE
7...CLEARANCE

(57) Abstract: A method for hot forming, wherein in the cooling step of hot pressing, a formed product is first cooled at a rate of a critical cooling rate or higher down to the Ms point thereof and then cooled at a rate of 25 to 150°C/s from the Ms point to 200°C; and a hot pressed member which has been formed by the method and has a Vickers hardness of less than (the maximum quench hardness - 10) and (the maximum quench hardness - 100) or more. The hot pressed member is manufactured from a high strength steel sheet by means of hot pressing and exhibits a stable strength and toughness in combination.

[Continued]

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WO 2004/106573 A1

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(81) Designated Nations (all kinds of international protection are possible unless otherwise specified):

AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated Nations (all kinds of wide-area protection are possible unless otherwise specified):

ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasiasia (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), Europe (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Appended Publication Documents:
International Search Report

For the 2-letter codes and other abbreviations, refer to the "Guidance Notes for Codes and Abbreviations," which are published in the prefaces of the respective *PCT Gazettes* that are issued periodically.

(**57**) **Abstract:** Hot-pressed members with both stable strength and toughness are manufactured from a high-strength steel sheet by means of hot pressing. In the cooling step of hot pressing, the formed product is first cooled to the Ms point at a rate of the critical cooling rate or higher and then cooled in the temperature range from the Ms point to 200°C at a cooling rate of 25–150°C/sec. The Vickers hardnesses of the hot-pressed members are less than the maximum quench hardness – 10 and equal to or greater than the maximum quench hardness – 100.

Specifications

Method for Hot Forming and Hot-Formed Members

Field of Technology

This invention concerns hot-formed members, including mechanical structural parts, such as automobile body structural parts, suspension parts, etc., and a method for hot forming which is used in manufacturing them. More specifically, this invention concerns hot-pressed members and a hot-pressing method for that purpose.

Below, this invention will be explained by using hot-press forming as an example, but this invention can also be applied to hot-forming methods other than press forming, such as roll forming, forging, etc.

Prior Art

In recent years, in order to reduce the weights of automobiles, efforts have been made to increase the strengths of the steel materials by giving them tensile strengths of 590 MPa or higher, for example, and reducing their weights. In this kind of trend, as the strengths of the thin steel plates that are widely used in automobiles have been increased, their press-forming abilities have decreased, and it has been difficult to produce complex shapes. Specifically, as their strengths have increased, their ductilities have decreased and fractures are caused in places which have high degrees of working. The spring-back and wall camber have become larger, and the problem of worsening dimensional accuracy has arisen.

Therefore, in the case of steel plates with high strengths, especially ones with tensile strengths of 780 MPa or higher, it is not easy to produce parts by using press forming as a method of cold working. These high-strength steel plates can be worked by using roll forming instead of press forming, but roll forming can only be employed with parts which have uniform cross sections in the longitudinal direction, so that the shapes of the products to which it can be employed are limited.

On the other hand, as disclosed in UK Patent No. 1490535, in a hot press method in which heated steel plates are press formed, the steel plates are heated to high temperatures so that the steel plate material is softened and becomes highly ductile. As a result, complex shapes can be formed with good dimensional accuracy in the heated state. Furthermore, by the method of die cooling, that is, heating the steel plates to the austenitic temperature range and quenching them in dies, increasing the strengths of the plates by martensitic transformation, that is, hardening, can be accomplished at the same time.

However, when die cooling is used in the hot press method, the quench hardness of the material is in the range of Hv 400–490, which is insufficient, in the case of 0.2% C materials. In addition, there is the problem that the hardness of the material has an extremely large dispersion.

A hot press technique which was developed by the Swedish company Plunger was disclosed in Advanced Materials & Processes, Vol. 146, No. 6, 12/94, p. 16. In this technique, the die quenching is done starting from 980°C. The die temperature is assumed to be in the range of room temperature to several tens of °C, since it is not stated that the die is heated in that disclosure.

In the Japanese Unexamined Patent Application Heisei 8 [1996]-269615, rapid-quenching hot rolled steel plates are disclosed containing C: 0.18–0.30%, Si: 0.01–1.0%, Mn: 0.2–1.5%, P: ≤0.03%, S: ≤0.02%, sol. Al: ≤0.08%, Cr: 0.1–0.5%, B: 0.0006–0.0040%, and N: ≤0.01%, and in some cases also at least one of Cu: ≤0.5%, Ni: ≤0.3%, and Ti: 0.01–0.05%, with the remaining content being iron. These steel plates are given high strengths by high-frequency quenching after they have been cold worked.

Disclosure of the Invention

This invention provides hot-formed members which can be produced from high-strength steel plates by using a hot-forming method and which also have stabilized strengths and toughnesses, as well as a hot-forming method for producing them.

More specifically, this invention provides hot-pressed members, including mechanical structural parts, such as automobile body structural parts, suspension parts, etc., and a method for hot pressing which is used in manufacturing them.

By means of this method, it is possible to produce hot-formed members that also have stabilized strengths and toughnesses from hot forming; in this method, when the members are cooled after forming, for example, when they are die-cooled, the average cooling rate in the temperature range below the Ms point (the temperature at which martensite begins to be formed from austenite) is kept within a specific range.

In one embodiment, this invention concerns a method of hot forming in which a steel plate that has a composition essentially containing C: 0.15–0.45%, Mn: 0.5–3.0%, Cr: 0.1–0.5%, Ti: 0.01–0.1%, B: 0.0002–0.004%, Si: ≤0.5%, P: ≤0.05%, S: ≤0.05%, Al: ≤1%, and N: ≤0.01%, as well as one or two or more of Ni: ≤2%, Cu: ≤1%, Mo: ≤1%, V: ≤1%, and Nb: ≤1%, with the remaining content being Fe and unavoidable impurities, is heated and kept at the Ac_3 point or

higher, after which it is formed to the final product shape. By means of this invention, during the forming or when the material is cooled from the forming temperature after forming, a quenching process is performed in which the cooling rate to the Ms point of the formed member is at or above the critical cooling rate, and the average cooling rate from the Ms point to 200°C is 25–150°C/sec. Furthermore, in this invention, the term "critical cooling rate" means the upper critical cooling rate.

In another embodiment, this invention concerns hot-formed members that have been formed from a steel plate which has the aforementioned steel composition. These hot-formed members have a hardness after the hot forming which is less than the maximum quench hardness – 10 and equal to or greater than the maximum quench hardness – 100.

In a favorable embodiment of this invention, the hot forming is hot-press forming which is performed by using a die for press forming.

By means of this invention, it is possible to make hot-press members which have both stabilized strength and toughness. Therefore, this invention contributes greatly to expanding the applications of high-strength steel plates as a material for press-formed members.

Simple Explanation of the Drawings

Fig. 1 is a schematic explanatory drawing of the hot-forming method.

Fig. 2 is a schematic drawing which shows the shape of a test piece for measuring the critical cooling rate.

Detailed Explanation of the Invention

The reasons for employing the aforementioned steel composition and forming conditions in this invention are as follows. In this invention, "%" in the steel composition, that is, the chemical composition of the steel, means "wt %."

1. Composition of the base steel plate

C: 0.15–0.45%

Carbon (C) is an extremely important element which raises the hardening ability of the steel plate and principally determining its strength after hardening. Furthermore, it is an element which lowers the Ac_3 point and furthers the lowering of the hardening treatment temperature. However, if the C content is less than 0.15%, its effect will be insufficient, and if it exceeds 0.45%, there will be a deterioration in the toughness of the hardened parts. The lower limit of

the desirable C content is 0.16% and its upper limit is 0.35%.

Mn: 0.5–3.0%

Manganese (Mn) is an extremely effective element for raising the hardening ability of the steel plate and stabilizing and maintaining its strength after hardening. Furthermore, it is an element which lowers the Ac_3 point and furthers the lowering of the hardening treatment temperature. However, if the Mn content is less than 0.5%, its effect will be insufficient, and if it exceeds 3.0%, there will be a deterioration in the toughness of the hardened parts. The range of the desirable Mn content is 0.8–2.0%.

Cr: 0.1–0.5%

Chromium (Cr) is an effective element for raising the hardening ability of the steel plate and stabilizing and maintaining its strength after hardening. However, if the Cr content is less than 0.1%, its effect will be insufficient, and if it exceeds 0.5%, its effectiveness will be saturated and a useless increase in cost will be invited. The range of the desirable Cr content is 0.15–0.30%.

Ti: 0.01–0.1%

Titanium (Ti) is an effective element for raising the hardening ability of the steel plate and stabilizing and maintaining its strength after hardening. However, if the Ti content is less than 0.01%, its effect will be insufficient, and if it exceeds 0.1%, its effectiveness will be saturated and a useless increase in cost will be invited. The range of the desirable Ti content is 0.015–0.03%.

B: 0.0002–0004%

Boron (B) is an important element for raising the hardening ability of the steel plate and further raising the stabilizing and maintaining of its strength after hardening. However, if the B content is less than 0.0002%, its effect will be insufficient, and if it exceeds 0.004%, its effectiveness will be saturated and an increase in cost will be invited. The range of the desirable B content is 0.0005–0.0025%.

Si: ≤0.5%, P: ≤0.05%, S: ≤0.05%, Al: ≤1%, and N: ≤0.01%

All of these elements are also effective in raising the hardening ability of the steel plate and raising the stabilizing of its strength after hardening. However, if their contents are above the respective upper limits mentioned above, their effectiveness will be saturated and cost increases will be invited.

1 or 2 or more of Ni: ≤2%, Cu: ≤1%, Mo: ≤1%, V: ≤1%, and Nb: ≤1%

All of these elements are also effective in raising the hardening ability of the steel plate and raising the stabilizing of its strength after hardening; therefore, 1 or 2 or more of them are contained in the composition of the steel plate. However, even if their contents are above their respective upper limits, the effectiveness will be small and useless cost increases will be invited. Therefore, the contents of these alloy elements are made within the aforementioned ranges.

The steel plate which is used in this invention is heated to the austenite temperature range and an austenite transformation is caused when it is heated before the forming; therefore, its mechanical properties at room temperature before the heating are not important and its metal structure before the heating is not particularly limited. Consequently, the basic steel plate that is used may be a hot rolled steel plate, cold rolled steel plate, or plated sheet steel, and the method for producing it is not particularly limited. Examples of the plated sheet steels are aluminum-based plating steel sheet (that is, aluminized and aluminum alloy plating steel sheets) and zinc-based plating steel sheet (that is, zincified and zinc alloy plating steel sheets). The plated steel sheets may be electroplated steel sheets or molten plated sheet steels. Moreover, alloyed hot dip galvanized steel sheets may also be used.

2. Heating conditions and holding time

In the die cooling at the time of the hot pressing, in order to perform the hardening treatment after forming the formed members, that is, the hot-pressed members, the base steel plate must first be heated to the austenite temperature range and put into the austenite phase. For this, it is heated at or above the Ac_3 point and held for 1 minute or more at this temperature under the ordinary conditions. No particular upper limit is set for the holding time, but it is desirable for the upper limit to be about 10 minutes, considering the efficiency of the actual production.

3. Cooling rate at the time of the hot pressing

The cooling rate during the hot pressing (in the die) or after the hot pressing (after deforming) is a parameter which plays an extremely important role in obtaining stabilized strength and toughness in the hot-pressed members.

In order to give the hot-pressed members stabilized strength and toughness, it is not essential to make the structure after the hot pressing a complete martensite structure, but rather to make it an auto-tempered martensite structure. In order to make this auto-tempered martensite structure, in the cooling step during or after the hot pressing, it is cooled to the Ms

point at a cooling rate at or above the critical cooling rate, so that a diffusion transformation does not occur, and in the temperature range from the Ms point to 200°C, it is cooled at a slow cooling rate, that is, an average cooling rate of 25–150°C/sec. By performing this kind of cooling, the tempering is performed at the same time that the martensite transformation occurs; therefore, there is little variation in strength and a martensite structure with excellent toughness is obtained. Desirable cooling rates from the Ms point to 200°C are in the range of 30–120°C/sec.

4. The method of forming in the hot-pressing method

Shapes of the forming in the hot-pressing method include bending, drawing, stretch forming, hole expansion, and flanging. Furthermore, if a means for cooling the steel plate simultaneously with or immediately after the forming is provided, this invention may also be applied to forming methods other than hot pressing, for example, roll forming.

5. Hot-pressed members

The members which are produced by the hot-pressing method described above have tempered martensite structures with little variation in strength and excellent toughness. Moreover, since the strength obtained is the strength of the tempered martensite structure, the hardness is lower than the hardness (Hv), that is, the maximum quench hardness – 10, and since they are not excessively tempered, it is equal to or greater than the maximum quench hardness – 100. If the value of Hv becomes higher than the maximum quench hardness – 10, the toughness will be lowered, and if it is less than the maximum quench hardness – 100, the strength will be lowered. Desirable values of Hv are in the range of less than the maximum quench hardness – 20 or lower and the maximum quench hardness – 80 or higher.

Here, the "maximum quench hardness" is the hardness that is obtained when a water-cooling treatment is performed after the material is kept for 10 minutes in a salt bath heated to 900°C.

6. The method of cooling at the time of the hot-press forming

Ordinarily, since steel dies are kept at room temperature or several tens of degrees Celsius, cooling of the formed members is accomplished by these steel dies when hot-press forming is done. Therefore, in order to change the cooling rate, it is understood that the die dimensions may be changed and the thermal capacity changed.

Moreover, the cooling rate can also be changed by changing the die material to a dissimilar metal (for example, copper, etc.). Moreover, if the die dimensions or material are not changed, the cooling rate can also be changed by changing the quantity of cooling water, when a water-

cooled die is used. In this case, also, the cooling rate of the press-formed members can also be changed by, for example, using a die which has a number of grooves cut in it beforehand and causing water to flow through the grooves during the pressing, or raising the pressing machine during the press formation and causing water to flow between the dies.

Therefore, the following means are considered for changing the cooling rate before and after the Ms point:

(1) transferring to a die with a different thermal capacity or a room-temperature die immediately after the Ms point is reached;

(2) in the case of using a water-cooled die, changing the quantity of water flowing in the die immediately after the Ms point is reached; and

(3) changing the quantity of water flowing between the die and the member immediately after the Ms point is reached.

Working Examples

The following working examples are examples of this invention, but the invention is not limited in any way by them.

In these examples, steel plates (1.0 mm thick) with the composition shown in Table 1 are used as the base steel plates. These steel plates were made by hot or cold rolling slab ingots which were made in the laboratory. Furthermore, for steel No. 2, hot dip galvanizing (60 g/m^2 of Zn adhering per side) was performed, after which an alloying treatment was performed (Fe content in the plating film 15 mass %).

These steel plates were cut into pieces 40 W x 60 L (mm) and heated at 900°C x 5 minutes in a furnace with an air atmosphere, after which they were removed from the furnace and hot-press forming was performed immediately thereafter with a flat plate steel die. For steel No. 2, the hot-press forming was performed by changing the cooling conditions (tests Nos. 2, 5, and 6).

The Vickers hardnesses of the hot-pressed members that were obtained were measured (load 9.8 N, number of measurements: 5). Moreover, the cooling rates after the press forming were measured by attaching thermocouples to the steel plates. The cooling rates were primarily changed by changing the die dimensions.

Furthermore, for test No. 2, the cooling rate was adjusted by injecting water between the dies immediately after the steel plate temperature reached the Ms point.

The maximum quench hardness was taken to be the hardness that was obtained when a water-cooling treatment was performed after the material was kept for 10 minutes in a salt bath heated to 900°C.

Table 2 shows the results that were obtained, in terms of the Ac_3 points, Ms points, and critical cooling rates of each kind of steel, which were measured by the following methods.

Cylindrical test pieces 3.0 mm in diameter and 10 mm long (Fig. 2) were cut from the hot-rolled plates and heated in air to 950°C at a temperature rise rate of 10°C/sec. After they were kept at this temperature for 5 minutes, they were cooled to room temperature at various cooling rates. The Ac_3 and Ms points were measured by measuring the changes in the thermal expansions of the test pieces during the heating and cooling. Moreover, the Vickers hardnesses (load 49 N, number of measurements: 5) of the test pieces that were obtained were measured, and their structures were observed, and the critical cooling rates were estimated from these results.

Table 1

Steel No.	Chemical composition (mass %; remainder: essentially Fe)														
	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Ti	Nb	Al	B	N
1	0.16	0.02	1.36	0.019	0.004	0.01	0.01	0.19	–	0.01	0.03	–	0.06	0.0013	0.008
2	0.21	0.25	1.20	0.008	0.002	0.01	0.02	0.20	–	0.01	0.02	0.01	0.05	0.0007	0.005
3	0.33	0.11	1.53	0.001	0.001	–	–	0.20	–	–	0.02	–	0.04	0.0015	0.001
4	0.42	0.11	1.51	0.001	0.001	–	–	0.20	0.01	–	0.02	–	0.04	0.0014	0.001

Table 2

Test No.	Steel No.	Ac_3 point (°C)	Ms point (°C)	Critical cooling rate (°C/sec)	Measured cooling rate to Ms point (°C/sec)	Average cooling rate from Ms point to 200°C	Hardness after hot pressing (HV)	Maximum quench hardness (HV)	Die size (t x W x L mm)	Notes
1	1	860	450	25	60	40	418	461	50 x 400 x 400	Working Examples
2	2	823	410	17	60	100	451	501	50 x 400 x 400*1	
3	3	823	390	10	60	40	560	652	50 x 400 x 400	
4	4	785	370	10	60	30	683	750	50 x 400 x 400	
5	2	823	410	17	60	22*3	390	501	50 x 50 x 400	Comparison Examples
6	2	823	410	17	60	200*3	500	501	50 x 50 x 400*2	

*1 Water injected between dies immediately after the Ms point

*2 Pressing machine raised immediately after the Ms point and test pieces immediately put into a water bath

*3 Conditions outside the range of this invention

In Tests Nos. 1–4 in these examples of the invention, since the average cooling rate from the Ms point to 200°C was correct, the hardnesses obtained were lower than the maximum quench hardness – 10 and higher than the maximum quench hardness – 100.

In Test No. 5, a comparison example, the cooling rate was above the critical cooling rate but the average cooling rate from the Ms point to 200°C was slow; therefore, sufficient hardness was not obtained. Moreover, in Test No. 6, another comparison example, the average cooling rate from the Ms point to 200°C was too rapid; therefore, it was too hard. Here, the meaning of "too hard" is not that the absolute value of the hardness was high, but that it was near the maximum quench hardness.

In the case of the steel plate of Test No. 2, an example of this invention, the plate was heated at 900°C x 5 minutes in a furnace with an air atmosphere, removed from the furnace and hat-type hot-press forming was performed [blank size: 1.0 T x 80 W x 320 L (mm)].

A schematic drawing of the hat-forming method used in this case is shown in Fig. 1. The hot-press forming conditions used were: forming height 70 mm, Rd (die shoulder R) 8 mm, Rp (punch shoulder R) 8 mm, clearance 1.0 mm, and blank holding force 12.7 kN.

Moreover, the Vickers hardnesses were measured in the bottom punch part, middle side wall part, and flange part of the hot-press formed member (load 9.8 N, number of measurements: 5). The cooling rates at these locations were measured by attaching thermocouples at each location. The results are shown in Table 3.

Table 3

	Average cooling rate from Ms point to 200°C (°C/sec)	Hardness after hot pressing (HV)
Bottom of punch	55	460
Center of side wall	100	471
Flange	120	480

Since the average cooling rate from the Ms point to 200°C was correct in each location, good hardnesses were obtained. Moreover, it can be seen that the variation in hardness within the same member was small.

Claims

1. A method of hot forming which is a method in which steel plates having essentially the steel compositions of C: 0.15–0.45%, Mn: 0.5–3.0%, Cr: 0.1–0.5%, Ti: 0.01–0.1%, B: 0.0002–0.004%, Si: ≤0.5%, P: ≤0.05%, S: ≤0.05%, Al: ≤1%, and N: ≤0.01%, as well as one or two or more of Ni: ≤2%, Cu: ≤1%, Mo: ≤1%, V: ≤1%, and Nb: ≤1%, with the remaining content being Fe and unavoidable impurities, are heated and kept at a temperature of the Ac_3 point or higher, after which they are formed to the final product shape; moreover, when they are cooled from the forming temperature during or after the forming, the cooling rate to the Ms point of the formed member is at or above the critical cooling rate and a quenching treatment is performed in which they are cooled at an average cooling rate from the Ms point to 200°C in the range of 25–150°C/sec.

2. The method of hot forming in Claim 1 in which the aforementioned forming is performed by using a press-forming die.

3. The method of hot forming in Claim 1 or Claim 2 in which, after the aforementioned forming is performed by using a die for press forming, the cooling is performed by injecting water between the dies.

4. Hot-formed members, characterized in that they are constituted from steel plates which have essentially the steel compositions of C: 0.15–0.45%, Mn: 0.5–3.0%, Cr: 0.1–0.5%, Ti: 0.01–0.1%, B: 0.0002–0.004%, Si: ≤0.5%, P: ≤0.05%, S: ≤0.05%, Al: ≤1%, and N: ≤0.01%, as well as one or two or more of Ni: ≤2%, Cu: ≤1%, Mo: ≤1%, V: ≤1%, and Nb: ≤1%, with the remaining content being Fe and unavoidable impurities, and their hardnesses after the hot forming are Vickers hardnesses which are less than the maximum quench hardness – 10 and equal to or greater than the maximum quench hardness – 100.

5. Hot-formed members of Claim 4 in which the aforementioned hot forming is hot-press forming.

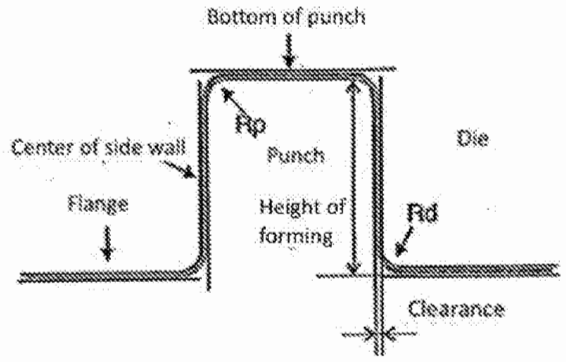

Bottom of punch
Rp
Center of side wall
Punch
Die
Flange
Height of forming
Rd
Clearance

Fig. 1

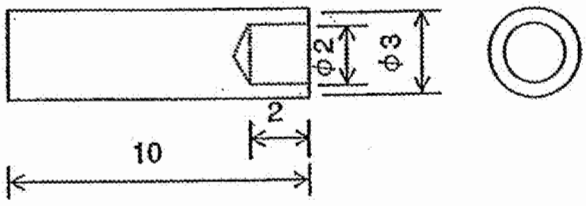

φ2
φ3
2
10

Fig. 2

DECLARATION OF JON JOHANNING

I, Jon Johanning, declare the following:

1. I am over 18 years of age and competent to make this declaration.

2. I am a qualified Japanese to English translator as certified by the American Translators Association.

3. I have translated the attached patent application regarding International Publication No. WO 2004/106573 A1 (PCT/JP2004/007654), bearing a publication date of December 9, 2004.

4. I affirm that the translated text has been translated and edited to the best of my ability and knowledge to accurately reflect the content, meaning, and style of the original text. I hereby certify under penalty of perjury under the laws of the United States of America that the foregoing constitutes, pursuant to my knowledge and belief, a true and correct translation of the original document.

5. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.



Jon Johanning

Dated and signed on May 3, 2019.

(12)特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2004 年12 月9 日 (09.12.2004)

PCT

(10) 国際公開番号
WO 2004/106573 A1

(51) 国際特許分類[7]: C22C 38/00, 38/58, B21D 5/01, 22/20, C21D 1/02

(21) 国際出願番号: PCT/JP2004/007654

(22) 国際出願日: 2004 年5 月27 日 (27.05.2004)

(25) 国際出願の言語: 日本語

(26) 国際公開の言語: 日本語

(30) 優先権データ:
特願2003-151106 2003 年5 月28 日 (28.05.2003) JP

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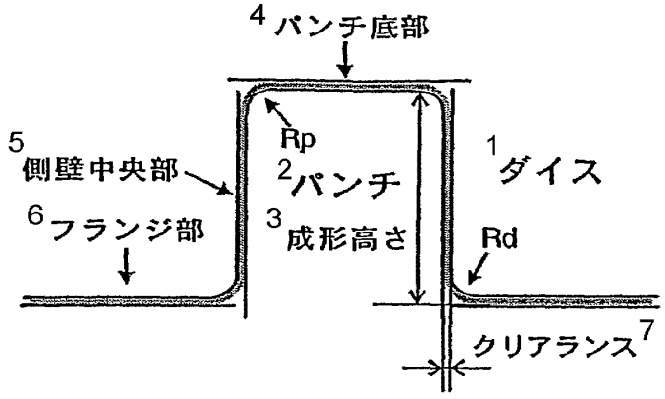
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[続葉有]

(54) Title: METHOD FOR HOT FORMING AND HOT FORMED MEMBER

(54) 発明の名称: 熱間成形法と熱間成形部材



1...DIE
2...PUNCH
3...HEIGHT OF FORMING
4...BOTTOM OF PUNCH
5...CENTER OF SIDE WALL
6...FLANGE
7...CLEARANCE

(57) Abstract: A method for hot forming, wherein in the cooling step of hot pressing, a formed product is first cooled at a rate of a critical cooling rate or higher down to the Ms point thereof and then cooled at a rate of 25 to 150°C/s from the Ms point to 200°C; and a hot pressed member which has been formed by the method and has a Vickers hardness of less than (the maximum quench hardness - 10) and (the maximum quench hardness - 100) or more. The hot pressed member is manufactured from a high strength steel sheet by means of hot pressing and exhibits a stable strength and toughness in combination.

[続葉有]

WO 2004/106573 A1

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(84) 指定国 (表示のない限り、全ての種類の広域保護が可能): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), ヨーロッパ (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

添付公開書類:
— 国際調査報告書

２文字コード及び他の略語については、定期発行される各*PCT*ガゼットの巻頭に掲載されている「コードと略語のガイダンスノート」を参照。

(57) 要約: 高強度鋼板から、安定した強度と靭性を併せ持つ熱間プレス部材を熱間プレスにより作製する。熱間プレス時の冷却過程において、Ms点までは臨界冷却速度以上で冷却し、Ms点から200℃までの温度範囲の冷却速度を25～150℃/sとする。熱間プレス部材のビッカース硬さは、（最高焼入れ硬さ−10）未満、かつ（最高焼入れ硬さ−100)以上である。

明　細　書

熱間成形法と熱間成形部材

技術分野

本発明は、自動車のボディー構造部品、足回り部品等を初めとする機械構造部品等の熱間成形部材と、その製造に使用される熱間成形方法に関する。さらに詳述すれば、本発明は、熱間プレス部材とそのための熱間プレス方法に関する。

以下では、熱間プレス成形を例にとって本発明を説明するが、本発明はロール成形、鍛造等のプレス成形以外の熱間成形にも適用可能である。

背景技術

近年、自動車の軽量化のため、例えば引張強さ590 MPa 以上というように鋼材の高強度化を図り、使用重量を減ずる努力が進んでいる。自動車に広く使用される薄鋼板では、そのような傾向の下、鋼板強度の増加に伴って、プレス成形性が低下し、複雑な形状を製造することが困難になってきている。具体的には、強度増加に伴って延性が低下し、加工度が高い部位で破断が生じたり、スプリングバックや壁反りが大きくなり、寸法精度が劣化するという問題が発生する。

従って、高強度、特に引張強さ780 MPa 級以上の鋼板の場合、冷間加工手段としてプレス成形を利用して部品を製造することは容易ではない。プレス成形ではなくロール成形を利用すれば、上記の高強度鋼板の加工が可能であるが、ロール成形は長手方向に一様な断面を有する部品にしか適用できず、適用できる製品の形状が限定される。

一方、英国特許第1490535 号に開示されているように、加熱した鋼板をプレス成形する熱間プレス法では、鋼板を高温で加熱することから、鋼板の材質は軟化して高延性になっているため、加熱状態で複雑な形状を寸法精度よく成形することが可能である。さらに、鋼板をオーステナイト域温度に加熱しておき、金型内で急冷するという金型冷却により、マルテンサイト変態による鋼板の高強度化、即ち、焼入れ、が同時に達成できる。

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Filed with Petition for IPR of U.S. Patent No. 9,708,683

しかし、熱間プレス法における金型冷却では、部材の焼入れ硬さが、0.2 %C材の場合でHv 400～490 と十分ではなく、しかも部材中の硬さのばらつきが非常に大きいという問題がある。

Advanced Materials & Processes, Vol. 146, No. 6, 12/94, p. 16 には、スェーデンのプランジャ社により開発されたホットプレス技術が紹介されており、980 ℃からダイクエンチ（金型内急冷）することが記載されている。金型温度は、加熱との記載がないので、常温～数十℃と推定される。

特開平 8 －269615号には、C：0.18～0.30%、Si：0.01～1.0 %、Mn： 0.2～1.5 %、P：0.03%以下、S：0.02%以下、sol.Al：0.08%以下、Cr： 0.1～0.5 %、B：0.0006～0.0040%、N：0.01%以下を含み、場合によりCu：0.5 %以下、Ni：0.3 %以下、Ti：0.01～0.05%の少なくとも 1 種をさらに含み、残部鉄からなる、急速焼入れ用熱延鋼板が開示されている。この鋼板は、冷間加工した後、高周波焼入れにより高強度化させるものである。

発明の開示

本発明は、熱間成形法により高強度鋼板から製造でき、かつ安定した強度と靱性を併せ持つ熱間成形部材と、それを作製する熱間成形法を提供する。

より具体的には、本発明は、自動車のボディー構造部品、足回り部品等を初めとする機械構造部品等の熱間プレス部材と、その製造に使用される熱間プレス方法を提供する。

本発明によれば、成形後の冷却時、例えば金型冷却時に、Ms点（オーステナイトからマルテンサイトが生成し始める温度）以下の温度域での平均冷却速度を一定範囲内に収めることにより、熱間成形によって安定した強度および靱性を併せ持つ熱間成形部材を製造することができる。

1 態様において、本発明は、質量%で、C：0.15～0.45%、Mn： 0.5～3.0 %、Cr： 0.1～0.5 %、Ti：0.01～0.1 %、B：0.0002～0.004 %、Si：0.5 %以下、P：0.05%以下、S：0.05%以下、Al： 1 %以下、N：0.01%以下を含有し、かつNi： 2 %以下、Cu： 1 %以下、Mo： 1 %以下、V： 1 %以下、およびNb： 1 %以下の 1 種または 2 種以上を含有し、残部Feおよび不可避的不純物から本質

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的になる鋼組成を有する鋼板を、Ac_3 点以上に加熱・保持した後、最終製品形状への成形を行う熱間成形方法に関する。本発明によれば、成形中または成形後の成形温度からの冷却に際して、成形部材のMs点までの冷却速度が臨界冷却速度以上で、かつ、Ms点から200 ℃までの平均冷却速度が25～150 ℃/sで冷却して焼入れ処理を行う。なお、本発明では、臨界冷却速度は上部臨界冷却速度の意味である。

別の態様において、本発明は、上記鋼組成を有する鋼板から構成された熱間成形部材に関する。この熱間成形部材は、熱間成形後の硬さが、ビッカース硬さで、（最高焼入れ硬さ－10）未満、かつ（最高焼入れ硬さ－100)以上、である。

本発明の好適態様において、熱間成形は、プレス成形用金型を用いて行う熱間プレス成形である。

本発明によれば、安定した強度と靱性を併せ持つ熱間プレス部材の作製が可能となる。従って、本発明は、高強度鋼板のプレス成形部材としての用途拡大に大きく寄与する。

図面の簡単な説明

図 1 はハット成形法の模式的説明図である。

図 2 は臨界冷却速度の測定用試験片の形状を示す模式図である。

発明の詳細な説明

本発明において前述した鋼組成および成形条件を採用する理由は次の通りである。本発明において、鋼組成、つまり鋼の化学組成を示す「%」は「質量%」を表す。

1.素地鋼板の組成

C：0.15～0.45%

炭素（C）は、鋼板の焼入れ性を高め、かつ焼入れ後、強度を主に決定する非常に重要な元素である。さらにAc_3 点を下げ、焼入れ処理温度の低温化を促進する元素である。しかし、C含有量が0.15%未満ではその効果は十分ではなく、一方でC含有量が0.45%を超えると、焼入れ部の靱性劣化が著しくなる。好ましい

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C含有量の下限は0.16%、上限は0.35%である。

Mn： 0.5～3.0 %

マンガン（Mn）は、鋼板の焼入れ性を高め、かつ焼入れ後に強度を安定して確保するために非常に効果のある元素である。さらに、Ac_3点を下げ、焼入れ処理温度の低温化を促進する元素である。しかし、Mn含有量が0.5 %未満ではその効果は十分ではなく、一方でMn含有量が3.0 %を超えるとその効果は飽和し、さらに焼入れ部の靱性劣化を招く。好ましいMn含有量は 0.8～2.0 %である。

Cr： 0.1～0.5 %

クロム（Cr）は、鋼板の焼入れ性を高め、かつ焼入れ後、強度を安定して確保するために効果のある元素である。しかし、Cr含有量が0.1 %未満ではその効果は十分ではなく、一方でCr含有量が0.5 %をこえるとその効果は飽和し、いたずらにコスト増を招く。好ましいCr含有量は0.15～0.30%である。

Ti：0.01～0.1 %

チタン（Ti）は、鋼板の焼入れ性を高め、かつ焼入れ後、強度を安定して確保するために効果のある元素である。さらに焼入れ部の靱性も向上させる効果を有する。しかし、Ti含有量が0.01%未満ではその効果は十分ではなく、一方でTi含有量が0.1 %を超えるとその効果は飽和し、いたずらにコスト増を招く。好ましいTi含有量は 0.015～0.03%である。

B：0.0002～0.004 %

ホウ素（B）は、鋼板の焼入れ性を高め、かつ焼入れ後、強度の安定確保効果をさらに高める重要な元素である。しかし、B含有量が0.0002%未満ではその効果は十分ではなく、一方でB含有量が0.004 %を超えるとその効果は飽和し、かつコスト増を招く。好ましいB含有量は0.0005～0.0025%である。

Si：0.5 %以下、P：0.05%以下、S：0.05%以下、Al：1%以下、N：0.01%以下

これらの元素も、いずれも鋼板の焼入れ性を高め、かつ焼入れ後の強度の安定化を高める効果を有する。しかし、それらの含有量が上記のそれぞれの上限を超えると、その効果は飽和し、かえってコスト増を招く。

Ni：2%以下、Cu：1%以下、Mo：1%以下、V：1%以下、Nb：1%以下の

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1種または2種以上

これらの元素も、鋼板の焼入れ性を高め、かつ焼入れ後、強度の安定確保に効果のある元素であるので、1種または2種以上を含有させる。しかし、それぞれ上限値を越えて含有させてもその効果は小さく、かついたずらにコスト増を招くため、各合金元素の含有量は上述の範囲とする。

本発明で使用する鋼板については、成形に先立つ加熱の際にオーステナイト温度域に加熱し、オーステナイト変態をさせるため、加熱前の室温での機械的性質は重要ではなく、加熱前の金属組織については特に制限されない。従って、素地鋼板としては、熱延鋼板、冷延鋼板、めっき鋼板のいずれを使用してもよく、その製造方法については特に限定はしない。めっき鋼板としては、アルミ系めっき鋼板（即ち、アルミめっきおよびアルミ合金めっき鋼板）と亜鉛系めっき鋼板（即ち、亜鉛めっきおよび亜鉛合金めっき鋼板）が例示される。めっき鋼板は、電気めっき鋼板でも、溶融めっき鋼板でもよい。また、合金化溶融亜鉛めっき鋼板も使用できる。

2. 加熱条件および保持時間

熱間プレス時の金型冷却において、成形部材、つまり熱間プレス部材に成形後焼入れ処理を行うためには、まず素地鋼板をオーステナイト温度域まで加熱し、素地鋼板を一度、オーステナイト相にする必要がある。そのためには、Ac_3 点以上に加熱し、その温度で通常の条件では1分以上保持する。保持時間の上限は特には設けないが、実際の生産上の効率を考えて、保持時間の上限を10分程度にするのが望ましい。

3. 熱間プレス時の冷却速度

熱間プレス中（金型内）または熱間プレス後（脱型後）の冷却速度は、熱間プレス部材において安定した強度および靱性を得るために非常に重要な役割を果たすパラメータである。

安定した強度および靱性を熱間プレス部材に付与するためには、熱間プレス後の組織を、完全マルテンサイト組織とするのではなく、自動焼き戻しマルテンサイト組織とすることが肝要である。この自動焼き戻しマルテンサイト組織にするためには、熱間プレス時または熱間プレス後の冷却段階でMs点までは拡散変態が

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起きないように臨界冷却速度以上で冷却し、かつMs点から200 ℃までの温度範囲は平均冷却速度25～150 ℃/sという、遅い冷却速度で冷却する。このような冷却により、マルテンサイト変態が起こると同時に焼き戻しされるため、強度のばらつきが少なく、かつ靱性に優れたマルテンサイト組織が得られる。Ms点から200 ℃までの好ましい平均冷却速度は30～120 ℃/sである。

4.熱間プレス法における成形方法

熱間プレス法における成形の形態としては、曲げ加工、絞り成形、張出し成形、穴拡げ成形、フランジ成形等がある。また、成形と同時またはその直後に鋼板を冷却する手段を備えていれば、プレス成形以外の成形法、例えばロール成形に本発明を適用してもよい。

5.熱間プレス部材

前述の熱間プレス法にて作製された部材は、強度のばらつきが少なく、かつ靱性に優れた焼き戻しマルテンサイト組織を有する部材となる。また、得られる強度は、焼き戻しマルテンサト組織の強度であるため、硬さ（Hv）で言い換えると、（最高焼入れ硬さ－10）よりも低いが、過度に焼き戻されていないため、（最高焼入れ硬さ－100)以上の硬さを有する。Hvの値が（最高焼入れ硬さ－10）より高くなると靱性が低下し、（最高焼入れ硬さ－100)より低くなると強度が低下する。好ましいHvの値は、（最高焼入れ硬さ－20）以下、（最高焼入れ硬さ－80)以上である。

ここに「最高焼入れ硬さ」とは、900 ℃に加熱した塩浴中でその材料を10分間保持後、水冷処理を施した時に得られる硬さである。

6.熱間プレス成形時の冷却方法

通常、鋼製金型は常温または数十℃程度の温度に保持されているから、熱間プレス成形に際して、この鋼製金型によりプレス成形部材の冷却が達成される。従って、冷却速度を変化させるためには、金型寸法を変え熱容量を変化させればよいことが分かる。

また、金型材質を異種金属（例えば銅など）に変えることでも冷却速度を変化させることができる。金型寸法も、材質も変えられない場合、水冷型の金型を用いてそのときの冷却水量を変えることによっても、冷却速度を変えることができ

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る。その場合でも、例えば、予め溝を数カ所切った金型を用い、プレス中に水を溝に通すことによって冷却速度を変えたり、プレス成形途中でプレス機を上げ、その間に水を流すことでもプレス成形部材の冷却速度を変えることができる。

従って、Ms点の前後で冷却速度を変化させる手段には次のような手段が考えられる。

(1) MS点到達直後に、熱容量の異なる金型または室温状態の金型に移動させて、冷却速度を変える。

(2) 水冷金型の場合、MS点到達直後に、金型中を流れる水量を変化させて、冷却速度を変える。

(3) Ms点到達直後に金型と部材の間に水を流し、その水量を変化させることで、冷却速度を変える。

実施例

以下の実施例は本発明を例示するものであるが、本発明はそれによりいかなる制限も受けない。

本例では、表1に示した組成を有する鋼板（板厚：1.0 mm）を素地鋼板とした。これらの鋼板は、実験室にて溶製したスラブを、熱間圧延、冷間圧延により製造した鋼板である。さらに鋼種No.2には、めっきシミュレータを用いて溶融亜鉛めっき（片面あたりのZn付着量は60 g/m²）を施し、その後、合金化処理（めっき皮膜中のFe含有量は15質量%）を行った。

これらの鋼板を40 W×60 L（mm）の寸法に切断し、大気雰囲気の加熱炉内で、900 ℃×5分の加熱を行ってから、加熱炉より取り出し、その直後に、平板の鋼製金型を用いて、熱間プレス成形を行った。鋼種No.2については、冷却条件を変化させて熱間プレス成形を行った（試験No.2, 5, 6）。

得られた熱間プレス部材について、ビッカース硬さ測定（荷重9.8 N、測定数：5）を行った。また鋼板に熱電対を貼付し、プレス成形後の冷却速度の測定も行った。冷却速度については、主に金型寸法を変えて冷却速度を変化させた。

なお、試験No.2については、鋼板温度がMs点に到達した直後に金型間に水を注入し冷却速度を調節した。

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最高焼入れ硬さについては、900 ℃に加熱した塩浴中でその材料を10分間保持後、水冷処理を施した時に得られる硬さを最高焼入れ硬さとした。

得られた結果を、次の方法で測定した各鋼種のAc_3 点、Ms点、および臨界冷却速度と共に表 2 にまとめて示す。

熱延鋼板から直径3.0 mm、長さ10 mm の円柱試験片（図 2 ）を切り出し、大気中で950 ℃まで10℃/sの昇温速度にて加熱し、その温度で 5 分間保持したのち、種々の冷却速度で室温まで冷却した。そのときの加熱、冷却中の試験片の熱膨張変化を測定することにより、Ac_3 点、Ms点を測定した。また、得られた試験片のビッカース硬度測定（荷重49N 、測定数： 5 ）および組織観察を行い、それらの結果から臨界冷却速度を見積もった。

表 1

鋼種No.	化学組成（質量%、残部：実質的にFe）														
	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Ti	Nb	Al	B	N
1	0.16	0.02	1.36	0.019	0.004	0.01	0.01	0.19	—	0.01	0.03	—	0.06	0.0013	0.008
2	0.21	0.25	1.20	0.008	0.002	0.01	0.02	0.20	—	0.01	0.02	0.01	0.05	0.0007	0.005
3	0.33	0.11	1.53	0.001	0.001	—	—	0.20	—	—	0.02	—	0.04	0.0015	0.001
4	0.42	0.11	1.51	0.001	0.001	—	—	0.20	0.01	—	0.02	—	0.04	0.0014	0.001

表 2

試験No.	鋼種No.	Ac_3 点 (℃)	Ms 点 (℃)	臨界冷却速度 (℃/s)	Ms点迄の実測冷却速度 (℃/s)	Ms点～200℃の平均冷却速度 (℃/s)	熱間プレス後の硬さ (HV)	最高焼入れ硬さ (HV)	金型サイズ (t×W×Lmm)	備考
1	1	860	450	25	60	40	418	461	50×400 ×400	発明例
2	2	823	410	17	60	100	451	501	50×400 ×400 *1	
3	3	823	390	10	60	40	560	652	50×400 ×400	
4	4	785	370	10	60	30	683	750	50×400 ×400	
5	2	823	410	17	60	22*3	390	501	50×50×400	比較例
6	2	823	410	17	60	200*3	500	501	50×50×400 *2	

*1 Ms点直後に金型間へ水を注入。
*2 Ms点直後にプレス機を上昇させ、試験片を直ちに水槽へ投入。
*3 本発明の範囲外の条件

本発明例である試験No. 1～4では、Ms点から200 ℃までの平均冷却速度が適正であるため、得られた硬さは（最高焼入れ硬さ－10）よりも低く、また（最高焼入れ硬さ－100)よりも高い。

比較例である試験No. 5は、臨界冷却速度以上で冷却しているが、Ms点から200 ℃までの平均冷却速度が遅いため、十分な硬さが得られていない。また、やはり比較例である試験No. 6は、Ms点から200 ℃までの平均冷却速度が速すぎるため、硬くなりすぎている。ここに、「硬すぎる」との意味は、硬さの絶対値が高いということではなく、最高焼き入れ硬さに近いということである。

本発明例である試験No. 2の鋼板について、大気雰囲気の加熱炉内で900 ℃×5分加熱して、加熱炉より取り出し、ハット型の熱間プレス成形［ブランクサイズ：1.0 t ×80 W×320 L (mm)］を行った。

このときのハット成形法の模式図を図1に示す。採用した熱間プレス成形条件は、成形高さ70 mm 、Rd（ダイス肩部R） 8 mm、Rp（パンチ肩部R） 8 mm、クリアランス1.0 mm、しわ押さえ力12.7 kN であった。

また、熱間プレス成形品のパンチ底部、側壁中央部、フランジ部について、ビッカース硬さ測定（荷重9.8 N 、測定数：5)を行った。さらに、各部位に熱電対を貼付し、その部位の冷却速度も測定した。結果を表3にまとめて示す。

表3

	Ms点～200 ℃までの平均冷却速度 (℃/s)	熱間プレス後の硬さ (HV)
パンチ底部	55	460
側壁中央部	100	471
フランジ部	120	480

各部位でのMs点から200 ℃までの平均冷却速度が適正であるため、良好な硬さが得られている。また同じ部材中での硬さのばらつきも小さいことがわかる。

請 求 の 範 囲

1．質量%で、C：0.15～0.45%、Mn： 0.5～3.0 %、Cr： 0.1～0.5 %、Ti：0.01～0.1 %、B：0.0002～0.004 %、Si：0.5 %以下、P：0.05%以下、S：0.05%以下、Al：1%以下、N：0.01%以下を含有し、かつNi：2%以下、Cu：1%以下、Mo：1%以下、V：1%以下、およびNb：1%以下の1種または2種以上を含有し、残部Feおよび不可避的不純物から本質的になる鋼組成を有する鋼板を、Ac_3 点以上の温度に加熱・保持した後、最終製品形状への成形を行う方法であって、成形中または成形後の成形温度からの冷却に際して、成形部材のMs点までの冷却速度が臨界冷却速度以上で、かつMs点から200 ℃までの平均冷却速度が25～150 ℃/sで冷却して焼入れ処理を行う、熱間成形法。

2．前記成形をプレス成形用金型を用いて行う請求項1記載の熱間成形法。

3．前記成形をプレス成形用金型を用いて成形後、金型間に水を注入して冷却する請求項1または2記載の熱間成形法。

4．質量%で、C：0.15～0.45%、Mn： 0.5～3.0 %、Cr： 0.1～0.5 %、Ti：0.01～0.1 %、B：0.0002～0.004 %、Si：0.5 %以下、P：0.05%以下、S：0.05%以下、Al：1%以下、N：0.01%以下を含有し、かつNi：2%以下、Cu：1%以下、Mo：1%以下、V：1%以下、およびNb：1%以下の1種または2種以上を含有し、残部Feおよび不可避的不純物から本質的になる鋼組成を有する鋼板から構成され、熱間成形後の硬さが、ビッカース硬さで、（最高焼入れ硬さ－10）未満、かつ（最高焼入れ硬さ－100)以上であることを特徴とする、熱間成形部材。

5．前記熱間成形が熱間プレス成形である請求項4記載の熱間成形部材。

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Filed with Petition for IPR of U.S. Patent No. 9,708,683

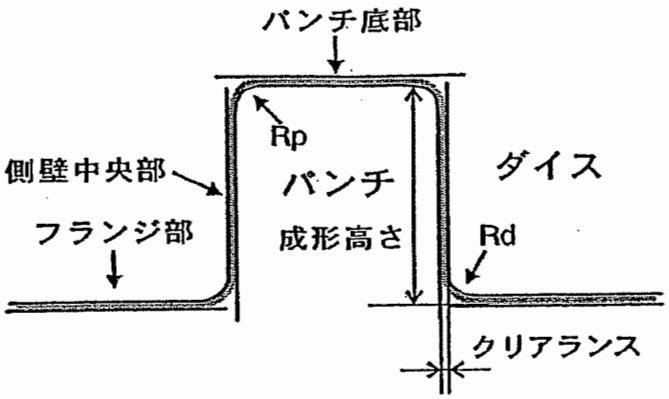


Fig. 1

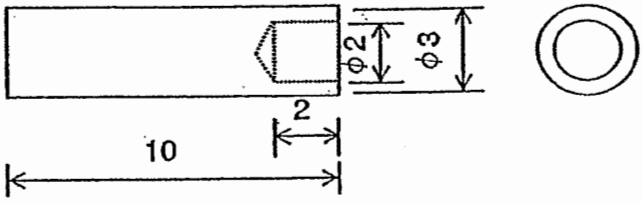


Fig. 2

POSCO Exhibit 1007-0027
Filed with Petition for IPR of U.S. Patent No. 9,708,683

(12)特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2004 年12 月9 日 (09.12.2004)

PCT

(10) 国際公開番号
WO 2004/106573 A1

(51) 国際特許分類[7]: C22C 38/00, 38/58, B21D 5/01, 22/20, C21D 1/02

(21) 国際出願番号: PCT/JP2004/007654

(22) 国際出願日: 2004 年5 月27 日 (27.05.2004)

(25) 国際出願の言語: 日本語

(26) 国際公開の言語: 日本語

(30) 優先権データ:
特願2003-151106 2003 年5 月28 日 (28.05.2003) JP

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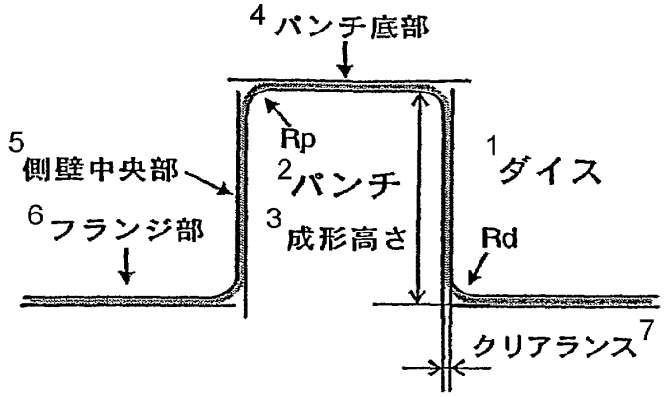
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[続葉有]

(54) Title: METHOD FOR HOT FORMING AND HOT FORMED MEMBER

(54) 発明の名称: 熱間成形法と熱間成形部材



1...DIE
2...PUNCH
3...HEIGHT OF FORMING
4...BOTTOM OF PUNCH
5...CENTER OF SIDE WALL
6...FLANGE
7...CLEARANCE

(57) Abstract: A method for hot forming, wherein in the cooling step of hot pressing, a formed product is first cooled at a rate of a critical cooling rate or higher down to the Ms point thereof and then cooled at a rate of 25 to 150°C/s from the Ms point to 200°C; and a hot pressed member which has been formed by the method and has a Vickers hardness of less than (the maximum quench hardness - 10) and (the maximum quench hardness - 100) or more. The hot pressed member is manufactured from a high strength steel sheet by means of hot pressing and exhibits a stable strength and toughness in combination.

[続葉有]

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POSCO Exhibit 1006-0001
Filed with Petition for IPR of U.S. Patent No. 9,708,683

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(81) 指定国 (表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) 指定国 (表示のない限り、全ての種類の広域保護が可能): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), ヨーロッパ (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

添付公開書類:
— 国際調査報告書

２文字コード及び他の略語については、定期発行される各*PCT*ガゼットの巻頭に掲載されている「コードと略語のガイダンスノート」を参照。

(57) 要約: 高強度鋼板から、安定した強度と靭性を併せ持つ熱間プレス部材を熱間プレスにより作製する。熱間プレス時の冷却過程において、Ms点までは臨界冷却速度以上で冷却し、Ms点から200℃までの温度範囲の冷却速度を25～150℃/sとする。熱間プレス部材のビッカース硬さは、（最高焼入れ硬さ−10）未満、かつ（最高焼入れ硬さ−100)以上である。

POSCO Exhibit 1006-0002
Filed with Petition for IPR of U.S. Patent No. 9,708,683

明　細　書

熱間成形法と熱間成形部材

技術分野

本発明は、自動車のボディー構造部品、足回り部品等を初めとする機械構造部品等の熱間成形部材と、その製造に使用される熱間成形方法に関する。さらに詳述すれば、本発明は、熱間プレス部材とそのための熱間プレス方法に関する。

以下では、熱間プレス成形を例にとって本発明を説明するが、本発明はロール成形、鍛造等のプレス成形以外の熱間成形にも適用可能である。

背景技術

近年、自動車の軽量化のため、例えば引張強さ590 MPa 以上というように鋼材の高強度化を図り、使用重量を減ずる努力が進んでいる。自動車に広く使用される薄鋼板では、そのような傾向の下、鋼板強度の増加に伴って、プレス成形性が低下し、複雑な形状を製造することが困難になってきている。具体的には、強度増加に伴って延性が低下し、加工度が高い部位で破断が生じたり、スプリングバックや壁反りが大きくなり、寸法精度が劣化するという問題が発生する。

従って、高強度、特に引張強さ780 MPa 級以上の鋼板の場合、冷間加工手段としてプレス成形を利用して部品を製造することは容易ではない。プレス成形ではなくロール成形を利用すれば、上記の高強度鋼板の加工が可能であるが、ロール成形は長手方向に一様な断面を有する部品にしか適用できず、適用できる製品の形状が限定される。

一方、英国特許第1490535 号に開示されているように、加熱した鋼板をプレス成形する熱間プレス法では、鋼板を高温で加熱することから、鋼板の材質は軟化して高延性になっているため、加熱状態で複雑な形状を寸法精度よく成形することが可能である。さらに、鋼板をオーステナイト域温度に加熱しておき、金型内で急冷するという金型冷却により、マルテンサイト変態による鋼板の高強度化、即ち、焼入れ、が同時に達成できる。

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Filed with Petition for IPR of U.S. Patent No. 9,708,683

しかし、熱間プレス法における金型冷却では、部材の焼入れ硬さが、0.2 %C材の場合でHv 400～490 と十分ではなく、しかも部材中の硬さのばらつきが非常に大きいという問題がある。

Advanced Materials & Processes, Vol. 146, No. 6, 12/94, p. 16 には、スェーデンのプランジャ社により開発されたホットプレス技術が紹介されており、980 ℃からダイクエンチ（金型内急冷）することが記載されている。金型温度は、加熱との記載がないので、常温～数十℃と推定される。

特開平 8 －269615号には、C：0.18～0.30%、Si：0.01～1.0 %、Mn： 0.2～1.5 %、P：0.03%以下、S：0.02%以下、sol.Al：0.08%以下、Cr： 0.1～0.5 %、B：0.0006～0.0040%、N：0.01%以下を含み、場合によりCu：0.5 %以下、Ni：0.3 %以下、Ti：0.01～0.05%の少なくとも 1 種をさらに含み、残部鉄からなる、急速焼入れ用熱延鋼板が開示されている。この鋼板は、冷間加工した後、高周波焼入れにより高強度化させるものである。

発明の開示

本発明は、熱間成形法により高強度鋼板から製造でき、かつ安定した強度と靱性を併せ持つ熱間成形部材と、それを作製する熱間成形法を提供する。

より具体的には、本発明は、自動車のボディー構造部品、足回り部品等を初めとする機械構造部品等の熱間プレス部材と、その製造に使用される熱間プレス方法を提供する。

本発明によれば、成形後の冷却時、例えば金型冷却時に、Ms点（オーステナイトからマルテンサイトが生成し始める温度）以下の温度域での平均冷却速度を一定範囲内に収めることにより、熱間成形によって安定した強度および靱性を併せ持つ熱間成形部材を製造することができる。

1 態様において、本発明は、質量%で、C：0.15～0.45%、Mn： 0.5～3.0 %、Cr： 0.1～0.5 %、Ti：0.01～0.1 %、B：0.0002～0.004 %、Si：0.5 %以下、P：0.05%以下、S：0.05%以下、Al： 1 %以下、N：0.01%以下を含有し、かつNi： 2 %以下、Cu： 1 %以下、Mo： 1 %以下、V： 1 %以下、およびNb： 1 %以下の 1 種または 2 種以上を含有し、残部Feおよび不可避的不純物から本質

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的になる鋼組成を有する鋼板を、Ac_3 点以上に加熱・保持した後、最終製品形状への成形を行う熱間成形方法に関する。本発明によれば、成形中または成形後の成形温度からの冷却に際して、成形部材のMs点までの冷却速度が臨界冷却速度以上で、かつ、Ms点から200 ℃までの平均冷却速度が25～150 ℃/sで冷却して焼入れ処理を行う。なお、本発明では、臨界冷却速度は上部臨界冷却速度の意味である。

別の態様において、本発明は、上記鋼組成を有する鋼板から構成された熱間成形部材に関する。この熱間成形部材は、熱間成形後の硬さが、ビッカース硬さで、（最高焼入れ硬さ－10）未満、かつ（最高焼入れ硬さ－100)以上、である。

本発明の好適態様において、熱間成形は、プレス成形用金型を用いて行う熱間プレス成形である。

本発明によれば、安定した強度と靱性を併せ持つ熱間プレス部材の作製が可能となる。従って、本発明は、高強度鋼板のプレス成形部材としての用途拡大に大きく寄与する。

図面の簡単な説明

図 1 はハット成形法の模式的説明図である。

図 2 は臨界冷却速度の測定用試験片の形状を示す模式図である。

発明の詳細な説明

本発明において前述した鋼組成および成形条件を採用する理由は次の通りである。本発明において、鋼組成、つまり鋼の化学組成を示す「%」は「質量%」を表す。

1.素地鋼板の組成

C：0.15～0.45%

炭素（C）は、鋼板の焼入れ性を高め、かつ焼入れ後、強度を主に決定する非常に重要な元素である。さらにAc_3 点を下げ、焼入れ処理温度の低温化を促進する元素である。しかし、C含有量が0.15%未満ではその効果は十分ではなく、一方でC含有量が0.45%を超えると、焼入れ部の靱性劣化が著しくなる。好ましい

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C含有量の下限は0.16%、上限は0.35%である。

Mn： 0.5～3.0 %

マンガン（Mn）は、鋼板の焼入れ性を高め、かつ焼入れ後に強度を安定して確保するために非常に効果のある元素である。さらに、Ac_3点を下げ、焼入れ処理温度の低温化を促進する元素である。しかし、Mn含有量が0.5 %未満ではその効果は十分ではなく、一方でMn含有量が3.0 %を超えるとその効果は飽和し、さらに焼入れ部の靱性劣化を招く。好ましいMn含有量は 0.8～2.0 %である。

Cr： 0.1～0.5 %

クロム（Cr）は、鋼板の焼入れ性を高め、かつ焼入れ後、強度を安定して確保するために効果のある元素である。しかし、Cr含有量が0.1 %未満ではその効果は十分ではなく、一方でCr含有量が0.5 %をこえるとその効果は飽和し、いたずらにコスト増を招く。好ましいCr含有量は0.15～0.30%である。

Ti：0.01～0.1 %

チタン（Ti）は、鋼板の焼入れ性を高め、かつ焼入れ後、強度を安定して確保するために効果のある元素である。さらに焼入れ部の靱性も向上させる効果を有する。しかし、Ti含有量が0.01%未満ではその効果は十分ではなく、一方でTi含有量が0.1 %を超えるとその効果は飽和し、いたずらにコスト増を招く。好ましいTi含有量は 0.015～0.03%である。

B：0.0002～0.004 %

ホウ素（B）は、鋼板の焼入れ性を高め、かつ焼入れ後、強度の安定確保効果をさらに高める重要な元素である。しかし、B含有量が0.0002%未満ではその効果は十分ではなく、一方でB含有量が0.004 %を超えるとその効果は飽和し、かつコスト増を招く。好ましいB含有量は0.0005～0.0025%である。

Si：0.5 %以下、P：0.05%以下、S：0.05%以下、Al：1%以下、N：0.01%以下

これらの元素も、いずれも鋼板の焼入れ性を高め、かつ焼入れ後の強度の安定化を高める効果を有する。しかし、それらの含有量が上記のそれぞれの上限を超えると、その効果は飽和し、かえってコスト増を招く。

Ni：2%以下、Cu：1%以下、Mo：1%以下、V：1%以下、Nb：1%以下の

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1種または2種以上

これらの元素も、鋼板の焼入れ性を高め、かつ焼入れ後、強度の安定確保に効果のある元素であるので、1種または2種以上を含有させる。しかし、それぞれ上限値を越えて含有させてもその効果は小さく、かついたずらにコスト増を招くため、各合金元素の含有量は上述の範囲とする。

本発明で使用する鋼板については、成形に先立つ加熱の際にオーステナイト温度域に加熱し、オーステナイト変態をさせるため、加熱前の室温での機械的性質は重要ではなく、加熱前の金属組織については特に制限されない。従って、素地鋼板としては、熱延鋼板、冷延鋼板、めっき鋼板のいずれを使用してもよく、その製造方法については特に限定はしない。めっき鋼板としては、アルミ系めっき鋼板（即ち、アルミめっきおよびアルミ合金めっき鋼板）と亜鉛系めっき鋼板（即ち、亜鉛めっきおよび亜鉛合金めっき鋼板）が例示される。めっき鋼板は、電気めっき鋼板でも、溶融めっき鋼板でもよい。また、合金化溶融亜鉛めっき鋼板も使用できる。

2. 加熱条件および保持時間

熱間プレス時の金型冷却において、成形部材、つまり熱間プレス部材に成形後焼入れ処理を行うためには、まず素地鋼板をオーステナイト温度域まで加熱し、素地鋼板を一度、オーステナイト相にする必要がある。そのためには、Ac_3 点以上に加熱し、その温度で通常の条件では1分以上保持する。保持時間の上限は特には設けないが、実際の生産上の効率を考えて、保持時間の上限を10分程度にするのが望ましい。

3. 熱間プレス時の冷却速度

熱間プレス中（金型内）または熱間プレス後（脱型後）の冷却速度は、熱間プレス部材において安定した強度および靱性を得るために非常に重要な役割を果たすパラメータである。

安定した強度および靱性を熱間プレス部材に付与するためには、熱間プレス後の組織を、完全マルテンサイト組織とするのではなく、自動焼き戻しマルテンサイト組織とすることが肝要である。この自動焼き戻しマルテンサイト組織にするためには、熱間プレス時または熱間プレス後の冷却段階でMs点までは拡散変態が

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起きないように臨界冷却速度以上で冷却し、かつMs点から200 ℃までの温度範囲は平均冷却速度25～150 ℃/sという、遅い冷却速度で冷却する。このような冷却により、マルテンサイト変態が起こると同時に焼き戻しされるため、強度のばらつきが少なく、かつ靱性に優れたマルテンサイト組織が得られる。Ms点から200 ℃までの好ましい平均冷却速度は30～120 ℃/sである。

4.熱間プレス法における成形方法

熱間プレス法における成形の形態としては、曲げ加工、絞り成形、張出し成形、穴拡げ成形、フランジ成形等がある。また、成形と同時またはその直後に鋼板を冷却する手段を備えていれば、プレス成形以外の成形法、例えばロール成形に本発明を適用してもよい。

5.熱間プレス部材

前述の熱間プレス法にて作製された部材は、強度のばらつきが少なく、かつ靱性に優れた焼き戻しマルテンサイト組織を有する部材となる。また、得られる強度は、焼き戻しマルテンサト組織の強度であるため、硬さ（Hv）で言い換えると、（最高焼入れ硬さ－10）よりも低いが、過度に焼き戻されていないため、（最高焼入れ硬さ－100)以上の硬さを有する。Hvの値が（最高焼入れ硬さ－10）より高くなると靱性が低下し、（最高焼入れ硬さ－100)より低くなると強度が低下する。好ましいHvの値は、（最高焼入れ硬さ－20）以下、（最高焼入れ硬さ－80)以上である。

ここに「最高焼入れ硬さ」とは、900 ℃に加熱した塩浴中でその材料を10分間保持後、水冷処理を施した時に得られる硬さである。

6.熱間プレス成形時の冷却方法

通常、鋼製金型は常温または数十℃程度の温度に保持されているから、熱間プレス成形に際して、この鋼製金型によりプレス成形部材の冷却が達成される。従って、冷却速度を変化させるためには、金型寸法を変え熱容量を変化させればよいことが分かる。

また、金型材質を異種金属（例えば銅など）に変えることでも冷却速度を変化させることができる。金型寸法も、材質も変えられない場合、水冷型の金型を用いてそのときの冷却水量を変えることによっても、冷却速度を変えることができ

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る。その場合でも、例えば、予め溝を数カ所切った金型を用い、プレス中に水を溝に通すことによって冷却速度を変えたり、プレス成形途中でプレス機を上げ、その間に水を流すことでもプレス成形部材の冷却速度を変えることができる。

従って、Ms点の前後で冷却速度を変化させる手段には次のような手段が考えられる。

(1) MS点到達直後に、熱容量の異なる金型または室温状態の金型に移動させて、冷却速度を変える。

(2) 水冷金型の場合、MS点到達直後に、金型中を流れる水量を変化させて、冷却速度を変える。

(3) Ms点到達直後に金型と部材の間に水を流し、その水量を変化させることで、冷却速度を変える。

実施例

以下の実施例は本発明を例示するものであるが、本発明はそれによりいかなる制限も受けない。

本例では、表1に示した組成を有する鋼板（板厚：1.0 mm）を素地鋼板とした。これらの鋼板は、実験室にて溶製したスラブを、熱間圧延、冷間圧延により製造した鋼板である。さらに鋼種No.2には、めっきシミュレータを用いて溶融亜鉛めっき（片面あたりのZn付着量は60 g/m²）を施し、その後、合金化処理（めっき皮膜中のFe含有量は15質量%）を行った。

これらの鋼板を40 W×60 L（mm）の寸法に切断し、大気雰囲気の加熱炉内で、900 ℃×5分の加熱を行ってから、加熱炉より取り出し、その直後に、平板の鋼製金型を用いて、熱間プレス成形を行った。鋼種No.2については、冷却条件を変化させて熱間プレス成形を行った（試験No.2, 5, 6）。

得られた熱間プレス部材について、ビッカース硬さ測定（荷重9.8 N、測定数：5）を行った。また鋼板に熱電対を貼付し、プレス成形後の冷却速度の測定も行った。冷却速度については、主に金型寸法を変えて冷却速度を変化させた。

なお、試験No.2については、鋼板温度がMs点に到達した直後に金型間に水を注入し冷却速度を調節した。

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最高焼入れ硬さについては、900 ℃に加熱した塩浴中でその材料を10分間保持後、水冷処理を施した時に得られる硬さを最高焼入れ硬さとした。

得られた結果を、次の方法で測定した各鋼種のAc_3 点、Ms点、および臨界冷却速度と共に表 2 にまとめて示す。

熱延鋼板から直径3.0 mm、長さ10 mm の円柱試験片（図 2 ）を切り出し、大気中で950 ℃まで10℃/sの昇温速度にて加熱し、その温度で 5 分間保持したのち、種々の冷却速度で室温まで冷却した。そのときの加熱、冷却中の試験片の熱膨張変化を測定することにより、Ac_3 点、Ms点を測定した。また、得られた試験片のビッカース硬度測定（荷重49N 、測定数： 5 ）および組織観察を行い、それらの結果から臨界冷却速度を見積もった。

表 1

鋼種No.	化学組成（質量%、残部：実質的にFe）														
	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	Ti	Nb	Al	B	N
1	0.16	0.02	1.36	0.019	0.004	0.01	0.01	0.19	—	0.01	0.03	—	0.06	0.0013	0.008
2	0.21	0.25	1.20	0.008	0.002	0.01	0.02	0.20	—	0.01	0.02	0.01	0.05	0.0007	0.005
3	0.33	0.11	1.53	0.001	0.001	—	—	0.20	—	—	0.02	—	0.04	0.0015	0.001
4	0.42	0.11	1.51	0.001	0.001	—	—	0.20	0.01	—	0.02	—	0.04	0.0014	0.001

表 2

試験No.	鋼種No.	Ac_3 点 (℃)	Ms 点 (℃)	臨界冷却速度 (℃/s)	Ms点近の実測冷却速度 (℃/s)	Ms点～200℃の平均冷却速度 (℃/s)	熱間プレス後の硬さ (HV)	最高焼入れ硬さ (HV)	金型サイズ (t×W×L mm)	備考
1	1	860	450	25	60	40	418	461	50×400 ×400	発明例
2	2	823	410	17	60	100	451	501	50×400 ×400 *1	
3	3	823	390	10	60	40	560	652	50×400 ×400	
4	4	785	370	10	60	30	683	750	50×400 ×400	
5	2	823	410	17	60	22*3	390	501	50×50×400	比較例
6	2	823	410	17	60	200*3	500	501	50×50×400 *2	

*1 Ms点直後に金型間へ水を注入。
*2 Ms点直後にプレス機を上昇させ、試験片を直ちに水槽へ投入。
*3 本発明の範囲外の条件

本発明例である試験No. 1～4では、Ms点から200 ℃までの平均冷却速度が適正であるため、得られた硬さは（最高焼入れ硬さ－10）よりも低く、また（最高焼入れ硬さ－100)よりも高い。

比較例である試験No. 5は、臨界冷却速度以上で冷却しているが、Ms点から200 ℃までの平均冷却速度が遅いため、十分な硬さが得られていない。また、やはり比較例である試験No. 6は、Ms点から200 ℃までの平均冷却速度が速すぎるため、硬くなりすぎている。ここに、「硬すぎる」との意味は、硬さの絶対値が高いということではなく、最高焼き入れ硬さに近いということである。

本発明例である試験No. 2の鋼板について、大気雰囲気の加熱炉内で900 ℃×5分加熱して、加熱炉より取り出し、ハット型の熱間プレス成形［ブランクサイズ：1.0 t ×80 W×320 L (mm)］を行った。

このときのハット成形法の模式図を図1に示す。採用した熱間プレス成形条件は、成形高さ70 mm 、Rd（ダイス肩部R） 8 mm、Rp（パンチ肩部R） 8 mm、クリアランス1.0 mm、しわ押さえ力12.7 kN であった。

また、熱間プレス成形品のパンチ底部、側壁中央部、フランジ部について、ビッカース硬さ測定（荷重9.8 N 、測定数：5)を行った。さらに、各部位に熱電対を貼付し、その部位の冷却速度も測定した。結果を表3にまとめて示す。

表3

	Ms点～200 ℃までの平均冷却速度 (℃/s)	熱間プレス後の硬さ (HV)
パンチ底部	55	460
側壁中央部	100	471
フランジ部	120	480

各部位でのMs点から200 ℃までの平均冷却速度が適正であるため、良好な硬さが得られている。また同じ部材中での硬さのばらつきも小さいことがわかる。

請 求 の 範 囲

1．質量%で、C：0.15～0.45%、Mn： 0.5～3.0 %、Cr： 0.1～0.5 %、Ti：0.01～0.1 %、B：0.0002～0.004 %、Si：0.5 %以下、P：0.05%以下、S：0.05%以下、Al：1%以下、N：0.01%以下を含有し、かつNi：2%以下、Cu：1%以下、Mo：1%以下、V：1%以下、およびNb：1%以下の1種または2種以上を含有し、残部Feおよび不可避的不純物から本質的になる鋼組成を有する鋼板を、Ac_3 点以上の温度に加熱・保持した後、最終製品形状への成形を行う方法であって、成形中または成形後の成形温度からの冷却に際して、成形部材のMs点までの冷却速度が臨界冷却速度以上で、かつMs点から200 ℃までの平均冷却速度が25～150 ℃/sで冷却して焼入れ処理を行う、熱間成形法。

2．前記成形をプレス成形用金型を用いて行う請求項1記載の熱間成形法。

3．前記成形をプレス成形用金型を用いて成形後、金型間に水を注入して冷却する請求項1または2記載の熱間成形法。

4．質量%で、C：0.15～0.45%、Mn： 0.5～3.0 %、Cr： 0.1～0.5 %、Ti：0.01～0.1 %、B：0.0002～0.004 %、Si：0.5 %以下、P：0.05%以下、S：0.05%以下、Al：1%以下、N：0.01%以下を含有し、かつNi：2%以下、Cu：1%以下、Mo：1%以下、V：1%以下、およびNb：1%以下の1種または2種以上を含有し、残部Feおよび不可避的不純物から本質的になる鋼組成を有する鋼板から構成され、熱間成形後の硬さが、ビッカース硬さで、（最高焼入れ硬さ－10）未満、かつ（最高焼入れ硬さ－100)以上であることを特徴とする、熱間成形部材。

5．前記熱間成形が熱間プレス成形である請求項4記載の熱間成形部材。

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1/1

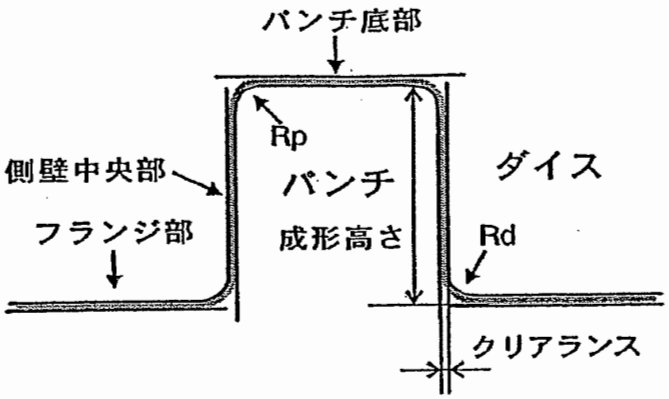


Fig. 1

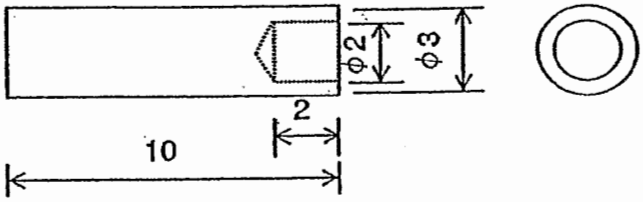


Fig. 2

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/007654

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] C22C38/00, C22C38/58, B21D5/01, B21D22/20, C21D1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] C22C38/00, C22C38/58, B21D5/01, B21D22/20, C21D1/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2004
Kokai Jitsuyo Shinan Koho 1971-2004 Jitsuyo Shinan Toroku Koho 1996-2004

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2001-353548 A (USINOR), 25 December, 2001 (25.12.01), Full text & US 6564604 B2 & EP 1143029 A1	1-5
Y	JP 2003-147499 A (Sumitomo Metal Industries, Ltd.), 21 May, 2003 (21.05.03), Full text & EP 1439240 A1 & WO 03/35922 A1	1-5
Y	JP 2002-309345 A (NKK Corp.), 23 October, 2002 (23.10.02), Full text & US 2003/121576 A1 & WO 02/63058 A1 & EP 1359235 A1	1-5

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 August, 2004 (16.08.04)	31 August, 2004 (31.08.04)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/007654

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2002-180186 A (Nippon Steel Corp.), 26 June, 2002 (26.06.02), Full text (Family: none)	1-5
A	JP 2002-241895 A (Kobe Steel, Ltd.), 28 August, 2002 (28.08.02), Full text & EP 1215297 A2 & US 2002/114724 A1	1-5
A	JP 2944540 B2 (Kobe Steel, Ltd.), 06 September, 1999 (06.09.99), Full text (Family: none)	1-5

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

国際調査報告

国際出願番号　PCT／JP2004／007654

A.　発明の属する分野の分類（国際特許分類（IPC））

Int. Cl⁷　C22C38／00, C22C38／58, B21D5／01, B21D22／20
C21D　1／02

B.　調査を行った分野

調査を行った最小限資料（国際特許分類（IPC））

Int. Cl⁷　C22C38／00, C22C38／58, B21D5／01, B21D22／20
C21D　1／02

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報　1922－1996年
日本国公開実用新案公報　1971－2004年
日本国登録実用新案公報　1994－2004年
日本国実用新案登録公報　1996－2004年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

WPI

C.　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
Y	JP　2001－353548　A（ユジノール） 2001．12．25，全文 & US　6564604　B2 & EP　1143029　A1	1-5
Y	JP　2003－147499　A（住友金属工業株式会社） 2003．05．21，全文 & EP　1439240　A1 & WO　03／35922　A1	1-5

☒ C欄の続きにも文献が列挙されている。　☐ パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー
「A」特に関連のある文献ではなく、一般的技術水準を示すもの
「E」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
「L」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
「O」口頭による開示、使用、展示等に言及する文献
「P」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
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国際調査を完了した日	国際調査報告の発送日
16．08．2004	31.8.2004

国際調査機関の名称及びあて先	特許庁審査官（権限のある職員）		
日本国特許庁（ISA／JP） 郵便番号100－8915 東京都千代田区霞が関三丁目4番3号	鈴木　正紀	4K	3237
	電話番号　03－3581－1101　内線　3435		

様式PCT／ISA／210（第2ページ）（2004年1月）

POSCO Exhibit 1006-0016
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Ｙ	ＪＰ　２００２－３０９３４５　Ａ（日本鋼管株式会社） ２００２．１０．２３，全文 ＆　ＵＳ　２００３／１２１５７６　Ａ１ ＆　ＷＯ　０２／６３０５８　Ａ１ ＆　ＥＰ　１３５９２３５　Ａ１	1-5
Ｙ	ＪＰ　２００２－１８０１８６　Ａ（新日本製鐵株式会社） ２００２．０６．２６，全文（ファミリーなし）	1-5
Ａ	ＪＰ　２００２－２４１８９５　Ａ（株式会社神戸製鋼所） ２００２．０８．２８，全文 ＆　ＥＰ　１２１５２９７　Ａ２ ＆　ＵＳ　２００２／１１４７２４　Ａ１	1-5
Ａ	ＪＰ　２９４４５４０　Ｂ２（株式会社神戸製鋼所） １９９９．０９．０６，全文（ファミリーなし）	1-5

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Filed with Petition for IPR of U.S. Patent No. 9,708,683

Electronic Acknowledgement Receipt

EFS ID:	36519894
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	William C. Gehris/Simon Steiner
Filer Authorized By:	William C. Gehris
Attorney Docket Number:	11020631.1028con5
Receipt Date:	08-JUL-2019
Filing Date:	16-MAY-2019
Time Stamp:	16:29:47
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	IDSJuly2019.PDF	1037535 1c59c0f549de6034ed43b3d4fe54e268fa64b980	no	6

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New International Application Filed with the USPTO as a Receiving Office

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	16413799
	Filing Date	2019-05-16
	First Named Inventor	Drillet
	Art Unit	1784
	Examiner Name	TBD
	Attorney Docket Number	20631.1028CON5

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7867344	B2	2011-01-11	Kusumi et al.	
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	1	20040238080	A1	2004-12-02	Vandeputte et al.	

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	1	2004106573	WO	A1	2004-12-09	SUMITOMO METAL IND	See English translation	
	2	2833504	FR	A1	2003-06-20	Laurent et al.	See English translation	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	3	1013785	FR	B1	2006-10-25	Laurent	See English translation	
	4	2006051543	JP	A	2006-02-23	Kusumi et al.	See English machine translation, also e.g. US 7867344	

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	1	Mahesh C. Somani, et al., "Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process," ISIJ International, 2001, Volume 41, Issue 4, Pages 361-367 ("Somani")	
	2	Declaration of Mel Desart, dated April 16, 2019, relating to attached "High Strength Steels for Automotive Safety Parts," SAE Technical Paper 2001-01-0078. 2001, by Cornette, D., Hourman, T., Hudin, O., Laurent, J., and Reynaert, A."	
	3	Declaration Dr. Michael Miles, dated June 28, 2019 as filed in IPR2019-01275, US Patent No. 9,708,683	
	4	Declaration of Mel Desart, dated May 30, 2019, relating to attached "High Strength Steels for Automotive Safety Parts," SAE 2001 Transactions Journal of Materials & Manufacturing-V110-5, by Corneae, D., Hourman, T., Hudin, 0., Laurent, J., and Reynaert, A."	
	5	Declaration of Dr. Michael L. Knott dated April 22, 2019 realting to attached Somani (Mahesh C. Somani, et al., 'Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process," ISIJ International, 2001, Volume 41, Issue 4, Pages 361-367 ("Somani")) from University of Michigan's Art, Architecture, and Engineering Library's Technical Services Department	
	6	Publication History from SAE Mobilus, dated May 30, 2019 for Cornette et al., "High Strength Steels for Automotive Safety Parts" SAE Technical Paper Series 2001-01-0078, March 24 001, ISSN: 0148-7191	
	7	Fekete, J., Stibich, A., and Shi, M., "A Comparison of the Response of HSLA and Dual Phase Sheet Steel in Dynamic Crush," SAE Technical Paper 2001-01-3101, 2001	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	Drillet
	Art Unit	1784
	Examiner Name	TBD
	Attorney Docket Number	20631.1028CON5

	8	Robert R. Mayer, "Theoretical Effects of Hydroforming on Crashworthiness of Straight Sections," ASME International Mechanical Engineering Congress and Exposition, Applied Mechanics (2004):591-603
	9	Publication History from ISIJ International for "Mahesh C. Somani, et al., "Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process," ISIJ International, 2001, Volume 41, Issue 4, Pages 361-367 ("Somani")"
	10	Webster's New Twentieth Century Dictionary (2nd ed. 1964), published by The World Publishing Company
	11	Random House Webster's Unabridged Dictionary (2nd ed. 1998), Random House New York
	12	ASM Materials Engineering Dictionary, ASM INternational, The Materials Information Society, 1992
	13	Dictionary of Materials and Manufacturing, Nichols Publishing: New York, 1990
	14	McGraw-Hill Dictionary of Scientific and Technical Terms, Sixth Edition, 2003
	15	Certified Translation of "alliation" and "alliage"
	16	Ahindra Ghosh, "Secondary Steelmaking, Principles and Applications" (2001), CRC Press
	17	Åkerström, P. et al., "Material parameter estimation for boron steel from simultaneous cooling and compression experiments," Modelling and Simulation in Materials Science and Engineering. 2005, Vol.13, No.8, p.1291
	18	ASTM Dictionaly of Engineering Science & Technology, ASTM International 2005

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	Art Unit	1784
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	Attorney Docket Number	20631.1028CON5

	19	Chambers Dictionary of Science and Technology, Tenth edition, 1999
	20	Webster's Third New International Dictionary of the English Language Unabridged, 2003
	21	Engels, H. et al., "Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels." – p. 135-50 ("Engels"), published in Liewald, M. (Ed.). "New developments in sheet metal forming": Frankfurt a.M.: MATINFO, Werkstoff-Informationsges (2006)
	22	Declaration of Marcel Thoms of University of Stuttgart dated June 7, 2019 relating to attached "Engels, H. et al., "Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels." – p. 135-50 ("Engels"), published in Liewald, M. (Ed.). "New developments in sheet metal forming": Frankfurt a.M.: MATINFO, Werkstoff-Informationsges (2006)"
	23	Certified translation of "Stahl"
	24	Preliminary Opinion issued on June 19, 2019 in opposition proceedings of European Patent Application 06842403.5

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	Filing Date	2019-05-16
	First Named Inventor	Drillet
	Art Unit	1784
	Examiner Name	TBD
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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jennifer L. O'Connell/	Date (YYYY-MM-DD)	2019-07-08
Name/Print	Jennifer L. O'Connell	Registration Number	57392

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	Application Number	16413799
	Filing Date	2019-05-16
	First Named Inventor	Drillet
	Art Unit	
	Examiner Name	
	Attorney Docket Number	20631.1028CON5

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	Attorney Docket Number	20631.1028CON5

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The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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Signature	/Jennifer L. O'Connell/	Date (YYYY-MM-DD)	2019-06-04
Name/Print	Jennifer L. O'Connell	Registration Number	57392

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Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	William C. Gehris/Simon Steiner
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Attorney Docket Number:	11020631.1028con5
Receipt Date:	04-JUN-2019
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Application Type:	Utility under 35 USC 111(a)

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	2	7559998	B2	2009-07-14	Nishibata et al.	
	3	8307680		2012-11-13	Drillet et al.	
	4	9708683		2017-07-18	Drillet et al.	
	5	8127449	B2	2012-03-06	Bayer et al.	
	6	7137201		2006-11-21	Brodt et al.	
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	1	3290199	EP	A1	2018-03-07	Drillet	In English	
	2	2758571	FR	A	1998-07-24	Lorraine	See English Abstract and EPO machine translation	
	3	2006097593	WO	A	2006-09-21	Laurent	See US 2008/0283156	
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	9	2012048841	WO	A1	2012-04-19	Tata Steel IJMUIDEN B. V.	In English	
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	17	3931251	JP		2007-06-13	Laurent	See US 6296805	
	18	2005009642	WO		2005-02-03	Bayer	See US 8127449	
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	20	H11156293	JP		1999-06-15	Kada	See English Abstract and EPO machine translation	
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	24	2007522345	JP		2007-08-09		See US 20070163683	
	25	1829813	CN		2006-09-06	Sumitomo Metal Ind	See US 7559998	
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	28	720079	FR		1995-11-24	FR DE FILETAGE INDESSERRABLE D	See English Abstract and EPO machine translation	
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	1	Raviere et al, Hot Stamping Experiment and Numerical Simulation of Pre-coated USIBOR1500 Quenchable Steels, SAE 2003-01-2859, 2003	
	2	Merklein, M et al., "Einflussgrößen im Presshärteprozess" Tagungsband 4. Chemnitzer Karosseriekolloquium, November 2005, ISSN: 3-937524-33-9, see English translation	
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	Application Number	16413799
	Filing Date	2016-05-16
	First Named Inventor	Drillet
	Art Unit	
	Examiner Name	
	Attorney Docket Number	20631.1028CON5

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	Attorney Docket Number	20631.1028CON5

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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Signature	/Jennifer L. O'Connell/	Date (YYYY-MM-DD)	2019-06-04
Name/Print	Jennifer L. O'Connell	Registration Number	57392

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EFS ID:	36194058
Application Number:	16413799
International Application Number:	
Confirmation Number:	7637
Title of Invention:	Coated Steel Strips, Coated Stamped Products and Methods
First Named Inventor/Applicant Name:	Pascal DRILLET
Customer Number:	23280
Filer:	William C. Gehris/Simon Steiner
Filer Authorized By:	William C. Gehris
Attorney Docket Number:	11020631.1028con5
Receipt Date:	04-JUN-2019
Filing Date:	16-MAY-2019
Time Stamp:	17:35:42
Application Type:	Utility under 35 USC 111(a)

Payment information:

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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 290 199 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.03.2018 Bulletin 2018/10

(51) Int Cl.:
B32B 15/00 *(2006.01)* ***C21D 9/46*** *(2006.01)*

(21) Application number: **17192410.3**

(22) Date of filing: **30.10.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
06842403.5 / 2 086 755

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Remarks:
This application was filed on 21.09.2017 as a divisional application to the application mentioned under INID code 62.

(54) COATED STEEL STRIPS, METHODS OF MAKING THE SAME, METHODS OF USING THE SAME, STAMPING BLANKS PREPARED FROM THE SAME, STAMPED PRODUCTS PREPARED FROM THE SAME, AND ARTICLES OF MANUFACTURE WHICH CONTAIN SUCH A STAMPED PRODUCT

(57) Coated steel having a well defined and uniform thickness is useful and advantageous for preparing products by hot stamping. Products prepared by hot stamping such a steel are particularly advantageous when subjected to a subsequent spot welding step.

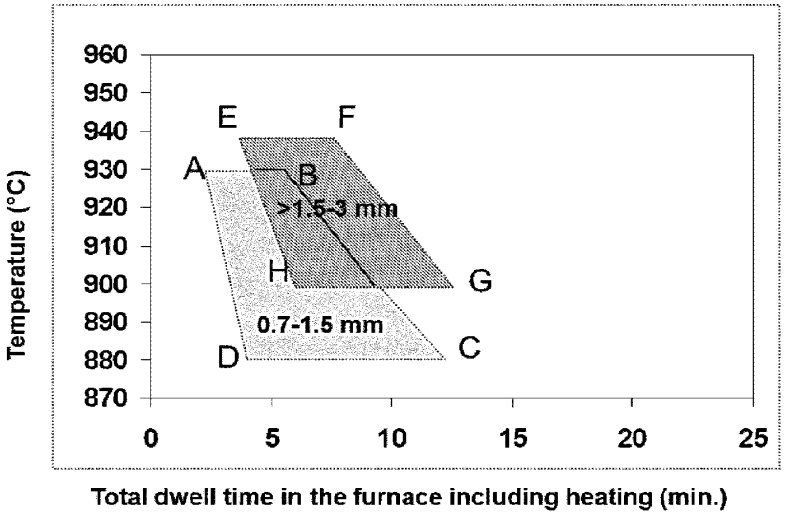


FIG.7

EP 3 290 199 A1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to, among other things, coated steels, methods of making such coated steels, including hot dipping, methods of using such coated steels, stamping blanks prepared from coated steels, stamped products prepared from coated steels, and to various uses of the invention products such as in spot welding, etc.

[0002] Additional advantages and other features of the present invention will be set forth in part in the description that follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from the practice of the present invention. The advantages of the present invention may be realized and obtained as particularly pointed out in the appended claims. As will be realized, the present invention is capable of other and different embodiments, and its several details are capable of modifications in various obvious respects, all without departing from the present invention. The description is to be regarded as illustrative in nature, and not as restrictive.

BACKGROUND OF THE INVENTION

[0003] In recent years the use of pre-coated steels in hot-stamping processes for the shaping of parts has become important, especially in the automotive industry. Fabrication of such parts may include the following main steps:

- Pre-coating of a steel sheets, by hot dipping
- Trimming or cutting for obtaining blanks
- Heating the blanks in order to obtain alloying of the steel substrate with the pre-coating, as well as the austenitizing of the steel
- Hot forming followed by rapid cooling of the part in order to obtain predominantly martensitic structures

See for Example U.S. 6,296,805, incorporated herein by reference.

[0004] Thanks to an alloying of the pre-coating with the steel substrate, which has the effect of creating intermetallic alloys with high melting temperature, the blanks having such coating may be heated in a temperature range where austenitizing of the metallic substrate takes place, allowing further hardening by quenching.

[0005] Heat treatments of the blanks in view of the intermetallic alloying of the coating and austenitizing of the substrate are most frequently performed in furnaces, where blanks are traveling on rollers. The thermal cycles experienced by the blanks include first a heating phase whose rate is a function of parameters such as blank thickness, furnace temperature, traveling speed, and coating reflectivity. After this heating phase, thermal cycles generally include a holding phase, whose temperature is the regulation temperature of the furnace. Problems however are experienced with the furnace operation: the rollers may become fouled by metallic deposits which come from the pre-coating of the blanks. If these deposits are excessive, maintenance of the rollers has to be performed and productivity is decreased.

[0006] Parts obtained after heating and rapid cooling display very high mechanical resistance and may be used for structural applications, for example for automotive industry applications. These parts must be frequently welded with others and high weldability is required. This means that:

- The welding operation should be performable in a sufficiently wide operating range in order to guarantee that an eventual drift of the nominal welding parameters has no incidence on weld quality. For resistance welding, which is very common in the automotive industry, an operating welding range is defined by the combination of parameters: welding current intensity I and force F applied of the parts during welding being among the most important. A proper combination of these parameters helps to ensure that insufficient nugget diameter is not obtained (caused by too low intensity or too low force) and that no weld expulsion occurs.
- The welding operation should also be performed in such a way that high mechanical resistance is obtained on the weld. This mechanical resistance may be evaluated by tests such as by shear-tensile tests or cross-tensile tests.

[0007] There remains a need for coated steels which may be conveniently used to prepare shaped parts by a stamping process. There also remains a need for coated steels which may be used to prepare shaped parts by a stamping process which are suitable for welding. There also remains a need for processes for preparing such coated steels and stamped parts.

SUMMARY OF THE INVENTION

[0008] The inventors have discovered that certain coated steels in which a base steel strip is at least partially coated (sometimes termed "pre-coated," this prefix indicating that a transformation of the nature of the pre-coating will take place during heat treatment before stamping) on at least one side with a coating of either aluminum or an aluminum alloy and in which the coating has a defined thickness and is preferably substantially uniform, are conveniently formed into shaped parts after heating by stamping and are conveniently welded. In addition, the inventors have discovered that the roller fouling problem described above generally arises from an insufficient degree of intermetallic alloying between the substrate and the metallic pre-coating. Furthermore, it was discovered that the location of the fouling of the rollers corresponds to zones of the blanks in contact with the rollers where

the metallic pre-coating thickness locally exceeds the average thickness. While not bound by a particular theory, it is believed that if a pre-coating is locally too thick, intermetallic alloying is insufficient and the pre-coating melts, fouling the rollers. Thus, the inventors have discovered that the control of the homogeneity of the pre-coating thickness over the entire sheet within given tolerances is an important factor for obtaining the desired degree of intermetallic alloying, allowing one to improve the resistance to the subsequent melting of the coating during travel on rollers.

[0009] The inventors have also discovered that particularly good weldability of aluminized and hot stamped parts is associated with a special succession of coating layers on the parts, proceeding from steel substrate outwards.

[0010] The inventors have also discovered that a specific combination of transfer time between the heating furnace and the stamping die, the amount of deformation during stamping, the temperature of stamping, the cooling rate of the product during stamping, leads to the fabrication of a part with a fully homogeneous martensitic structure and that an increase in ductility or energy absorption of the parts after stamping is obtained by a reduction of sulfur below a critical value, these two benefits being obtained with or without the invention aluminum/aluminum alloy coating, and with other coatings.

OBJECTS OF THE INVENTION

[0011] Accordingly, and in view of the above, it is one object of the present invention to provide novel pre-coated steels strips which may be conveniently processed into stamping blanks.

[0012] It is another object of the present invention to provide novel pre-coated steels strips or sheets which may be conveniently formed into parts by stamping.

[0013] It is another object of the present invention to provide novel coated steels which may be conveniently formed into parts by hot stamping.

[0014] It is another object of the present invention to provide novel methods for making such a coated steel.

[0015] It is another object of the present invention to provide novel stamping blanks which are prepared from such a coated steel.

[0016] It is another object of the present invention to provide novel methods of making such stamping blanks.

[0017] It is another object of the present invention to provide novel stamped parts which are prepared from such a coated steel.

[0018] It is another object of the present invention to provide novel methods of making such stamped parts.

[0019] It is another object of the present invention to provide novel articles of manufacture, such as a motor vehicle, which contain such stamped parts.

[0020] It is another object of the present invention to provide novel stamped parts.

[0021] It is another object of the present invention to provide novel methods of making welded stamped parts.

[0022] It is another object of the present invention to provide novel articles of manufacture, such as a motor vehicle, which contain such welded stamped parts.

[0023] It is another object of the present invention to provide novel welded coated steels and welded stamping blanks.

[0024] It is another object of the present invention to provide novel methods of making such welded coated steels and welded stamping blanks.

[0025] These and other objects, which will become apparent during the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Figure 1 illustrates a preferred embodiment of an invention coated part, after heat treatment and stamping. The succession of layers of the coating on the steel substrate is: (a) interdiffusion layer; (b) intermediate layer; (c) Intermetallic layer; and (d) superficial layer. This arrangement is particularly favorable for the further welding of the part.

Figure 2 illustrates a coating of a steel substrate after heat treatment and stamping which does not correspond to the invention. This succession of layers (interdiffusion layer and intermetallic layer) yields inferior results in resistance spot welding.

Figure 3 illustrates a microstructure of a steel part, hot stamped and cooled under conditions not according to the invention.

Figure 4 illustrates the microstructure of a steel part, hot stamped and cooled according to a preferred set of conditions according to the invention.

Figure 5 illustrates the influence of sulfur on the bending angle of parts after hot stamping.

Figure 6 illustrates the influence of sulfur on the initiation energy of fracture of parts after hot stamping.

Figure 7 shows conditions of furnace temperature as a function of the total dwell time in the furnace for sheets of total thicknesses of from 0.7-1.5 and 1.5-3 mm that provide particularly favorable coatings for welding.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] As noted above, the inventors' discovery that certain coated steels, in which a base steel is at least partially pre-coated on at least one side with a coating of either aluminum or an aluminum alloy and in which the pre-coating has a defined thickness and is substantially uniform, are conveniently formed into shaped parts by stamping, forms one basis for the invention.

[0028] In the context of the present invention, the terms first side (or side 1) and second side (or side 2) of the strip or sheet, etc., of base steel refer to the two large,

opposite-facing, surfaces which have a surface area defined by the length and width of the strip of base steel. In contrast, the side edges of the strip of base steel are the two small, opposite-facing, surfaces which have a surface area defined by the length and thickness of the strip. The top and bottom edges of the strip of base steel are the two small, opposite-facing, surfaces which have a surface area defined by the width and thickness of the strip. In the following, t_p designates the thickness of the pre-coating, at any considered location on the sides 1 and 2 of a sheet or a blank. In particular, in the case of sheets coated on two sides 1 and 2, t_{p1} stands for the thickness on side 1, and t_{p2} for the thickness on side 2. According to a highly preferred embodiment t_p is controlled in a precise range, expressed by (t_{pmin}, t_{pmax}), in order to improve the resistance to the fouling of the rollers. The thickness is preferably controlled, both in the longitudinal (or rolling) direction of the strip or sheet, as well in the transverse direction.

[0029] In relation to the problem of the fouling of rollers, the control of the pre-coating thickness on the side of the sheet or blank which is directly in contact with the rollers is especially important. Because different operations can follow the step of coating the steel sheet (for example hot-dip-coating which provides coated sides 1 and 2), it is preferable to carefully control the pre-coating on both sides of the sheet. For example, after any of coiling, handling, cutting, punching, etc., sides 1 and 2 may be not readily identifiable. But when control of t_p is effected on the two sides of the sheet that has been coated (first side and second side) it is not necessary to track sides 1 and 2 as neither side will foul the roller. In addition, it is not necessary to trim the sheet in order to obtain a preferred smaller sheet having a more uniform homogeneity of pre-coating thickness, thus providing a sheet that is pre-coated by, e.g., hot-dipping. In other words, important benefits are obtained when one controls the pre-coating minimum and maximum thickness of the first side (t_{pmin1}, t_{pmax1}) and the pre-coating minimum and maximum thickness of the second side (t_{pmin2}, t_{pmax2}) of the subject steel sheet or blank.

Hot-dip coated steels are the preferred steels herein. However, regardless of the coating method, the pre-coating thickness on one or both sides of the sheet can be measured and monitored continuously on a coating line directly after the coating operation. This may be realized by devices known per se, such as thickness gages relying on X-Ray absorption. At every moment, the measurement of thickness at a given location may be performed for example on an area of a few hundreds of mm^2, this representing the dimension of the zone irradiated by X-Ray.

[0030] In a preferred embodiment, a plurality of such devices are positioned at different distances in the transverse direction of the strip in order to obtain a profile of the thickness of the pre-coating along the strip width.

[0031] The inventors have discovered that the resistance to the pollution or fouling of the rollers in the furnaces is improved when the minimum and maximum thickness respectively of at least one of the first side (t_{pmin1}, t_{pmax1}) and the second side (t_{pmin2}, t_{pmax2}) are respectively equal to 20 and 33 micrometers (a micrometer is the same as a micron and is a metric unit of length equal to one millionth of a meter). In other words, in a preferred embodiment, at every location on at least one face of the sheet or the blank, the thickness t_p of the pre-coating is preferably from 20 - 33 micrometers in thickness, including 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31 and 32 micrometers and all ranges and subranges therebetween, and including all numbers between each listed value as if written out in its entirety (e.g., 22.34 micrometers). For hot-dip coating, precise control of this range of pre-coating thickness can be realized on an operating line for example using a system of nozzles blowing gas after coating, for example after exit of the strip or sheet from a bath, and by the flatness of the strip. Number, geometry and location of the nozzles, and flow rates are among the main parameters for a precise control of the thickness t_p. Given the present disclosure, one of ordinary skill in this art can control the pre-coating thickness as described herein without undue labor.

The invention refers to strips produced in industrial conditions, i.e. where control of pre-coating thickness is effective over a wide surface strip, i.e. with a length greater than 100m, and with a width greater than 600mm. In such a way, blanks cut or trimmed out these strips display very high homogeneity of pre-coating thickness, and the settings of the heating treatments in the furnace do not have to be changed for being adapted to eventual variations of this thickness.

[0032] While not bound by a particular theory of operation, the inventors believe that several of the benefits of the invention are related to this pre-coating thickness range, such as the following :

- For a pre-coating thickness less than 20 micrometers, the alloyed layer which is formed during the heating of the blank has an insufficient roughness. Thus, the adhesion of subsequent painting is low on this surface, and the corrosion resistance is decreased.
- If the pre-coating thickness is more than 33 micrometers at a given location on a sheet, the risk is that the difference of thickness between this location and some other locations where the pre-coating is thinner, becomes too important : The settings of the heating treatment in the furnace may be adapted to the thinner value of the pre-coating, but not to the thicker one. Thus, the alloying reaction forming the intermetallic alloy may take place to an insufficient degree since the mean diffusion distance of the elements in the pre-coating becomes significantly less than the local value of the pre-coating thickness. As a matter of results, alloying will become much more difficult in the external (or superficial) part, particularly in the case of high heating rate.

[0033] Thus, in a first embodiment, the present invention provides certain coated steel strips, which comprise a strip of base steel and a pre-coating of aluminum or an aluminum alloy on at least a part of one side of the strip of the base steel. For many applications, the strip of base steel may comprise any type of steel which may be coated with either aluminum or an aluminum alloy. However, for certain applications, such as a structural part of an automobile, it is preferred that the strip of base steel comprise an ultra high strength steel (UHSS). In such cases, it is particularly preferred that the strip of base steel comprises a boron steel.

[0034] The inventors have also discovered that good welding results are achieved if the coating obtained on parts made out of blanks having undergone intermetallic alloying, austenitizing and hot stamping, displays distinctive features. It must be pointed out that this coating is different from the initial pre-coating, since the thermal treatment causes an alloying reaction with the steel substrate which modifies both the physico-chemical nature and the geometry of the pre-coating : in this regard, the inventors have discovered that particularly good weldability of aluminized and hot stamped parts is associated with the following succession of coating layers on the parts, proceeding from steel substrate outwards :

- (a) Interdiffusion layer,
- (b) Intermediate layer,
- (c) Intermetallic layer,
- (d) Superficial layer

See, e.g., Figure 1. In a preferred embodiment these layers are as follows:

- (a) Interdiffusion layer, preferably with medium hardness (e.g., HV50g between 290 and 410, HV50g designating the hardness measured under a load of 50 grams) In a preferred embodiment this layer has the following composition, by weight: 86-95%Fe, 4-10%Al, 0-5%Si
- (b) Intermediate layer (HV50g around 900 - 1000 e.g., +/- 10%)) In a preferred embodiment this layer has the following composition, by weight: 39-47% Fe, 53-61%Al, 0-2%Si
- (c) Intermetallic layer, with hardness HV50g around 580-650, e.g., +/- 10%) In a preferred embodiment this layer has the following composition, by weight: 62-67%Fe, 30-34 %Al, 2-6%Si
- (d) Superficial layer (HV50g around 900 - 1000 e.g., +/- 10%))

[0035] In a preferred embodiment this layer has the following composition, by weight: 39-47% Fe, 53-61 %Al, 0-2%

[0036] In a preferred embodiment the total thickness of layers (a) to (d) is greater than 30 micrometers.

[0037] In another preferred embodiment, the thickness of layer (a) is less than 15 micrometers, for example 14, 12, 10, 8, 6, 4, 2, or 1 micrometers, and all whole numbers, ranges and subranges therebetween, and including all numbers between each listed value as if written out in its entirety (e.g., 13.84 micrometers).

[0038] The inventors have discovered that high weldability is especially obtained when layers (c) and (d) are essentially continuous (i.e.: occupying at least 90% of the level corresponding to the considered layer) and when less than 10% of layer (c) is present at the extreme surface of the part. Without being bound by a theory, it is thought that this particular layer disposal, in particular layer (a) and layers (c) and (d) influence the resistivity of the coating both by their intrinsic characteristics and by the effect of roughness. Thus, current flow, heat generation at the surfaces, and nugget formation in the initial stage of spot welding are affected by this particular arrangement.

[0039] This favorable layer disposition is obtained for example when aluminum- or aluminum alloy pre-coated steel sheets, whose thickness range from, e.g., 0.7 to 3mm, are heated for 3 to 13 minutes (this dwell time includes the heating phase and the holding time) in a furnace heated to a temperature of 880 to 940°C. Other conditions leading to such favorable layer dispositions are found in Figure 7:

For sheets of total thicknesses greater or equal to 0.7mm, and less than or equal to 1.5mm, the preferred treatment conditions : (furnace temperature, total dwell time in the furnace) are illustrated in figure 7 by conditions lying within the limits of diagram "ABCD"

For sheets of total thicknesses greater than 1.5mm, and less than or equal to 3mm, the preferred treatment conditions : (furnace temperature, total dwell time in the furnace) are illustrated in figure 7 by diagram "EFGH" .

The heating rate V_c is comprised between 4 and 12°C/s for producing a favorable alloyed layer disposition. In this regard, this "heating rate" reflects the temperature rise which is experienced by the pre-coated steel upon being located in the preheated furnace. V_c is defined as the mean heating rate between 20 and 700°C. The inventors have discovered that the control of V_c in this precise range is a key factor, because it controls directly the nature and the morphology of the alloyed layers which are formed. It is here underlined that the heating rate V_c is different from the mean heating rate, which is the heating rate between room temperature and furnace temperature. The rates of 6, 7, 8, 9, 10, and 11 °C/s are included as are all numbers, ranges and subranges therebetween, and including all numbers between each listed value as if written out in its entirety (e.g., 7.7 °C/s). In this regard, all of the conditions specified within Figure 7 are incorporated herein by reference thereto. Particularly preferred conditions are:

(for thicknesses of 0.7-1.5mm)

[0040]

- 930°C, from 3 minutes up to 6 minutes;
- 880°C, from 4 minutes 30 seconds up to 13 minutes

(for thicknesses of 1.5 to 3 mm)

[0041]

- 940°C, from 4 minutes up to 8 minutes;
- 900°C, from 6 minutes 30 seconds up to 13 minutes

A special advantage arises from pre-coatings whose thickness is comprised between 20 and 33 micrometers, since this thickness range yields favorable layer disposal, and since the homogeneity of the pre-coating thickness is associated to an homogeneity of the coating formed after alliation treatment.

[0042] Heated blanks are thereafter transferred to a die, hot stamped to obtain a part or product, and cooled at a rate of more than 30°C/s. The cooling rate is defined here as the mean rate between the exit of the heated blank from the furnace, down to 400°C.

[0043] The strip of base steel is coated with either aluminum or an aluminum alloy. Commercially pure aluminum is known in the art as Type 2 aluminum, while alloys of aluminum with 5 to 11 % by weight of silicon are known in the art as Type 1 aluminum. Silicon is present in order to prevent the formation of a thick iron-metallic intermetallic layer which reduces adherence and formability. Other alloying elements useful with aluminum herein include iron, between 2.5 and 3% by weight, and calcium, between 15 and 30ppm by weight, including combinations of two or more thereof with aluminum.

[0044] A typical metal bath for an Al-Si coating generally contains in its basic composition by weight, from 8% to 11% silicon, from 2% to 4% iron, the remainder being aluminum or aluminum alloy, and impurities inherent in processing. Typical composition of Al-Si coating is: Al-9,3%Si-2,8%Fe. Invention coatings are not limited to these compositions, however.

[0045] The strip of base steel used herein may be any which can be coated by a conventional coating technique. For example, the strip of base steel may be any hot rolled strip, such as those prepared by hot rolling a steel slab (either with or without subsequent cold rolling). Typically, the strip of base steel will be stored and transported in the form of a coil both before and after the formation of the coating.

[0046] An example of a preferred steel for the strip of base steel is one having the following composition by weight:

0.10% < carbon < 0.5%
0.5% < manganese < 3%
0.1 % < silicon < 1%
0.01 % < chromium < 1 %
titanium < 0.2%
aluminum < 0.1 %
phosphorus < 0.1 %
sulfur < 0.05%
0.0005% < boron < 0.010%,

the remainder comprising, consisting essentially of, or consisting of iron and impurities inherent in processing. Use of such a steel provides a very high mechanical resistance after thermal treatment and the aluminum-based coating provides a high resistance to corrosion.

[0047] Particularly preferably, the composition by weight of the steel in the strip of base steel is the following:

0.15% < carbon < 0.25%
0.8% < manganese < 1.8%
0.1 % < silicon < 0.35%
0.01% < chromium < 0.5%
titanium < 0.1%
aluminum < 0.1 %
phosphorus < 0.1 %
sulfur < 0.05%
0.002% < boron < 0.005%,

the remainder comprising, consisting essentially of, or consisting of iron and impurities inherent in processing.

[0048] A preferred strip herein is 100 m long and 600mm wide. Preferred thicknesses are 0.7 to 3 mm.

[0049] Even more preferably, in the composition by weight of the sheet, the weight ratio of titanium content with respect to the nitrogen content is in excess of 3.42, believed to be a level at which the boron is no longer able to combine with the nitrogen.

[0050] An example of preferred commercially available steel for use in the strip of base steel is 22MnB5.

[0051] Chromium, manganese, boron and carbon may be added, in the composition of the steel according to the invention, for their effect on hardenability. In addition, carbon makes it possible to achieve high mechanical characteristics thanks to its effect on the hardness of the martensite.

[0052] Aluminum is introduced into the composition, to perform deoxidation in the liquid state and to protect the effectiveness of the boron.

[0053] Titanium, the ratio of the content of which with respect to the nitrogen content should be in excess of 3.42, is introduced for example in order to prevent combining of the boron with the nitrogen, the nitrogen being combined with titanium.

[0054] The alloying elements, Mn, Cr, B, make possible a hardenability allowing hardening in the stamping tools or the use of mild hardening fluids limiting deformation of the parts at the time of thermal treatment. In addition, the composition according to the invention is optimized from the point of view of weldability.

[0055] The steel in the sheet may undergo a treatment for globularization of sulfides performed with calcium,

which has the effect of improving the fatigue resistance of the sheet.

[0056] As mentioned above, ultra-high-strength can be provided with the steel sheet coated and hot stamped according to the invention. This high level of strength is sometimes associated with a limited ductility. In applications requiring a higher ductility, in particular when an ability for bending is required from a part or a product, the inventors have discovered that increased ductility can be obtained if sulfur is particularly controlled: when the sulfur level of base steel is lower than or equal to 0.002% (20 ppm), the bending angle can be greater than 60° and enhanced ductility and tearing resistance are obtained on the parts having experienced heat treatment and stamping. Preferred levels include 20, 18, 15, 13, 10, 8, 5, 2, etc ppm sulfur. In fact, this benefit applies to steels in general, and is not limited to coated steels or to steels coated with Al or Al alloy coatings. While not bound by a particular theory, when analyzing causes of premature failure of some parts in bending operations, the inventors observed that failure initiated on sulfide inclusions. It is thus believed that decohesions between inclusions and the martensitic or bainito-martensitic matrix act as stress-concentration factors and trigger further crack propagation in the ductile mode.

[0057] The invention also concerns a process for producing a part starting from an invention coated sheet, then cut into a blank which, after shaping, the coating of the blank is subjected to an increase in temperature at a speed in excess of 4°C/second, but lower than 12°C/second. The heating rate V_c is defined as the mean rate between 20 and 700°C.

[0058] The invention also concerns the use of a hot-rolled steel sheet which then can be cold-rolled and coated, for structural and/or anti-intrusion or substructure parts for a land motor vehicle, such as, for example, a bumper bar, a door reinforcement, a wheel spoke, etc.

[0059] The sheet according to the invention described above can derive, by reason of its processing, from a hot-rolling mill, and possibly may be cold-rerolled again depending on the final thickness desired. It then is coated with an aluminum-based coating, for example by dipping in a bath containing, in addition to the aluminum source/alloy, e.g., from 8% to 11% silicon and from 2% to 4% iron, the sheet having a high mechanical resistance after thermal treatment and a high resistance to corrosion, as well as a good capacity for painting and gluing.

[0060] The coating is preferably controlled as above, and has in particular the function of protecting the basic sheet against corrosion in various conditions. The thermal treatment applied at the time of a hot-forming process or after forming makes it possible to obtain high mechanical characteristics which can exceed 1500 MPa for mechanical resistance and 1200 MPa for yield stress. The final mechanical characteristics are adjustable and depend in particular on the martensite fraction of the structure, on the carbon content of the steel and on the thermal treatment. At the time of thermal treatment performed on a finished part or at the time of a hot-shaping process, the coating forms a layer having a substantial resistance to abrasion, wear, fatigue, shock, as well as a good resistance to corrosion and a good capacity for painting and gluing. The coating makes it possible to avoid different surface-preparation operations such as for steel sheets for thermal treatment not having any coating.

[0061] The steel sheet can be pre-coated by dipping, after pickling, in an aluminum bath containing for example only aluminum or either aluminum and from 8% to 11% silicon and 2% to 4% iron, or only from 2% to 4% iron, or even in an aluminum bath preferably containing from 9% to 10% silicon and 2% to 3.5% iron. The aluminum may be aluminum per se or an aluminum alloy.

[0062] In an example of implementation of a coating of the sheet by dipping in a metal bath containing an aluminum alloy comprising a proportion of approximately 90% aluminum, the coating layer comprises a first alloy layer in contact with the surface of the steel. This layer, directly in contact with the surface of the sheet, is highly alloyed with iron.

[0063] A second coating layer, on top of the first, contains approximately 90% aluminum and may contain silicon and a small amount of iron, depending on the composition of the bath.

[0064] The first alloy layer may crack when the sheet is submitted to high strains during cold forming operations of the manufacture of parts.

[0065] According to the invention, after the forming of the part, the coating is subjected to an increase in temperature at a speed in excess of 4°C /second. This rise in temperature makes possible a rapid remelting of the aluminum which fills in the cracks generated by the operation of shaping of the part.

[0066] At the time of thermal treatment, the base coating, of aluminum for example, is transformed into a layer alloyed with iron and comprising different phases depending on the thermal treatment and having a considerable hardness which may exceed 600 HV50 g.

[0067] Another advantage of the invention lies in the fact that the diffusion of the iron in the coating is initiated at high temperature. One thus will have a better cohesion between coating and steel in the sheet. In another form of the invention, the thermal treatment may be performed locally, in heavily deformed zones.

According to the invention, the sheet, in the delivery state in a coil or in a sheet, the thickness of which may range between 0.25 mm and 15 mm, has good forming properties and a good resistance to corrosion as well as a good capacity for painting or gluing. Preferably, the steel sheet or blank has a thickness less than 3 mm, since the cooling rates that may be achieved after quenching are high and help to obtain martensitic structures.

[0068] The steel sheet, a coated product, has a substantial resistance to corrosion in the delivery state, during forming and thermal treatments as well as during usage of the finished part.

The presence of the coating at the time of thermal treat-

ment of the parts makes it possible to prevent any decarburization of the base metal as well as any oxidation. That is an undeniable advantage, in particular in the case of hot forming. Furthermore, heating of the treated part does not require a furnace having a controlled atmosphere to prevent a decarburization.

[0069] Thermal treatment of the metal in the sheet comprising heating at a temperature ranging between Ac1, starting temperature of austenitic transformation when heating, for example 750°C and 1200°C, in a furnace, for a period which depends on the temperature to be reached and the thickness of the blank. The composition is optimized so as to limit the grain growth at the time of thermal treatment. If the structure sought is completely martensitic, the holding temperature should be in excess of Ac3, for example 840°C, temperature of complete austenitic transformation. The temperature holding should be followed by a cooling adjusted to the final structure sought.

[0070] Blanks are thereafter transferred from the furnace to a stamping press. When the elapsed time between the exit of the blanks from the furnace and the introduction in the stamping press is more 10 seconds, a partial transformation from austenite is susceptible to appear: if obtaining a full martensitic structure is desired, the transfer time between the exit of the furnace and stamping should be less than 10s.

[0071] The inventors have also discovered that the obtaining of a fully martensitic structure is linked to the amount of deformation in the hot forming operation: the amount of local deformation caused by hot forming is closely linked to the shape of the part or product and may exceed locally 40 or 50% in some particular regions. The inventors found that, when the local strain exceeds a critical value of 10%, the cooling rate must be sufficiently high in order to get a total martensitic transformation. Otherwise, bainitic transformation can take place at a significant amount instead of martensitic transformation. Thus, the risk is that heterogeneous structure appears on parts with complex shape where some locations are much more deformed than others. In this respect, the inventors put into evidence that, on the locations of the parts where the forming strain is higher than 10%, the cooling rate must be increased beyond 50°C/s in order to guarantee full martensitic transformation. The cooling rate is defined as the mean rate between the exit of the heated blank from the furnace, down to 400°C.

[0072] But one may also seek to obtain ferrito-bainitic or ferrito-martensitic structures, by a heating at a temperature ranging between Ac1, for example 750°C and Ac3, for example 840°C, followed by an appropriate cooling. According to the level of resistance to be achieved and the thermal treatment applied, one or several of these constituents is/are present in variable proportions.

[0073] The modulation of thermal treatment parameters makes it possible to achieve, with a given composition, different levels of hot and cold sheet resistance according to the thickness sought. For the highest resistance levels, the structure is composed predominantly of martensite.

[0074] The steel is particularly suited to the production of structural and anti-intrusion parts.

[0075] The invention thus enables one to produce a hot- or cold-rolled steel sheet of a desired thickness, coated, and affording extensive forming possibilities and which, after thermal treatment performed on the finished part, makes it possible to obtain a mechanical resistance in excess of 1000 MPa, a substantial resistance to shocks, fatigue, abrasion and wear, while retaining a good resistance to corrosion as well as a good capacity for welding, painting and gluing.

[0076] The present invention will now be further described by way a certain exemplary embodiments which are not intended to be limiting.

EXAMPLES

Example 1 :

[0077] In a first example of implementation, a cold rolled steel sheet, 1.9 mm thick, containing by weight: 0.23 % carbon, 1.25% manganese, 0.017% phosphorus, 0.002% sulfur, 0.27% silicon, 0.062% aluminum, 0.021 % copper, 0.019% nickel, 0.208% chromium, 0.005% nitrogen, 0.038% titanium, 0.004% boron, 0.003% calcium-has been pre-coated with an aluminum-based alloy with composition 9.3% silicon, 2.8% iron, the remainder being aluminum and unavoidable impurities. According to the conditions of fabrication, namely the settings of the blowing devices on the operating line, sheets of 120m long and 650mm wide with various thickness ranges were produced.

- Sheet A (according to the invention): The thickness t_{p1} and t_{p2} on each side of the sheet was controlled to be within the range (20-33) micrometers, at every location of the two faces of the sheet, both in the longitudinal (or rolling) direction and in the transversal direction. Measurement was performed continuously with thickness gages devices relying on X-Ray emission. At every moment, the spot of measurement of each gage was a circular zone of about 20mm radius. The sheets were afterwards cut into blanks of 1.2 x 0.5m^2 of overall dimensions.
- Sheet B (reference): On these sheets, the pre-coating thickness had a wider variability since the thickness t_{p1} and t_{p2} on the two sides of the sheet was comprised in the range (30-45) micrometers. Blanks cut out of these sheets exhibit the same pre-coating thickness.

[0078] The blanks were then submitted to heating in a furnace at T=920°C. Heating time was 3 min, with 4 mn holding time. The microstructure is then fully austenitic. Blanks were thereafter transferred from the furnace to a stamping press. When the elapsed time between the exit

of the blanks from the furnace and the transfer in the stamping press is more 10 seconds, a partial transformation from austenite was susceptible to appear, thus reducing the mechanical resistance of the stamped part. The blanks were directly cooled afterwards without hot stamping in order to appreciate the eventual remelting of the coating

On series A, no melting of the pre-coating was found. Intermetallic alloying between the pre-coating and the steel substrate occurred completely.

On series B, the pre-coating underwent mainly alloying, but some traces of remelting were found, particularly on the former thicker locations of the pre-coating. This partial remelting of the aluminium pre-coating contributes to the progressive fouling of the rollers in the furnace. The sheets according to the invention do not contribute to this progressive buildup on the rollers.

Example 2 :

[0079]

i) Conditions according to the invention: In a second example of implementation, a cold rolled steel sheet, 1,2mm thick, 120m long and 650mm wide, with same composition and same pre-coating as in example 1, has been fabricated. The sheets were afterwards cut into blanks which were heated at 920°C for 6mn, this time including the heating phase and the holding time. Heating rate V_c between 20 and 700°C was 10°C/s. The blanks were finally hot stamped and quenched in order to obtain full martensitic structures.

The parts obtained after hot-stamping are covered by a coating, 40 micrometers thick, illustrated at figure 1, which has a four layer structure. Starting from the steel substrate, the layers are the following:

- (a) Interdiffusion layer or intermetallic layer, 17 micrometers thick. This layer is itself composed of two sub-layers. Hardness HV50g ranges from 295 to 407, and the mean composition is: 90%Fe, 7%Al, 3%Si.
- (b) Intermediate layer, appearing darker, 8 micrometers thick. This layer has a hardness of 940HV50g and a mean composition, by weight : 43%Fe, 57%Al, 1 %Si.
- (c) Intermetallic layer appearing as a pale phase, 8 micrometers thick, displaying a hardness of 610HV50g, a mean composition of 65%Fe, 31%Al, 4%Si
- (d) Darker superficial layer, 7 micrometers thick, 950 HV50g, with a mean composition of 45%Fe, 54%Al, 1 %Si

Layers (c) and (d) are quasi-continuous, i.e. occupying at least 90% of the level corresponding to the considered layer. In particular, layer (c) does not reach the extreme surface except very exceptionally. Anyway, this layer (c) occupies less than 10% of the extreme surface.

ii) Conditions of reference: On the other hand, blanks with the same base material and pre-coating parts were furnace-heated in different conditions: The blanks were heated to 950°C for 7 minutes, this time including the heating phase. Heating rate V_c was 11°C/s. These conditions correspond to a degree of alloying which is more important than in conditions (i)

- In this coating, the pale intermetallic layer (c), is not continuous and appears as to be scattered within the coating. About 50% of this layer is present at the extreme surface of the part. Moreover, the interdiffusion layer, 10 micrometers thick in contact with the steel substrate is thinner than in the previous case of figure 1.

Resistance spot welding was performed in the two situations i) and ii):

- (i): Coating with quasi-continuous layers (c) and (d), layer (c) occupying less than 10% of the extreme surface
- (ii) : Coating with mixed and discontinuous layers, layer (c) occupying more than 10% of the extreme surface

[0080] Resistance spot welding was performed by superposing two parts and joining them in the following conditions:

- Squeeze force and welding force : 4000 N
- Squeeze time: 50 periods
- Welding and holding time: 18 periods respectively

[0081] In each condition, the suitable intensity range was determined for obtaining:

- No sputter during welding
- Acceptable nugget size.

[0082] For the condition i), the weldability range, expressed in terms of current intensity, is 1,4kA. For the condition ii) the weldability range is extremely small.

[0083] Thus, it may be seen that the coating according to the invention, yields much more satisfactory results.

Example 3 :

[0084] In a third example of implementation, a cold rolled steel sheet of the example 1 was cut into blanks of 500x500mm^2 which were heated at 920°C, during 6mn, then hot stamped and cooled in tools, in such conditions that two different cooling rates were obtained :

- (A): Cooling rate: V_A= 30°C/s

- (B) : Cooling rate: V_B = 60°C/s

[0085] Due to the shape of he parts, different deformation levels ε were created during hot stamping. In particular, some zones largely strained display deformation levels higher than 30%.

- As illustrated on figure 3, metallographic observations reveal that when ε >10%, partial bainitic or ferritic transformation occurs on parts cooled with V_A= 30°C/s, mainly on former austenitic grain boundaries. On the other hand, the parts cooled with V_B= 60°C/s display fully martensitic microstructure as illustrated on figure 4. The latter structures display superior mechanic resistance and a great homogeneity in the case of mechanical solicitation.
  Thus, even in products or parts where straining is larger than 10%, the application of cooling according to the invention guarantees a microstructural and mechanical homogeneity.

Example 4:

[0086] In a fourth example of implementation, steel castings containing different values of sulfur, were elaborated. These steels were further hot rolled, then cold rolled steel into sheets, 2,2mm thick. Sulfur content varies from 11ppm (0,0011%) to 59ppm (0,006%) in weight. Apart sulfur, the compositions of these different steel castings comprise in weight:

0,24% carbon, 1,17% manganese, 0,01% phosphorus, 0,25% silicon, 0,045% aluminum, 0,01% copper, 0,02% nickel, 0,2% chromium, 0,04% titanium, 0,003% boron, 0,002% calcium, the remainder being iron and unavoidable impurities.

[0087] These sheets were pre-coated with an aluminum-based alloy of composition comprising 9,3% silicon, 2.8% iron, the remainder being aluminum and unavoidable impurities.

[0088] The sheets were afterwards cut into blanks which were heated at 950°C for 5mn, then hot stamped and cooled in tools in order to obtain a full martensitic structure. Mechanical resistance exceeded 1450 MPa. Specimens were extracted according to the transverse sense of rolling direction and submitted to a bending test with alternate bending modes. The inventors put into evidence that the critical bending angle (angle at fracture) is closely related to the sulfur content of the steel: when sulfur content is lower than 0,002%, the bending angle exceeds 60°, which indicates higher ductility and energy absorption.

[0089] Compact Tensile-Test type specimens were also extracted according to the transverse rolling direction in order to measure the resistance to tearing, i.e. the energy which is necessary for the initiation or propagation of an existing crack. The results, illustrated on figure 6, indicate that a initiation energy higher than 18 Joules is achieved when sulfur content is lower than 0,002% in weight.

[0090] As these qualities of high resistance, high energy absorption and weldability are required in automobile industry, the parts or products fabricated according to the invention will be used with profit for such applications.

[0091] While the above description is clear with regard to the understanding of the invention, the following terms as used in the following list of preferred embodiments and claims have the following noted meanings in order to avoid any confusion:

pre-coating - the material (Al or Al alloy) coated on or located on at least a portion of the strip or sheet, etc., of base steel to form a pre-coating/base composite, the composite not having been subjected to an alliation reaction between the coated Al or Al alloy material and base steel
alliation - a reaction between the pre-coating and base steel, to produce at least one intermediate layer different in composition from both the base steel and the pre-coating. The alliation reaction happens during the heat treatment immediately preceding hot stamping. The alliation reaction affects the total thickness of the pre-coating. In a highly preferred embodiment the alliation reaction forms the following layers: (a) interdiffusion, (b) intermediate, (c) intermetallic, and (d) superficial as described above;
pre-coated steel - the pre-coating/base composite, not having been subjected to an alliation reaction between the coated material and base steel;
coating - the pre-coating after having been subjected to an alliation reaction between the pre-coating and base steel. In a highly preferred embodiment the coating comprises layers (a) interdiffusion, (b) intermediate, (c) intermetallic, and (d) superficial described above;
coated steel or product - the pre-coated steel or product that has been subjected to an alliation reaction between the pre-coating and base steel. In a highly preferred embodiment the coated steel is a strip or sheet, etc., of base steel having thereon an invention coating comprising layers (a) interdiffusion, (b) intermediate, (c) intermetallic, and (d) superficial described above;
blank - a shape cut from a strip.
product - a stamped blank

[0092] Thus, the present invention provides, among other things, the following preferred embodiments:

1. A pre-coated steel strip, comprising:

(a) a strip of base steel having a length, a width, a first side, and a second side;
(b) said length of said strip of base steel being

at least 100m and said width being at least 600mm, and
(c) an aluminum or an aluminum alloy pre-coating on at least part of one of said first and second sides of said strip of base steel, wherein

(i) the thickness t_p of the said pre-coating is from 20 - 33 micrometers at every location on at least one of said first and second sides.

2. A method for making a pre-coated steel strip according to embodiment 1 wherein the pre-coated steel strip has a thickness of not greater than 3 mm.

3. A process for making a hot stamped coated steel sheet product, comprising:

(A) heating an aluminum- or aluminum alloy pre-coated steel sheet in a furnace preheated to a temperature and during a time defined by diagram ABCD of figure 7 if thickness of said sheet is greater than or equal to 0.7mm and less than or equal to 1.5mm, and by diagram EFGH of figure 7 if thickness of said sheet is greater than 1.5mm and less than or equal to 3mm, at a heating rate V_c between 20 and 700°C comprised between 4 and 12°C/s, to obtain a heated blank;
(B) transferring said heated blank to a die; and
(C) stamping said heated blank in said die, to thereby obtain a hot stamped steel sheet product, and

wherein the said heated product is cooled at a rate of at least 30°C/s.

4. A process for making a hot stamped coated steel sheet product, comprising:

(A) providing a heated blank according to embodiment 3; and
(B) transferring said heated blank to a die; and
(C) stamping said heated blank in said die, to thereby obtain a hot stamped steel sheet product,

wherein the elapsed time between said heated blank exits said furnace and said stamping commences is not more than 10 seconds, and wherein said heated blank is deformed by a quantity higher than 10% during said stamping and the said heated product is cooled at a rate of at least 50°C/s.

5. A process for making a hot stamped coated steel sheet product, comprising :

hot dip pre-coating a steel strip having a first side and a second side with aluminum or aluminum alloy to obtain a pre-coated steel strip, the pre-coating thickness on at least one of said first side and said second side of said strip having a thickness of from 20 to 33 μm at every location on at least one of said first and second sides of said strip;
cutting said pre-coated steel strip to obtain a sheet;
heating the sheet in a pre-heated furnace to obtain a heated blank in which the steel is austenitic;
transferring said heated blank to a die while maintaining said steel in the austenitic phase; and
stamping said heated blank in a die to obtain a hot stamped steel sheet product in which the steel microstructure is martensitic.

6. A hot stamped coated steel sheet product, which is prepared by a process comprising :

(A) providing a pre-coated strip according to embodiment 1, said strip being pre-coated with aluminum or aluminum alloy
(B) Cutting said pre-coated steel strip to a predetermined size and shape to obtain a sheet
(C) heating said steel sheet in a furnace preheated to a temperature and during a time defined by diagram ABCD of figure 7 if thickness of said product is greater than or equal to 0.7mm and less than or equal to 1.5mm, and by diagram EFGH of figure 7 if thickness of said product is greater than 1.5mm and less than or equal to 3mm, to obtain a heated blank;
(D) transferring said heated blank to a die; and
(E) stamping said heated blank in said die, to thereby obtain a hot stamped steel sheet product,

wherein the elapsed time between said heated blank exits said furnace and said stamping commences is not more than 10 seconds, and wherein said heated product cools at a rate higher than 30°C/s during said stamping.

7. A process for making a hot stamped coated steel sheet product, comprising:

(A) providing a heated blank according to embodiment 6
(B) transferring said heated blank to a die; and
(C) stamping said heated blank in said die, to thereby obtain a hot stamped steel sheet product,

wherein the elapsed time between said heated blank exits said furnace and said stamping commences is not more than 10 seconds, and wherein said heated product cools at such a rate during said stamping

that the steel microstructure is martensitic.

8. The pre-coated steel strip according to embodiment 1, wherein the base steel comprises the following components by weight based on total weight:

0.15%<carbon<0.5%
0.5%<manganese<3%
0.1%<silicon<0.5%
0.01 %<chromium<1 %
titanium<0.2%
aluminum<0.1%
phosphorus<0.1 %
sulfur<0.05%
0.0005%<boron<0.08%,

and further comprises iron and impurities inherent in processing.

9. The pre-coated steel strip according to embodiment 8, wherein the base steel comprises the following components by weight based on total weight:

0.20%<carbon<0.5%
0.8%<manganese<1.5%
0.1%<silicon<0.35%
0.01 %<chromium<1 %
titanium<0.1 %
aluminum<0.1%
phosphorus<0.05%
sulfur<0.03%
0.0005%<boron<0.01%,

and further comprises iron and impurities inherent in processing.

10. The pre-coated steel strip according to embodiment 8 or 9, wherein the base steel comprises 20 ppm or less of sulfur.

11. The pre-coated steel strip according to any of embodiments 8 to 10, wherein the ratio of titanium to nitrogen in the steel sheet in weight % is in excess of 3.42.

12. The pre-coated steel strip according to any of the embodiments 1 or 8 to 11, wherein the aluminum or aluminum alloy pre-coating comprises from 8% to 11% silicon by weight, from 2% to 4% iron by weight, the remainder being aluminum and impurities inherent in processing.

13. A coated steel stamped product, which comprises:

(a) a strip of base steel having a first side and a second side; and
(b) a coating on at least one of said first side of said strip of base steel and said second side of said strip of base steel,

wherein:,

(i) said coating results from the interdiffusion between said base steel, and aluminium or aluminium alloy pre-coating,
(ii) said coating comprises, proceeding from base steel outwards,

- (a) Interdiffusion layer
- (b) Intermediate layer
- (c) Intermetallic layer
- (d) Superficial layer

14. A coated steel stamped product according to embodiment 13, wherein said coating has a thickness greater than 30 micrometers

15. A coated steel stamped product according to embodiments 13 or 14, wherein said layer (a) has a thickness less than 15 micrometers

16. A coated steel stamped product according to any of the embodiments 13 to 15, wherein the said layers (c) and (d) are occupying at least 90% of the level corresponding to the considered said layers and wherein less than 10% of layer (c) is present at the extreme surface of the product

17. A coated steel stamped product according to any of the embodiments 13 to 16, wherein the steel in the strip has a composition according to embodiment 8

18. A coated steel stamped product according to any of the embodiments 13 to 16, wherein the steel in the strip has a composition according to embodiment 9

19. A coated steel stamped product according to any of the embodiments 13 to 18, wherein the steel has a composition according to embodiment 10

20. A coated steel stamped product according to any of the embodiments 13 to 19, wherein the steel has a composition according to embodiment 11

21. A coated steel stamped product according to any of the embodiments 13 to 20, the aluminum or aluminum alloy pre-coating comprises from 8% to 11% silicon by weight, from 2% to 4% iron by weight, the remainder being aluminum and impurities inherent in processing.

22. A land motor vehicle comprising the heat treated coated steel product according to any of the embod-

iments 6, 13 to 21

23. A land motor vehicle comprising the heat treated coated steel product produced according to any of the embodiments 3, 4, 5, 7

[0093] The above written description of the invention provides a manner and process of making and using it such that any person skilled in this art is enabled to make and use the same, this enablement being provided in particular for the subject matter of the appended claims, which make up a part of the original description. As used above, the phrases "selected from the group consisting of," "chosen from," and the like include mixtures of the specified materials. Terms such as "contain(s)" and the like as used herein are open terms meaning 'including at least' unless otherwise specifically noted. All references, patents, applications, tests, standards, documents, publications, brochures, texts, articles, etc. mentioned herein are incorporated herein by reference. Where a numerical limit or range is stated, the endpoints are included. Also, all values and subranges within a numerical limit or range are specifically included as if explicitly written out. The above description is presented to enable a person skilled in the art to make and use the invention, and is provided in the context of a particular application and its requirements. Various modifications to the preferred embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the invention. Thus, this invention is not intended to be limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein.

Claims

1. A process for making a hot stamped coated steel sheet product, comprising:

   (C) heating an aluminum- or aluminum alloy pre-coated steel sheet in a furnace preheated to a temperature and during a time defined by diagram ABCD of figure 7 if thickness of said sheet is greater than or equal to 0.7mm and less than or equal to 1.5mm, and by diagram EFGH of figure 7 if thickness of said sheet is greater than 1.5mm and less than or equal to 3mm, at a heating rate V_c between 20 and 700°C comprised between 4 and 12°C/s, to obtain a heated blank, the heating rate Vc being different from the mean heating rate between room temperature and the furnace temperature;
   (D) transferring said heated blank to a die; and
   (E) hot stamping said heated blank in said die, to thereby obtain a hot stamped steel sheet product, and

   wherein said heated blank is cooled at a mean rate between the exit of the heated blank from the furnace, down to 400°C, of at least 30°C/s.

2. The process according to claim 1, wherein the elapsed time between said heated blank exits said furnace and said stamping commences is not more than 10 seconds, and
   wherein said heated blank is deformed by a quantity higher than 10% during said stamping and the heated blank is cooled at a mean rate between the exit of the heated blank from the furnace, down to 400°C of at least 50°C/s.

3. The process according to any one of claims 1 or 2, further comprising:

   (A) providing a pre-coated strip obtained by hot dip pre-coating a steel strip having a first side and a second side with aluminium or aluminium alloy, the pre-coating thickness on at least one of said first side and said second side of said strip having a thickness of from 20 to 33 μm at every location on at least one of said first and second sides of said strip;
   (B) cutting said pre-coated steel strip to obtain the aluminum- or aluminum alloy pre-coated steel sheet.

4. The process according to any one of claims 1 to 3, wherein the aluminum or aluminum alloy pre-coating comprises from 8% to 11% silicon by weight, from 2% to 4% iron by weight, the remainder being aluminum and impurities inherent in processing.

5. A coated steel stamped product, which comprises:

   (a) a strip of base steel having a first side and a second side; and
   (b) a coating on at least one of said first side of said strip of base steel and said second side of said strip of base steel,

   wherein:

   (i) said coating results from the interdiffusion between said base steel, and aluminium or aluminium alloy pre-coating,
   (ii) said coating comprises, proceeding from base steel outwards,

   - (a) Interdiffusion layer
   - (b) Intermediate layer
   - (c) Intermetallic layer
   - (d) Superficial layer

And wherein said layers (c) and (d) are occupying at least 90% of the level corresponding to the considered said layers and wherein less than 10% of layer (c) is present at the extreme surface of the product.

6. A coated steel stamped product according to claim 5, wherein said coating has a thickness greater than 30 micrometers

7. A coated steel stamped product according to any one of claims 5 or 6, wherein said layer (a) has a thickness less than 15 micrometers

8. A coated steel stamped product according to any of the claims 5 to 7, wherein the steel in the strip has a composition comprising, by weight:

0.15%<carbon<0.5%
0.5%<manganese<3%
0.1%<silicon<0.5%
0.01 %<chromium<1 %
titanium<0.2%
aluminum<0.1%
phosphorus<0.1 %
sulfur<0.05%
0.0005%<boron<0.08%,

and further comprises iron and impurities inherent in processing.

9. A coated steel stamped product according to any of the claims 5 to 7, wherein the steel in the strip has a composition comprising, by weight:

0.20%<carbon<0.5%
0.8%<manganese<1.5%
0.1%<silicon<0.35%
0.01 %<chromium<1 %
titanium<0.1 %
aluminum<0.1%
phosphorus<0.05%
sulfur<0.03%
0.0005%<boron<0.01%,

and further comprises iron and impurities inherent in processing.

10. A coated steel stamped product according to any of the claims 5 to 9, wherein the steel comprises 20 ppm or less of sulfur.

11. A coated steel stamped product according to any of the claims 5 to 10, wherein the ratio of titanium to nitrogen in the steel in weight% is in excess of 3.42.

12. A coated steel stamped product according to any of the claims 5 to 11, wherein the aluminum or aluminum alloy pre-coating comprises from 8% to 11% silicon by weight, from 2% to 4% iron by weight, the remainder being aluminum and impurities inherent in processing.

13. A coated steel stamped product according to any of the claims 5 to 12, wherein the interdiffusion layer has the following composition, by weight: 86-95% Fe, 4-10% Al, 0-5% Si.

14. A coated steel stamped product according to any of the claims 5 to 13, wherein the intermediate layer has the following composition, by weight: 39-47% Fe, 53-61% Al, 0-2% Si.

15. A coated steel stamped product according to any of the claims 5 to 14, wherein the intermetallic layer has the following composition, by weight: 62-67% Fe, 30-34% Al, 2-6% Si.

16. A coated steel stamped product according to any of the claims 5 to 15, wherein the superficial layer has the following composition, by weight: 39-47% Fe, 53-61% Al, 0-2% Si.

17. A land motor vehicle comprising the coated steel stamped product according to any of the claims 5 to 16.

18. A land motor vehicle comprising the hot stamped coated steel sheet product produced according to any of the claims 1 to 4.

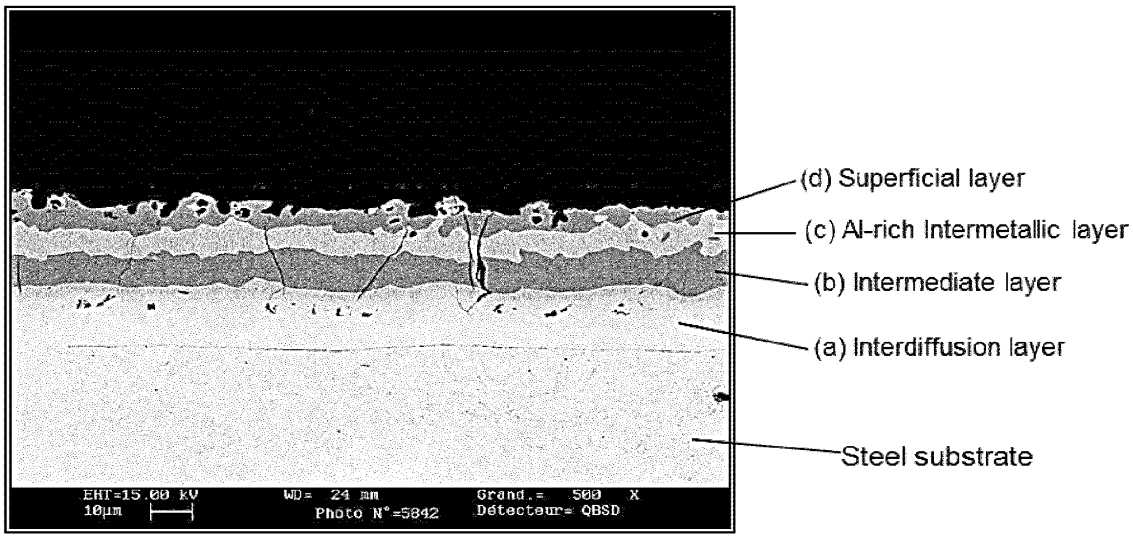

(d) Superficial layer
(c) Al-rich Intermetallic layer
(b) Intermediate layer
(a) Interdiffusion layer
Steel substrate
EHT=15.00 kV
10µm
WD= 24 mm
Photo N°=5842
Grand.= 500 X
Détecteur= QBSD
10µm

FIG.1

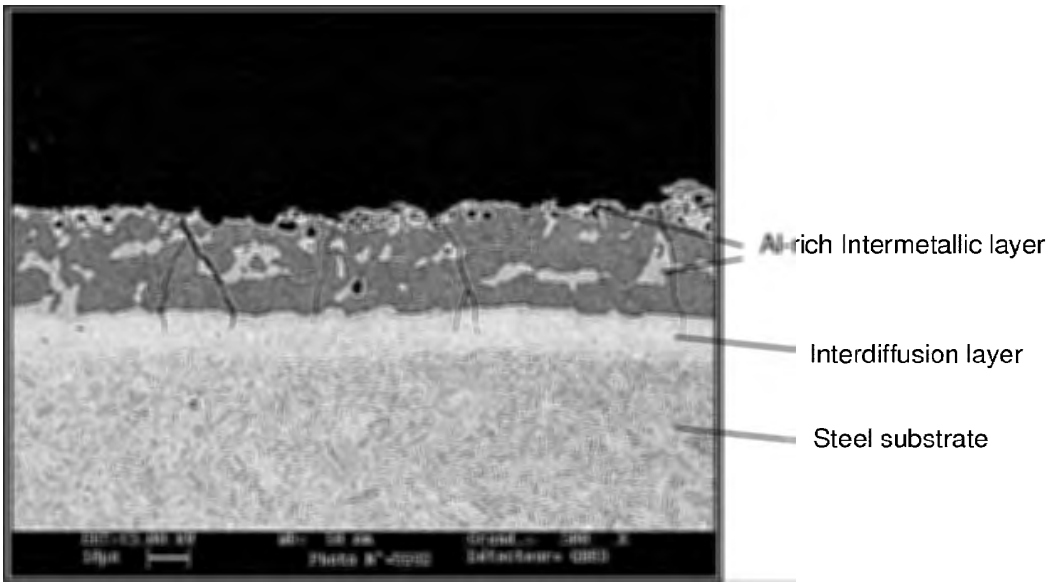

Al-rich Intermetallic layer
Interdiffusion layer
Steel substrate
10µm

FIG.2

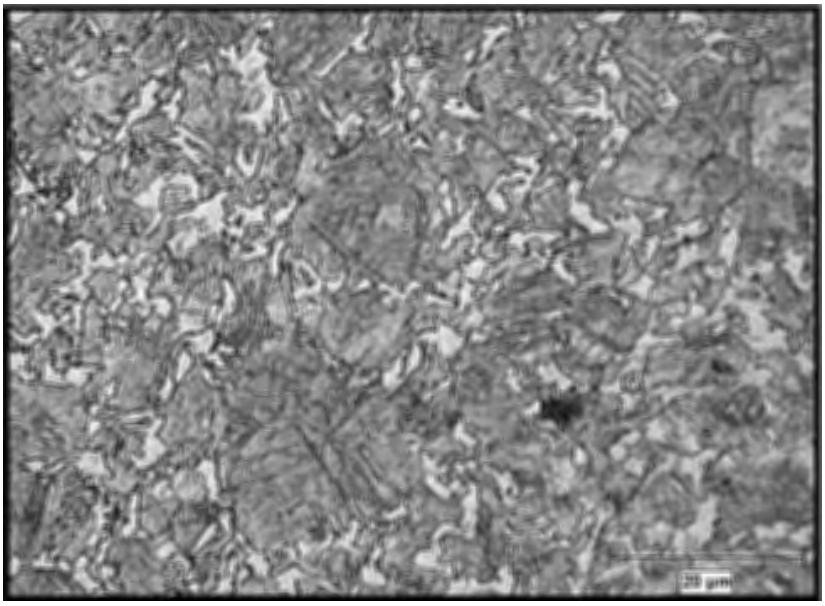


FIG.3

10μm

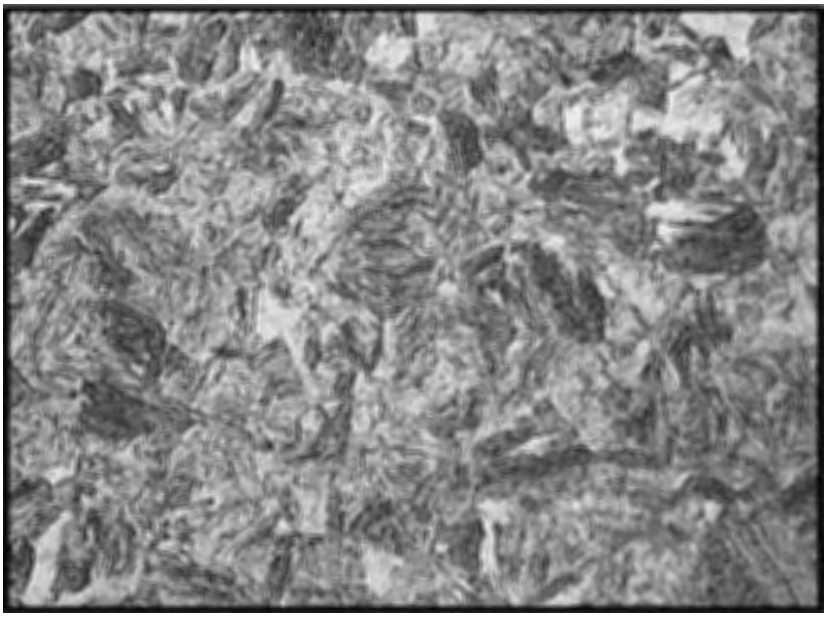


FIG.4

10 μm

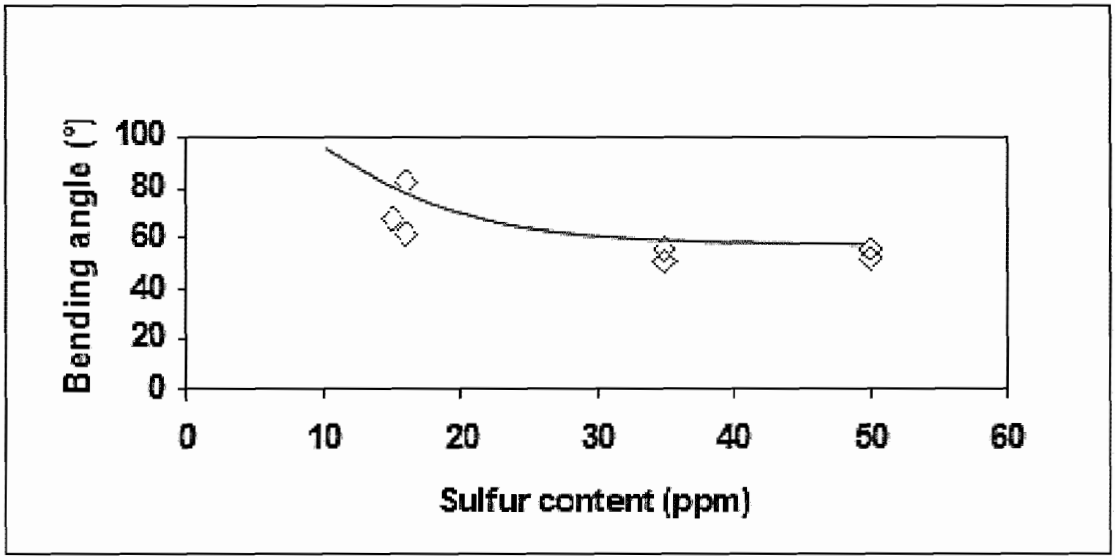

Bending angle (°)
100
80
60
40
20
0
0
10
20
30
40
50
60
Sulfur content (ppm)

FIG.5

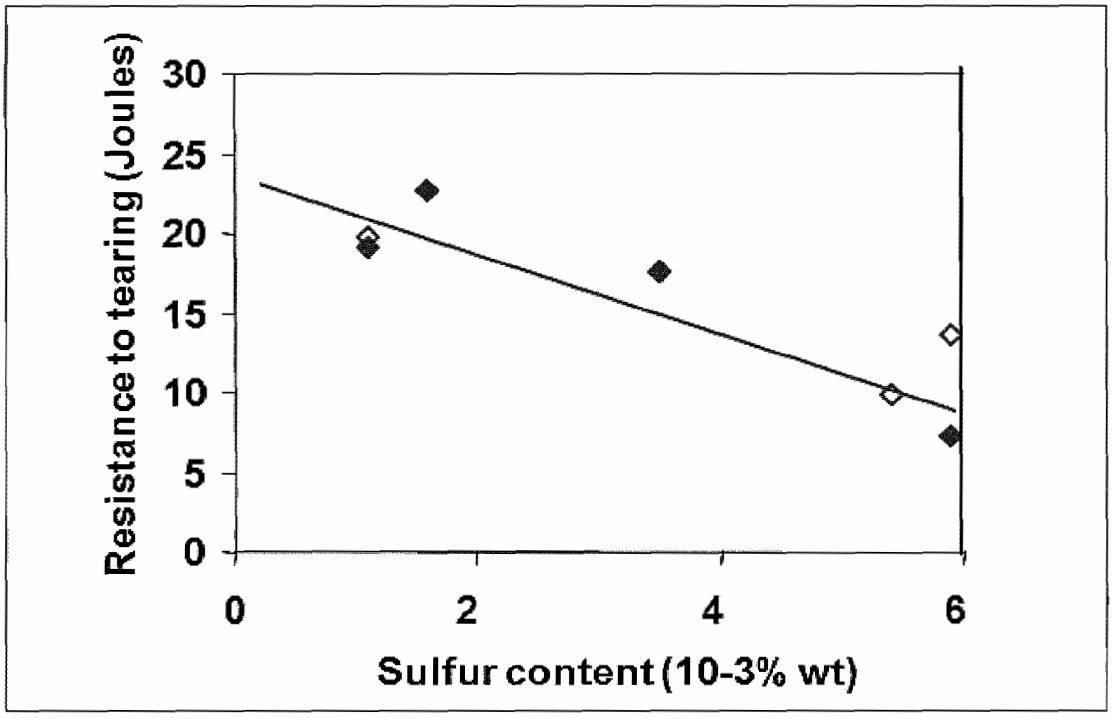

Resistance to tearing (Joules)
30
25
20
15
10
5
0
0
2
4
6
Sulfur content (10-3% wt)

FIG.6

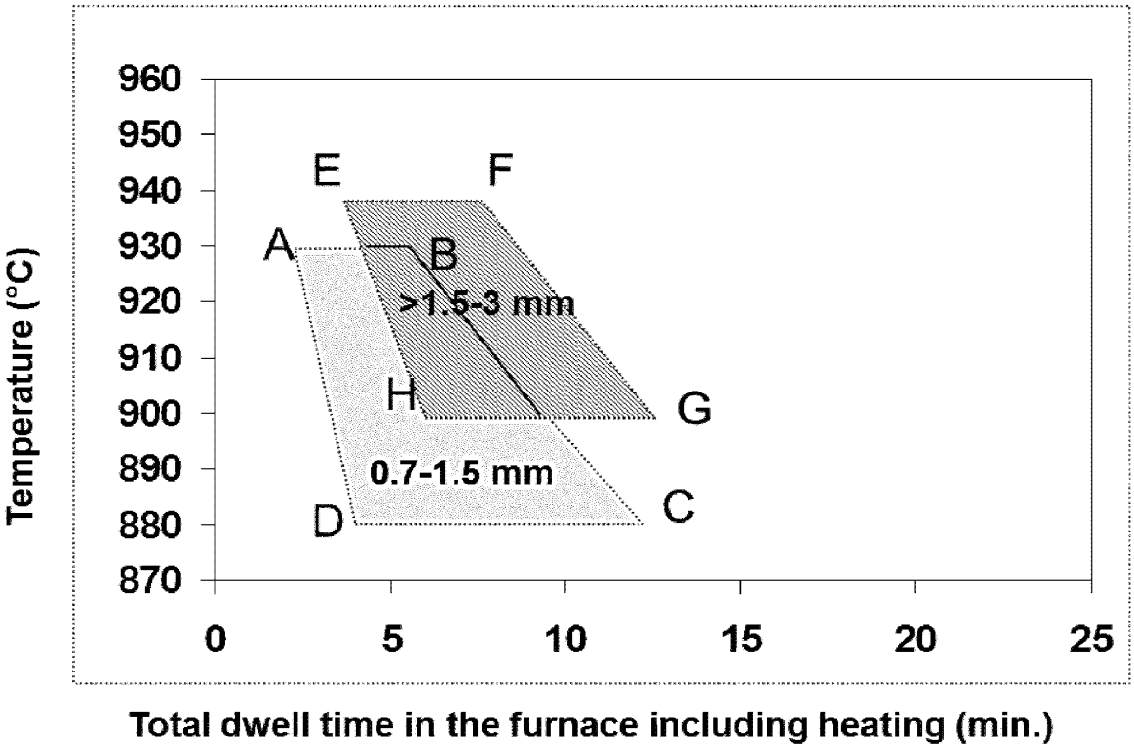

960
950
940
930
920
910
900
890
880
870
Temperature (°C)
E
F
A
B
>1.5-3 mm
H
G
0.7-1.5 mm
D
C
0
5
10
15
20
25
Total dwell time in the furnace including heating (min.)

FIG.7

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EUROPEAN SEARCH REPORT

Application Number
EP 17 19 2410

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 296 805 B1 (LAURENT JEAN-PIERRE [FR] ET AL) 2 October 2001 (2001-10-02) * column 2, line 25 - column 4, line 18 * * claims 1-14 *	1-18	INV. B32B15/00 C21D9/46
A	EP 1 013 785 A1 (LORRAINE LAMINAGE [FR] ARCELOR FRANCE [FR]) 28 June 2000 (2000-06-28) * paragraphs [0001], [0003] - [0005], [0011] - [0013], [0019]; claims 1-11 *	1-18	
A	EP 1 336 666 A (BHP STEEL JLA PTY LTD [AU]) 20 August 2003 (2003-08-20) * paragraphs [0007], [0041] - [0043], [0060], [0079] * * claims 1,6 *	1,2	
A	EP 0 356 783 A2 (ARMCO INC [US] ARMCO STEEL CO LP [US]) 7 March 1990 (1990-03-07) * the whole document *	1-18	
A	FR 2 720 079 A1 (LORRAINE LAMINAGE [FR]) 24 November 1995 (1995-11-24) * the whole document *	1-18	TECHNICAL FIELDS SEARCHED (IPC) C22C B32B C23C C23F
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A	WO 2006/097593 A (ARCELOR FRANCE [FR]; LAURENT JEAN-PIERRE [FR]; DEVROC JACQUES [FR]) 21 September 2006 (2006-09-21) * the whole document *	1-18	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 January 2018	Gavriliu, Alexandru

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 19 2410

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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24-01-2018

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Espacenet

Bibliographic data: FR2758571 (A1) — 1998-07-24

Steel sheet coated with double layer of aluminium@ alloys

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Classification: **- international:** ***C23C2/12;*** (IPC1-7): C21D9/46; C23C2/12
- cooperative: **C23C2/12**

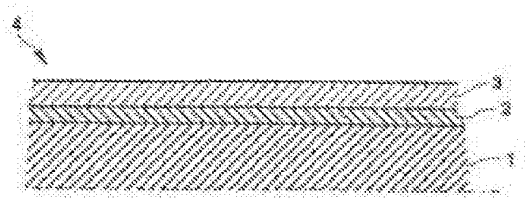
Application number: FR19970000565 19970121

Priority number(s): FR19970000565 19970121

Also published as: FR2758571 (B1)

Abstract of FR2758571 (A1)

A steel sheet (1) is coated on both sides with a layer (3) containing by weight 95-98% of aluminium and less than 4% iron, separated from sheet (1) by an intermediate layer (2) comprising 40-65% Al, 30-50% Fe and 3-12% of one or more elements whose atomic diameter is within 15% of that of Fe. Also claimed is dipping a steel sheet in a melt of 88-95% Al and 7-12% of the one or more elements in order to form layer (2) thereon, draining excess alloy from the sheet to leave a layer (2) 3-7 mu m thick and then dipping the sheet in molten Al.



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DESCRIPTION FR2758571

STEEL SHEET HAVING A ALUMINUM COATING.

The present invention relates to the field of coated sheets.

It relates specifically to sheets provided with an aluminum-based coating, called aluminized sheets.

These aluminized sheets are particularly used in the automotive field for producing exhaust lines, heat shields intended to isolate the body from exhaust lines, fuel tanks, or suspension arms, for example.

They are also used in the building industry in the production of, for example, fire doors, flues, chimney inserts, ducts or covering elements.

Aluminum sheets are also used in the field of household appliances for the production of toasters, minifours, deep fryers, boiler combustion chambers and burners.

It is known to use aluminized sheets made of a steel substrate coated with an alloy based on aluminum and silicon.

Such an aluminized sheet is produced by dipping a steel strip in a molten bath containing about 90% aluminum and 10% silicon, in order to obtain a coating layer, for example of 20 microns, thickness.

After diffusion of the iron atoms of the substrate into the coating layer, it has a first highly alloyed layer in contact with the substrate containing by weight approximately 45% iron, 53% aluminum, 2% silicon and then Intermediate layer containing about 32% iron, 58% aluminum, 10% silicon, and finally an outer layer containing about 90% aluminum, 9% silicon and very little iron (less than 3%).

At the traditional strength of the substrate steel, this type of aluminum-silicon coating provides good resistance to hot oxidation, good resistance to high temperature and good resistance to corrosion, which confers this type of Aluminized sheet metal, a particular ability to produce automobile exhaust lines, heat shields and, more generally, parts subjected to high temperatures.

The high alloy layer containing about 45% of iron being very small, on the order of a micrometer, and the intermediate layer still containing an average of 32% of iron being also weak, on the order of 4 micrometers, An alloy layer of small thickness, of the order of 5 micrometers, which gives this type of coating a good adhesion and therefore permits deep drawing.

It is also known to use aluminized sheets made of a steel substrate coated with an aluminum alloy.

Such an aluminized sheet is produced by dipping a strip of steel in an aluminum melt in order to obtain a coating layer on the order of 35 to 60 microns thick.

After diffusion of the iron atoms of the substrate into the coating layer, the latter has a first highly alloyed layer in contact with the substrate containing by weight approximately 42% iron, 58% aluminum and then an outer layer containing about 98 % Of aluminum and almost no iron (less than 3% present as precipitates Fale3, Fe2Al5 and Fe2A17).

This type of aluminized sheet has excellent resistance to industrial, urban and marine corrosion, excellent resistance to aggressive corrosion of hydrocarbon combustion products and corrosion in the presence of heat.

Moreover, this type of aluminized sheet offers a very good radiation reflectance (greater than 85%), close to that of a pure aluminum sheet.

It also has good resistance to heat and fire. Up to a temperature of 450 ° C., the coating is not altered, and between 450 and 600 ° C., a visual transformation of the coating layer is observed but without any appreciable alteration of its protective power.

This type of coating is perfectly suited for the construction of building roofs and for heat insulation parts.

However, the adhesion of the coating is modest because of the importance of the highly alloyed layer, generally greater than 12 micrometres thick for this type of aluminized sheet.

It is for this reason that the coating layer is of large thickness, usually between 35 and 60 micrometers, in order to guarantee the presence of a sufficient non-alloy layer.

Due to this adhesion problem, it is impossible to carry out deep drawings on this type of aluminized sheet without altering the coating, and in the case of folding of such a sheet, certain precautions must be observed, particularly in terms of radii Of curvature in order to avoid degradation of the coating. Indeed, in the case of stamping or bending under severe conditions, cracks are created in the highly alloyed layer, resulting in cracking, overlap and decohesion of the coating.

Thus, the known technique proposes either an aluminized sheet having a very good resistance to corrosion and very good reflective properties close to those of pure but not very formable aluminum sheets or an aluminized sheet allowing deep drawing but having a Less corrosion resistance and less good reflective properties.

The object of the present invention is to propose an aluminized sheet having both very good resistance to corrosion, a very good resistance to hot oxidation, very good reflectivity properties close to those of pure aluminum sheets, allowing Deep drawings.

The subject of the invention is a coated steel sheet made of a steel substrate provided on both sides with an aluminum-based coating, characterized in that the coating is a coating consisting of two superimposed layers: An internal layer in contact with the substrate comprising by weight between 40 and 65% of aluminum, between 30 and 50% of iron and between 3 and 12% of one or more elements selected from those whose relative difference in atomic diameter with An iron atom is less than or equal to 15%; An outer layer comprising by weight between 95 and 98% of aluminum and less than 4% of iron.

According to other characteristics of the invention, the internal layer comprises by weight between 40 and 65% of aluminum, between 30 and 50% of iron and between 3 and 12% of one or more elements chosen from silicon, Titanium, beryllium, manganese, the thickness of the inner layer is between 2 and 7 micrometers, the outer layer comprises by weight between 95 and 98% of aluminum, less than 4% of iron and less than 2 % Of one or more elements selected from those whose relative difference in atomic diameter with an iron atom is less than or equal to 15%; The thickness of the outer layer is between 5 and 50 micrometers.

The invention also relates to a method for producing such a coated steel sheet, characterized in that it comprises at least three steps: a first step in which, in order to form an alloyed inner layer containing by weight Between 40 and 65% of aluminum, between 30 and 50% of iron and between 3 and 12% of one or more elements selected from those whose relative difference in atomic diameter with an iron atom is less than or equal to 15% , A steel sheet is quenched in a melt containing between 88 and 95% aluminum and between 7 and 12% of one or more elements selected from those whose relative difference in atomic diameter with an iron atom is Less than or equal to 15%; A second step in which the sheet is wiped to eliminate the surface portion of unalloyed coating and to retain only an alloyed inner layer with a thickness of between 2 and 7 micrometers; A third stage in which the sheet is quenched in a bath of molten aluminum.

The invention also relates to another method of manufacturing such a coated steel sheet, characterized in that: an annealing of a steel strip under a non-oxidizing atmosphere containing atoms in gaseous form, d One or more elements whose relative difference in atomic diameter with an iron atom is less than or equal to 15%, so as to form an inner layer; And then the strip is

soaked in a bath of molten aluminum.

According to other characteristics: the non-oxidizing atmosphere in which the strip is annealed contains one or more elements chosen from silicon, titanium, beryllium, manganese, in gaseous form; The non-oxidizing atmosphere in which the strip is annealed contains silane.

BRIEF DESCRIPTION OF THE DRAWINGS The characteristics and advantages will appear more clearly from the following description given solely by way of example, with reference to the accompanying drawings, in which: FIG. 1 is a schematic view of an aluminized sheet according to the invention FIG. 2 is a graph showing the diameter factors of the main elements, FIG. 3 is a schematic view of an installation making it possible to implement a first process for manufacturing an aluminized sheet according to the invention; FIG. 4 is a schematic view of an installation for implementing a second process for manufacturing an aluminized sheet according to the invention, FIG. 5 is a diagrammatic view of another installation enabling the method to be implemented. FIG. Second method of manufacturing an aluminized sheet according to the invention.

As can be seen in FIG. 1, the aluminized steel sheet according to the invention consists of a substrate 1 made of steel coated with two layers of a distinct coating.

The first internal layer 2 in contact with the substrate 1 comprises, by weight, between 40 and 65% of aluminum, between 30 and 50% of iron and between 3 and 12% of one or more elements selected from those whose difference Relative atomic diameter with an iron atom is less than or equal to 15%.

These elements are identified in FIG. 2 between the two dashed lines which indicate the limits between which the relative difference in atomic diameter with an iron atom is less than 15% according to the Hume-Rothery classification.

These elements are beryllium, silicon, phosphorus, vanadium, chromium, manganese, cobalt, nickel, copper, zinc, germanium, arsenic, molybdenum, ruthenium, rhodium, Palladium, tin, tungsten, rhenium, iridium, platinum, titanium, niobium, silver, antimony, and gold.

The second outer layer 3 comprises by weight between 95 and 98% of aluminum and less than 4% of iron.

This second outer layer 3 may also comprise less than 2% of one or more elements selected from those whose relative difference in atomic diameter with an iron atom is less than or equal to 15%, for example beryllium, silicon, Phosphorus, vanadium, chromium, manganese, cobalt, nickel, copper, zinc, germanium, arsenic, molybdenum, ruthenium, rhodium, palladium, tin, tungsten, Rhenium, iridium, platinum, titanium, niobium, silver, antimony, or gold.

The first inner layer 2 has a low thickness between 2 and 7 micrometers in order to preserve the adhesive qualities of the coating and the second layer 3 may be between 5 and 50 micrometers according to the total thickness of coating desired. Preferably, the thickness of the layer 2 is less than or equal to 5 micrometers.

The element or elements whose atomic diameter is such that the relative difference in atomic diameter of each of these elements with an iron atom is less than 15%, contained in the layer 2 in contact with the substrate, make it possible to limit the phenomenon d The alloy between this coating layer and the substrate.

Indeed, elements whose atomic diameter is greater than that of iron have difficulty dislodging and thus block the migration of iron atoms.

On the other hand, elements whose atomic diameter is less than that of iron can more easily dislodge, but the space left free is insufficient for an iron atom or an aluminum atom.

In practice, the non-toxic elements and the lower cost elements will preferably be chosen. Thus, the use of arsenic, silver, gold or platinum, although limiting the phenomenon of alloying, will be very rarely used.

Moreover, depending on the type of steel of the substrate, elements which tend to combine with components of the steel, such as, for example, niobium, which tends to trap the carbon contained in the steel, will be avoided.

Preferably, one or more elements chosen from silicon, titanium, beryllium and manganese will be used.

A first process for producing an aluminized sheet according to the invention consists in annealing a steel strip in a non-oxidizing atmosphere containing atoms in gaseous form of one or more elements whose relative difference in atomic diameter with An iron atom is less than or equal to 15%, and then soaking the strip in a bath of molten aluminum.

As can be seen in FIG. 3, a strip 4 of steel continuously passes through an annealing chamber 5 in which care has been taken to maintain a non-oxidizing atmosphere.

During annealing, one or more elements whose atmospheric difference in atomic diameter with an iron atom is less than or equal to 15% are introduced into the atmosphere of the annealing enclosure.

It is very important that the gaseous form under which these elements are introduced into the annealing enclosure is a non-oxidizing form. For example, in the case of silicon, the silicon atoms are introduced in the form of silane Six4.

At the outlet of the annealing chamber, the strip is held in a non-oxidizing atmosphere in a chute 6 until it is soaked in a bath 7 of molten aluminum.

In the annealing chamber 5 and in the chute 6, the non-oxidizing atmosphere is composed, for example, of a mixture of nitrogen and hydrogen, and the temperature of the strip is brought to a value close to the temperature of Bath 7, preferably between 660 ° C. and 730 ° C.

The nitrogen used to constitute the non-oxidizing atmosphere preferably contains less than 5 ppm of oxygen and has a dew point of less than -60 ° C.

When the strip 4 is heated in the annealing chamber, its main faces are charged with atoms of the element or elements introduced into said chamber.

At the outlet of the bath of molten aluminum, the two faces coated with the strip 4 are drained by a gas blown through the wiper nozzles 8 and the strip is discharged and discharged into sheets.

This process makes it possible to produce the bi-layer coating according to the invention by dipping the strip in a single molten bath, constituted solely of aluminum. The first inner layer 2 is produced by the introduction of elements introduced into the annealing chamber.

A second method for manufacturing an aluminized sheet according to the invention consists in depositing the two inner layers 2 and outer layer 3 separately.

The strip is first soaked in a molten bath containing an aluminum-based alloy containing between 88 and 95% aluminum and between 7 and 12% of one or more elements selected from those whose relative diameter difference Atomic ratio with an iron atom is less than or equal to 15%, preferably silicon, titanium, beryllium, manganese, in order to form an alloyed inner layer containing by weight between 40 and 65% aluminum between 30 and 50% of iron and between 3 and 12% of one or more elements selected from those whose relative difference in atomic diameter with an iron atom is less than or equal to 15%.

Thereafter, the strip is drained to remove the surface portion of the unalloyed coating and to retain only a layer containing between 40 and 65% aluminum, between 30 and 50% iron, and between 3 and 12% of the element Of addition, with a thickness of between 3 and 7 micrometers.

Finally, the strip is dipped in a bath of molten aluminum.

Before soaking the strip in the first bath, the strip advantageously undergoes an annealing under a non-oxidizing atmosphere in order to bring its temperature to a value close to the temperature of the bath.

This method has the advantage of perfectly controlling the thickness of the first coating layer 2.

The installation illustrated in FIG. 4 makes it possible to implement this method.

The steel strip 4 penetrates into an annealing chamber 5 in which the atmosphere is non-oxidizing and is deflected by a roller 9 to pass through a chute 6 and to dip into a coating metal bath 10, for

example a bath containing Between 88 and 95% aluminum and between 7 and 12% silicon.

Then, after being deflected by a roller 11 disposed in the bath 10, the strip 4 emerges from the bath 10 and is dewatered by blown gas through the nozzles 8.

This dewatering operation makes it possible to eliminate the part of the coating layer deposited on the non-alloy strip. The strip then comprises a first coating layer 2, with a thickness of between 3 and 7 micrometers, preferably equal to 5 micrometers.

The strip 4 then enters immediately into a bath of molten aluminum.

It is very important to cause the strip to penetrate into the bath 12 immediately after its dewatering in order to avoid any oxidation.

In the illustrated embodiment, the strip 4 passes vertically through the bath 10 and is then evacuated after having undergone a further dewatering operation, for example by blown gas through the nozzles 8.

The installation illustrated in FIG. 5 also makes it possible to implement this method.

In this installation, the strip 4 emerges from the bath 10, is wringed by blown gas through the nozzles 8.

Then, after being deflected by means of a roller 13, it is immersed in a bath 14 of molten aluminum, in which it is again deflected by means of a roller 15 disposed in the bottom of the bath 14 and then Strip spring of the bath 14 and undergoes a new operation of scavenging by gas blown through the nozzles 8.

Optionally, if the path of the strip between the wiper nozzles 8 and the second bath 14 is long, the strip is protected by arranging a chute 16 between said wiping nozzles and the second bath, in which a non- oxidizing.

The aluminized steel sheet according to the invention offers a very good reflectance to radiation (greater than 85%), close to that of a pure aluminum sheet, good resistance to heat and fire.

It allows deep drawing because the alloy layer 2 is of very small thickness and makes a barrier to the diffusion of the aluminum atoms of the external layer 3 towards the substrate 1 and the diffusion of the iron atoms of the substrate 1 towards the layer External 3.

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CLAIMS FR2758571

CLAIMS

1

- Coated steel sheet consisting of a steel substrate provided on both sides with an aluminum-based coating, characterized in that the coating consists of two superimposed layers: an inner layer (2) in contact With the substrate comprising by weight between 40 and 65% aluminum, between 30 and 50% iron and between 3 and 12% of one or more elements selected from those whose relative difference in atomic diameter with an iron atom is Less than or equal to 15%; An outer layer (3) comprising by weight between 95 and 98% of aluminum and less than 4% of iron.

2

Coated steel sheet according to claim 1, characterized in that the inner layer (2) comprises by weight between 40 and 65% of aluminum, between 30 and 50% of iron and between 3 and 12% of Or several elements selected from silicon, titanium, beryllium, manganese.

3

Coated steel sheet according to claim 1 or 2, characterized in that the thickness of the inner layer (2) is between 2 and 7 micrometers.

4

Coated steel sheet according to claim 1, characterized in that the outer layer (3) comprises, by weight, between 95 and 98% of aluminum, less than 4% of iron and less than 2% of one or more elements Chosen from those whose relative difference in atomic diameter with an iron atom is less than or equal to 15%;

5

Coated steel sheet according to claim 1 or 4, characterized in that the thickness of the outer layer (3) is between 5 and 50 micrometers.

6

A method of manufacturing a steel sheet coated on its two main faces with an aluminum-based coating according to claim 1, characterized in that it comprises at least three steps: a first step in which, In order to form an alloyed inner layer containing by weight between 40 and 65% of aluminum, between 30 and 50% of iron and between 3 and 12% of one or more elements selected from those whose relative difference in atomic diameter With an iron atom being less than or equal to 15%, a steel sheet is quenched in a molten bath containing between 88 and 95% aluminum and between 7 and 12% of one or more elements selected from those of which The relative difference in atomic diameter with an iron atom is less than or equal to 15%; A second stage in which the sheet is drained to remove the surface portion of unalloyed coating and to retain only an alloyed inner layer with a thickness of between 3 and 7 micrometers; A third stage in which the sheet is quenched in a bath of molten aluminum.

7

Process according to claim 6, characterized in that prior to the first step, the steel strip is annealed in a non-oxidizing atmosphere.

8

Process for the production of a steel sheet coated on its two main faces with an aluminum-based coating according to claim 1, characterized in that: an annealing of a strip of steel under an atmosphere Non-oxidizing composition containing atoms, in gaseous form, of one or more elements whose relative difference in atomic diameter with an iron atom is less than or equal to 15%, so as to form an inner layer; And then the strip is soaked in a bath of molten aluminum.

9

Process according to claim 8, characterized in that the non-oxidizing atmosphere in which the strip is annealed contains one or more elements chosen from silicon, titanium, beryllium and manganese in gaseous form.

10

Process according to claim 9, characterized in that the non-oxidizing atmosphere in which the strip is annealed contains silane.

(19) RÉPUBLIQUE FRANÇAISE

INSTITUT NATIONAL
DE LA PROPRIÉTÉ INDUSTRIELLE

PARIS

(11) N° de publication : **2 758 571**
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(21) N° d'enregistrement national : **97 00565**

(51) Int Cl[6] : **C 23 C 2/12**, C 21 D 9/46

(12) DEMANDE DE BREVET D'INVENTION A1

(22) **Date de dépôt** : 21.01.97.

(30) **Priorité** :

(43) **Date de la mise à disposition du public de la demande** : 24.07.98 Bulletin 98/30.

(56) **Liste des documents cités dans le rapport de recherche préliminaire** : *Se reporter à la fin du présent fascicule.*

(60) **Références à d'autres documents nationaux apparentés** :

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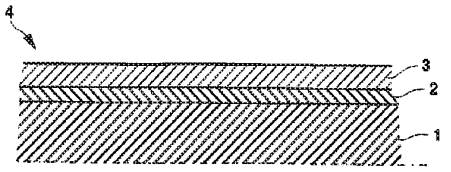
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(54) TOLE D'ACIER MUNIE D'UN REVETEMENT A BASE D'ALUMINIUM.

(57) L'invention a pour objet une tôle d'acier revêtue. Le revêtement est constitué de deux couches juxtaposées:

- une couche interne en contact avec le substrat comprenant en poids entre 40 et 65% d'aluminium, entre 30 et 50% de fer et entre 3 et 12% d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15%, par exemple le silicium, le titane, le béryllium, le manganèse;
- une couche externe comprenant en poids entre 95 et 98% d'aluminium et moins de 4% de fer.§.



FR 2 758 571 - A1

TOLE D'ACIER MUNIE D'UN REVETEMENT A BASE D'ALUMINIUM.

La présente invention concerne le domaine des tôles revêtues.

Elle a trait spécifiquement aux tôles munies d'un revêtement à base d'aluminium, dites tôles aluminiées.

Ces tôles aluminiées sont particulièrement utilisées dans le domaine automobile pour réaliser des lignes d'échappement, des écrans thermiques destinées à isoler la caisse des lignes d'échappement, des réservoirs à carburant, ou des bras de suspension par exemple.

Elles trouvent également leur utilisation dans le domaine du bâtiment dans la réalisation par exemple de portes coupe-feu, de conduits de fumées, d'inserts de cheminée, de gaines ou d'éléments de couverture.

On utilise aussi les tôles aluminiées dans le domaine de l'électroménager pour la réalisation par exemple de grille-pains, de mini-fours, de friteuses, de chambre de combustion de chauffe-eau, de brûleurs.

Il est connu d'utiliser des tôles aluminiées constituées d'un substrat d'acier revêtu d'un alliage à base d'aluminium et de silicium.

Une telle tôle aluminiée est réalisée par trempage d'une bande d'acier dans un bain en fusion contenant environ 90 % d'aluminium et 10 % de silicium, dans le but d'obtenir une couche de revêtement par exemple de 20 microns d'épaisseur.

Après diffusion des atomes de fer du substrat dans la couche de revêtement, celui-ci présente une première couche fortement alliée en contact avec le substrat contenant en poids environ 45 % de fer, 53 % d'aluminium, 2 % de silicium, puis une couche intermédiaire contenant environ 32 % de fer, 58 % d'aluminium, 10 % de silicium, et enfin une couche externe contenant environ 90 % d'aluminium, 9 % de silicium et très peu de fer (moins de 3 %).

A la résistance traditionnelle de l'acier du substrat, ce type de revêtement aluminium-silicium apporte une bonne tenue à l'oxydation à chaud, une bonne résistance à haute température et une bonne tenue à la corrosion, ce qui confère à ce type de tôle aluminiée une aptitude particulière à la réalisation de lignes d'échappement de véhicules automobile, d'écrans thermiques, et plus généralement de pièces soumises à des températures élevées.

La couche fortement alliée contenant environ 45 % de fer étant très faible, de l'ordre du micromètre, et la couche intermédiaire contenant encore en moyenne 32 % de fer étant également faible, de l'ordre de 4 micromètres, cela permet d'obtenir une couche alliée de faible épaisseur, de l'ordre de 5 micromètres, ce qui confère à ce type de revêtement une bonne adhérence et autorise donc des emboutissages profonds.

Il est également connu d'utiliser des tôles aluminiées constituées d'un substrat d'acier revêtu d'un alliage d'aluminium.

Une telle tôle aluminiée est réalisée par trempage d'une bande d'acier dans un bain en fusion d'aluminium, dans le but d'obtenir une couche de revêtement de l'ordre de 35 à 60 microns d'épaisseur.

Après diffusion des atomes de fer du substrat dans la couche de revêtement, celui-ci présente une première couche fortement alliée en contact avec le substrat contenant en poids environ 42 % de fer, 58 % d'aluminium, puis une couche externe contenant environ 98 % d'aluminium et quasiment pas de fer (moins de 3 % présent sous forme de précipités $FeAl_3$, Fe_2Al_5 et Fe_2Al_7).

Ce type de tôle aluminiée présente une excellente résistance à la corrosion industrielle, urbaine et marine, une excellente résistance à la corrosion agressive des produits de combustion des hydrocarbures et à la corrosion en présence de chaleur.

De plus, ce type de tôle aluminiée offre une très bonne réflectance au rayonnement (supérieure à 85 %), proche de celle d'une tôle en aluminium pur.

Elle présente également une bonne résistance à la chaleur et au feu. Jusqu'à une température égale à 450 °C, le revêtement n'est pas altéré, et entre 450 et 600 °C, on assiste à une transformation visuelle de la couche de revêtement mais sans altération notable de son pouvoir de protection.

Ce type de revêtement est parfaitement adapté pour la réalisation de toitures de bâtiments et pour les pièces de calorifugeage.

Mais l'adhérence du revêtement est modeste du fait de l'importance de la couche fortement alliée, d'épaisseur généralement supérieure à 12 micromètres pour ce type de tôle aluminiée.

C'est pour cette raison que la couche de revêtement est d'épaisseur importante, entre 35 et 60 micromètres habituellement afin de garantir la présence d'une couche non alliée suffisante.

Du fait de ce problème d'adhérence, il est impossible de réaliser des emboutissages profonds sur ce type de tôle aluminiée sans altérer le revêtement, et en cas de pliage d'une telle tôle, il convient de respecter certaines précautions notamment en terme de rayons de courbure afin d'éviter de dégrader le revêtement. En effet, en cas d'emboutissage ou de pliage en conditions sévères, on crée des fissures dans la couche fortement alliée, entraînant fissuration, chevauchement et décohésion du revêtement.

Ainsi la technique connue propose soit une tôle aluminiée présentant une très bonne tenue à la corrosion, et de très bonnes propriétés réflectives, proches de celles des tôles en aluminium pur, mais peu formables, soit une tôle aluminiée autorisant des emboutissages profonds, mais présentant une moins bonne tenue à la corrosion et de moins bonnes propriétés réflectives.

La présente invention a pour but de proposer une tôle aluminiée présentant à la fois une très bonne tenue à la corrosion, une très bonne tenue à l'oxydation à chaud, de très bonnes propriétés réflectives proches de celles des tôles en aluminium pur, autorisant des emboutissages profonds.

L'invention a pour objet une tôle d'acier revêtue constituée d'un substrat en acier muni sur ses deux faces d'un revêtement à base d'aluminium, caractérisé en ce que le revêtement est un revêtement constitué de deux couches superposées :

- une couche interne en contact avec le substrat comprenant en poids entre 40 et 65 % d'aluminium, entre 30 et 50 % de fer et entre 3 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 % ;
- une couche externe comprenant en poids entre 95 et 98 % d'aluminium et moins de 4 % de fer.

Selon d'autres caractéristiques de l'invention :

- la couche interne comprend en poids entre 40 et 65 % d'aluminium, entre 30 et 50 % de fer, et entre 3 et 12 % d'un ou plusieurs éléments choisis parmi le silicium, le titane, le béryllium, le manganèse ;
- l'épaisseur de la couche interne est comprise entre 2 et 7 micromètres ;

- la couche externe comprend en poids entre 95 et 98 % d'aluminium, moins de 4 % de fer et moins de 2% d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 % ;

- l'épaisseur de la couche externe est comprise entre 5 et 50 micromètres.

L'invention concerne également un procédé de fabrication d'une telle tôle d'acier revêtue, caractérisé en ce qu'il comprend au moins trois étapes :

- une première étape dans laquelle, dans le but de former une couche interne alliée contenant en poids entre 40 et 65 % d'aluminium, entre 30 et 50 % de fer et entre 3 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %, on trempe une tôle d'acier dans un bain en fusion contenant entre 88 et 95 % d'aluminium et entre 7 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 % ;

- une seconde étape dans laquelle on effectue un essorage de la tôle pour éliminer la partie superficielle de revêtement non allié et ne conserver qu'une couche interne alliée d'épaisseur comprise entre 2 et 7 micromètres ;

- une troisième étape dans laquelle on trempe la tôle dans un bain d'aluminium en fusion.

L'invention concerne aussi un autre procédé de fabrication d'une telle tôle d'acier revêtue, caractérisé en ce que :

- on effectue un recuit d'une bande d'acier sous atmosphère non oxydante contenant des atomes, sous forme gazeuse, d'un ou plusieurs éléments dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %, de manière à former une couche interne ;

- puis on trempe la bande dans un bain d'aluminium en fusion.

Selon d'autres caractéristiques :

- l'atmosphère non oxydante dans laquelle la bande est recuite contient un ou plusieurs éléments choisis parmi le silicium, le titane, le béryllium, le manganèse, sous forme gazeuse ;

- l'atmosphère non oxydante dans laquelle la bande est recuite contient du silane.

Les caractéristiques et avantages apparaîtront mieux à la suite de la description qui suit, donnée uniquement à titre d'exemple, faite en référence aux dessins annexés, dans lesquels :

- la figure 1 est une vue schématique d'une tôle aluminiée selon l'invention,
- la figure 2 est un graphique représentant les facteurs de diamètre des principaux éléments,
- la figure 3 est une vue schématique d'une installation permettant de mettre en oeuvre un premier procédé de fabrication d'une tôle aluminiée selon l'invention,
- la figure 4 est une vue schématique d'une installation permettant de mettre en oeuvre un second procédé de fabrication d'une tôle aluminiée selon l'invention,
- la figure 5 est une vue schématique d'une autre installation permettant de mettre en oeuvre le second procédé de fabrication d'une tôle aluminiée selon l'invention.

Comme on peut le voir sur la figure 1, la tôle d'acier aluminiée selon l'invention est constituée d'un substrat 1 en acier revêtu de deux couches d'un revêtement distinct.

La première couche interne 2 en contact avec le substrat 1 comprend, en poids, entre 40 et 65 % d'aluminium, entre 30 et 50 % de fer et entre 3 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %.

Ces éléments sont identifiés sur la figure 2 entre les deux droites en tirets qui indiquent les limites entre lesquelles la différence relative de diamètre atomique avec un atome de fer est inférieure à 15 %, selon la classification de Hume-Rothery.

Ces éléments sont le béryllium, le silicium, le phosphore, le vanadium, le chrome, le manganèse, le cobalt, le nickel, le cuivre, le zinc, le germanium, l'arsenic, le molybdène, le ruthénium, le rhodium, le palladium, l'étain, le tungstène, le rhénium, l'iridium, le platine, le titane, le niobium, l'argent, l'antimoine, et l'or.

La seconde couche externe 3 comprend en poids entre 95 et 98 % d'aluminium et moins de 4 % de fer.

Cette seconde couche externe 3 peut également comprendre moins de 2% d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %, par exemple le béryllium, le silicium, le phosphore, le vanadium, le chrome, le manganèse, le cobalt, le nickel, le cuivre, le zinc, le germanium, l'arsenic, le molybdène, le ruthénium, le rhodium, le palladium, l'étain, le tungstène, le rhénium, l'iridium, le platine, le titane, le niobium, l'argent, l'antimoine, ou l'or.

La première couche interne 2 présente une épaisseur faible, entre 2 et 7 micromètres, afin de préserver les qualités d'adhérence du revêtement et la seconde couche 3 peut être comprise entre 5 et 50 micromètres selon l'épaisseur totale de revêtement désiré. De préférence, l'épaisseur de la couche 2 est inférieure ou égale à 5 micromètres.

Le ou les éléments dont le diamètre atomique est telle que la différence relative de diamètre atomique de chacun de ces éléments avec un atome de fer est inférieure à 15 %, contenus dans la couche 2 en contact avec le substrat, permettent de limiter le phénomène d'alliation entre cette couche de revêtement et le substrat.

En effet, les éléments dont le diamètre atomique est supérieur à celui du fer ont des difficultés à se déloger et ainsi bloquent la migration des atomes de fer.

En revanche, les éléments dont le diamètre atomique est inférieur à celui du fer peuvent plus facilement se déloger, mais la place libre laissée est insuffisante pour un atome de fer ou un atome d'aluminium.

Dans la pratique, on choisira de manière préférentielle les éléments exempts de toxicité et les éléments de plus faible coût. Ainsi, l'utilisation de l'arsenic, de l'argent, l'or ou le platine, bien que permettant de limiter le phénomène d'alliation, ne seront que très rarement utilisés.

De plus, selon le type d'acier du substrat, on évitera les éléments qui auront tendance à se combiner avec des constituants de l'acier, comme par exemple le niobium qui a tendance à piéger le carbone contenu dans l'acier.

De préférence, on utilisera un ou plusieurs éléments choisis parmi le silicium, le titane, le béryllium et le manganèse.

Un premier procédé pour fabriquer une tôle aluminiée selon l'invention consiste à effectuer un recuit d'une bande d'acier sous atmosphère

non oxydante contenant des atomes, sous forme gazeuse, d'un ou plusieurs éléments dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %, puis à tremper la bande dans un bain d'aluminium en fusion.

Comme on peut le voir sur la figure 3, une bande 4 en acier défile en continu dans une enceinte de recuit 5 dans laquelle on a pris soin de faire régner une atmosphère non oxydante.

Au cours du recuit, on introduit dans l'atmosphère de l'enceinte de recuit un ou plusieurs éléments dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %.

Il est très important que la forme gazeuse sous laquelle ces éléments sont introduits dans l'enceinte de recuit soit une forme non oxydante. Par exemple dans le cas du silicium, on introduit les atomes de silicium sous forme de silane S_iH_4.

A la sortie de l'enceinte de recuit, la bande est maintenue dans une atmosphère non oxydante dans une goulotte 6 jusqu'à ce qu'elle soit trempée dans un bain 7 d'aluminium en fusion.

Dans l'enceinte de recuit 5 et dans la goulotte 6, l'atmosphère non oxydante est composée par exemple d'un mélange d'azote et d'hydrogène, et la température de la bande est amenée à une valeur voisine de la température du bain 7, de préférence comprise entre 660°C et 730°C.

L'azote utilisé pour constituer l'atmosphère non oxydante contient de préférence moins de 5 ppm d'oxygène et a un point de rosée inférieur à -60°C.

Lorsque la bande 4 est réchauffée dans l'enceinte de recuit, ses faces principales se chargent des atomes de l'élément ou des éléments introduits dans ladite enceinte.

A la sortie du bain d'aluminium en fusion, les deux faces revêtues de la bande 4 sont essorées par un gaz soufflé à travers les buses d'essorage 8, et la bande est évacuée et débitée en tôles.

Ce procédé permet de réaliser le revêtement bi-couches selon l'invention en trempant la bande dans un seul bain en fusion, constitué uniquement d'aluminium. La première couche interne 2 est réalisée grâce à l'apport de ou des éléments introduits dans l'enceinte de recuit.

Un second procédé pour fabriquer une tôle aluminiée selon l'invention consiste à déposer les deux couches interne 2 et externe 3 séparément.

La bande est d'abord trempée dans un bain en fusion contenant un alliage à base d'aluminium contenant entre 88 et 95 % d'aluminium et entre 7 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %, de préférence le silicium, le titane, le béryllium, le manganèse, dans le but de former une couche interne alliée contenant en poids entre 40 et 65 % d'aluminium, entre 30 et 50 % de fer et entre 3 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %.

Ensuite, la bande est essorée pour éliminer la partie superficielle de revêtement non allié et ne conserver qu'une couche contenant entre 40 et 65 % d'aluminium, entre 30 et 50 % de fer, et entre 3 et 12 % du ou des éléments d'addition, d'épaisseur comprise entre 3 et 7 micromètres.

Enfin, la bande est trempée dans un bain d'aluminium en fusion.

Avant de tremper la bande dans le premier bain, la bande subit avantageusement un recuit sous atmosphère non oxydante pour amener sa température à une valeur voisine de la température du bain.

Ce procédé présente l'avantage de parfaitement contrôler l'épaisseur de la première couche de revêtement 2.

L'installation illustrée sur la figure 4 permet de mettre en oeuvre ce procédé.

La bande 4 en acier pénètre dans une enceinte de recuit 5 dans laquelle l'atmosphère est non oxydante, et est déviée par un rouleau 9 pour traverser une goulotte 6 et pour plonger dans un bain 10 de métal de revêtement, par exemple un bain contenant entre 88 et 95 % d'aluminium et entre 7 et 12 % de silicium.

Ensuite, après être déviée par un rouleau 11 disposé dans le bain 10, la bande 4 ressort du bain 10 et est essorée par du gaz soufflé à travers les buses 8.

Cette opération d'essorage permet d'éliminer la partie de la couche de revêtement déposé sur la bande non alliée. La bande comporte

alors une première couche de revêtement 2, d'épaisseur comprise entre 3 et 7 micromètres, de préférence égale à 5 micromètres.

La bande 4 pénètre alors immédiatement dans un 12 bain d'aluminium en fusion.

Il est très important de faire pénétrer la bande dans le bain 12 immédiatement après son essorage pour éviter toute oxydation.

Dans l'exemple de réalisation représenté, la bande 4 traverse verticalement le bain 10 puis est évacuée après avoir subie éventuellement une nouvelle opération d'essorage par exemple par du gaz soufflé à travers les buses 8.

L'installation illustrée sur la figure 5 permet également de mettre en oeuvre ce procédé.

Dans cette installation, la bande 4 ressort du bain 10, est essorée par du gaz soufflé à travers les buses 8.

Ensuite, après être déviée au moyen d'un rouleau 13, elle plonge dans un bain 14 d'aluminium en fusion, dans lequel elle est à nouveau déviée au moyen d'un rouleau 15, disposé dans le fond du bain 14, puis la bande ressort du bain 14 et subit une nouvelle opération d'essarage par du gaz soufflé à travers les buses 8.

Eventuellement, si le trajet de la bande entre les buses d'essorage 8 et le second bain 14 est long, on protège la bande en disposant une goulotte 16 entre lesdites buses d'essorage et le second bain, dans laquelle on maintien une atmosphère non oxydante.

La tôle d'acier aluminiée selon l'invention offre une très bonne réflectance au rayonnement (supérieur à 85 %), proche de celle d'une tôle en aluminium pur, une bonne résistance à la chaleur et au feu.

Elle autorise des emboutissages profonds car la couche alliée 2 est d'épaisseur très faible et fait barrière à la diffusion des atomes d'aluminium de la couche externe 3 vers le substrat 1 et à la diffusion des atomes de fer du substrat 1 vers la couche externe 3.

10

REVENDICATIONS

1 - Tôle d'acier revêtue constituée d'un substrat en acier muni sur ses deux faces d'un revêtement à base d'aluminium, caractérisé en ce que le revêtement est constitué de deux couches superposées :

- une couche interne (2) en contact avec le substrat comprenant en poids entre 40 et 65 % d'aluminium, entre 30 et 50 % de fer et entre 3 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 % ;
- une couche externe (3) comprenant en poids entre 95 et 98 % d'aluminium et moins de 4 % de fer.

2 - Tôle d'acier revêtue selon la revendication 1, caractérisée en ce que la couche interne (2) comprend en poids entre 40 et 65 % d'aluminium, entre 30 et 50 % de fer, et entre 3 et 12 % d'un ou plusieurs éléments choisis parmi le silicium, le titane, le béryllium, le manganèse.

3 - Tôle d'acier revêtue selon les revendications 1 ou 2, caractérisée en ce que l'épaisseur de la couche interne (2) est comprise entre 2 et 7 micromètres.

4 - Tôle d'acier revêtue selon la revendication 1, caractérisée en ce que la couche externe (3) comprend en poids entre 95 et 98 % d'aluminium, moins de 4 % de fer et moins de 2% d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 % ;

5 - Tôle d'acier revêtue selon les revendications 1 ou 4, caractérisée en ce que l'épaisseur de la couche externe (3) est comprise entre 5 et 50 micromètres.

6 - Procédé de fabrication d'une tôle d'acier revêtue sur ses deux faces principales d'un revêtement à base d'aluminium selon la revendication 1, caractérisé en ce qu'il comprend au moins trois étapes :

- une première étape dans laquelle, dans le but de former une couche interne alliée contenant en poids entre 40 et 65 % d'aluminium, entre

30 et 50 % de fer et entre 3 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 % ,on trempe une tôle d'acier dans un bain en fusion contenant entre 88 et 95 % d'aluminium et entre 7 et 12 % d'un ou plusieurs éléments choisis parmi ceux dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 % ;

- une seconde étape dans laquelle on effectue un essorage de la tôle pour éliminer la partie superficielle de revêtement non allié et ne conserver qu'une couche interne alliée d'épaisseur comprise entre 3 et 7 micromètres ;

- une troisième étape dans laquelle on trempe la tôle dans un bain d'aluminium en fusion.

7 - Procédé selon la revendication 6, caractérisé en ce que préalablement à la première étape, on effectue un recuit de la bande d'acier dans une atmosphère non oxydante.

8 - Procédé de fabrication d'une tôle d'acier revêtue sur ses deux faces principales d'un revêtement à base d'aluminium selon la revendication 1, caractérisé en ce que :

- on effectue un recuit d'une bande d'acier sous atmosphère non oxydante contenant des atomes, sous forme gazeuse, d'un ou plusieurs éléments dont la différence relative de diamètre atomique avec un atome de fer est inférieure ou égale à 15 %, de manière à former une couche interne ;

- puis on trempe la bande dans un bain d'aluminium en fusion.

9 - Procédé selon la revendication 8, caractérisé en ce que l'atmosphère non oxydante dans laquelle la bande est recuite contient un ou plusieurs éléments choisis parmi le silicium, le titane, le béryllium, le manganèse, sous forme gazeuse.

10 - Procédé selon la revendication 9, caractérisé en ce que l'atmosphère non oxydante dans laquelle la bande est recuite contient du silane.

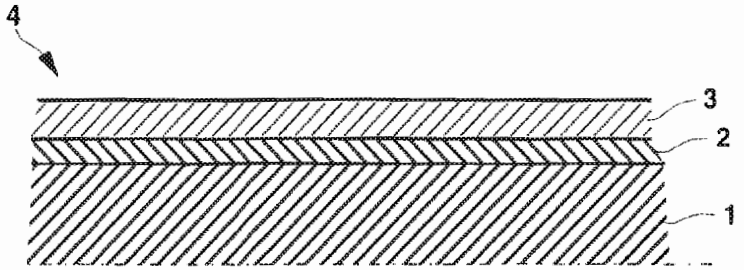

4
3
2
1

Fig. 1

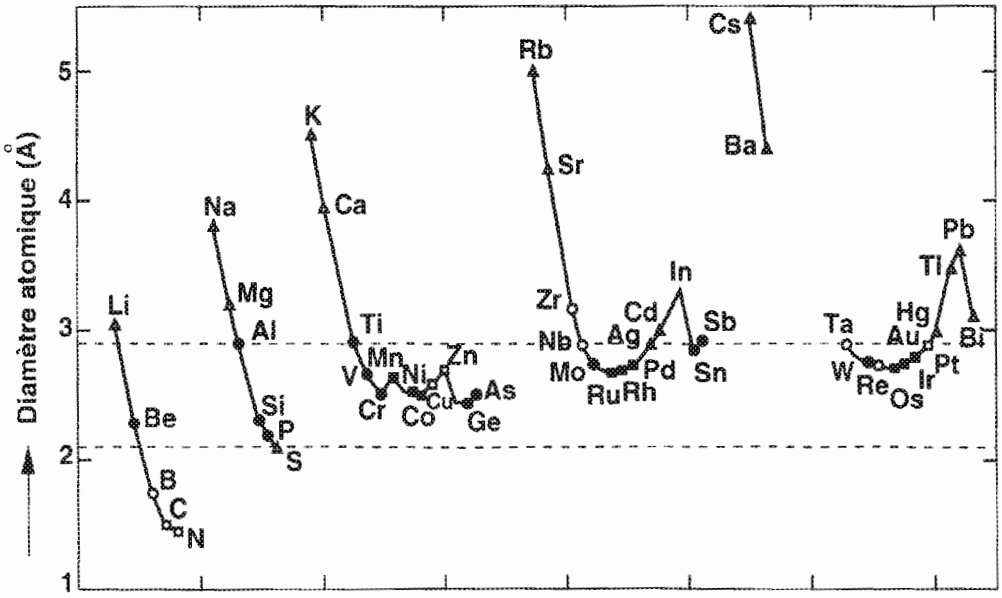

Diamètre atomique (Å)
5
4
3
2
1
Li
Be
B
C
N
Na
Mg
Al
Si
P
S
K
Ca
Ti
V
Cr
Mn
Co
Ni
Cu
Zn
Ga
Ge
As
Rb
Sr
Zr
Nb
Mo
Ru
Rh
Pd
Ag
Cd
In
Sn
Sb
Cs
Ba
Ta
W
Re
Os
Ir
Pt
Au
Hg
Tl
Pb
Bi

Fig. 2

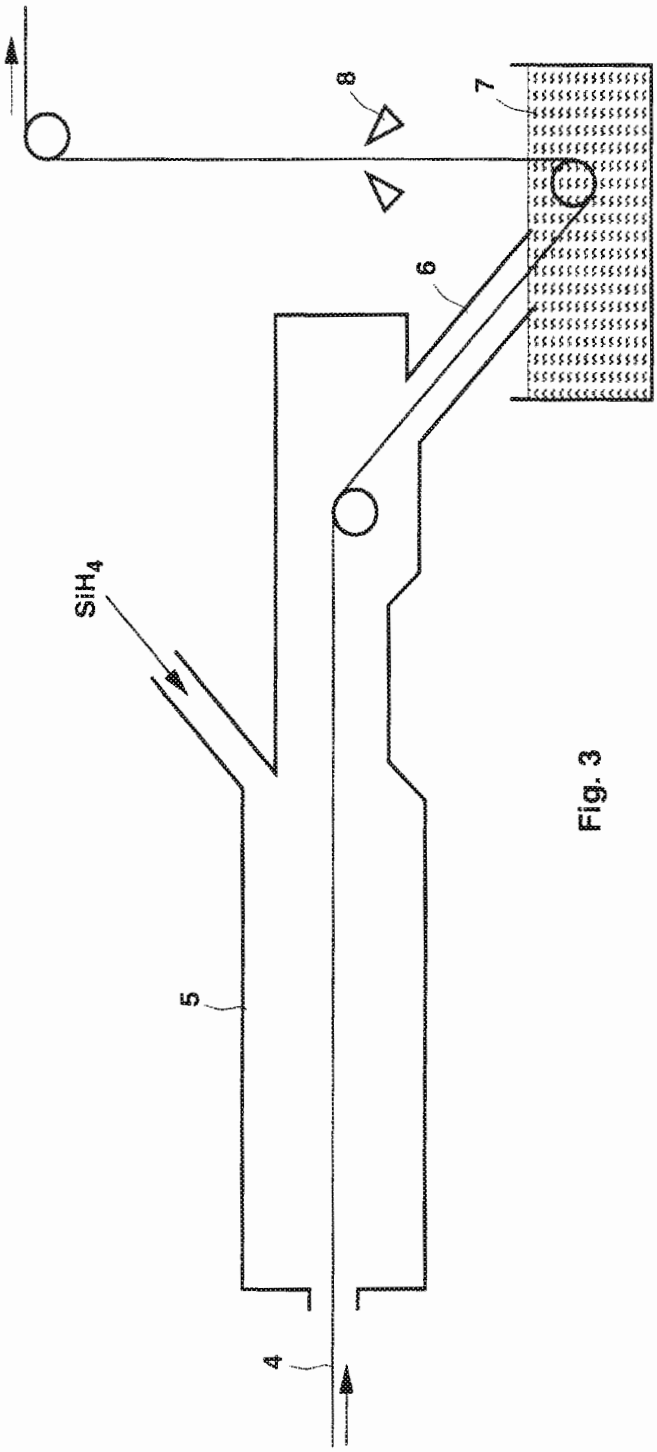


Fig. 3

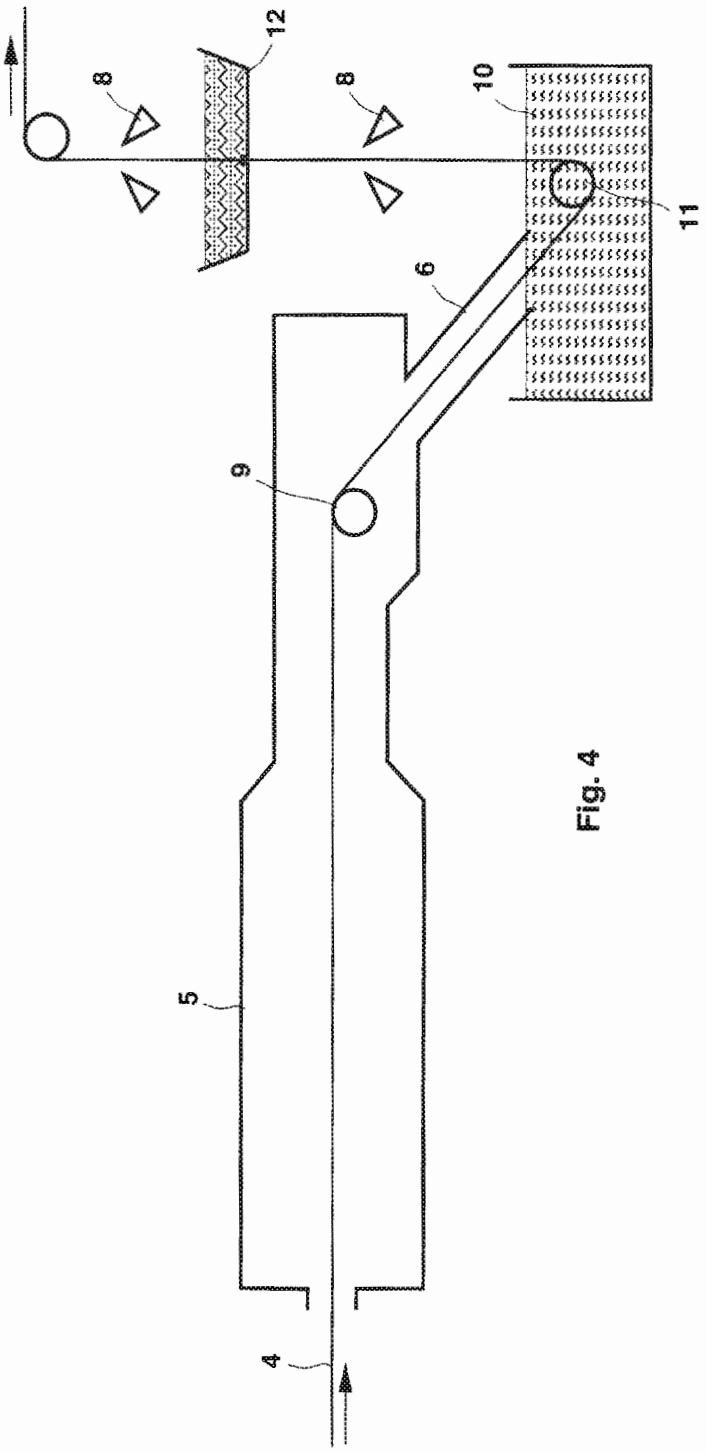


Fig. 4

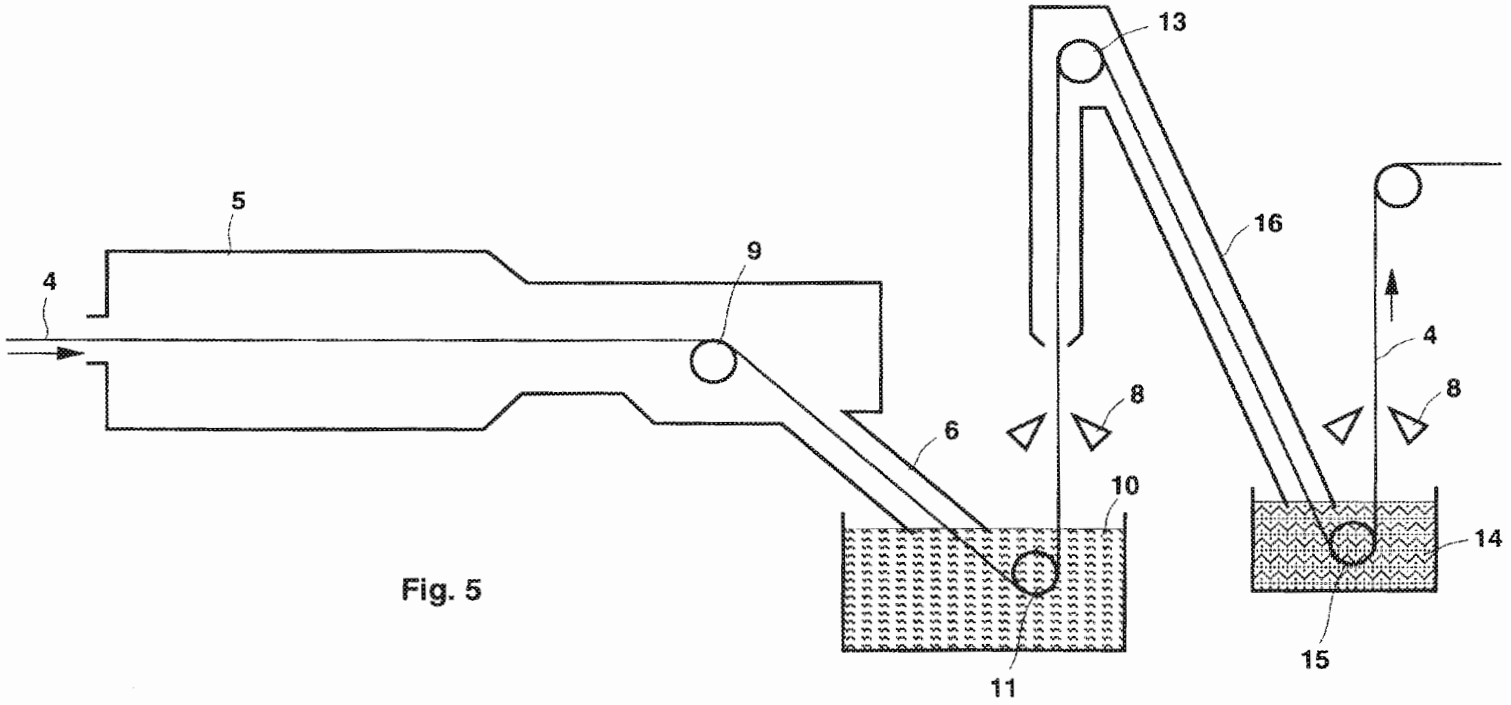


Fig. 5

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INSTITUT NATIONAL
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établi sur la base des dernières revendications déposées avant le commencement de la recherche

N° d'enregistrement national

FA 537846
FR 9700565

DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie	Citation du document avec indication, en cas de besoin, des parties pertinentes	Revendications concernée de la demande examinée
X	EP 0 743 373 A (NIPPON STEEL CORPORATION) * revendications 1,3 *	1-3
A	GB 2 118 211 A (NISSHIN SEIKO) * page 1, ligne 50 - page 2, ligne 43; revendications 1,2 *	1-5
A	FR 1 080 870 A (HARALD LUNDIN) * page 2, colonne 1, alinéa 3 - colonne 2, alinéa 4 * * page 3, colonne 1, alinéa 1; revendications 1-8 *	1,2,6
A	FR 2 374 093 A (UNIVERSITY COLLEGE CARDIFF OF C.U.I.C) * revendications 1,4,6,7 *	1-6
Y	GB 1 005 873 A (WELLWOTZHY) * revendications 1,3 *	6
Y	PATENT ABSTRACTS OF JAPAN vol. 012, no. 365 (C-532), 29 septembre 1988 & JP 63 118057 A (NISSHIN STEEL CO LTD), 23 mai 1988, * abrégé *	6
A	DE 25 53 051 A (POLITECHNICA SLASKA) * revendications 1,2 *	6
X	PATENT ABSTRACTS OF JAPAN vol. 016, no. 265 (C-0951), 16 juin 1992 & JP 04 063258 A (NIPPON STEEL CORP), 28 février 1992, * abrégé *	8-10
X	GB 1 101 973 A (YAWATA IRON & STEEL) * revendications 1,3 *	8-10

DOMAINES TECHNIQUES RECHERCHES (Int.Cl.6)

C23C

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Date d'achèvement de la recherche	Examinateur
6 octobre 1997	Elsen, D

CATEGORIE DES DOCUMENTS CITES

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O : divulgation non-écrite
P : document intercalaire

T : théorie ou principe à la base de l'invention
E : document de brevet bénéficiant d'une date antérieure à la date de dépôt et qui n'a été publié qu'à cette date de dépôt ou qu'à une date postérieure.
D : cité dans la demande
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& : membre de la même famille, document correspondant

EPO FORM 1503 03.82 (P04C13)

(12) DEMANDE INTERNATIONALE PUBLIÉE EN VERTU DU TRAITÉ DE COOPÉRATION EN MATIÈRE DE BREVETS (PCT)

(19) Organisation Mondiale de la Propriété Intellectuelle
Bureau international

(43) Date de la publication internationale
21 septembre 2006 (21.09.2006)

PCT

(10) Numéro de publication internationale
WO 2006/097593 A1

(51) Classification internationale des brevets :
C23C 22/78 (2006.01) *C23F 17/00* (2006.01)

(21) Numéro de la demande internationale :
PCT/FR2006/000466

(22) Date de dépôt international : 2 mars 2006 (02.03.2006)

(25) Langue de dépôt : français

(26) Langue de publication : français

(30) Données relatives à la priorité :
0502404 11 mars 2005 (11.03.2005) FR

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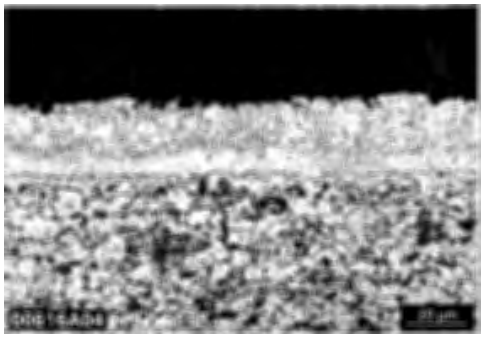
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(81) États désignés *(sauf indication contraire, pour tout titre de protection nationale disponible)* : AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG,

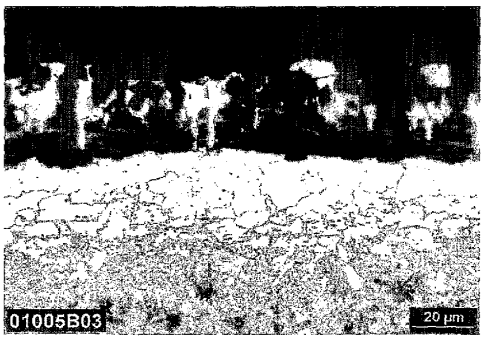
[Suite sur la page suivante]

(54) Title: METHOD FOR MAKING A COATED STEEL PART HAVING VERY HIGH RESISTANCE AFTER HEAT TREATMENT

(54) Titre : PROCEDE DE FABRICATION D'UNE PIECE D'ACIER REVETU PRESENTANT UNE TRES HAUTE RESISTANCE APRES TRAITEMENT THERMIQUE



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(57) Abstract: The invention concerns a method for making a part with very high mechanical characteristics from a hot- or cold-rolled steel strip, comprising precoating said strip with aluminum or an aluminum alloy, cold process deformation of the coated strip, optionally cutting off excess plate metal in view of the final shape of the part, heating the part so as to produce an intermetallic compound from the steel-coating interface and to austenize the steel, transferring the part into an equipment, cooling the part inside the equipment at a speed such that the steel structure after cooling is martensitic, or bainitic or martensito-bainitic. The precoating is performed by electroplating, chemical or physical vapour deposition, or combined rolling.

(57) Abrégé : L'invention concerne un procédé de fabrication d'une pièce à très hautes caractéristiques mécaniques à partir d'une bande d'acier laminée à chaud ou à froid, comportant un pré-revêtement de ladite bande par de l'aluminium ou un alliage d'aluminium, une déformation à froid de la bande revêtue, une découpe éventuelle des excédents de tôle en vue de la géométrie finale de la pièce, un chauffage de la pièce de façon à réaliser un composé intermétallique à partir de l'interface acier-revêtement et à austénitiser l'acier, un transfert de la pièce au sein d'un outillage, un refroidissement de la pièce au sein de l'outillage avec une vitesse telle que la structure de l'acier après refroidissement soit martensitique, ou bainitique ou martensito-bainitique. Le pré-revêtement est effectué par électrodéposition, dépôt chimique ou physique en phase vapeur, ou colaminage.

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KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) États désignés *(sauf indication contraire, pour tout titre de protection régionale disponible)* : ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasien (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), européen (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Publiée :

— *avec rapport de recherche internationale*

En ce qui concerne les codes à deux lettres et autres abréviations, se référer aux "Notes explicatives relatives aux codes et abréviations" figurant au début de chaque numéro ordinaire de la Gazette du PCT.

PROCEDE DE FABRICATION D'UNE PIECE D'ACIER REVÊTU PRESENTANT UNE TRES HAUTE RESISTANCE APRES TRAITEMENT THERMIQUE

L'invention concerne la fabrication de pièces d'acier revêtu laminé à chaud ou à froid, présentant une haute résistance mécanique ainsi qu'une bonne résistance à la corrosion.

Pour certaines applications, on cherche à réaliser des pièces en acier combinant une résistance mécanique élevée, une grande résistance aux chocs et une bonne tenue à la corrosion. Ce type de combinaison est particulièrement désirable dans l'industrie automobile où l'on recherche un allègement significatif des véhicules. Ceci peut être notamment obtenu grâce à l'utilisation d'aciers à très hautes caractéristiques mécaniques : Des pièces anti-intrusion, de structure ou de sécurité des véhicules automobiles (traverses de pare-choc, renforts de portière ou de pied milieu, bras de roue) nécessitent par exemple les qualités évoquées plus haut.

Le brevet FR 2807447 divulgue un procédé de fabrication où on approvisionne une tôle d'acier de base avec un pré-revêtement métallique, l'acier possédant une résistance à la rupture de l'ordre de 500MPa, on procède à une opération de mise en forme à froid, par exemple d'emboutissage ou de profilage à froid, puis l'on effectue un traitement thermique en vue d'une trempe ultérieure au sein d'un outillage de forme adapté à la géométrie de la pièce. Durant la phase de chauffage de ce traitement thermique, on forme un revêtement intermétallique à la surface de la pièce par alliation du pré-revêtement initial et de l'acier de base. De la sorte, on obtient par exemple des pièces avec une résistance mécanique supérieure à 1500MPa offrant une résistance à la corrosion.

La tôle d'acier de base peut être prérevêtue d'aluminium ou d'un alliage d'aluminium par un procédé au trempé. On peut cependant rencontrer des limitations à la mise en œuvre de ce procédé dans certains cas . Lors d'opérations de mise en forme à froid de la pièce avant traitement thermique, certaines zones peuvent être soumises à une déformation plus sévère, et l'on peut éventuellement assister à un endommagement de l'interface entre le

substrat et le pré-revêtement, sous forme de décohésion locale. Dans ce cas, le traitement thermique ultérieur peut conduire à la formation de calamine au voisinage de la couche interfaciale d'alliage. La présence de cette calamine est néfaste à la réalisation d'une alliation satisfaisante entre l'acier de base et le pré-revêtement aluminié.

Par ailleurs, après mise en forme à froid des pièces aluminiées, on peut effectuer une découpe, un poinçonnage ou un détourage en vue d'enlever l'excédent de matière avant le traitement thermique ultérieur d'alliation. La présence du pré-revêtement aluminié au trempé peut contribuer à l'usure de l'outillage de découpe.

D'autre part, le pré-revêtement des tôles aluminiées au trempé peut présenter une variation d'épaisseur par rapport à l'épaisseur nominale. Le chauffage lors du traitement thermique d'alliation est effectué assez rapidement, typiquement en quelques minutes. En cas de surépaisseur excessive, on assiste à une alliation incomplète du revêtement. La température de fusion des pré-revêtements usuels étant de 660°C pour l'aluminium ou de 580°C pour un alliage aluminium-10% silicium, on pourra assister à une fusion prématurée du côté le plus épais du revêtement avant d'atteindre la température d'austénitisation de la pièce. Les traitements thermiques étant effectués généralement dans des fours où les pièces sont déplacées sur des rouleaux, la surface de ces derniers est polluée d'une couche provenant de la fusion partielle du pré-revêtement, ce qui nuit à la bonne marche des fours. En outre, une alliation incomplète du pré-revêtement est néfaste lors d'opérations ultérieures de cataphorèse

La présente invention a pour but de résoudre les problèmes évoqués ci-dessus. Elle vise en particulier à mettre à disposition un procédé de fabrication de pièces d'acier laminées à chaud ou à froid pré-revêtues d'aluminium ou d'alliage d'aluminium, permettant une déformation importante préalable à froid avant traitement d'alliation sans risque de conséquence ultérieure sur le traitement d'alliation. Elle vise à réduire l'usure de l'outillage lors de l'usinage mécanique avant le traitement thermique d'alliation. Elle vise également à obtenir, après traitement thermique, une alliation complète du pré-revêtement d'aluminium ou d'alliage d'aluminium.

Dans ce but, l'invention a pour objet un procédé de fabrication d'une pièce à très hautes caractéristiques mécaniques à partir d'une bande d'acier, laminée à chaud ou à froid, comportant les étapes successives suivantes :

- On effectue un pré-revêtement de la bande par de l'aluminium ou d'un alliage d'aluminium. Ce pré-revêtement peut être réalisé par une ou plusieurs étapes selon les modes ci-dessous, seuls ou en combinaison :
  - pré-revêtement par une ou plusieurs étapes d'électrodéposition d'aluminium ou d'alliage d'aluminium
  - pré-revêtement par une ou plusieurs étapes de dépôt chimique en phase vapeur d'aluminium ou d'alliage d'aluminium
  - pré-revêtement par une ou plusieurs étapes de dépôt physique en phase vapeur d'aluminium ou d'alliage d'aluminium.
  - pré-revêtement par une ou plusieurs étapes de colaminage entre la bande d'acier et un feuillard d'aluminium ou d'alliage d'aluminium.
  - Grâce à la mise en œuvre de ces modes de pré-revêtement, l'interface entre la bande d'acier et le pré-revêtement ne comporte pas de phase intermétallique.
- On déforme à froid la bande revêtue
- On retire éventuellement les excédents de tôle en vue de la géométrie finale de ladite pièce
- On chauffe la pièce, par exemple au sein d'un four, de façon à réaliser un composé intermétallique à la surface de la pièce, à partir de l'interface acier-revêtement et à austénitiser l'acier. Durant la phase de chauffage de ce traitement thermique, on forme, par alliation de la couche de pré-revêtement initial et de l'acier de base, un revêtement intermétallique à la surface de la pièce, cette alliation étant réalisée dans la totalité de l'épaisseur de la couche de revêtement.
- Après chauffage, on transfère la pièce au sein d'un outillage. Le temps de transfert entre la phase de chauffage et le contact avec l'outillage est suffisamment court pour qu'une transformation de l'austénite n'intervienne pas durant ce laps de temps. La géométrie et la conception de l'outillage sont adaptées à la pièce à traiter et à la

drasticité de la trempe. En particulier, ces outils peuvent être refroidis, notamment par circulation de fluide pour augmenter la productivité des opérations et/ou accroître la sévérité de trempe. Un effort de serrage peut assurer un contact intime entre les pièces et l'outillage, permettant ainsi un refroidissement efficace par conduction et une déformation minimale. On refroidit la pièce au sein de l'outillage avec une vitesse telle que la structure de l'acier après refroidissement soit martensitique, ou bainitique ou martensito-bainitique.

Selon un mode particulier, le taux de la déformation généralisée de la déformation à froid est supérieure à 20% en au moins un point de la pièce.

L'invention a également pour objet l'utilisation d'une pièce à très hautes caractéristiques mécaniques à partir d'une bande d'acier, fabriquée selon l'un des modes ci-dessus, pour la fabrication de pièces de structures ou de sécurité pour véhicule automobile terrestre à moteur.

D'autres caractéristiques et avantages de l'invention apparaîtront au cours de la description ci-dessous, donnée à titre d'exemple.

La figure 1 présente un exemple d'interface acier-alliage d'aluminium déposé au trempé, avant déformation à froid

La figure 2 présente l'évolution de cette interface après déformation généralisée à froid supérieure à 20%.

La figure 3 présente un exemple d'interface acier-alliage d'aluminium déposé au trempé, sans déformation à froid, après traitement d'alliation.

La figure 4 illustre la couche superficielle après déformation à froid supérieure à 20%, suivie par un traitement d'alliation.

On a examiné l'évolution de l'interface acier-revêtement au cours d'un procédé de fabrication conventionnel : dans ce but, on a considéré des pièces d'acier de 1,2 ou 2mm d'épaisseur, de composition pondérale suivante :

Carbone : 0,15 à 0,25%

Manganèse : 0,8 à 1,5%

Silicium : 0,1 à 0,35%

Chrome : 0,01 à 0,2%

Titane < 0,1%

Phosphore< 0,05%

Soufre <0,03%

B : 0,0005% à 0,01%,

Celles-ci ont été pré-revêtues grâce à un procédé conventionnel au trempé dans un bain à base d'aluminium comportant :

Silicium : 9-10%

Fer : 2 à 3,5%

Le solde étant constitué d'aluminium et des inévitables impuretés

Il est connu que le contact d'un acier dans un bain d'aluminium pur à plus de 660°C conduit à une formation très rapide d'une épaisse couche d'alliage intermétallique, comportant notamment FeAl3-Fe2Al5. Cette couche présentant une faible aptitude à la déformation, une addition de 10% de silicium dans le bain permet de réduire l'épaisseur de cette couche intermédiaire. La figure 1 indique que la couche intermétallique, d'une dureté de 600 à 800HV, a une épaisseur d'environ 7 micromètres, celle-ci étant surmontée par une couche métallique à base d'aluminium de 15 micromètres environ.

Les pièces pré-revêtues ont été soumises à une déformation à froid sur éprouvettes de type Nakazima, sollicitant celles-ci selon différents modes : traction uniaxiale, expansion équibiaxiale. Au moyen de grilles à motifs circulaires préalablement photodéposées, on a mesuré en divers points les déformations principales ε_1, ε_2, c'est à dire les déformations dans un repère principal. On en déduit la déformation généralisée : $\bar{\varepsilon} = \frac{2}{\sqrt{3}}\sqrt{(\varepsilon_1^2 + \varepsilon_1\varepsilon_2 + \varepsilon_2^2)}$ relative à ces différents points.

Simultanément, on a observé en ces différents emplacements le comportement du pré-revêtement : Les observations révèlent que, jusqu'à une déformation généralisée de l'ordre de 10%, la couche intermédiaire est fissurée de manière fine et régulière, sans conséquence sur la couche supérieure d'aluminium métallique surmontant celle-ci. Un traitement thermique ultérieur en four à 900°C pendant 5 ou 7 minutes, suivi d'une trempe au sein d'un outillage refroidi à l'eau conduit à une alliation complète du revêtement initial et à la disparition de ce réseau limité de fissures (figure

3). Au-delà de 20% de déformation généralisée, on assiste à une fragmentation de la couche intermétallique (figure 2), et par endroits, à une dégradation du revêtement métallique à base d'aluminium. Le traitement thermique ultérieur d'alliation peut alors provoquer la croissance d'une couche de calamine ou une décarburation à la surface de l'acier (figure 4) néfaste à la mise en œuvre ultérieure de la pièce, par exemple à une mise en peinture

Ainsi, la mise en œuvre d'un procédé de déformation à froid avec une déformation sévère peut conduire à des difficultés à partir d'un pré-revêtement conventionnel à base d'aluminium. Dans le cadre de l'invention, on a mis en évidence que ce problème était résolu lorsque l'interface entre l'acier et l'aluminium ne comportait pas de phase intermétallique. En effet, compte tenu de la ductilité intrinsèque de l'aluminium ou de l'alliage d'aluminium, liée à sa structure cubique-face-centrée, une déformation à froid importante d'un acier pré-revêtu ne conduit à aucune dégradation de l'interface ou du pré-revêtement, si bien que le traitement d'alliation ultérieur intervient dans des conditions optimales.

Le pré-revêtement d'aluminium ou d'un alliage d'aluminium est réalisé par électrodéposition, par dépôt physique ou chimique en phase vapeur, ou encore par colaminage entre une bande d'acier et un feuillard d'aluminium ou d'alliage d'aluminium. Par ces différentes étapes, on aboutit ainsi à une pièce sans couche intermétallique entre l'acier de base et le pré-revêtement avant le traitement d'alliation. Le procédé selon l'invention peut être mis en œuvre en appliquant une même étape de pré-revêtement en une seule reprise, ou en appliquant celui-ci à plusieurs reprises. De même, le procédé peut être mis en œuvre selon l'invention en combinant successivement différentes étapes de pré-revêtements de façon à exploiter les avantages intrinsèques aux différents procédés et aux différentes caractéristiques des dépôts.

L'application du procédé selon l'invention facilite la mise en œuvre dans le cas d'un découpage, d'un poinçonnage ou d'un détourage des pièces après l'opération de mise en forme à froid. En effet, un usinage intermédiaire peut s'avérer utile dans le but de diminuer le volume de métal à réchauffer dans le traitement d'alliation. Selon l'invention, cet usinage intermédiaire est facilité

par l'absence de la couche intermétallique dure (de 600 à 800 HV) que l'on rencontre dans le procédé conventionnel. De la sorte, l'usure des outils de découpe est réduite.

Par ailleurs, les étapes de pré-revêtement selon l'invention sont associées à des dépôts d'une grande régularité d'épaisseur : par exemple, les conditions de pré-revêtement en phase vapeur peuvent être associées à un dépôt d'épaisseur compris entre 15 et 20 micromètres avec une variation d'épaisseur d'ordre micrométrique.

Selon les procédés d'aluminiage au trempé, la variation d'épaisseur du pré-revêtement mesurée sur coupe micrographique peut être de l'ordre de ±10 micromètres pour une épaisseur moyenne de 25 micromètres. Dans le but de maximiser la productivité, on souhaite que le chauffage lors du traitement thermique d'alliation s'effectue le plus rapidement possible. La constatation de la présence d'une surépaisseur peut conduire à allonger la phase de chauffage, pour que l'alliation soit complète. Pour un traitement thermique donné, la méconnaissance d'une surépaisseur excessive peut avoir pour conséquence une alliation incomplète, se traduisant par une fusion partielle du pré-revêtement.

L'étape de pré-revêtement selon l'invention conduit à une faible variabilité de l'épaisseur, ce qui diminue le risque de fusion et augmente la stabilité de la marche des fours.

Par ailleurs, après austénitisation, le traitement de trempe par refroidissement au sein d'un outillage confère une structure martensitique ou bainitique ou martensito-bainitique à l'acier. Selon la composition de l'acier, en particulier sa teneur en carbone, ainsi qu'en manganèse, chrome et bore, la résistance maximale obtenue sur les pièces selon l'invention, varie de 1200 à 1700MPa.

Selon l'invention, la coupe s'effectuant de manière plus nette en raison de l'absence de couche intermétallique, l'effet d'entaille en bord de découpe est moindre après traitement de trempe, puisque l'on sait que des structures totalement ou partiellement martensitiques sont par essence plus sensibles aux effets de concentrations locales de contraintes.

Ainsi, l'invention permet la fabrication de pièces à hautes caractéristiques revêtues, avec des formes plus complexes, puisque la déformation à froid

peut atteindre des taux importants. L'invention est mise en œuvre de façon particulièrement avantageuse lorsque le taux de la déformation généralisée à froid préalable au traitement d'alliation est supérieur à 20%. Elle permet une réduction de l'usure de l'outillage lors des opérations intermédiaires de découpe et conduit à une plus grande efficacité du traitement final d'alliation.

REVENDICATIONS

1. Procédé de fabrication d'une pièce à très hautes caractéristiques mécaniques à partir d'une bande d'acier, laminée à chaud ou à froid, comportant les étapes successives suivantes :

- On effectue un pré-revêtement de ladite bande par de l'aluminium ou un alliage d'aluminium
- On déforme à froid ladite bande revêtue
- On retire éventuellement les excédents de tôle en vue de la géométrie finale de ladite pièce
- On chauffe ladite pièce de façon à réaliser un composé intermétallique à la surface de ladite pièce à partir de l'interface acier-revêtement et à austénitiser l'acier
- On transfère ladite pièce au sein d'un outillage
- On refroidit ladite pièce au sein d'un outillage avec une vitesse telle que la structure de l'acier après refroidissement soit martensitique ou bainitique ou martensito-bainitique,
- caractérisé en ce que l'interface entre ladite bande d'acier et le pré-revêtement avant ledit chauffage ne comporte pas de phase intermétallique et que l'on réalise ledit pré-revêtement par au moins une étape d'électrodéposition d'aluminium ou d'alliage d'aluminium, par au moins une étape de dépôt chimique en phase vapeur d'aluminium ou d'alliage d'aluminium, par au moins une étape de dépôt physique en phase vapeur d'aluminium ou d'alliage d'aluminium, par au moins une étape de colaminage entre ladite bande d'acier et un feuillard d'aluminium ou d'alliage d'aluminium, lesdites au moins une étape de pré-revêtement pouvant être réalisées seules ou en combinaison

2 Procédé de fabrication selon la revendication 1 caractérisé en ce que le taux de la déformation généralisée de ladite déformation à froid est supérieur à 20% en au moins un point de ladite pièce

3 Utilisation d'une pièce à très hautes caractéristiques mécaniques à partir d'une bande d'acier fabriquée selon la revendication 1 ou 2 pour la fabrication de pièces de structures ou de sécurité pour véhicule automobile terrestre à moteur.

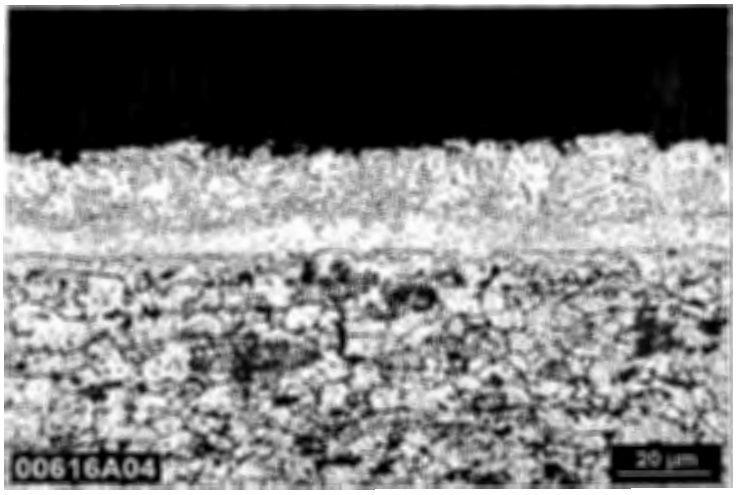


Figure 1

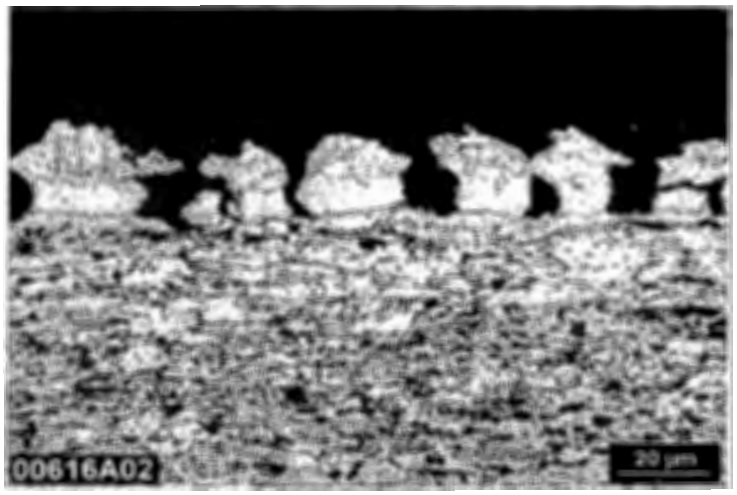


Figure 2



Figure 3

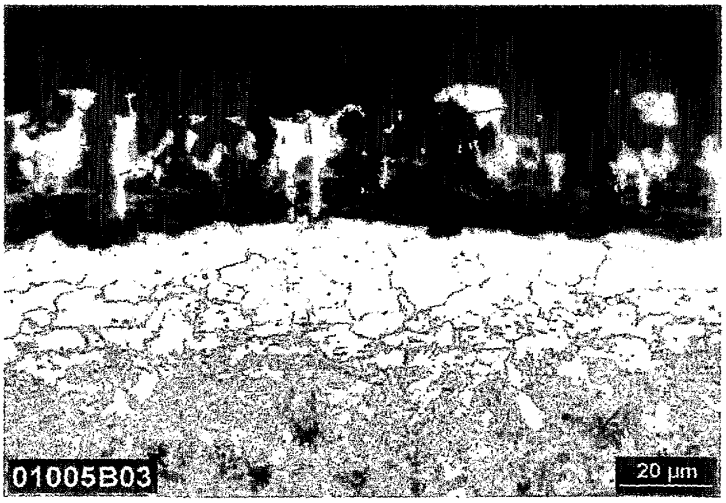


Figure 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/FR2006/000466

A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C22/78 C23F17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C21D C25D C23F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6 197 132 B1 (ANDERSSON-DRUGGE ING-MARIE) 6 March 2001 (2001-03-06). column 1, lines 5-11 column 2, lines 1-12,35-67; figures 2,4; example 2 column 4, lines 10-13 claims 1-4	1-3
Y	US 6 296 805 B1 (LAURENT JEAN-PIERRE ET AL) 2 October 2001 (2001-10-02) column 3, line 60 - column 4, line 17	1

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
23 June 2006	30/06/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Handrea-Haller, M

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/FR2006/000466

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1 403 388 A (THYSSENKRUPP STAHL AG) 31 March 2004 (2004-03-31) page 2, paragraphs 1,10 page 3, paragraphs 13,14 page 4, paragraph 26 page 5, paragraph 33 page 6, paragraphs 40,45,46 claims 1,12,13,15,18,21,22	1-3
Y	US 3 214 820 A (SMITH EDWIN J ET AL) 2 November 1965 (1965-11-02) column 1, lines 9,10,68-72 column 2, lines 41-54 column 3, lines 1-20 column 4, lines 6-17,35-37 column 5, lines 5-9,41-50 column 6, lines 45-47,51,66,67 claims 1-3,8,11	1-3
Y	FR 857 779 A (COSTE & COMPAGNIE) 28 September 1940 (1940-09-28) the whole document	1-3
Y	DE 102 24 319 A1 (BENTELER AUTOMOBILTECHNIK GMBH) 18 December 2003 (2003-12-18) column 1, paragraphs 1,4 column 1, paragraph 6 - column 2, paragraphs 7-9,11,13 column 3, paragraph 17 - column 4, paragraph 23 claims 1,3-6	1-3
Y	GB 1 489 618 A (SUMITOMO METAL IND LTD) 26 October 1977 (1977-10-26) page 1, lines 7-9,25-46 page 2, lines 1-12; examples 2,4 claims 1-4,6-8	1-3
Y	WO 99/55469 A (WEIRTON STEEL CORPORATION) 4 November 1999 (1999-11-04) the whole document	1-3
A	DE 12 90 024 B (INTERLICENCE S. A) 27 February 1969 (1969-02-27) the whole document	1-3
A	EP 1 013 785 A (SOLLAC) 28 June 2000 (2000-06-28) the whole document	1-3

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/FR2006/000466

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RAPPORT DE RECHERCHE INTERNATIONALE

Demande internationale n°
PCT/FR2006/000466

A. CLASSEMENT DE L'OBJET DE LA DEMANDE
INV. C23C22/78 C23F17/00

Selon la classification internationale des brevets (CIB) ou à la fois selon la classification nationale et la CIB

B. DOMAINES SUR LESQUELS LA RECHERCHE A PORTE

Documentation minimale consultée (système de classification suivi des symboles de classement)
C21D C25D C23F

Documentation consultée autre que la documentation minimale dans la mesure où ces documents relèvent des domaines sur lesquels a porté la recherche

Base de données électronique consultée au cours de la recherche internationale (nom de la base de données, et si cela estréalisable, termes de recherche utilisés)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie*	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
Y	US 6 197 132 B1 (ANDERSSON-DRUGGE ING-MARIE) 6 mars 2001 (2001-03-06) colonne 1, ligne 5-11 colonne 2, ligne 1-12,35-67; figures 2,4; exemple 2 colonne 4, ligne 10-13 revendications 1-4	1-3
Y	US 6 296 805 B1 (LAURENT JEAN-PIERRE ET AL) 2 octobre 2001 (2001-10-02) colonne 3, ligne 60 - colonne 4, ligne 17	1

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[X] Voir la suite du cadre C pour la fin de la liste des documents

[X] Les documents de familles de brevets sont indiqués en annexe

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Date à laquelle la recherche internationale a été effectivement achevée	Date d'expédition du présent rapport de recherche internationale
23 juin 2006	30/06/2006

Nom et adresse postale de l'administration chargée de la recherche internationale	Fonctionnaire autorisé
Office Européen des Brevets, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Handrea-Haller, M

Formulaire PCT/ISA/210 (deuxième feuille) (avril 2005)

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Demande internationale n°
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C(suite). DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie*	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
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Y	DE 102 24 319 A1 (BENTELER AUTOMOBILTECHNIK GMBH) 18 décembre 2003 (2003-12-18) colonne 1, alinéas 1,4 colonne 1, alinéa 6 - colonne 2, alinéas 7-9,11,13 colonne 3, alinéa 17 - colonne 4, alinéa 23 revendications 1,3-6	1-3
Y	GB 1 489 618 A (SUMITOMO METAL IND LTD) 26 octobre 1977 (1977-10-26) page 1, ligne 7-9,25-46 page 2, ligne 1-12; exemples 2,4 revendications 1-4,6-8	1-3
Y	WO 99/55469 A (WEIRTON STEEL CORPORATION) 4 novembre 1999 (1999-11-04) le document en entier	1-3
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Deutsches Patent- und Markenamt

(10) **DE 10 2004 007 071 A1** 2005.09.08

(12) # Offenlegungsschrift

(21) Aktenzeichen: **10 2004 007 071.7**
(22) Anmeldetag: **13.02.2004**
(43) Offenlegungstag: **08.09.2005**

(51) Int Cl.[7]: **C21D 8/02**
C21D 7/13

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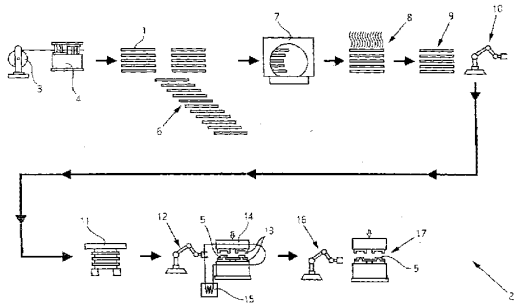
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Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

Prüfungsantrag gemäß § 44 PatG ist gestellt.

(54) Bezeichnung: **Verfahren zur Herstellung eines Bauteils durch Umformen einer Platine und Vorrichtung zur Durchführung des Verfahrens**

(57) Zusammenfassung: Die Erfindung bezieht sich auf ein Verfahren zur Herstellung eines Bauteils (5) durch Umformen einer beschichteten Platine (1) aus einem Vergütungsstahl, wobei sie vor dem Umformen über eine erste Wärmebehandlung austenitisiert wird, wobei sich darüber hinaus ein Schichtdickenwachstum vollzieht.
Eine Optimierung im Prozessablauf und ein Vermeiden von Ausschussplatinen bei Prozessstörungen ist dadurch erreichbar, dass nach einem raschen Abkühlen die wärmebehandelte Platine (1) zwischengelagert wird, dass unmittelbar vor dem Umformen zum Bauteil (5) die Platine einer erneuten, kurzzeitigen Erwärmung auf Austenitisierungstemperatur unterzogen wird und dass nach erfolgter Gefügeumwandlung das Umformen und Härten der Platine (1) vonstatten geht. Vorzugsweise geschieht die zweite Erwärmung der Platine (1) durch Induktion.



Beschreibung

[0001] Die Erfindung bezieht sich auf ein Verfahren zur Herstellung eines Bauteils durch Umformen einer beschichteten, vorzugsweise aluminiumbeschichteten Platine aus einem Vergütungsstahl nach dem Oberbegriff des Patentanspruches 1. Die Erfindung betrifft des weiteren eine Vorrichtung zur Durchführung des Verfahrens.

[0002] Im Stand der Technik sind verschiedene Umformverfahren für Platinen aus einem Vergütungsstahl in Verbindung mit Härtungsprozessen allgemein bekannt. Bei einem sogenannten „direkten" Umformverfahren wird eine ebene Platine aus einem Vergütungsstahl in einem Ofen, vorzugsweise einem Durchlaufofen, unter Schutzgasatmosphäre austenitisiert. Beispielsweise kann ein Vergütungsstahl in der Qualität 22MnB5 verwendet werden, der für die Austenitisierung mehrere Minuten bei ca. 950°C geglüht wird. Anschließend wird mit einer vorzugsweise automatisierten Transfereinrichtung die heiße austenitisierte ebene Platine in ein für Serienprozesse gekühltes Umform-/Vergütungswerkzeug eingelegt. Dieses Werkzeug ist Bestandteil einer Presse und beim Schließen derselben wird die heiße Platine zu einem Bauteil auf Endform umgeformt und im geschlossenen Werkzeug bei aufgebrachter Schließkraft relativ schnell abgekühlt und dadurch gehärtet. Das gehärtete Bauteil wird aus dem Werkzeug entnommen und, falls es sich um ein unbeschichtetes Blech handelt, in einem Reinigungsschritt beispielsweise durch Sand- oder Kugelstrahlen entzundert (dies ist bei beschichteten Bauteilen entbehrlich, da z. B. aluminierte Bleche ausreichend Korrosionsschutz bieten und eine Verzunderung verhindert wird). Abschließend folgt ein Fertigkontur- und Lochbeschnitt des fertig geformten und gehärteten Bauteiles, vorzugsweise mittels Laserschneiden. Auch ein mechanisches Schneiden im sogenannten Pressenverbund ist denkbar.

[0003] Während der Wärmebehandlung im Ofen erfährt z. B. eine im Ausgangszustand etwa 25 µm starke Aluminiumbeschichtung ein Schichtdickenwachstum auf etwa 45 µm, wobei sich unmittelbar an das Grundmaterial der Platine angrenzend eine Al-Si-Schicht mit eindiffundiertem Eisen heraus bildet, die eine darüber hinaus sich bildende, relativ harte und spröde AlSi-Schicht trägt, die die eigentliche Korrosionsschutzfunktion erfüllt.

[0004] Ein typischer Verfahrensablauf (Warmumformkurve **20**) hinsichtlich der Wärmebehandlung der Platine im Zuge ihres Umformens ist beispielsweise in Fig. 1 in einem Zeit-Temperatur-Diagram dargestellt. Je nach verwendeter Vergütungsstahlqualität, Blechdicke, Ausgangsschichtdicke u.s.w. sind die in Fig. 1 angegebenen Werte natürlich auch gewissen Schwankungen unterworfen (Wärmebehandlungunter-/obergrenze **18**, **19**). So ist ohne weiteres denkbar, dass die Platine sich über eine Verweildauer von bis zu 30 Minuten im Ofen befindet.

[0005] Der verwendete Ofen ist häufig ein sogenannter Durchlaufofen mit Formnestern oder Platinenaufnahmen oder ein Rostdurchschubofen mit Rosten, welche die Platine tragen und diese innerhalb von etwa 2 Minuten mittels Gasbrenner auf Austenitisierungstemperatur erwärmen und anschließend mehrere Minuten mittels elektrischer Heizung auf dieser Temperatur halten. Vorzug des Gasbrenners ist eine höhere Leistung, wohingegen elektrische Heizungen besser regelbar sind.

[0006] Gemäß Fig. 1 wird also die Platine im Ofen auf eine Solltemperatur von etwa 950° C erhitzt und auf dieser Temperatur gehalten. Die Austenitisierung vollzieht sich bei Temperaturen oberhalb etwa 720° C. Üblicherweise beträgt die Verweildauer im Ofen ca. 9 Minuten, wobei sich die Platine innerhalb der ersten beiden Minuten auf Solltemperatur erwärmt, während in den darauffolgenden etwa 7 Minuten das Umkörnen des Grundmaterials vom kubisch-raumzentrierten Ferrit/Perlit-Gefüge ins kubisch- flächenzentrierte Austenit, das für ein Härten notwendig ist, vonstatten geht. Daneben ist die genannte Zeitspanne vor allem auch wichtig, um ein ausreichendes Anwachsen der AlSi-Schutzschicht zu erreichen.

[0007] Insbesondere hinsichtlich minimaler Glühtemperatur und maximaler Verweildauer der Platine im Ofen gibt es gewisse, mehr oder weniger enge Grenzen, innerhalb derer der Prozess noch Gutteile liefert, d. h., dass die aus dem Ofen entnommenen Platinen überhaupt noch für den Umformprozess und die weitere Verwendung verwertbar sind.

[0008] Stellt sich nun im weiteren Ablauf eine Störung ein, sei es bei der Entnahme einer Platine aus dem Ofen und ihrem Weitertransport zum Umform-/Vergütungswerkzeug bzw. innerhalb der Station des Fertigkontur- und Lochbeschnittes, so kann für die Dauer der Störung keine Platine mehr aus dem Ofen entnommen werden, die maximal zulässige Verweildauer wird in der Regel überschritten und sämtliche im Ofen befindlichen Platinen sind Ausschuss und müssen von daher entsorgt werden.

Aufgabenstellung

[0009] Der Erfindung liegt die Aufgabe zugrunde, das gattungsgemäße Verfahren zur Herstellung eines Bauteiles durch Umformen einer beschichteten Platine aus einem Vergütungsstahl in der Weise weiterzubilden, dass eine Optimierung im Prozessablauf erreichbar ist und dass insbesondere bei eventuellen Prozessstörungen dem kostenträchtigen Anfallen von Ausschussplatinen vorgebeugt werden kann.

[0010] Diese Aufgabe wird hinsichtlich des Verfahrens mit den weiteren Merkmalen nach dem Kennzeichen des Patentanspruches 1 und hinsichtlich der Vorrichtung zur Durchführung des erfindungsgemäßen Verfahrens mit den Merkmalen des Patentanspruches 10 gelöst.

[0011] Die Vorteile der erfindungsgemäßen Vorgehensweise sind mannigfaltig. So besteht nun keine Abhängigkeit mehr bezüglich der Verweildauer der Platinen innerhalb des Ofens und Ablaufstörungen im Prozess außerhalb des Ofens. Durch die Entkopplung der Abläufe ergibt sich für den eigentlichen Prozess der Platinenumformung ein geringerer Flächenbedarf und ein Weniger an Infrastruktur. Eine Pufferung/Zwischenlagerung der wärmebehandelten Platinen ist möglich, so dass eine Wärmebehandlung, unter anderem zur Beeinflussung der AlSi-Schicht, ohne weiteres auch bereits beim Stahlhersteller bzw. Blechlieferanten erfolgen kann.

Stand der Technik

[0012] Eine solche ausgelagerte, vorgeschaltete Wärmebehandlung ist an sich bereits bekannt, wie aus der EP 0 946 311 B1 und der DE 102 12 400 C1 hervorgeht. Auch eine Glühbehandlung mittels Induktionserwärmung ist für sich gesehen bereits bekannter Stand der Technik, wie dies im letztgenannten Dokument beispielsweise auch erwähnt ist.

[0013] Vorteilhafte Ausgestaltungen und Weiterbildungen der Erfindung sind in den jeweiligen Unteransprüchen beansprucht.

Ausführungsbeispiel

[0014] Die Erfindung ist nachstehend anhand eines Ausführungsbeispieles näher erläutert. In der Zeichnung zeigen:

[0015] Fig. 1 den erfindungsgemäßen Verfahrensablauf zur Herstellung eine Bauteiles durch Umformen einer Platine,

[0016] Fig. 2 ein Temperatur- Zeit- Diagramm der ersten Platinen-Wärmebehandlung und

[0017] Fig. 3 ein Temperatur- Zeit- Diagramm der zweiten Platinen- Wärmebehandlung.

[0018] In Fig. 1 ist schematisch der erfindungsgemäße Verfahrensablauf zur Herstellung eines Bauteiles **5** durch Umformen einer beschichteten Platine **1** aus einem Vergütungsstahl mittels einer hierfür geeigneten Vorrichtung **2** gezeigt. Von dem im aufgerolltem Zustand angelieferten Stahl, einem sogenannten Coil **3**, wird mittels eines Werkzeuges **4** der Stahl abgerollt, geglättet und die für das fertige Bauteil **5** notwendige Größe der Platine **1** ausgestanzt bzw. abgeschnitten. Von dort aus werden die Platinen **1** einer Pufferzone **6** zugeführt. Dieses Zwischenlagern ist allerdings nicht unbedingt erforderlich, vielmehr können die Platinen **1** auch unmittelbar nach Verlassen des Werkzeuges **4** einem ersten Ofen **7** zugeführt werden, in dem sie eine Wärmebehandlung gemäß dem Temperatur- Zeit- Diagramm nach Fig. 2 erfahren. Unmittelbar dem ersten Ofen **7** nachgelagert ist eine Abkühlzone **8**, in der die Platinen **1** abgeschreckt werden und die abschließenden Phasen der Wärmebehandlung durchlaufen. Die Abkühlzone **8** verlassend werden die wärmebehandelten Platinen **1** einem Zwischenlager **9** zugeführt.

[0019] Der erste Ofen **7** kann vom konstruktiven Aufbau her ein bereits erwähnter Durchlaufofen, ein Karussell-Ofen oder dergleichen sein.

[0020] Die einzelnen Phasen der Wärmebehandlung wurden bereits eingangs mit Hinweis auf Fig. 2 erläutert. Das relativ langsam vonstatten gehende Aufheizen auf Solltemperatur sowie die übrige Verweildauer im ersten Ofen **7** zum Herbeiführen der Austenitisierung und zum Verändern der Topographie (Beschichtungsaufbau, Schichtdicke) summiert sich auf eine Gesamt-Verweildauer von etwa 9 Minuten, wobei erfahrungsgemäß eine maximale Verweildauer von 30 Minuten nicht überschritten werden darf, damit die Platine nicht unbrauchbar wird. Der Transport in die Abkühlzone **8** und die dortige Abschreckung der Platine **1** vollzieht sich innerhalb relativ kurzer Zeiträume, während ein restliches Abkühlen auf Raumtemperatur RT im Zwischenlager **9** erfolgen kann. Am Ende der Wärmebehandlung weist die Platine **1** ein Martensitgefüge auf.

[0021] Mittels einer geeigneten Transportvorrichtung **10**, beispielsweise einem Gelenkarmroboter, werden die Platinen **1** einem Induktionsofen **11** zugeführt, von wo aus sie über eine weitere Transportvorrichtung **12**, z. B. wiederum ein Gelenkarmroboter, in ein für Serienprozesse geeignetes, gekühltes Umform-Vergütungswerkzeug **13** eingelegt werden. Diesem ist eine Presseneinrichtung **14** sowie eine Kühlvorrichtung **15** zugeordnet, und beim Schließen der Presseneinrichtung **14** wird die heiße Platine **1** zu einem Bauteil **5** auf Entform umgeformt und im geschlossenen Umform-Vergütungswerkzeug **13** bei aufgebrachter Schließkraft schnell abgekühlt und dadurch gehärtet. In einem letzten Verfahrenschritt wird jedes Bauteil **5** über eine Transportvorrichtung **16** einer Beschnittvorrichtung **17** zugeführt, wo ein Fertigkontur- und Lochbeschnitt des fertig geformten und gehärteten Bauteiles **5** vorzugsweise mittels Laserschneiden durchgeführt wird. Selbstverständlich kann dies auch über geeignete Beschnittmesser auf mechanischem Wege erfolgen.

[0022] Die im Induktionsofen **11** und im nachgeschalteten Umform-Vergütungswerkzeug **13** vonstat-

ten gehende Wärmebehandlung der Platine **1** ist im Temperatur- Zeit- Diagramm gemäß Fig. 3 anhand der Warmumformkurve **20** und der Wärmebehandlungsunter-/obergenze **18**, **19** dargestellt. Sie ist gekennzeichnet durch eine ausgesprochen kurze Verweildauer der Platine im Induktionsofen **11**. Während das Aufheizen auf Solltemperatur (Austenitisierungstemperatur) innerhalb weniger Sekunden (ca. zehn sec.) erfolgt dient eine nachgeschaltete kurze Verweilzeit von etwa zehn Sekunden bis maximal zwei Minuten dazu, eine Gefügeumwandlung vonstatten gehen zu lassen. Eine Änderung von Dicke und Aufbau der Beschichtung ist nicht mehr erforderlich, da dies bereits im ersten Ofen **7** erfolgt ist. Nach demzufolge äußerst kurzer Verweildauer im Induktionsofen **11** kann die Platine bereits dem Umfom-Vergütungswerkzeug **13** zugeführt werden, in dem neben der Umformung das Abschrecken in gleicher Weise (gleicher Verlauf der Warmumformkurve **20**) vonstatten geht wie in der Abkühlzone **8**. Beim Verlassen des Umform-Vergütungswerkzeuges **13** weist das Bauteil **5** bereits Martensitgefüge auf, die Abkühlung auf Raumtemperatur RT kann beim Weitertransport zur bzw. innerhalb der Beschnittvorrichtung **17** erfolgen.

[0023] Auf diese Weise wurde eine eine ursprüngliche Zugfestigkeit von etwa 500 bis 600 N/mm^2 aufweisende Platine **1** in ein eine Zugfestigkeit von etwa 1300 bis 1500 N/mm^2 aufweisendes Bauteil **5** umgeformt.

[0024] In vorteilhafter Weiterbildung der Erfindung wäre denkbar, im Induktionsofen **11** die Platine **1** partiell unterschiedlich stark zu erwärmen, mit der Folge, dass, falls dies gewünscht ist, das umgeformte und abgeschreckte Bauteil **5** partiell unterschiedliche Festigkeiten aufweist.

[0025] Weiter wäre vorteilhaft möglich, die Platine **1** vor der zweiten Wärmebehandlung (Induktionsofen **11**) zum Beispiel durch Aufschweißen von Verstärkungsblechen (Patches) lokal zu verstärken. Ein solchermaßen gepatchtes Verbundblech könnte dann dem zweiten Ofen und danach dem Umform-Vergütungswerkzeug **13** zugeführt werden. Dies hätte insgesamt positive Auswirkungen auf die Werkstoffeigenschaften und die Formgenauigkeit.

[0026] Das erfindungsgemäße Verfahren ist auch bei Verwendung von Tailored blanks Platinen vorteilhaft anwendbar.

[0027] Ein wesentlicher Vorteil der Erfindung ist die Möglichkeit der Entkopplung der einzelnen Verfahrensschritte. So kann die erste Wärmebehandlung im Ofen **7** bereits beim Stahl- bzw. Blechhersteller erfolgen und die so vorbehandelten Platinen **1** können dann dem weiterverarbeitenden Unternehmen (z. B. Fahrzeughersteller) bereitgestellt werden (Zwischenlager **9**).

[0028] In einer weiteren vorteilhaften Weiterbildung der Erfindung ist denkbar, der Transportvorrichtung **10** einen Induktor zuzuordnen bzw. diesen in die Transportvorrichtung **10** baulich zu integrieren, so dass die Wärmebehandlung der Platine **1** während ihres Transportes zum Umform-Vergütungswerkzeug **13** vonstatten gehen kann. Ein separater Induktionsofen **11** sowie eine diesem nachgeschaltete weitere Transportvorrichtung **12** könnten dadurch entfallen.

Patentansprüche

1. Verfahren zur Herstellung eines Bauteils durch Umformen einer beschichteten, vorzugsweise aluminiumbeschichteten Platine aus einem Vergütungsstahl, wobei vor dem Umformen in einem ersten Verfahrensschritt die Platine einem ersten Ofen zugeführt und dort austenitisiert wird und wobei die Verweildauer der Platine im ersten Ofen so gewählt wird, dass neben der Gefügeumwandlung ein Schichtdickenwachstum vonstatten geht, gekennzeichnet durch folgende weitere Verfahrensschritte:
– schnelles Abkühlen und anschließendes Zwischenlagern der wärmebehandelten Platine (**1**)
– erneutes, kurzzeitiges Erwärmen der Platine (**1**) in einem zweiten Ofen (**11**) auf Austenitisierungstemperatur unmittelbar vor dem Umformen zum Bauteil (**5**) und
– nach erfolgter Gefügeumwandlung Umformen und Härten der Platine (**1**).

2. Verfahren nach Patentanspruch 1, gekennzeichnet durch eine Verweildauer im ersten Ofen (**7**) zwischen neun Minuten und dreißig Minuten.

3. Verfahren nach Patentanspruch 1, dadurch gekennzeichnet, dass bei der wiederholten Erwärmung der Platine (**1**) auf Austenitisierungstemperatur im zweiten Ofen (**11**) die Verweildauer so gewählt wird, dass lediglich eine Gefügeumwandlung, aber kein Schichtdickenwachstum mehr statt findet.

4. Verfahren nach Patentanspruch 3, gekennzeichnet durch eine Verweildauer der Platine (**1**) im zweiten Ofen (**11**) von zehn Sekunden bis zweieinhalb Minuten.

5. Verfahren nach Patentanspruch 1, dadurch gekennzeichnet, dass die Erwärmung der Platine (**1**) im ersten Ofen (**7**) auf Elektro- oder Gas-Basis erfolgt, während die Erwärmung im zweiten Ofen (**11**) durch Induktion vonstatten geht.

6. Verfahren nach Patentanspruch 1, dadurch gekennzeichnet, dass die erste Erwärmung beim Stahl- bzw. Blechhersteller erfolgt, während die zweite Wärmebehandlung beim weiterverarbeitenden Unternehmen, z. B. Fahrzeughersteller, vonstatten geht.

7. Verfahren nach Patentanspruch 1, dadurch ge-

kennzeichnet, dass während der zweiten Wärmebehandlung die Platine (**1**) über ihre Oberfläche unterschiedlich stark erwärmt wird.

8. Verfahren nach Patentanspruch 1, dadurch gekennzeichnet, dass die Platine (**1**) vor dem erneuten Erwärmen im zweiten Ofen (**11**) durch Aufbringen von mindestens einem Verstärkungsblech lokal verstärkt wird.

9. Verfahren nach Patentanspruch 1, gekennzeichnet durch die Verwendung eines Tailored blanks als Platine (**1**).

10. Vorrichtung zur Durchführung des Verfahrens nach einem der Patentansprüche 1–9, gekennzeichnet durch
– ein Werkzeug (**4**) zum Herstellen von Platinen (**1**) aus einem Coil (**3**),
– einen ersten Ofen (**7**) zur ersten Wärmebehandlung einschließlich Herbeiführen eines Schichtdickenwachstums der Platinen (**1**),
– eine Abkühlzone (**8**) für die Platinen (**1**),
– ein Zwischenlager (**9**) für die Platinen (**1**),
– einen zweiten Ofen (**11**) zur erneuten Wärmebehandlung der Platinen (**1**),
– ein Umform-Vergütungswerkzeug (**13**) mit einer Presseneinrichtung (**14**) und einer Kühlvorrichtung (**15**) und
– eine Beschnittvorrichtung (**17**) zur Herstellung eines Fertigkontur- und Lochbeschnittes.

11. Vorrichtung nach Patentanspruch 10, gekennzeichnet durch einen ersten Ofen (**7**) auf Elektro- und/oder Gas-Basis und einen Induktionsofen (**11**) zur zweiten Wärmebehandlung.

12. Vorrichtung nach Patentanspruch 11, dadurch gekennzeichnet, dass ein Induktor in eine Transportvorrichtung (**10**) integriert ist, die zwischen Zwischenlager (**9**) und Umform-Vergütungswerkzeug (**13**) angeordnet ist.

13. Vorrichtung nach Patentanspruch 10, dadurch gekennzeichnet, dass zwischen der Abkühlzone (**8**) und dem zweiten Ofen (**11**) eine Station zum Aufbringen, insbesondere Aufschweißen, von mindestens einem Verstärkungsblech auf die Platine (**1**) angeordnet ist.

Es folgen 3 Blatt Zeichnungen

Anhängende Zeichnungen

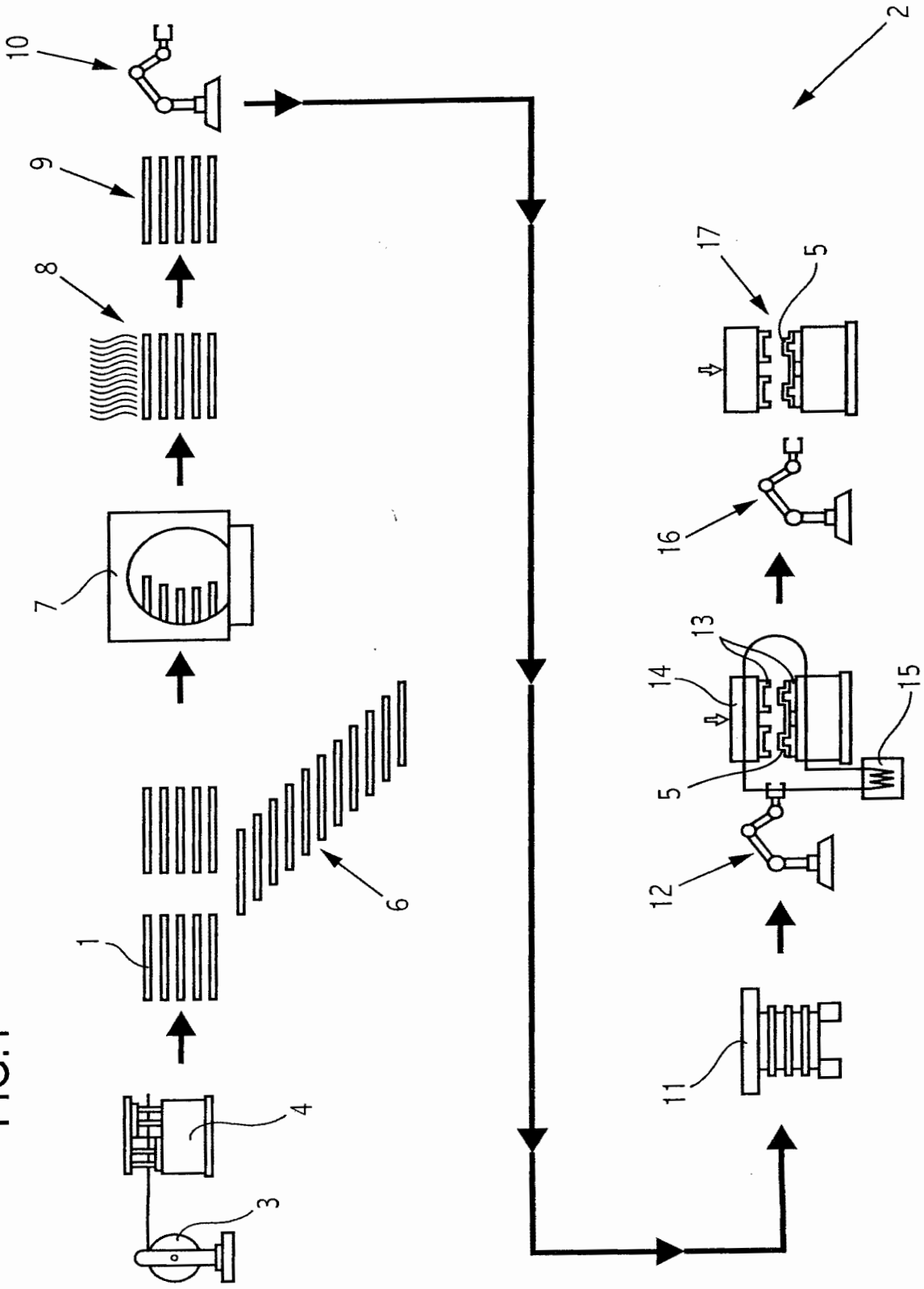


FIG.1

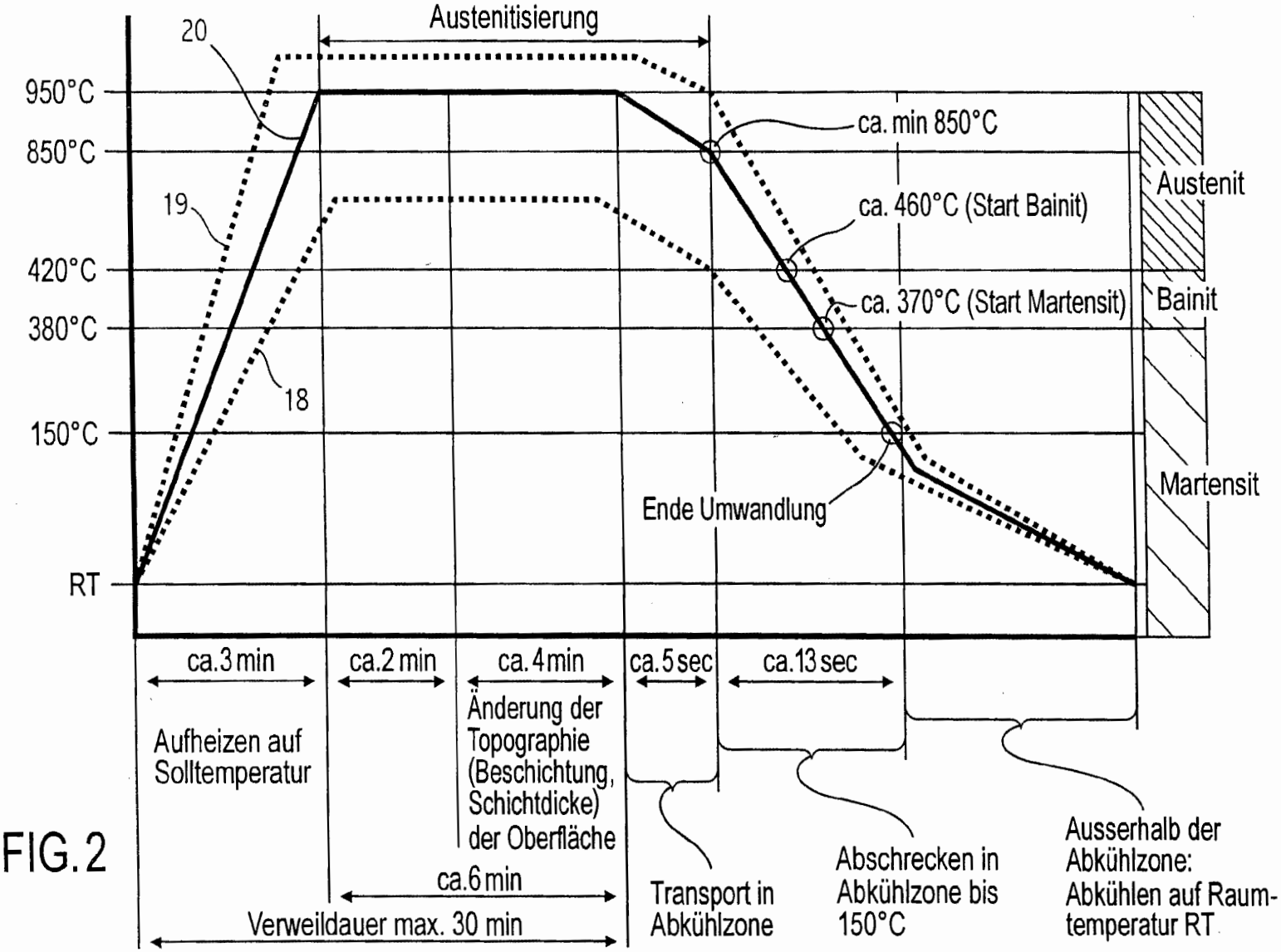
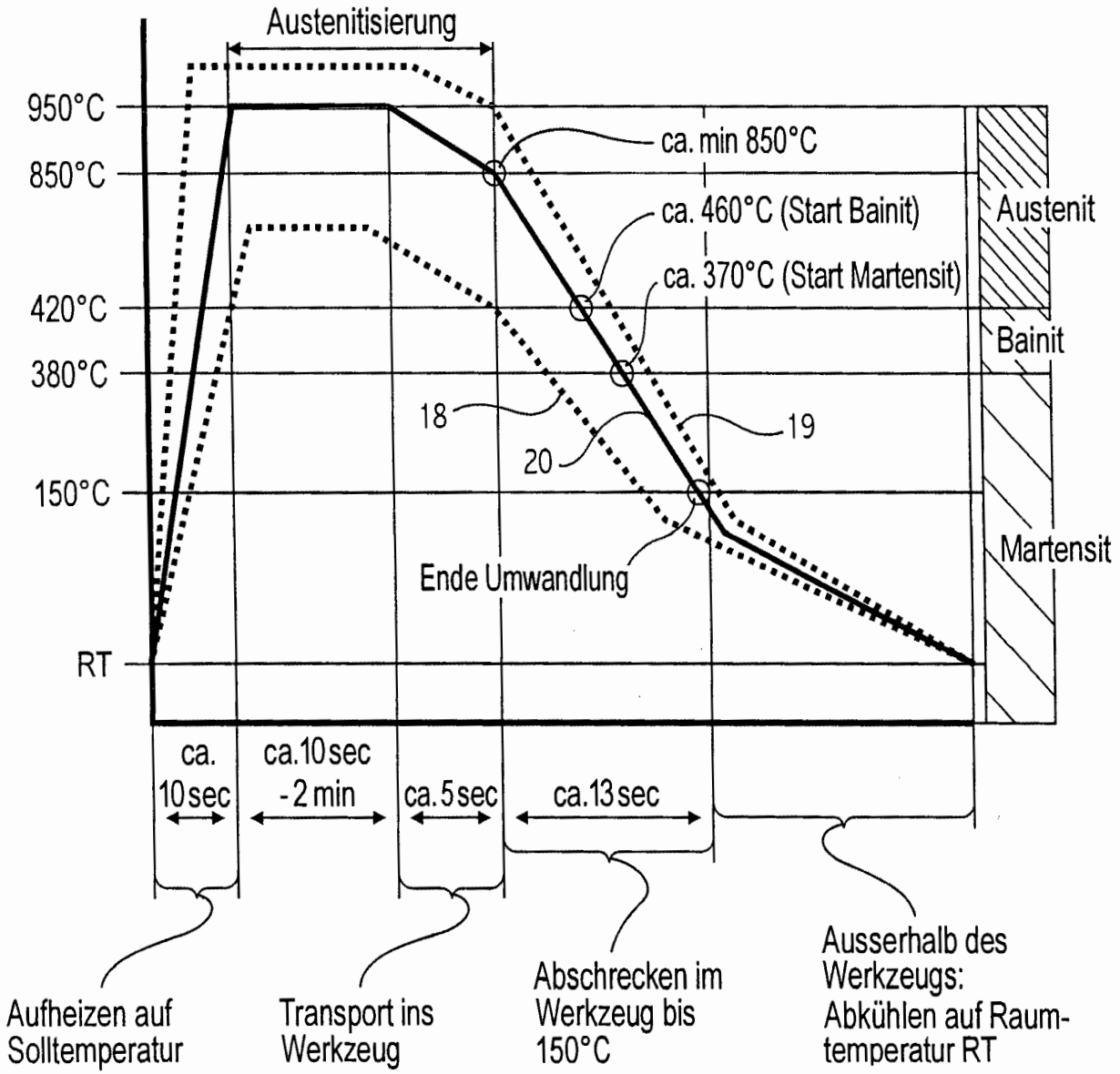


FIG.2

DE 10 2004 007 071 A1 2005.09.08

FIG. 3


Austenitisierung
950°C
850°C
420°C
380°C
150°C
RT
ca. min 850°C
ca. 460°C (Start Bainit)
ca. 370°C (Start Martensit)
18
19
20
Ende Umwandlung
Austenit
Bainit
Martensit
ca. 10 sec
ca. 10 sec - 2 min
ca. 5 sec
ca. 13 sec
Aufheizen auf Solltemperatur
Transport ins Werkzeug
Abschrecken im Werkzeug bis 150°C
Ausserhalb des Werkzeugs: Abkühlen auf Raumtemperatur RT

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 242 863 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
08.01.2014 Bulletin 2014/02

(21) Application number: **09701846.9**

(22) Date of filing: **12.01.2009**

(51) Int Cl.:
C23C 2/26 *(2006.01)* ***C23C 2/28*** *(2006.01)*
B21D 22/02 *(2006.01)* ***C21D 8/02*** *(2006.01)*
C22C 38/32 *(2006.01)* ***C22C 38/38*** *(2006.01)*
C23C 2/12 *(2006.01)*

(86) International application number:
PCT/IB2009/000322

(87) International publication number:
WO 2009/090555 (23.07.2009 Gazette 2009/30)

(54) **PROCESS FOR MANUFACTURING STAMPED PRODUCTS, AND STAMPED PRODUCTS PREPARED FROM THE SAME**

PROZESS FÜR DIE HERSTELLUNG DER STANZLINGEN UND STANZLINGE VORBEREITET AUS DEN SELBEN

PROCÉDÉ DE FABRICATION DE PRODUITS ESTAMPÉS ET PRODUITS ESTAMPÉS PRÉPARÉS À L'AIDE DE CELUI-CI

(84) Designated Contracting States:
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 SE SI SK TR

(30) Priority: **15.01.2008 PCT/IB2008/000079**

(43) Date of publication of application:
27.10.2010 Bulletin 2010/43

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Printed by Jouve, 75001 PARIS (FR)

Description

FIELD OF THE INVENTION

[0001] The present invention relates to methods of manufacturing hot stamped products prepared from coated steels and to various uses of the invention products such as in spot welding.

BACKGROUND OF THE INVENTION

[0002] In recent years the use of coated steels in hot-stamping processes for the shaping of parts has become important, especially in the automotive industry. Fabrication of such parts or products may include the successive following main steps:

- Coating of steel strips or sheets,
- Trimming or cutting for obtaining blanks
- Heating the blanks in order to obtain alloying of the steel substrate with the pre-coating, as well as the austenitizing of the steel
- Hot forming followed by rapid cooling of the part in order to obtain predominantly martensitic structures

This is illustrated for example by U.S. 6,296,805, incorporated herein by reference.
Thanks to an alloying of the pre-coating with the steel substrate, which has the effect of creating intermetallic alloys with high melting temperature, the blanks having such coating may be heated in a temperature range where austenitizing of the metallic substrate takes place, allowing further hardening by quenching.
[0003] Heat treatments of the blanks in view of the intermetallic alloying of the coating and austenitizing of the substrate are most frequently performed in furnaces. The thermal cycles experienced by the blanks include first a heating phase whose rate is a function of parameters such as furnace temperature settings, travelling speed, blank thickness, heating process, and coating reflectivity, After this heating phase, thermal cycles generally include a holding phase, whose temperature is the regulation temperature of the furnace.
[0004] Parts or products obtained after heating, hot stamping and rapid cooling display very high mechanical resistance and may be used for structural applications, for example for automotive industry applications. These parts must be frequently welded with others and high weldability is required. This means that:

- The welding operation should be performable in a sufficiently wide operating range in order to guarantee that an eventual drift of the nominal welding parameters has no incidence on weld quality, For resistance welding, which is very common in the automotive industry, an operating welding range is defined by the combination of parameters: welding current intensity I and force F applied of the parts during welding being among the most important. A proper combination of these parameters helps to ensure that insufficient nugget diameter is not obtained (caused by too low intensity or too low force) and that no weld expulsion occurs.
- The welding operation should also be performed in such a way that high mechanical resistance is obtained in the weld. This mechanical resistance may be evaluated by tests such as by shear-tensile tests or cross-tensile tests.

EP1380666 discloses also a process including hot stamping of Al-coated steel sheets for the fabrication of welded structural members. But the weldability needs to be further improved.
There remains a need for a process making possible to prepare stamped parts or products which are very suitable to spot welding, which are easy to paint and which display good corrosion resistance.

SUMMARY OF THE INVENTION

[0005] The inventors have discovered that certain coated steels in which a base steel strip or sheet is at least partially coated (sometimes termed "pre-coated," this prefix indicating that a transformation of the nature of the pre-coating will take place during heat treatment before hot stamping or forming) on at least one side with a coating of either aluminum or an aluminum alloy and in which the coating has a defined thickness, are conveniently formed into shaped parts after heating in particular conditions, and thereby display particular improved weldability.
[0006] The inventors have also discovered that particular good weldability of aluminized and hot stamped parts is associated with a special succession of coating layers on the parts, proceeding from steel substrate outwards, and a controlled fraction of porosities in these layers.
[0007] The inventors have also discovered that this special disposal of layers is associated to specific heating conditions.

OBJECTS OF THE INVENTION

[0008] It is an object of the present invention to provide novel hot stamped parts which are prepared from a pre-coated steel.
[0009] It is another object of the present invention to provide novel articles of manufacture, such as a motor vehicle, which contain such stamped parts.
[0010] It is another object of the present invention to provide novel methods of making stamped parts displaying high weldability.
[0011] These and other objects, which will become apparent during the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Figure 1 shows conditions of furnace temperature as a function of the total dwell time in the furnace for sheets of total thicknesses of from 0.7-1.5 mm and 1.5-3 mm that provide particularly favorable coatings for welding.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The invention is implemented with certain pre-coated steel strips, which comprise a strip of base steel and a pre-coating of aluminum or an aluminum alloy on at least a part of one side of the strip of the base steel. For many applications, the strip or sheet of base steel may comprise any type of steel which may be coated with either aluminum or an aluminum alloy. However, for certain applications, such as a structural part of an automobile, it is preferred that the strip of base steel comprises a steel for providing ultra high strength on the part, higher than 1000MPa. In such cases, it is particularly preferred that the strip of base steel comprises a boron steel.

[0014] The strip can derive, by reason of its processing, from a hot-rolling mill, and possibly may be cold-rerolled again depending on the final thickness desired. Preferred thicknesses are 0.7 to 3 mm. Typically, the strip of base steel will be stored and transported in the form of a coil both before and after the formation of the coating.

[0015] An example of a preferred steel for the strip of base steel is one having the following composition by weight:

0.10% < carbon < 0.5%

0.5% < manganese < 3%

0.1% < silicon < 1%

0.01% < chromium < 1%

nickel<0.1%

copper<0.1%

titanium < 0.2%

aluminum < 0.1%

phosphorus < 0.1%

sulfur < 0.05%

0.0005% < boron < 0.010%,

the remainder comprising, consisting essentially of, or consisting of iron and impurities inherent in processing. Use of such a steel provides a very high mechanical resistance after thermal treatment and the aluminum-based coating provides a high resistance to corrosion.

[0016] Particularly preferably, the composition by weight of the steel in the strip of base steel is the following:

0.15% < carbon < 0.25%

0.8% < manganese < 1.8%

0.1% < silicon < 0.35%

0.01% < chromium < 0.5%

nickel<0.1%

copper<0.1%

titanium < 0.1%

aluminum < 0.1%

phosphorus < 0.1%

sulfur < 0.05%

0.002% < boron < 0.005%,

the remainder comprising, consisting essentially of, or consisting of iron and impurities inherent in processing. An example of preferred commercially available steel for use in the strip of base steel is 22MnB5.

[0017] Chromium, manganese, boron and carbon may be added, in the composition of the steel according to the invention, for their effect on hardenability. In addition, carbon makes it possible to achieve high mechanical characteristics thanks to its effect on the hardness of the martensite.

[0018] Aluminum is introduced into the composition, to perform deoxidation in the liquid state and to protect the effectiveness of the boron.

[0019] Titanium, the ratio of the content of which with respect to the nitrogen content should be in excess of 3.42, is introduced for example in order to prevent combining of the boron with the nitrogen, the nitrogen being combined with titanium.

[0020] The alloying elements, Mn, Cr, B, make possible a hardenability allowing hardening in the stamping tools or the use of mild hardening fluids limiting deformation of the parts at the time of thermal treatment. In addition, the composition according to the invention is optimized from the point of view of weldability. Additions of Ni and Cu, up to 0.1%, may also be performed.

[0021] The steel may undergo a treatment for globularization of sulfides performed with calcium, which has the effect of improving the fatigue resistance of the sheet.

[0022] The strip of base steel is coated (or pre-coated, this prefix indicating that a transformation of the nature of the pre-coating will take place during heat treatment before stamping) with either aluminum or an aluminum alloy, preferably with hot-dip. A typical metal bath for an Al-Si coating generally contains in its basic composition by weight, from 8% to 11 % silicon, from 2% to 4% iron, the remainder being aluminum or aluminum alloy, and impurities inherent in processing. Silicon is present in order to prevent the formation of a thick iron-metallic intermetallic layer which reduces adherence and formability. Other alloying elements useful with aluminum herein include iron, and calcium, between 15 and 30ppm by weight, including combinations of two or more thereof with aluminium. Typical composition of Al-Si coating is: Al-9,3%Si-2,8%Fe. Invention coatings are not limited to these compositions, however.

While not bound by a particular theory of operation, the inventors believe that several of the benefits of the invention are first related to a specific range of pre-coating thickness tp of 20 to 33 micrometers :

- For a pre-coating thickness less than 20 micrometers, the alloyed layer which is formed during the heating of the blank has an insufficient roughness. Thus, the adhesion of subsequent painting is low on this surface, and the corrosion resistance is decreased.
- If the pre-coating thickness is more than 33 micrometers at a given location on a sheet, the risk is that the difference of thickness between this location and some other locations where the pre-coating is thinner, becomes too important, and that alloying during the heating of the blank becomes uneven. The inventors have also shown that the control of the pre-coating thickness in the narrow range presented above, contributes to form coatings after alliation whose thickness is also controlled in a precise range. This is also a factor for ensuring that the range of resistance welding parameters applied on parts after alliation is not subject to variability.

The pre-coated steel sheets or strips are then cut into blanks, and submitted to heat treatments in furnace prior to hot stamping, in order to obtain products or parts. The inventors have discovered that very good welding properties are achieved if the coating obtained on parts or products made out of blanks having undergone intermetallic alloying, austenitizing and hot stamping, displays distinctive features. It must be pointed out that this coating is different from the initial pre-coating, since the thermal treatment causes an alloying reaction with the steel substrate which modifies both the physicochemical nature and the geometry of the pre-coating : in this regard, the inventors have discovered that particularly good weldability of aluminized and hot stamped parts is associated with the following succession of coating layers on the parts, proceeding from steel substrate outwards :

- (a) Interdiffusion layer,
- (b) Intermediate layer,
- (c) Intermetallic layer,
- (d) Superficial layer

The inventors have also discovered that particular good weldability is obtained with a limited quantity of porosities in the coating layers, as will be detailed below.

In a preferred embodiment, the layers are as follows:

- (a) Interdiffusion layer, preferably with medium hardness (e.g., HV50g between 290 and 410, HV50g designating the hardness measured under a load of 50 grams) In a preferred embodiment this layer has the following composition, by weight: 86-95%Fe, 4-10%Al, 0-5%Si
- (b) Intermediate layer (HV50g around 900 - 1000 e.g., +/- 10%)) In a preferred embodiment this layer has the following composition, by weight: 39-47% Fe, 53-61%Al, 0-2%Si
- (c) Intermetallic layer, with hardness HV50g around 580-650, e.g., +/- 10%) In a preferred embodiment this layer has the following composition, by weight: 62-67%Fe, 30-34 %Al, 2-6%Si
- (d) Superficial layer (HV50g around 900 - 1000 e.g.,

+/- 10%)) In a preferred embodiment this layer has the following composition, by weight : 39-47% Fe, 53-61%Al, 0-2%Si

In a preferred embodiment the total thickness of layers (a) to (d) is greater than 30 micrometers.
In another preferred embodiment, the thickness of layer (a) is less than 15 micrometers.

[0023] The inventors have discovered that high weldability is especially obtained when layers (c) and (d) are essentially continuous; the character of essential continuity of these layers is defined in the following manner: the layers may be fully continuous. But they may be fragmented in some areas due to layer parts coming from lower or upper levels. According to the invention, this fragmentation must be limited, i.e. layers (c) and (d) must occupy at least 90% of their respective level. High weldability is obtained when less than 10% of layer (c) is present at the extreme surface of the part. Without being bound by a theory, it is thought that this particular layer disposal, in particular layer (a) and layers (c) and (d) influence the resistivity of the coating both by their intrinsic characteristics and by the effect of roughness. Thus, current flow, heat generation at the surfaces, and nugget formation in the initial stage of spot welding are affected by this particular arrangement.
This favorable layer disposition is obtained for example when aluminum- or aluminum alloy pre-coated steel sheets, whose thickness range from, e.g., 0.7 to 3mm, are heated for 3 to 13 minutes (this dwell time includes the heating phase and the holding time) in a furnace without special atmosphere heated to a temperature of 880 to 940°C. The invention does not require a furnace with a controlled atmosphere. Other conditions leading to such favorable layer dispositions are found in Figure 1 and below.
Particularly preferred conditions are:

- for thicknesses of 0.7-1.5mm
    - 930°C, from 3 minutes up to 6 minutes;
    - 880°C, from 4 minutes 30 seconds up to 13 minutes
- for thicknesses of 1.5 to 3 mm
    - 940°C, from 4 minutes up to 8 minutes;
    - 900°C, from 6 minutes 30 seconds up to 13 minutes

For sheets of total thicknesses greater or equal to 0.7mm, and less than or equal to 1.5mm, the preferred treatment conditions : (furnace temperature, total dwell time in the furnace) are illustrated in figure 1 by conditions lying within the limits of diagram "ABCD" For sheets of total thicknesses greater than 1.5mm, and less than or equal to 3mm, the preferred treatment conditions: (furnace temperature, total dwell time in the furnace) are illustrated in figure 1 by diagram "EFGH".

The heating rate V_c is comprised between 4 and 12°C/s for producing a favorable alloyed layer disposition. V_c, depending in particular of furnace settings, is defined as the mean heating rate between 20 and 700°C experienced by the pre-coated steel blank in the preheated furnace. The inventors have discovered that the control of V_c in this particular range allows to influence the nature and the morphology of the alloyed layers which are formed. It is here underlined that the heating rate V_c is different from the mean heating rate, which is the heating rate between room temperature and furnace holding temperature.
The inventors have discovered in a surprising manner that special heating conditions are particularly favourable for the formation of alloyed layers, leading to less porosities formation. Without being bound by a theory of the invention, it is believed that the formation of the preferred alloyed layers takes place in a particular temperature range due to the particular kinetics of alliation in this range: in this respect, it has been discovered that the control of the heating rate in the particular temperature range between 500 and 700°C (designated here as V_c') is especially important and that the value of V_c' has to be comprised between 1.5 and 6°C/s.
When V_c' is lower than 1.5°C/s, there is a risk that the kinetics of oxidation, resulting from the interaction of oxygen of the furnace atmosphere with the pre-coating surface, competes with the kinetics of alliation between the steel substrate and the pre-coating. Thus, the desired alloyed layer disposal is not obtained. Furthermore slow heating rate V'_c causes a too high quantity of porosities in the coating.
When V_c' is higher than 6°C/s, the intermetallic layer (c) has a tendency to be present in more than 10% at the extreme surface of the part, thus reducing weldability. When V_c is comprised between 1.5 and 6°C/s, the character of essential continuity of layers (c) and (d) is fully ensured.
Without being bound by a theory, it is thought that the porosity formation and its influence on weldability, may be explained as follows:

- Porosities appear mainly during the interdiffusion of pre-coating with the steel substrate, due to the difference of diffusion fluxes, This implies a flux of vacancies with a creation of Kirkendal defects. This manifestation of vacancies under the form of porosities appears to be optimized when heating rate V'_c is comprised between 1.5 and 6°C/s.

During spot welding of welding products, current flows initially around the porosities, which collapse progressively due to pressure and temperature elevation. Thus, the current flows through a coating whose some properties may change discontinuously, which in turn may lead to increased sparking and splashings during the welding

operation.

Increased spot weldability is observed when the coating resulting from interdiffusion contains, in surfacic fraction, less than 10% of porosities. For a given area representative of the coating, this fraction is the total surface occupied by porosities, as referred to the area of the coating.

Special good weldability is experienced when the superficial layer has a controlled compacity, which means that the superficial layer (d) contains less than 20% porosities: this fraction is the surface of porosities in the superficial layer (d), as referred to the area of this superficial layer.

A special advantage arises from pre-coatings whose thickness is comprised between 20 and 33 micrometers, since this thickness range yields favorable layer disposal, and since the homogeneity of the pre-coating thickness is associated to an homogeneity of the coating formed after alliation treatment.

[0024] Heated blanks are thereafter transferred from the furnace to a die, hot stamped in a press to obtain a part or product, and cooled at a rate V_r of more than 30°C/s. The cooling rate V_r is defined here as the mean rate between the exit of the heated blank from the furnace, down to 400°C. In these conditions, austenite formed at high temperature mainly transform into martensitic or martensitic-bainitic structures with high strength.

In a preferred embodiment, the elapsed time between the exit of the heated blank and the introduction of the blank in the hot stamping press is not more than 10 seconds. Otherwise, a partial transformation from austenite is susceptible to appear: if obtaining a full martensitic structure is desired, the transfer time between the exit of the furnace and stamping should be less than 10s.

The coating obtained has in particular the function of protecting the basic sheet against corrosion in various conditions. At the time of thermal treatment performed on a finished part or at the time of a hot-shaping process, the coating forms a layer having a substantial resistance to abrasion, wear, fatigue, shock, as well as a good resistance to corrosion and a good capacity for painting and gluing. The coating makes it possible to avoid different surface-preparation operations such as for steel sheets for thermal treatment not having any coating.

The thermal treatment applied at the time of a hot-forming process or after forming makes it possible to obtain high mechanical characteristics which can exceed 1500 MPa for mechanical resistance and 1200 MPa for yield stress. The final mechanical characteristics are adjustable and depend in particular on the martensite fraction of the structure, on the carbon content of the steel and on the thermal treatment.

The invention also concerns the use of a hot-rolled steel sheet which then can be cold-rolled and coated, for structural and/or anti-intrusion or substructure parts for a land motor vehicle, such as, for example, a bumper bar, a door reinforcement, a wheel spoke, etc.

The present invention will now be further described by way a certain exemplary embodiments which are not intended to be limiting.

EXAMPLES

[0025]

i) - Conditions according to the invention: in an example of implementation, a cold rolled steel sheet, 1.2 mm thick, has been fabricated: it contains by weight: 0.23 % carbon, 1.25% manganese, 0.017% phosphorus, 0.002% sulfur, 0.27% silicon, 0.062% aluminum, 0.021% copper, 0.019% nickel, 0.208% chromium, 0.005% nitrogen, 0.038% titanium, 0.004% boron, 0.003% calcium. The sheet has been pre-coated with an aluminum-based alloy with composition 9.3% silicon, 2.8% iron, the remainder being aluminum and unavoidable impurities. The thickness on each side of the sheet was controlled to be within the range (20-33) micrometers.

The sheets were afterwards cut into blanks which were heated at 920°C for 6mn, this time including the heating phase and the holding time. Heating rate V_c between 20 and 700°C was 10°C/s. The heating rate V_c' between 500 and 700°C was 5°C/s. No special control of furnace atmosphere was performed. The blanks were transferred from the furnace to a press in less than 10s, hot stamped and quenched in order to obtain full martensitic structures.

The parts obtained after hot-stamping are covered by a coating, 40 micrometers thick, which has a four layer structure. Starting from the steel substrate, the layers are the following:

- (a) Interdiffusion layer or intermetallic layer, 17 micrometers thick. This layer is itself composed of two sub-layers. Hardness HV50g ranges from 295 to 407, and the mean composition is, by weight: 90%Fe, 7%Al, 3%Si.
- (b) Intermediate layer, 8 micrometers thick. This layer has a hardness of 940HV50g and a mean composition, by weight: 43%Fe, 57%Al, 1%Si,
- (c) Intermetallic layer, 8 micrometers thick, displaying a hardness of 610HV50g, a mean composition of, by weight: 65%Fe, 31%Al, 4%Si
- (d) Superficial layer, 7 micrometers thick, 950 HV50g, with a mean composition of, by weight: 45%Fe, 54%Al, 1%Si

Layers (c) and (d) are quasi-continuous, i.e. occupying at least 90% of the level corresponding to the considered layer. In particular, layer (c) does not reach the extreme surface except very exceptionally. Anyway, this layer (c) occupies less than 10% of the extreme surface.

A small number of porosities were observed in the coating, their surfacic fraction in this coating being lower than 10%. The surfacic fraction of porosities

in the superficial layer (d) is lower than 20%.

ii) Conditions of reference: blanks with the same base material and pre-coating were furnace-heated in different conditions: The blanks were heated to 950°C for 7 minutes, this time including the heating phase. Heating rate V_c was 11°C/s. Heating rate V_c' between 500 and 700°C was 7°C/s. These conditions correspond to a degree of alloying which is more important than in conditions (i)

- In this coating, the intermetallic layer (c), is not continuous and appears as to be scattered within the coating. About 50% of this layer is present at the extreme surface of the part. The interdiffusion layer, 10 micrometers thick in contact with the steel substrate is thinner than in the previous case. Moreover the porosities are much more numerous than in condition (i) since their surfacic fraction in the coating exceeds 10%. These porosities are especially more numerous in the superficial layer (d) wherein the surfacic fraction exceeds 20%.
  Resistance spot welding was performed in the two situations i) and ii):
- (i): Coating with quasi-continuous layers (c) and (d), layer (c) occupying less than 10% of the extreme surface, and low surfacic fraction of porosities
- (ii) : Coating with mixed and discontinuous layers, layer (c) occupying more than 10% of the extreme surface, and higher surfacic fraction of porosities

Resistance spot welding was performed by superposing two parts and joining them in the following conditions:

- Squeeze force and welding force : 4000 N
- Squeeze time: 50 periods
- Welding and holding time: 18 periods respectively

In each condition, the suitable intensity range was determined for obtaining:

- No sputter during welding
- Acceptable nugget size.

Tensile tests were also performed to assess the weldability range.

- For the condition i), the weldability range, expressed in terms of current intensity, is 1,4kA. For the condition ii) the weldability range is extremely small. The higher fraction of porosities and the layer disposal are associated to sparks and coating splashing.

Thus, it may be seen that the coating according to the invention, yields much more satisfactory results.

[0026] While the above description is clear with regard to the understanding of the invention, the following terms as used in the following list of preferred embodiments and claims have the following noted meanings in order to avoid any confusion:

pre-coating : - the material (Al or Al alloy) coated on or located on at least a portion of the strip or sheet, etc., of base steel to form a pre-coating/base composite, the composite not having been subjected to an alliation reaction between the coated Al or Al alloy material and base steel
alliation or alloying : - a reaction between the pre-coating and base steel, to produce at least one intermediate layer different in composition from both the base steel and the pre-coating. The alliation reaction happens during the heat treatment immediately preceding hot stamping. The alliation reaction affects the total thickness of the pre-coating. In a highly preferred embodiment the alliation reaction forms the following layers: (a) interdiffusion, (b) intermediate, (c) intermetallic, and (d) superficial as described above;
pre-coated steel : - the pre-coating/base composite, not having been subjected to an alliation reaction between the coated material and base steel;
coating : - the pre-coating after having been subjected to an alliation reaction between the pre-coating and base steel. In a highly preferred embodiment the coating comprises layers (a) interdiffusion, (b) intermediate, (c) intermetallic, and (d) superficial described above;
coated steel or product : - the pre-coated steel or product that has been subjected to an alliation reaction between the pre-coating and base steel. In a highly preferred embodiment the coated steel is a strip or sheet, etc., of base steel having thereon an invention coating comprising layers (a) interdiffusion, (b) intermediate, (c) intermetallic, and (d) superficial described above;
blank : - a shape cut from a strip.
product : - a hot stamped blank

The above written description of the invention provides a manner and process of making and using it such that any person skilled in this art is enabled to make and use the same.

Claims

1. A process for making a hot stamped coated steel blank,
   comprising:

- pre-coating a steel strip or sheet with aluminium-or aluminium alloy, by hot dip of said steel strip or sheet having a first side and a second side, in an aluminium or aluminium alloy bath, the thickness t_p of the said pre-coating being from 20 to 33 micrometers at every location on said first and second sides of said strip or sheet, then
- cutting said pre-coated steel strip or sheet to obtain a pre-coated steel blank, then
- heating said aluminum- or aluminum alloy pre-coated steel blank in a furnace preheated to a temperature and during a time defined by diagram ABCD of figure 1 if thickness of said sheet is greater than or equal to 0.7mm and less than or equal to 1.5mm, and by diagram EFGH of figure 1 if thickness of said sheet is greater than 1.5mm and less than or equal to 3mm, at a heating rate V_c between 20 and 700°C comprised between 4 and 12°C/s, and at a heating rate V_c' between 500 and 700°C comprised between 1.5 and 6°C/s, to obtain a heated blank; then
- transferring said heated blank to a die; then
- hot stamping said heated blank in said die, to thereby obtain a hot stamped steel blank, then
- cooling said hot stamped steel blank at a mean rate V_r between the exit of said heated blank from the furnace, down to 400°C, of at least 30°C/s.

2. A process according to claim 1, wherein the elapsed time between said heated blank exits said furnace and said stamping commences is not more than 10 seconds

3. A hot stamped coated steel blank, which comprises:

(a) a strip of base steel having a first side and a second side; and
(b) a coating on at least one of said first side of said strip of base steel and said second side of said strip of base steel,
wherein:,

(i) said coating results from the interdiffusion between said base steel, and aluminium or aluminium alloy pre-coating,
(ii) said coating comprises, proceeding from base steel outwards,

- (a) Interdiffusion layer
- (b) Intermediate layer
- (c) Intermetallic layer
- (d) Superficial layer

(iii) said coating contains, in surfacic fraction, less than 10% of porosities

and wherein the said layers (c) and (d) are quasi-continuous by occupying at least 90% of their respective level and wherein less than 10% of layer (c) is present at the extreme surface of said hot stamped coated steel blank

4. A hot stamped coated steel blank according to claim 3, wherein said superficial layer (d) contains, in surfacic fraction, less than 20% of porosities

5. A hot stamped coated steel blank according to claims 3 or 4, wherein said coating has a thickness greater than 30 micrometers

6. A hot stamped coated steel blank according to any of claims 3 to 5, wherein said layer (a) has a thickness less than 15 micrometers

7. A hot stamped coated steel blank according to any of the claims 3 to 6, wherein the steel composition in the strip comprises the following components by weight based on total weight:

0.15%<carbon<0.5%

0.5%<manganese<3%

0.1%<silicon<0.5%

0.01%<chromium<1%

nickel<0.1%

copper<0.1%

titanium<0.2%

aluminum<0.1%

phosphorus<0.1%

sulfur<0.05%

0.0005%<boron<0.08%,

the balance being iron and unavoidable impurities.

8. A hot stamped coated steel blank according to any of the claims 3 to 6, wherein the steel composition in the strip comprises the following components by weight based on total weight:

0.20%<carbon<0.5%

0.8%<manganese<1.5%

0.1%<silicon<0.35%

0.01%<chromium<1%

nickel<0.1%

copper<0.1%

titanium<0.1%

aluminum<0.1%

phosphorus<0.05%

sulfur<0.03%

0.0005%<boron<0.01%,

the balance being iron and unavoidable impurities.

9. A hot stamped coated steel blank according to any of the claims 3 to 8, wherein the aluminum or aluminum alloy pre-coating comprises from 8% to 11% silicon by weight, from 2% to 4% iron by weight, the remainder being aluminum and impurities inherent in processing.

10. Use of a hot stamped coated steel blank according to any of the claims 3 to 9 for the manufacturing of a land motor vehicle

11. Use of a hot stamped coated steel blank manufactured according to a process according to any of the claims 1 or 2, for the manufacturing of a land motor vehicle.

Patentansprüche

1. Verfahren zum Herstellen eines heißgestanzten beschichteten Stahlabschnitts, umfassend:

- Vorbeschichten eines Stahlstreifens oder-blechs mit Aluminium oder einer Aluminiumlegierung durch Schmelztauchen des eine erste und eine zweite Seite aufweisenden Stahlstreifens oder-blechs in ein Aluminium- oder Aluminiumlegierungsbad, wobei die Dicke tp der Vorbeschichtung von 20 bis 33 μm an jeder Stelle der ersten und zweiten Seite des Streifens oder Blechs ist, dann
- Schneiden des vorbeschichteten Stahlstreifens oder-blechs, um einen vorbeschichteten Stahlabschnitt zu erhalten, Heizen des vorbeschichteten Alumium-oder Aluminiumlegierungs-Stahlabschnitts in einem Ofen, der auf eine Temperatur und während eines Zeitraums angeheizt wird, die durch das Diagramm ABCD der Figur 1, wenn die Dicke des Blechs größer als oder gleich 0,7 mm und kleiner als oder gleich 1,5 mm ist, und durch das Diagramm EFGH der Figur 1 definiert sind, wenn die Dikke des Blechs größer als 1,5 mm und kleiner als oder gleich 3 mm ist, zwischen 20 und 700°C bei einer Heizrate V_c zwischen 4 und 12°C/s und zwischen 500 und 700°C bei einer Heizrate V_c' zwischen 1,5 und 6°C/s, um einen aufgeheizten Abschnitt zu erhalten; dann
- Übertragen des aufgeheizten Abschnitts in ein Presswerkzeug; dann
- Heißstanzen des aufgeheizten Abschnitts in dem Presswerkzeug, um dabei einen heißgestanzten Stahlabschnitt zu erhalten, dann
- Abkühlen des heißgestanzten Stahlabschnitts zwischen dem Austritt des aufgeheizten Abschnitts aus dem Ofen herunter auf 400°C bei einer mittleren Rate V_r von mindestens 30°C/s.

2. Verfahren nach Anspruch 1, bei der die Zeit, die zwischen dem Austritt des aufgeheizten Abschnitts aus dem Ofen und dem Beginn des Stanzens abläuft, nicht mehr als 10 Sekunden ist.

3. Heißgestanzter beschichteter Stahlabschnitt, der umfasst:

(a) einen Streifen eines Basisstahls mit einer ersten Seite und einer zweiten Seite; und
(b) eine Beschichtung auf mindestens einer der

ersten Seite des Stahlstreifens aus Basisstahl und der zweiten Seite des Streifens aus Basisstahl, wobei:

(i) die Beschichtung aus der Interdiffusion zwischen dem Basisstahl und einer Aluminium- oder Aluminiumlegierung-Vorbeschichtung resultiert,
(ii) die Beschichtung umfasst, beginnend vom Basisstahl nach außen, eine

- (a) Interdiffusionsschicht
- (b) Zwischenschicht
- (c) Intermetallische Schicht
- (d) Oberflächenschicht

(iii) die Beschichtung enthält in Oberflächenbruchteilen weniger als 10% Porosität und wobei die Schichten (c) und (d) quasi kontinuierlich durch Einnehmen von mindestens 90% ihres jeweiligen Niveaus und wobei weniger als 10% der Schicht (c) an der extremen Fläche des heißgestanzten beschichteten Stahlabschnitts vorhanden ist.

4. Heizgestanzter beschichteter Stahlabschnitt nach Anspruch 3, wobei die Oberflächenschicht (d) in Oberflächenbruchteilen weniger als 20% Porosität enthält.

5. Heizgestanzter beschichteter Stahlabschnitt nach Anspruch 3 oder 4, wobei die Beschichtung eine Dikke größer als 30 μm aufweist.

6. Heißgestanzter beschichteter Stahlabschnitt nach einem der Ansprüche 3 bis 5, bei dem die Schicht (a) eine Dicke kleiner als 15 μm aufweist.

7. Heißgestanzter beschichteter Stahlabschnitt nach einem der Ansprüche 3 bis 6, bei dem die Stahlzusammensetzung in dem Streifen die folgenden Komponenten in Gewichtsprozenten basierend auf dem Gesamtgewicht umfasst:

0,15%<Kohlenstoff<0,5%

0,5%<Mangan<3%

0,1%<Silizium<0,5%

0,01%<Chrom<1%

Nickel<0,1%

Kupfer<0,1%

Titan<0,2%

Aluminium<0,1%

Phosphor<0,1%

Schwefel<0,05%

0,0005%<Bor<0,08%,

wobei der Ausgleich Eisen und nicht vermeidbare Verunreinigungen sind.

8. Heißgestanzter beschichteter Stahlabschnitt nach einem der Ansprüche 3 bis 6, bei dem die Stahlzusammensetzung in dem Streifen die folgenden Komponenten in Gewichtsprozenten basierend auf dem Gesamtgewicht umfasst:

0,20%<Kohlenstoff<0,5%

0,8%<Mangan<1,5%

0,1%<Silizium<0,35%

0,01%<Chrom<1%

Nickel<0,1%

Kupfer<0,1%

Titan<0,1%

Aluminium<0,1%

Phosphor<0,05%

Schwefel<0,03%

0,0005%<Bor<0,01%,

wobei der Ausgleich Eisen und nicht vermeidbare Verunreinigungen sind.

9. Heißgestanzter beschichteter Stahlabschnitt nach einem der Ansprüche 3 bis 8, wobei die Aluminium- oder Aluminiumlegierung-Vorbeschichtung 8 bis 11 Gew.-% Silizium, 2 bis 4 Gew.-% Eisen, als Rest Aluminium und dem Verfahren inhärente Verunreinigungen umfasst.

10. Verwendung eines heißgestanzten beschichteten Stahlabschnitts nach einem der Ansprüche 3 bis 9 für die Herstellung von Landmotorfahrzeugen.

11. Verwendung eines heißgestanzten beschichteten Stahlabschnitts, hergestellt nach einem Verfahren nach einem der Ansprüche 1 oder 2 für die Herstellung von Landmotorfahrzeugen.

Revendications

1. Procédé pour produire une ébauche en acier revêtue estampée à chaud, comprenant les étapes consistant à :

   - pré-revêtir une bande ou tôle d'acier avec de l'aluminium ou un alliage d'aluminium, par trempage à chaud de ladite bande ou tôle d'acier ayant un premier côté et un deuxième côté, dans un bain d'aluminium ou d'alliage d'aluminium, l'épaisseur t_p dudit pré-revêtement étant de 20 à 33 micromètres en tout emplacement sur lesdits premier et deuxième côtés de ladite bande ou tôle, puis
   - découper ladite bande ou tôle d'acier pré-revêtue pour obtenir une ébauche en acier pré-revêtue, puis
   - chauffer ladite ébauche en acier pré-revêtue d'aluminium ou d'alliage d'aluminium dans un four préchauffé à une température pendant un temps défini par le diagramme ABCD de la Figure 1 si l'épaisseur de ladite tôle est supérieure ou égale à 0,7 mm et inférieure ou égale à 1,5 mm, et par le diagramme EFGH de la Figure 1 si l'épaisseur de ladite tôle est supérieure à 1,5 mm et inférieure ou égale à 3 mm, à une vitesse de chauffage V_c de 20 à 700°C comprise entre 4 et 12°C/s, et à une vitesse de chauffage V_c' de 500 à 700°C comprise entre 1,5 et 6°C/s, pour obtenir une ébauche chauffée ; puis
   - transférer ladite ébauche chauffée dans une matrice ; puis
   - estamper à chaud ladite ébauche chauffée dans ladite matrice, de façon à obtenir ainsi une ébauche en acier estampée à chaud, puis
   - refroidir ladite ébauche en acier estampée à chaud à une vitesse moyenne V_r depuis la sortie de ladite ébauche chauffée hors du four, jusqu'à 400°C, d'au moins 30°C/s.

2. Procédé selon la revendication 1, dans lequel le temps écoulé entre la sortie hors dudit four de ladite ébauche chauffée et le début dudit estampage ne dépasse pas 10 secondes.

3. Ebauche en acier revêtue estampée à chaud, qui comprend :

   (a) une bande d'acier de base ayant un premier côté et un deuxième côté ; et
   (b) un revêtement sur au moins l'un parmi ledit premier côté de ladite bande d'acier de base et ledit deuxième côté de ladite bande d'acier de base,
   dans laquelle :

   (i) ledit revêtement résulte de l'interdiffusion entre ledit acier de base, et un pré-revêtement d'aluminium ou d'alliage d'aluminium,
   (ii) ledit revêtement comprend, en allant de l'acier de base vers l'extérieur,

   - (a) une couche d'interdiffusion,
   - (b) une couche intermédiaire
   - (c) une couche intermétallique,
   - (d) une couche superficielle,

   (iii) ledit revêtement contient, en fraction surfacique, moins de 10 % de porosités,

   et dans laquelle lesdites couches (c) et (d) sont quasi-continues en occupant au moins 90 % de leur niveau respectif et dans laquelle moins de 10 % de la couche (c) est présent à la surface extrême de ladite ébauche en acier revêtue estampée à chaud.

4. Ebauche en acier revêtue estampée à chaud selon la revendication 3, dans laquelle ladite couche superficielle (d) contient, en fraction surfacique, moins de 20 % de porosités.

5. Ebauche en acier revêtue estampée à chaud selon la revendication 3 ou 4, dans laquelle ledit revête-

ment a une épaisseur supérieure à 30 micromètres.

6. Ebauche en acier revêtue estampée à chaud selon l'une quelconque des revendications 3 à 5, dans laquelle ladite couche (a) a une épaisseur inférieure à 15 micromètres.

7. Ebauche en acier revêtue estampée à chaud selon l'une quelconque des revendications 3 à 6, dans laquelle la composition de l'acier dans la bande comprend les composants suivants, en poids par rapport au poids total :

0,15 % < carbone < 0,5 %

0,5 % < manganèse < 3 %

0,1 % < silicium < 0,5 %

0,01 % < chrome < 1 %

nickel < 0,1 %

cuivre < 0,1 %

titane < 0,2 %

aluminium < 0,1 %

phosphore < 0,1 %

soufre < 0,05 %

0,0005 % < bore < 0,08 %

le reste étant du fer et des impuretés inévitables.

8. Ebauche en acier revêtue estampée à chaud selon l'une quelconque des revendications 3 à 6, dans laquelle la composition de l'acier dans la bande comprend les composants suivants, en poids par rapport au poids total :

0,20 % < carbone < 0,5 %

0,8 % < manganèse < 1,5 %

0,1 % < silicium < 0,35 %

0,01 % < chrome < 1 %

nickel < 0,1 %

cuivre < 0,1 %

titane < 0,1 %

aluminium < 0,1 %

phosphore < 0,05 %

soufre < 0,03 %

0,0005 % < bore < 0,01 %

le reste étant du fer et des impuretés inévitables.

9. Ebauche en acier revêtue estampée à chaud selon l'une quelconque des revendications 3 à 8, dans laquelle le pré-revêtement d'aluminium ou d'alliage d'aluminium comprend de 8 % à 11 % en poids de silicium, de 2 % à 4 % en poids de fer, le reste étant de l'aluminium et des impuretés inhérentes au traitement.

10. Utilisation d'une ébauche en acier revêtue estampée à chaud selon l'une quelconque des revendications 3 à 9 pour la fabrication d'un véhicule à moteur terrestre.

11. Utilisation d'une ébauche en acier revêtue estampée à chaud fabriquée conformément à un procédé selon

l'une quelconque des revendications 1 et 2, pour la fabrication d'un véhicule à moteur terrestre.

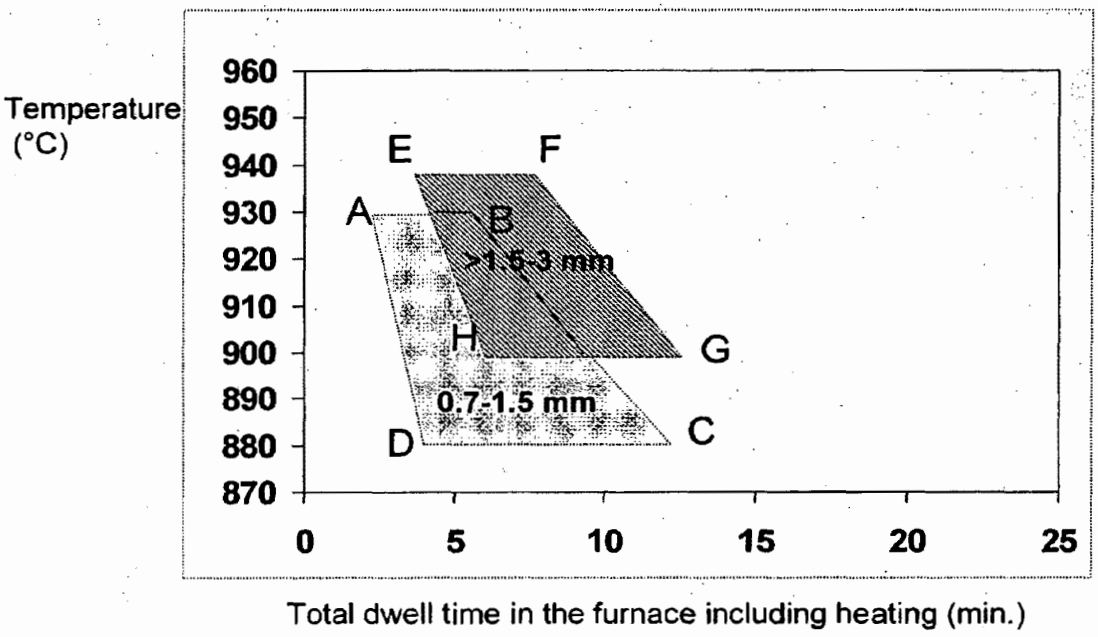

Temperature (°C)
960
950
940
930
920
910
900
890
880
870
0
5
10
15
20
25
E
F
A
B
>1.5-3 mm
H
G
0.7-1.5 mm
D
C
Total dwell time in the furnace including heating (min.)

Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

(43) Internationales Veröffentlichungsdatum
25. August 2005 (25.08.2005)

PCT

(10) Internationale Veröffentlichungsnummer
WO 2005/078144 A1

(51) Internationale Patentklassifikation[7]: C21D 9/46

(21) Internationales Aktenzeichen: PCT/EP2005/000853

(22) Internationales Anmeldedatum:
28. Januar 2005 (28.01.2005)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
10 2004 007 071.7
13. Februar 2004 (13.02.2004) DE

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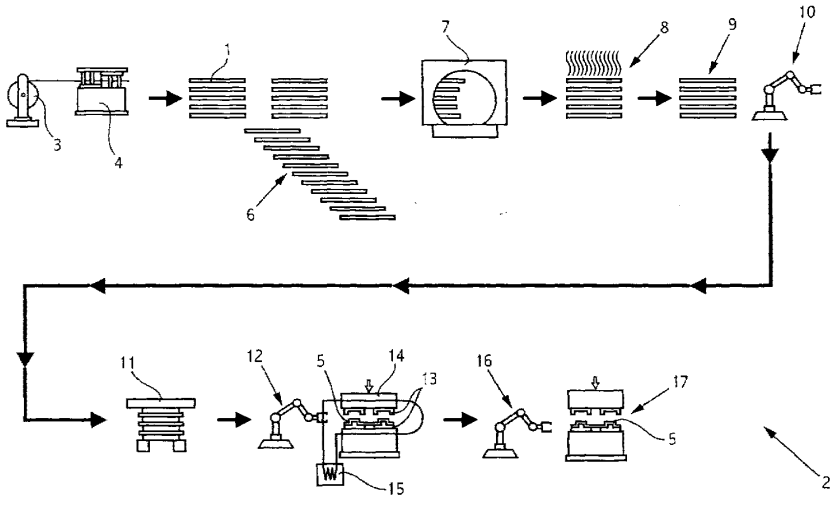
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(84) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL,

[Fortsetzung auf der nächsten Seite]

(54) Title: METHOD FOR PRODUCING A COMPONENT BY RESHAPING A PLATE, AND DEVICE FOR CARRYING OUT SAID METHOD

(54) Bezeichnung: VERFAHREN ZUR HERSTELLUNG EINES BAUTEILS DURCH UMFORMEN EINER PLATINE UND VORRICHTUNG ZUR DURCHFÜHRUNG DES VERFAHRENS



(57) Abstract: The invention relates to a method for producing a component (5) by reshaping a coated plate (1) consisting of tempering steel, said plate being austenitised before the reshaping by means of a first heat treatment, followed by the growth of the layer thickness. The aim of the invention is to optimise the process and to prevent the production of scrap plates caused by interruptions to the process. To this end, after being rapidly cooled, the heat-treated plate (1) is temporarily stored, and is briefly heated again to the austenitisation temperature, directly before being reshaped to form the component (5). Once the structure has been modified, the plate (1) is reshaped and hardened. Preferably, the plate (1) is heated a second time by induction.

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PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Erklärungen gemäß Regel 4.17:

— *hinsichtlich der Berechtigung des Anmelders, ein Patent zu beantragen und zu erhalten (Regel 4.17 Ziffer ii) für die folgenden Bestimmungsstaaten AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO Patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches Patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI Patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(57) Zusammenfassung: Die Erfindung bezieht sich auf ein Verfahren zur Herstellung eines Bauteils (5) durch Umformen einer beschichteten Platine (1) aus einem Vergütungsstahl, wobei sie vor dem Umformen über eine erste Wärmebehandlung austenitisiert wird, wobei sich darüber hinaus ein Schichtdickenwachstum vollzieht. Eine Optimierung im Prozessablauf und ein Vermeiden von Ausschußplatinen bei Prozessstörungen ist dadurch erreichbar, dass nach einem raschen Abkühlen die wärmebehandelte Platine (1) zwischengelagert wird, dass unmittelbar vor dem Umformen zum Bauteil (5) die Platine einer erneuten, kurzzeitigen Erwärmung auf Austenitisierungstemperatur unterzogen wird und dass nach erfolgter Gefügeumwandlung das Umformen und Härten der Platine (1) vonstatten geht. Vorzugsweise geschieht die zweite Erwärmung der Platine (1) durch Induktion.

IP 5081
Ge/Sc

Verfahren zur Herstellung eines Bauteils durch Umformen einer Platine und Vorrichtung zur Durchführung des Verfahrens

BESCHREIBUNG

Die Erfindung bezieht sich auf ein Verfahren zur Herstellung eines Bauteils durch Umformen einer beschichteten, vorzugsweise aluminiumbeschichteten Platine aus einem Vergütungsstahl nach dem Oberbegriff des Patentanspruches 1. Die Erfindung betrifft des weiteren eine Vorrichtung zur Durchführung des Verfahrens.

Im Stand der Technik sind verschiedene Umformverfahren für Platinen aus einem Vergütungsstahl in Verbindung mit Härtungsprozessen allgemein bekannt. Bei einem sogenannten „direkten" Umformverfahren wird eine ebene Platine aus einem Vergütungsstahl in einem Ofen, vorzugsweise einem Durchlaufofen, unter Schutzgasatmosphäre austenitisiert. Beispielsweise kann ein Vergütungsstahl in der Qualität 22MnB5 verwendet werden, der für die Austenitisierung mehrere Minuten bei ca. 950°C geglüht wird. Anschließend wird mit einer vorzugsweise automatisierten Transfereinrichtung die heiße austenitisierte ebene Platine in ein für Serienprozesse gekühltes Umform-/Vergütungswerkzeug eingelegt. Dieses Werkzeug ist Bestandteil einer Presse und beim Schließen derselben wird die heiße Platine zu einem Bauteil auf Endform umgeformt und im geschlossenen Werkzeug bei aufgebrachter Schließkraft relativ schnell abgekühlt und dadurch gehärtet. Das gehärtete Bauteil wird aus dem Werkzeug entnommen und, falls es sich um ein unbeschichtetes Blech handelt, in einem Reinigungsschritt beispielsweise durch Sand- oder Kugelstrahlen entzundert (dies ist bei beschichteten Bauteilen entbehrlich, da z. B. aluminierte Bleche ausreichend Korrosionsschutz bieten und eine Verzunderung verhindert wird). Abschließend folgt ein Fertigkontur- und Lochbeschnitt des fertig geformten und gehärteten Bauteiles, vorzugsweise mittels Laserschneiden. Auch ein mechanisches Schneiden im sogenannten Pressenverbund ist denkbar.

Während der Wärmebehandlung im Ofen erfährt z. B. eine im Ausgangszustand etwa 25 µm starke Aluminiumbeschichtung ein Schichtdickenwachstum auf etwa 45 µm, wobei sich unmittelbar an das Grundmaterial der Platine angrenzend eine AlSi-Schicht mit eindiffundiertem Eisen heraus bildet, die eine darüber hinaus sich bildende, relativ

harte und spröde AlSi-Schicht trägt, die die eigentliche Korrosionsschutzfunktion erfüllt.

Ein typischer Verfahrensablauf (Warmumformkurve 20) hinsichtlich der Wärmebehandlung der Platine im Zuge ihres Umformens ist beispielsweise in Fig. 1 in einem Zeit- Temperatur- Diagram dargestellt. Je nach verwendeter Vergütungsstahlqualität, Blechdicke, Ausgangsschichtdicke u.s.w. sind die in Fig.1 angegebenen Werte natürlich auch gewissen Schwankungen unterworfen (Wärmebehandlungunter- / obergrenze 18, 19). So ist ohne weiteres denkbar, dass die Platine sich über eine Verweildauer von bis zu 30 Minuten im Ofen befindet.

Der verwendete Ofen ist häufig ein sogenannter Durchlaufofen mit Formnestern oder Platinenaufnahmen oder ein Rostdurchschubofen mit Rosten, welche die Platine tragen und diese innerhalb von etwa 2 Minuten mittels Gasbrenner auf Austenitisierungstemperatur erwärmen und anschließend mehrere Minuten mittels elektrischer Heizung auf dieser Temperatur halten. Vorzug des Gasbrenners ist eine höhere Leistung, wohingegen elektrische Heizungen besser regelbar sind.

Gemäß Fig. 1 wird also die Platine im Ofen auf eine Solltemperatur von etwa 950° C erhitzt und auf dieser Temperatur gehalten. Die Austenitisierung vollzieht sich bei Temperaturen oberhalb etwa 720° C. Üblicherweise beträgt die Verweildauer im Ofen ca. 9 Minuten, wobei sich die Platine innerhalb der ersten beiden Minuten auf Solltemperatur erwärmt, während in den darauffolgenden etwa 7 Minuten das Umkörnen des Grundmaterials vom kubisch- raumzentrierten Ferrit/Perlit- Gefüge ins kubisch- flächenzentrierte Austenit, das für ein Härten notwendig ist, vonstatten geht. Daneben ist die genannte Zeitspanne vor allem auch wichtig, um ein ausreichendes Anwachsen der AlSi-Schutzschicht zu erreichen.

Insbesondere hinsichtlich minimaler Glühtemperatur und maximaler Verweildauer der Platine im Ofen gibt es gewisse, mehr oder weniger enge Grenzen, innerhalb derer der Prozess noch Gutteile liefert, d. h., dass die aus dem Ofen entnommenen Platinen überhaupt noch für den Umformprozess und die weitere Verwendung verwertbar sind.
Stellt sich nun im weiteren Ablauf eine Störung ein, sei es bei der Entnahme einer Platine aus dem Ofen und ihrem Weitertransport zum Umform-/ Vergütungswerkzeug bzw. innerhalb der Station des Fertigkontur- und Lochbeschnittes, so kann für die Dauer der Störung keine Platine mehr aus dem Ofen entnommen werden, die maximal zulässige Verweildauer wird in der Regel überschritten und sämtliche im Ofen befindlichen Platinen sind Ausschuss und müssen von daher entsorgt werden.

Der Erfindung liegt die Aufgabe zugrunde, das gattungsgemäße Verfahren zur Herstellung eines Bauteiles durch Umformen einer beschichteten Platine aus einem Vergütungsstahl in der Weise weiterzubilden, dass eine Optimierung im Prozessablauf erreichbar ist und dass insbesondere bei eventuellen Prozessstörungen dem kostenträchtigen Anfallen von Ausschussplatinen vorgebeugt werden kann.

Diese Aufgabe wird hinsichtlich des Verfahrens mit den weiteren Merkmalen nach dem Kennzeichen des Patentanspruches 1 und hinsichtlich der Vorrichtung zur Durchführung des erfindungsgemäßen Verfahrens mit den Merkmalen des Patentanspruches 10 gelöst.

Die Vorteile der erfindungsgemäßen Vorgehensweise sind mannigfaltig. So besteht nun keine Abhängigkeit mehr bezüglich der Verweildauer der Platinen innerhalb des Ofens und Ablaufstörungen im Prozess außerhalb des Ofens. Durch die Entkopplung der Abläufe ergibt sich für den eigentlichen Prozess der Platinenumformung ein geringerer Flächenbedarf und ein Weniger an Infrastruktur. Eine Pufferung / Zwischenlagerung der wärmebehandelten Platinen ist möglich, so dass eine Wärmebehandlung, unter anderem zur Beeinflussung der AlSi-Schicht, ohne weiteres auch bereits beim Stahlhersteller bzw. Blechlieferanten erfolgen kann.

Eine solche ausgelagerte, vorgeschaltete Wärmebehandlung ist an sich bereits bekannt, wie aus der EP 0 946 311 B1 und der DE 102 12 400 C1 hervorgeht. Auch eine Glühbehandlung mittels Induktionserwärmung ist für sich gesehen bereits bekannter Stand der Technik, wie dies im letztgenannten Dokument beispielsweise auch erwähnt ist.

Vorteilhafte Ausgestaltungen und Weiterbildungen der Erfindung sind in den jeweiligen Unteransprüchen beansprucht.

Die Erfindung ist nachstehend anhand eines Ausführungsbeispieles näher erläutert. In der Zeichnung zeigen:

Fig. 1 den erfindungsgemäßen Verfahrensablauf zur Herstellung eine Bauteiles durch Umformen einer Platine,

Fig. 2 ein Temperatur- Zeit- Diagramm der ersten Platinen- Wärmebehandlung und

Fig. 3 ein Temperatur- Zeit- Diagramm der zweiten Platinen- Wärmebehandlung.

In Fig. 1 ist schematisch der erfindungsgemäße Verfahrensablauf zur Herstellung eines Bauteiles 5 durch Umformen einer beschichteten Platine 1 aus einem Vergütungsstahl mittels einer hierfür geeigneten Vorrichtung 2 gezeigt. Von dem im aufgerolltem Zustand angelieferten Stahl, einem sogenannten Coil 3, wird mittels eines Werkzeuges 4