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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

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

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

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.

(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. _____

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 _____

Date _____

Typed or printed name _____

Registration No. _____



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16/413,799	05/16/2019	Pascal DRILLET	20631.1028CON5	7637
23280	7590	02/09/2021	EXAMINER	
Davidson, Davidson & Kappel, LLC 589 8th Avenue 22nd Floor New York, NY 10018			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	
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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>.

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

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 to 10% 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 to 10% 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 V_c , 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 V_c . 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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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	EXAMINER	
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New York, NY 10018				
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			1784	
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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

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 negated 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. 0.7 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

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 to 10% 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 to 10% 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. 112(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. 112.

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

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New York, New York 10018

***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

U.S. Patent and Trademark Office

PTOL-324 (11-13)

Part of Paper No. 20200226

Notice of Non-Compliant Amendment (37 CFR 1.121)

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 to 10% 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 to 10% 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,
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By: _____
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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	07/11/2019
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

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



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/413,799	05/16/2019	Pascal DRILLET	11020631.1028con5	7637
23280	7590	06/04/2019	EXAMINER	
Davidson, Davidson & Kappel, LLC 589 8th Avenue 16th Floor New York, NY 10018			ART UNIT	PAPER NUMBER
			1784	
			NOTIFICATION DATE	DELIVERY MODE
			06/04/2019	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

<i>Decision Granting Request for Prioritized Examination (Track I)</i>	Application No. 16/413,799	Applicant(s) DRILLET et al.	
	Examiner CHERYL P GIBSON BAYLOR	Art Unit OPET	AIA (FITF) Status No
1. THE REQUEST FILED <u>16 May 2019</u> IS GRANTED . The above-identified application has met the requirements for prioritized examination A. ☒ for an original nonprovisional application (Track I). B. ☐ for an application undergoing continued examination (RCE). 2. The above-identified application will undergo prioritized examination. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs: A. filing a <u>petition for extension of time</u> to extend the time period for filing a reply; B. filing an <u>amendment to amend the application to contain more than four independent claims, more than thirty total claims</u>, or a multiple dependent claim; C. filing a <u>request for continued examination</u> ; D. filing a notice of appeal; E. filing a request for suspension of action; F. mailing of a notice of allowance; G. mailing of a final Office action; H. completion of examination as defined in 37 CFR 41.102; or I. abandonment of the application. Telephone inquiries with regard to this decision should be directed to CHERYL GIBSON BAYLOR at (571)272-3213. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.			
/CHERYL GIBSON BAYLOR/ Paralegal Specialist, OPET			

**CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION
UNDER 37 CFR 1.102(e)** (Page 1 of 1)

First Named Inventor:	Pascal DRILLET	Nonprovisional Application Number (if known):	
Title of Invention:	Coated Steel Strips Coated Stamped Products and Methods		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently \$0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.
2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.
3. The applicable box is checked below:
 - I. ☒ **Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)**
 - i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.
---OR---
 - (b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.
 - ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, or the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.
 - II. ☐ **Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)**
 - i. A request for continued examination has been filed with, or prior to, this form.
 - ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
 - iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
 - iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
 - v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature <u>/Cary Kappel/</u>	Date <u>May 16, 2019</u>
Name (Print/Typed) <u>Cary Kappel</u>	Practitioner Registration Number <u>36561</u>
Note: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.*	
☒ *Total of <u>1</u> forms are submitted.	

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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.

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.

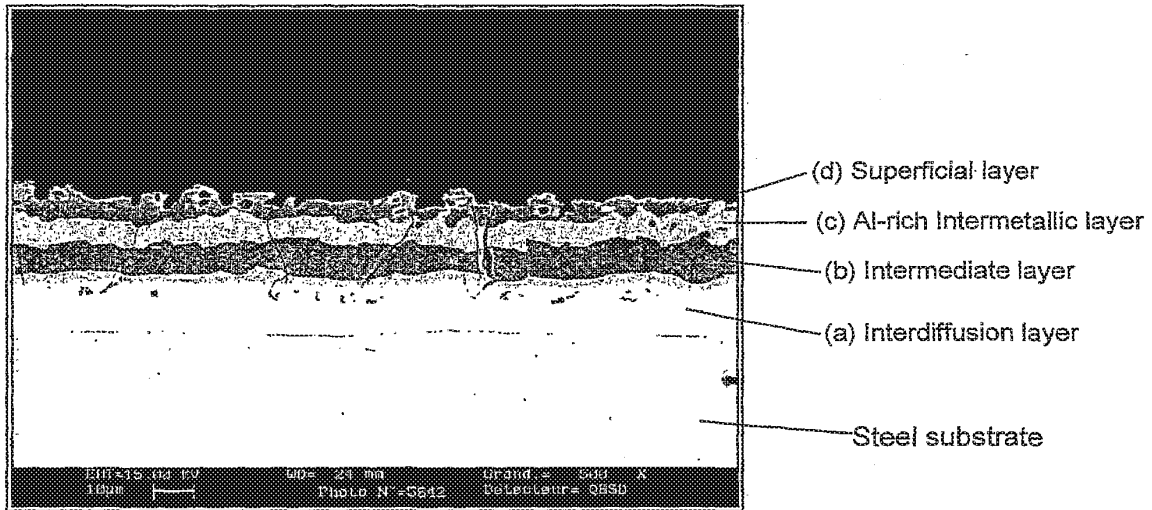


Fig. 1

10µm

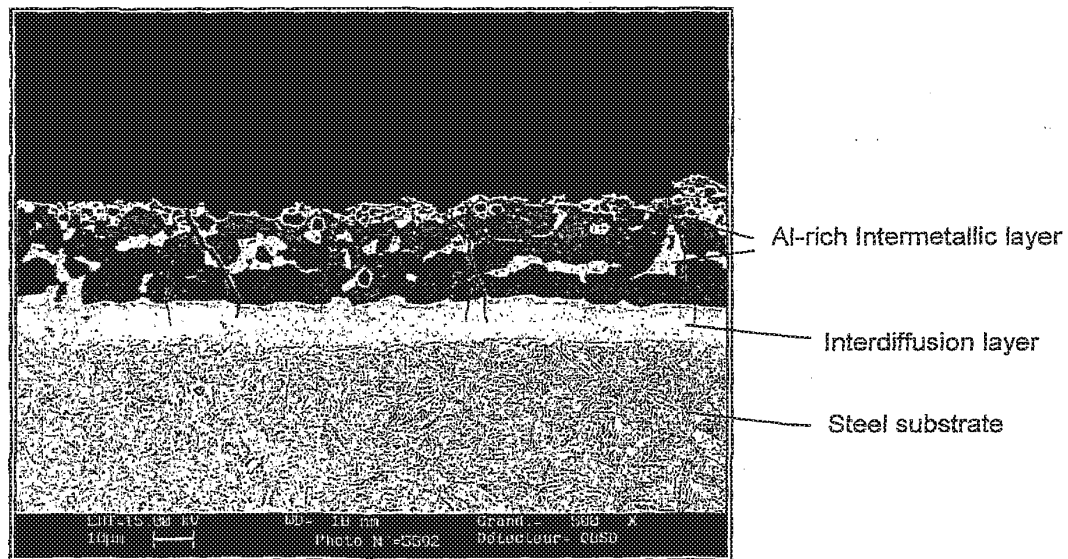


Fig.2

10µm

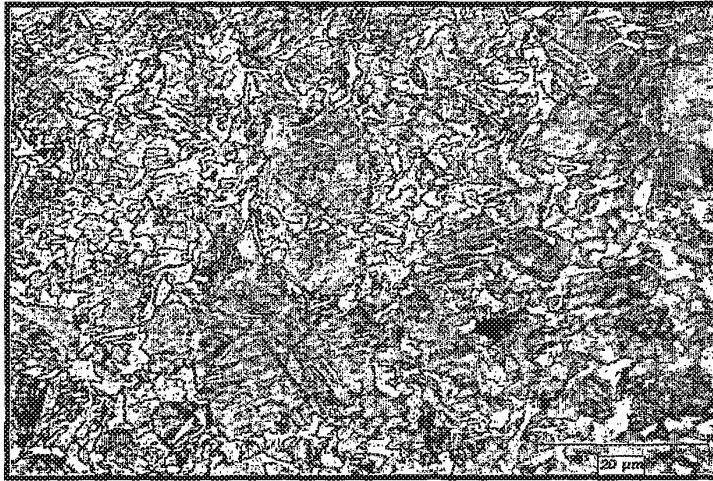


Fig. 3

10μm

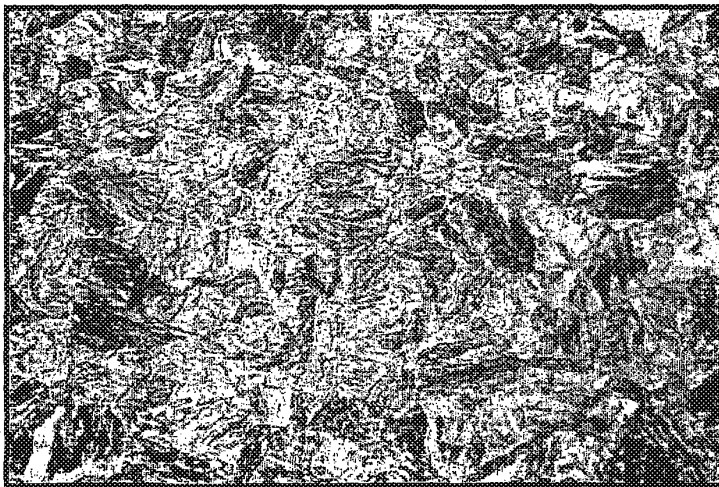


Fig. 4

10 μm

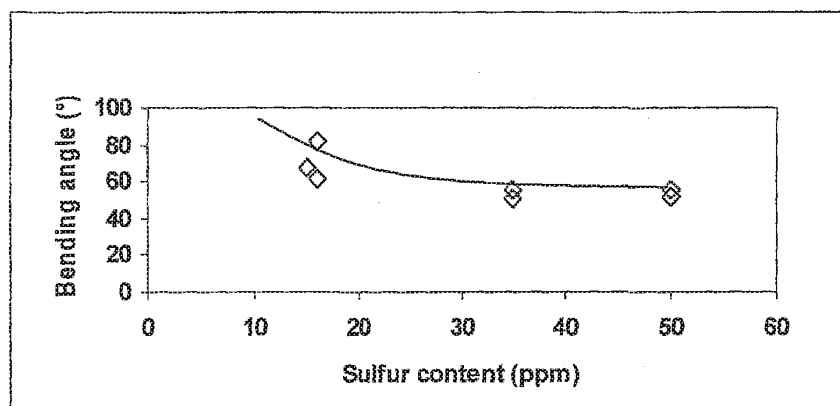


Fig. 5

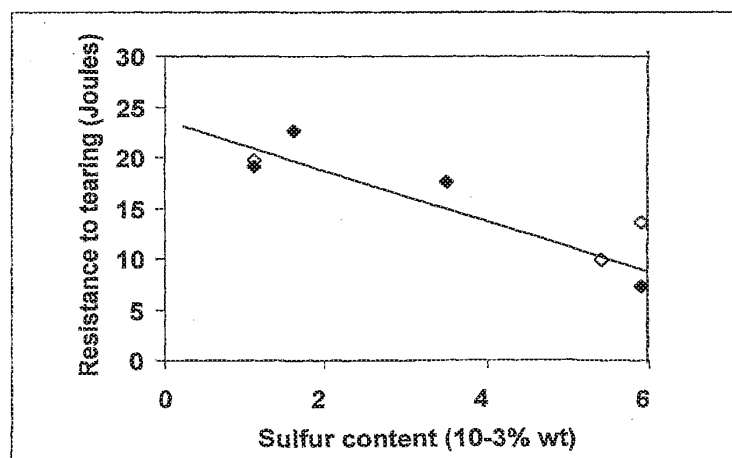


Fig. 6

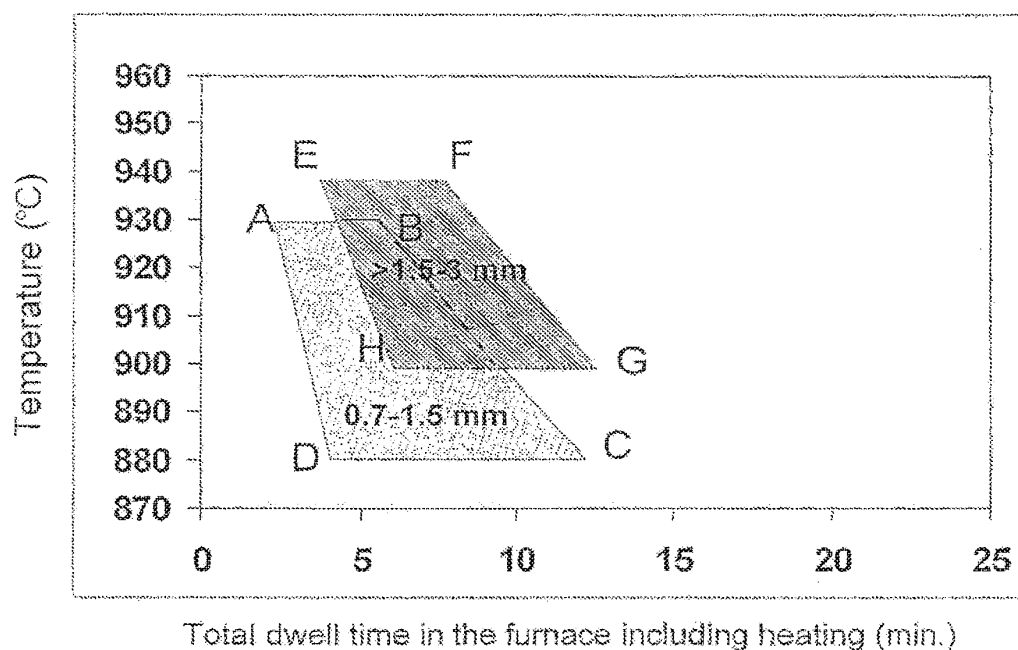


Fig. 7

ABSTRACT

A pre-coated steel strip is provided. The steel strip includes a strip of base steel having a length, a width, a first side, and a second side. The length of the strip is at least 100m and the width is at least 600mm. An aluminum or an aluminum alloy pre-coating is on at least part of at least one of the first or second sides of the strip of base steel. A thickness t_p of the pre-coating is from 20 to 33 micrometers at every location on at least one of the first or second sides. Processes, coated stamped products and land motor vehicles are also provided.

What is claimed is:

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 a thickness t_p of said pre-coating is from 20 to 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 claim 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 trapezoid ABCD having heating time, temperature coordinates of about A (3 minutes, 930°C), B (6 minutes, 930 °C), C (13 minutes, 880 °C) and D (4.5 minutes, 880°C) if thickness of said sheet is greater than or equal to 0.7mm and less than or equal to 1.5mm, and by trapezoid EFGH having heating time, temperature coordinates of about E (4 minutes, 940°C), F (8 minutes, 940°C), G (13 minutes, 900°C), and H (6.5 minutes, 900°C) 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,

wherein the said heated product is cooled at a rate of at least 50°C/s during an interval between when said product exits said furnace and when said product reaches 400°C.

4. A process according to claim 3, wherein said heated blank is deformed by a quantity higher than 10% during said stamping.
5. A process according to claim 3, wherein the elapsed time between said heated blank exits said furnace and said stamping commences is not more than 10 seconds.
6. 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.
7. A hot stamped coated steel sheet product, which is prepared by a process comprising:
 - (A) providing a pre-coated strip according to claim 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 trapezoid ABCD having heating time, temperature coordinates of about A (3 minutes, 930°C), B (6 minutes, 930 °C), C (13 minutes, 880 °C) and D (4.5 minutes, 880°C) if thickness of said product is greater than or equal to 0.7mm and less than or equal to 1.5mm, and by trapezoid EFGH having heating time, temperature coordinates of about E (4 minutes, 940°C), F (8 minutes, 940°C), G (13 minutes, 900°C), and H (6.5 minutes, 900°C) 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.

8. A process for making a hot stamped coated steel sheet product, comprising:

(A) providing a heated blank according to claim 7 ;

(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.

9. The pre-coated steel strip according to claim 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%;

iron; and

impurities inherent in processing.

10. The pre-coated steel strip according to claim 9, 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%,
iron;
and impurities inherent in processing.

11. The pre-coated steel strip according to claim 9, wherein the base steel comprises 20 ppm or less of sulfur.

12. The pre-coated steel strip according to claim 9, wherein the ratio of titanium to nitrogen in the steel sheet in weight % is in excess of 3.42.

13. The pre-coated steel strip according to claim 1, 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.

14. The pre-coated steel strip according to claim 9, 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.

15. 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, and

(ii) said coating comprises, proceeding from base steel outwards,

(1) Interdiffusion layer

(2) Intermediate layer

(3) Intermetallic layer

(4) Superficial layer.

wherein said coating has a thickness greater than 30 micrometers

16. A coated steel stamped product according to claim 15, wherein said layer (1) has a thickness less than 15 micrometers

17. A coated steel stamped product according to claim 15, wherein the said layers (3) and (4) are occupying at least 90% of the level corresponding to the considered said layers and wherein less than 10% of layer (3) is present at the extreme surface of the product

18. A coated steel stamped product according to claim 15, wherein the steel in the strip has a composition according to claim 9.

19. A coated steel stamped product according to claim 15, wherein the steel in the strip has a composition according to claim 10.

20. A coated steel stamped product according to claim 15, wherein the steel has a composition according to claim 11.

21. A coated steel stamped product according to claim 15, wherein the steel has a composition according to claim 12.

22. A coated steel stamped product according to claim 15, 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.

23. A land motor vehicle comprising the heat treated coated steel product according to claim 7 or 15.

24. A land motor vehicle comprising the heat treated coated steel product produced according to claim 3, 6 or 8.

Coated Steel Strips, Coated Stamped Products and Methods

CROSS REFERENCE TO RELATED APPLICATIONS

[0000.1] This is a Continuation of U.S. Patent Application No. 13/621,015, filed September 15, 2012 which is a Divisional of U.S. Patent Application No. 12/447,777, filed April 29, 2009, which is a National Phase Application of International Patent Application PCT/IB06/004019, filed October 30, 2006. All of the above patent applications are hereby incorporated by reference herein.

[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:

[0004] Pre-coating of a steel sheets, by hot dipping;

[0005] Trimming or cutting for obtaining blanks;

[0006] Heating the blanks in order to obtain alloying of the steel substrate with the pre-coating, as well as the austenitizing of the steel; and

[0007] Hot forming followed by rapid cooling of the part in order to obtain predominantly martensitic structures. See for Example U.S. Pat. No. 6,296,805, incorporated herein by reference.

[0008] 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.

[0009] 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.

[0010] 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:

[0011] 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.

[0012] 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.

SUMMARY OF THE INVENTION

[0013] 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.

[0014] 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] It is another object of the present invention to provide novel coated steels which may be conveniently formed into parts by hot stamping.

[0020] It is another object of the present invention to provide novel methods for making such a coated steel.

[0021] It is another object of the present invention to provide novel stamping blanks which are prepared from such a coated steel.

[0022] It is another object of the present invention to provide novel methods of making such stamping blanks.

[0023] It is another object of the present invention to provide novel stamped parts which are prepared from such a coated steel.

[0024] It is another object of the present invention to provide novel methods of making such stamped parts.

[0025] It is another object of the present invention to provide novel articles of manufacture, such as a motor vehicle, which contain such stamped parts.

[0026] It is another object of the present invention to provide novel stamped parts.

[0027] It is another object of the present invention to provide novel methods of making welded stamped parts.

[0028] 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.

[0029] It is another object of the present invention to provide novel welded coated steels and welded stamping blanks.

[0030] It is another object of the present invention to provide novel methods of making such welded coated steels and welded stamping blanks.

[0031] These and other objects, which will become apparent during the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] FIG. 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.

[0033] FIG. 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.

[0034] FIG. 3 illustrates a microstructure of a steel part, hot stamped and cooled under

conditions not according to the invention.

[0035] FIG. 4 illustrates the microstructure of a steel part, hot stamped and cooled according to a preferred set of conditions according to the invention.

[0036] FIG. 5 illustrates the influence of sulfur on the bending angle of parts after hot stamping.

[0037] FIG. 6 illustrates the influence of sulfur on the initiation energy of fracture of parts after hot stamping.

[0038] FIG. 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

[0039] 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.

[0040] 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.

[0041] 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.

[0039.1] 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.sup.2, this representing the dimension of the zone irradiated by X-Ray.

[0042] 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.

[0043] 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.

[0044] 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 100 m, and with a width greater than 600 mm. 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.

[0045] 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:

[0046] 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.

[0047] 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.

[0048] 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.

[0049] 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:

[0050] (a) Interdiffusion layer,

[0051] (b) Intermediate layer,

[0052] (c) Intermetallic layer,

[0053] (d) Superficial layer See, e.g., FIG. 1. In a preferred embodiment these layers are as follows:

[0054] (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

[0055] (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

[0056] (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

[0057] (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% 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, 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).

[0058] 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. 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 3 mm, 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 FIG. 7:

[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 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 FIG. 7 are incorporated herein by reference thereto. Particularly preferred conditions are:

[0060] (for thicknesses of 0.7-1.5 mm)

[0061] 930° C., from 3 minutes up to 6 minutes;

[0062] 880° C., from 4 minutes 30 seconds up to 13 minutes (for thicknesses of 1.5 to 3 mm)

[0063] 940° C., from 4 minutes up to 8 minutes;

[0064] 900° C., from 6 minutes 30 seconds up to 13 minutes.

[0064.1] 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.

[0065] 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.degree. 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.

[0066] 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 30 ppm by weight, including combinations of two or more thereof with aluminum.

[0067] 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.

[0068] 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.

[0069] An example of a preferred steel for the strip of base steel is one having the following composition by weight:

[0070] 0.10%<carbon<0.5%

[0071] 0.5%<manganese<3%

[0072] 0.1%<silicon<1%

[0073] 0.01%<chromium<1%

[0074] titanium<0.2%

[0075] aluminum<0.1%

[0076] phosphorus<0.1%

[0077] sulfur<0.05%

[0078] 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.

[0079] Particularly preferably, the composition by weight of the steel in the strip of base steel is the following:

[0080] $0.15\% < \text{carbon} < 0.25\%$

[0081] $0.8\% < \text{manganese} < 1.8\%$

[0082] $0.1\% < \text{silicon} < 0.35\%$

[0083] $0.01\% < \text{chromium} < 0.5\%$

[0084] $\text{titanium} < 0.1\%$

[0085] $\text{aluminum} < 0.1\%$

[0086] $\text{phosphorus} < 0.1\%$

[0087] $\text{sulfur} < 0.05\%$

[0088] $0.002\% < \text{boron} < 0.005\%$, the remainder comprising, consisting essentially of, or consisting of iron and impurities inherent in processing.

[0089] A preferred strip herein is 100 m long and 600 mm wide. Preferred thicknesses are 0.7 to 3 mm.

[0090] 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.

[0091] An example of preferred commercially available steel for use in the strip of base steel is 22MnB5.

[0092] 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.

[0093] Aluminum is introduced into the composition, to perform deoxidation in the liquid state and to protect the effectiveness of the boron.

[0094] 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.

[0095] 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.

[0096] 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.

[0097] 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 bainite-martensitic matrix act as stress-concentration factors and trigger further crack propagation in the ductile mode.

[0098] 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.

[0099] 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.

[0100] 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.

[0101] 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.

[0102] 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.

[0103] 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.

[0104] 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.

[0105] The first alloy layer may crack when the sheet is submitted to high strains during cold forming operations of the manufacture of parts.

[0106] 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.

[0107] 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.

[0108] 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.

[0109] 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 treatment 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.

[0110] Thermal treatment of the metal in the sheet comprising heating at a temperature ranging between A_{c1} , 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 A_{c3} , for example 840°C ., temperature of complete austenitic transformation. The temperature holding should be followed by a cooling adjusted to the final structure sought.

[0111] 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 10 s.

[0112] 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 .

[0113] 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.

[0114] 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.

[0115] The steel is particularly suited to the production of structural and anti-intrusion parts.

[0116] 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.

[0117] The present invention is described by way of certain exemplary embodiments which are not intended to be limiting.

EXAMPLES

Example 1

[0118] 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 120 m long and 650 mm wide with various thickness ranges were produced.

[0119] 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 20 mm radius. The sheets were afterwards cut into blanks of 1.2.times.0.5 m.sup.2 of overall dimensions.

[0120] 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.

[0121] The blanks were then submitted to heating in a furnace at $T=920^{\circ}$ 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

[0122] i) Conditions according to the invention: In a second example of implementation, a cold rolled steel sheet, 1.2 mm thick, 120 m long and 650 mm 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 6 mn, 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 FIG. 1, which has a four layer structure. Starting from the steel substrate, the layers are the following:

[0123] (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.

[0124] (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.

[0125] (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

[0126] (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)

[0127] 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 FIG. 1.

[0128] Resistance spot welding was performed in the two situations i) and ii):

[0129] (i): Coating with quasi-continuous layers (c) and (d), layer (c) occupying less than 10% of the extreme surface

[0130] (ii): Coating with mixed and discontinuous layers, layer (c) occupying more than 10% of the extreme surface Resistance spot welding was performed by superposing two parts and joining them in the following conditions:

[0131] Squeeze force and welding force: 4000 N

[0132] Squeeze time: 50 periods

[0133] Welding and holding time: 18 periods respectively In each condition, the suitable intensity range was determined for obtaining:

[0134] No sputter during welding

[0135] Acceptable nugget size. For the condition i), the weldability range, expressed in terms of current intensity, is 1.4 kA. For the condition ii) the weldability range is extremely small.

[0136] Thus, it may be seen that the coating according to the invention, yields much more satisfactory results.

Example 3

[0137] In a third example of implementation, a cold rolled steel sheet of the example 1 was cut into blanks of 500.times.500 mm.sup.2 which were heated at 920° C., during 6 mn, then hot stamped and cooled in tools, in such conditions that two different cooling rates were obtained:

[0138] (A): Cooling rate: $V_A=30^{\circ} \text{ C./s}$

[0139] (B): Cooling rate: $V_B=60^{\circ} \text{ C./s}$ Due to the shape of he parts, different deformation levels .epsilon. were created during hot stamping. In particular, some zones largely strained display deformation levels higher than 30%.

[0140] As illustrated on FIG. 3, metallographic observations reveal that when .epsilon.>10%, partial bainitic or ferritic transformation occurs on parts cooled with $V_A=30^{\circ} \text{ C./s}$, mainly on former austenitic grain boundaries. On the other hand, the parts cooled with $V_B=60^{\circ} \text{ C./s}$ display fully martensitic microstructure as illustrated on FIG. 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

[0141] 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, 2.2 mm thick. Sulfur content varies from 11 ppm (0.0011%) to 59 ppm (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. 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. The sheets were afterwards cut into blanks which were heated at 950° C. for 5 mn, 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. 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 FIG. 6, indicate that a initiation energy higher than 18 Joules is achieved when sulfur content is lower than 0.002% in weight. 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.

[0142] 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:

[0143] 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

[0144] 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;

[0145] pre-coated steel--the pre-coating/base composite, not having been subjected to an alliation reaction between the coated material and base steel;

[0146] 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;

[0147] 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;

[0148] blank--a shape cut from a strip.

[0149] product--a stamped blank

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

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Inventor(s): Drillet et al.
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May 16, 2019

PRELIMINARY AMENDMENT

Dear Madam or Sir:

Applicant requests that the following amendments be made in the above-identified matter prior to examination thereof:

Amendments to the Specification and Abstract

Please amend the specification as follows:

[0000.1] This is a Continuation of U.S. Patent Application No. 15/606,770 filed May 26, 2017 which is a Continuation of U.S. Patent Application No. 13/621,015, filed September 15, 2012 which is a Divisional of U.S. Patent Application No. 12/447,777, filed April 29, 2009, which is a National Phase Application of International Patent Application PCT/IB06/004019, filed October 30, 2006. All of the above patent applications are hereby incorporated by reference herein.

No new matter has been added.

Amendments to the Claims:

The following listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

Claims 1-24 (canceled).

Claim 25 (New) A precoated steel product comprising:

a strip of base steel having a first side and a second side; and
a precoating on at least one of the first side and the second side, the precoating being made of an aluminum alloy and having a controlled thickness to create a precoated steel strip heat treatable to form a coating comprising, proceeding from the base steel outwards:

- (a) an Interdiffusion layer,
- (b) an Intermediate layer,
- (c) an Intermetallic layer, and
- (d) a Superficial layer; wherein the coating has a thickness greater than 30 micrometers and wherein said layer (a) has a thickness less than 15 micrometers.

Claim 26 (New) The precoated steel product according to claim 25, wherein the said layers (c) and (d) are quasi continuous by occupying at least 90% of a level corresponding to each said layer and wherein less than 10% of layer (c) is present at an extreme surface of the product.

Claim 27 (New) The precoated steel product according to claim 25, 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.

Claim 28 (New) The precoated steel product according to claim 25, 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 29 (New) The precoated steel product according to claim 25, wherein the base steel comprises 20 ppm or less of sulfur.

Claim 30 (New) The precoated steel product according to claim 27, wherein the base steel comprises 20 ppm or less of sulfur.

Claim 31 (New) The precoated steel product according to claim 25, wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 32 (New) The precoated steel product according to claim 27, wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 33 (New) The precoated steel product according to claim 30, wherein a ratio of titanium to nitrogen in the base steel in weight % is in excess of 3.42.

Claim 34 (New). The precoated steel product according to claim 25, wherein the aluminum alloy precoating comprises from 8% to 11% silicon by weight, from 2% to 4% iron by weight, the remainder being aluminum and impurities inherent in processing.

Claim 35 (New). The precoated steel product according to claim 25, wherein said layer (a) has a thickness less than 10 micrometers.

Claim 36 (New). The precoated steel product according to claim 25, wherein a thickness t_p of said precoating is from 20 to 33 micrometers at every location on at least one of said first and second sides.

Claim 37 (New). The precoated steel product according to claim 25, wherein a thickness t_p of said precoating is from 20 to 33 micrometers at every location on both said first and second sides.

Claim 38 (New) The precoated steel product according to claim 34, wherein the aluminum alloy precoating comprises from 9% to 10% silicon by weight.

Claim 39 (New) The precoated steel product according to claim 38, wherein the aluminum alloy precoating comprises from 9.3% silicon by weight.

Claim 40 (New) The precoated steel product according to claim 25, wherein the Interdiffusion layer comprises the following components by weight based on total weight: 86 to 95% Fe, 4 to 10% Al, and 0 to 5% Si.

Claim 41 (New) The precoated steel product according to claim 25, 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 42 (New) The precoated steel product according to claim 25, 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 43 (New) The precoated steel product according to claim 25, wherein the Superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53to 61% Al, and 0 to 2% Si.

Claim 44 (New) The precoated steel product according to claim 40, 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 45 (New) The precoated steel product according to claim 44, 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 46 (New) The precoated steel product according to claim 45, wherein the Superficial layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53to 61% Al, and 0 to 2% Si.

Claim 47 (New) The precoated steel product according to claim 25, wherein the Interdiffusion layer has a thickness of from 1 micron to 15 microns.

REMARKS

Claims 1-24 are canceled. Claim 25-47 are added. The specification has been amended.
No new matter has been added.

Reconsideration and allowance of the present application is respectfully requested.

Respectfully submitted,

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