

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Pascal DRILLET et al.
U.S. Patent No.: 11,326,227 Attorney Docket No.: 58281-0003IP1
Issue Date: May 10, 2022
Appl. Serial No.: 17/319,306
Filing Date: May 13, 2021
Title: Coated Steel Strips, Coated Stamped Products and Methods

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT
NO. 11,326,227 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

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EXHIBITS

EX-1001	U.S. Patent No. 11,326,227 to Drillet (“the ’227 Patent”)
EX-1002	Excerpts from the Prosecution History of the ’227 Patent (“the Prosecution History”)
EX-1003	Declaration of Dr. Michael Miles
EX-1004	Curriculum Vitae of Dr. Michael Miles
EX-1005	Engels et al., “Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels” (2006) (“Engels”)
EX-1006	Translation Certificate of Michael L. Magee
EX-1007	Excerpt from “New Developments in Sheet Metal Forming” (2006)
EX-1008	Declaration of Prof. Mathias Liewald
EX-1009	Declaration of Christoph Wohlstein
EX-1010	“Engels” and “Hein,” in English and German, provided by the German National Library
EX-1011	[Reserved]
EX-1012	[Reserved]
EX-1013	[Reserved]

EX-1014	Cornette et al., “High Strength Steels for Automotive Safety Parts,” SAE Technical Paper Series 2001-01-0078 (2001) (“Cornette”)
EX-1015	Declaration of Mel DeSart
EX-1016	U.S. Patent Application Publication No. 2004/0009366 (“Takagi”)
EX-1017	Japanese Patent No. JP3738754
EX-1018	Translation and Certificate of Translation for portions of EX-1017
EX-1019	Hein et al., “Hot Stamping of USIBOR 1500 P: Part and Process Analysis Based on Numerical Simulation” (2006) (“Hein”)
EX-1020	Hein et al., “Pressharten von USIBOR 1500 P: Simulationsbasierte Bauteil- und Prozessanalyse” (2006)
EX-1021	Vaissiere et al., “Development of Pre-Coated Boron Steel for Applications on PSA Peugeot Citroën and RENAULT Bodies in White,” SAE Technical Paper Series 2002-01-2048, reprinted from the Proceedings of the 2002 SAE International Body Engineering Conference and Automotive & Transportation Technology Conference (2002) (“Vaissiere”)
EX-1022	Declaration of June Ann Munford - #1
EX-1023	U.S. Patent No. 6,296,805 (“Laurent”)
EX-1024	French Patent Publication No. FR2833504
EX-1025	Translation of EX-1024 and Certificate of Accuracy
EX-1026	GMW14400 material specification (“GMW14400”)

EX-1027	Declaration of June Ann Munford - #2
EX-1028	U.S. Patent No. 9,708,683 (“the ’683 Patent”)
EX-1029	Final Written Decision for IPR2019-01275, corresponding to EX-1028
EX-1030	Record of Oral Hearing for IPR2019-01275
EX-1031	Petition for IPR2019-01275
EX-1032	Somani et al., “Dimensional Changes and Microstructural Evolution in a B-bearing Steel in the Simulated Forming and Quenching Process,” ISIJ International, Vol. 41 (2001) (“Somani”)
EX-1033	Japanese Patent Publication JP2004244704
EX-1034	Translation of EX-1033 and Certification of Accuracy
EX-1035	WO Patent Application Publication No. WO02/103073
EX-1036	European Publication No. EP1865086
EX-1037	Translation of EX-1036 and Certification of Accuracy
EX-1038	Winkel, “Quenches for press hardening steel plate in the car industry” (2004)
EX-1039	Translation of EX-1038 and Certification of Accuracy
EX-1040	Excerpts from Vander Voort, “Microindentation Hardness Testing,” ASM Handbook, Vol. 8 (2000)
EX-1041	Manual for Buehler IndentaMet 1100 Series Indentation Hardness Tester (2005)

EX-1042	Vander Voort and Lucas, “Microindentation Hardness Testing,” Advanced Materials and Processes (Sept. 1998)
EX-1043	Qian et al., “Comparison of nano-indentation hardness to microhardness,” Surface & Coatings Technology 195 (2005)
EX-1044	E 384-05 Standard Test Method for Microindentation Hardness of Materials (2005)
EX-1045	Garcia-Aranda, “Étude thermomécanique et modélisation numérique de l’emboutissage à chaud de l’Usibor 1500,” École Nationale Supérieure des Mines de Paris (2004)
EX-1046	Translation of portions of EX-145 and Certification of Accuracy
EX-1047	Eriksson et al., “Testing and evaluation of material data for analysis of forming and hardening of boron steel components,” Modelling Simul. Mater. Sci. Eng. 10 277 (2002)
EX-1048	[Reserved]
EX-1049	WO Patent Application Publication No. 2004/106573
EX-1050	Translation of EX-1049 and Declaration of Accuracy

LISTING OF CLAIMS

Claim 1	
[1pre]	A hot stamped coated steel product, which comprises:
[1a]	(a) a strip of base steel having a first side and a second side; and
[1b]	(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:
[1c]	(i) said coating results from interdiffusion between said base steel and an aluminum or aluminum alloy pre-coating, and
[1d]	(ii) wherein said coating comprises, proceeding from the base steel outwards:
[1e]	(a) an Interdiffusion layer,
[1f]	(b) an Intermediate layer,
[1g]	(c) an Intermetallic layer, and
[1h]	(d) a Superficial layer,
[1i]	wherein layers (a), (b), (c), and (d) each have a different mean composition from one another,
[1j]	wherein said coating of the hot stamped coated steel product has a thickness greater than 30 micrometers.
Claim 2	
[2]	The hot stamped coated steel product according to claim 1, wherein said layer (a) has a thickness that is less than half of said thickness of the coating.
Claim 3	
[3]	The hot stamped coated steel product according to claim 1, wherein layer (a) has an HV50g hardness between 290 and 410; layer (b) has an HV50g hardness between 900 and 1000, $\pm 10\%$; layer (c) has an

	HV50g hardness between 580 and 650, $\pm 10\%$; and layer (d) has an HV50g hardness between 900 and 1000, $\pm 10\%$.
Claim 4	
[4]	The hot stamped coated steel product according to claim 1, wherein said layer (a) has a thickness of 17 micrometers or less.
Claim 5	
[5]	The hot stamped coated steel product according to claim 1, wherein said layer (a) has a thickness of 15 micrometers or less.
Claim 6	
[6]	The hot stamped coated steel product according to claim 4, wherein the coating is 40 micrometers thick.
Claim 7	
[7]	The hot stamped coated steel product according to claim 1, wherein the interdiffusion layer has a first mean iron composition, the intermediate layer has a second mean iron composition less than the first mean iron composition; wherein the intermetallic layer has a third mean iron composition, the third mean iron composition less than the first mean iron composition and greater than the second mean iron composition, and the superficial layer has a fourth mean iron composition, the fourth mean iron composition less than the third mean iron composition.
Claim 8	
[8]	The hot stamped coated steel product according to claim 1, wherein layer (a) has a thickness that is greater than a thickness of layer (b).
Claim 9	
[9]	The hot stamped coated steel product according to claim 1, wherein layer (a) has a thickness that is greater than a thickness of layer (c).

Claim 10	
[10]	The hot stamped coated steel product according to claim 1, wherein layer (a) has a thickness that is greater than a thickness of layer (d).
Claim 11	
[11]	The hot stamped coated steel product according to claim 1, wherein layer (a) has a thickness: that is greater than a thickness of layer (b); that is greater than a thickness of layer (c); and that is greater than a thickness of layer (d).
Claim 12	
[12]	The hot stamped coated steel product according to claim 1, wherein layer (a) has a thickness that is more than twice a thickness of layer (b).
Claim 13	
[13]	The hot stamped coated steel product according to claim 1, wherein layer (a) has a thickness that is more than twice a thickness of layer (c).
Claim 14	
[14]	The hot stamped coated steel product according to claim 1, wherein layer (a) has a thickness that is more than twice a thickness of layer (d).
Claim 15	
[15]	The hot stamped coated steel product according to claim 1, wherein the hot stamped coated steel product is fully martensitic.
Claim 16	
[16]	The hot stamped coated steel product according to claim 1, wherein the base steel consists of 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%; a remainder being iron and impurities inherent in processing.

Claim 17	
[17]	The hot stamped coated steel product according to claim 1, wherein the base steel consists of the following components by weight based on total weight: 0.15%<carbon<0.25%, 0.8%<manganese<1.8%, 0.10%<silicon<0.35%, 0.01%<chromium<0.5%, titanium<0.1% aluminum<0.1% phosphorus<0.1% 0.002%<boron<0.005%, a remainder being iron and impurities inherent in processing.
Claim 18	
[18]	The hot stamped coated steel product according to claim 1, 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 19	
[19]	The hot stamped coated steel product according to claim 18, 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 20	
[20]	The hot stamped coated steel product according to claim 19, 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 21	
[21]	The hot stamped coated steel product according to claim 20, 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, and wherein said layer (a) has a thickness that is less than half of said thickness of the coating.
Claim 22	
[22]	The hot stamped coated steel product according to claim 1, 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 23	
[23]	The hot stamped coated steel product according to claim 22, 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 24	
[24]	The hot stamped coated steel product according to claim 1, wherein the hot stamped coated steel product has a mechanical strength in excess of 1000 MPa.
Claim 25	
[25]	The hot stamped coated steel product according to claim 1, wherein the hot stamped coated steel product has a mechanical strength in excess of 1500 MPa.

POSCO Co., Ltd. petitions for *Inter Partes* Review (“IPR”) of claims 1-25 (“Challenged Claims”) of U.S. Patent No. 11,326,227 (“the ’227 patent”).

I. REQUIREMENTS FOR IPR

A. Grounds for Standing

Petitioner certifies that the ’227 Patent is available for IPR. Petitioner is not barred or estopped from requesting review of the Challenged Claims on the below-identified grounds.

B. Challenge and Relief Requested

Petitioner requests IPR of the Challenged Claims on the grounds below. Additional explanation is provided in EX-1003, Dr. Miles’s Declaration. EX-1003, 1-14.

Ground	Claims	Basis
1A-102	1-2, 4-5, 7, 18, 24-25	§102 – Engels
1A-103	1-2, 4-7, 9-10, 13-15, 18-25	§103 – Engels
1B	8, 11-14, 24-25	§103 – Engels, Cornette
1C	3, 8-11, 18-23	§103 – Engels, Takagi
1D	15-17	§103 – Engels, Hein
1E	15	§103 – Engels, Vaissiere
1F	16-17	§103 – Engels, Laurent
2A	1-25	§103 – Takagi, Hein, GMW14400
2B	15	§103 – Takagi, Hein, GMW14400, Vaissiere
2C	16-17	§103 – Takagi, Hein, GMW14400,

Ground	Claims	Basis
		Laurent

Although priority entitlement is not conceded, the earliest claimed priority date of the '227 Patent is 10/30/2006. EX-1001, 1:6-18. Each reference qualifies as prior art:

Engels and Hein qualify as prior art under §102(a). These documents are printed publications that were available as of 5/9/2006 based on public distribution at the “New Developments in Sheet Metal Forming” conference. EX-1008. Prof. Liewald explains how these documents were printed beforehand in the collected conference proceedings (*see* EX-1007) and distributed to conference attendees without restriction. EX-1008. The conference was publicly advertised and open to any interested researchers. *Id.* Engels and Hein also were catalogued and publicly available at the German National Library no later than 8/1/2006. EX-1009.

Cornette qualifies as prior art under §102(b). As explained in the Declaration of Mel DeSart (reproduced from IPR2019-01275), Cornette was publicly available at the Engineering Library at the University of Washington “within a few weeks of March 13, 2001.” EX-1015.

Vaissiere qualifies as prior art under §102(b). As June Munford explains, an identical version of this document was catalogued and publicly available at the Library of Congress by shortly after 10/31/2003. EX-1022. Vaissiere also was

cited in the proceedings of the 2004 conference of the Iron and Steel Institute of Japan. *Id.*

Laurent qualifies as prior art under §102(b). Laurent is a U.S. Patent with a publication date of 10/2/2001. EX-1023.

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

C. Claim Construction

Because the evidence and the prior art's description of the claimed elements are similar to those of the '227 Patent's specification, no formal claim constructions are necessary in this proceeding.¹ For this petition, Petitioner applies prior art in a manner consistent with Patent Owner's allegations of infringement in co-pending litigation.

¹ Petitioner is not conceding that each claim satisfies all statutory requirements, such as §§101 and 112, nor is Petitioner waiving any arguments concerning claim scope or grounds that can only be raised in litigation.

II. THE '227 PATENT

A. Summary

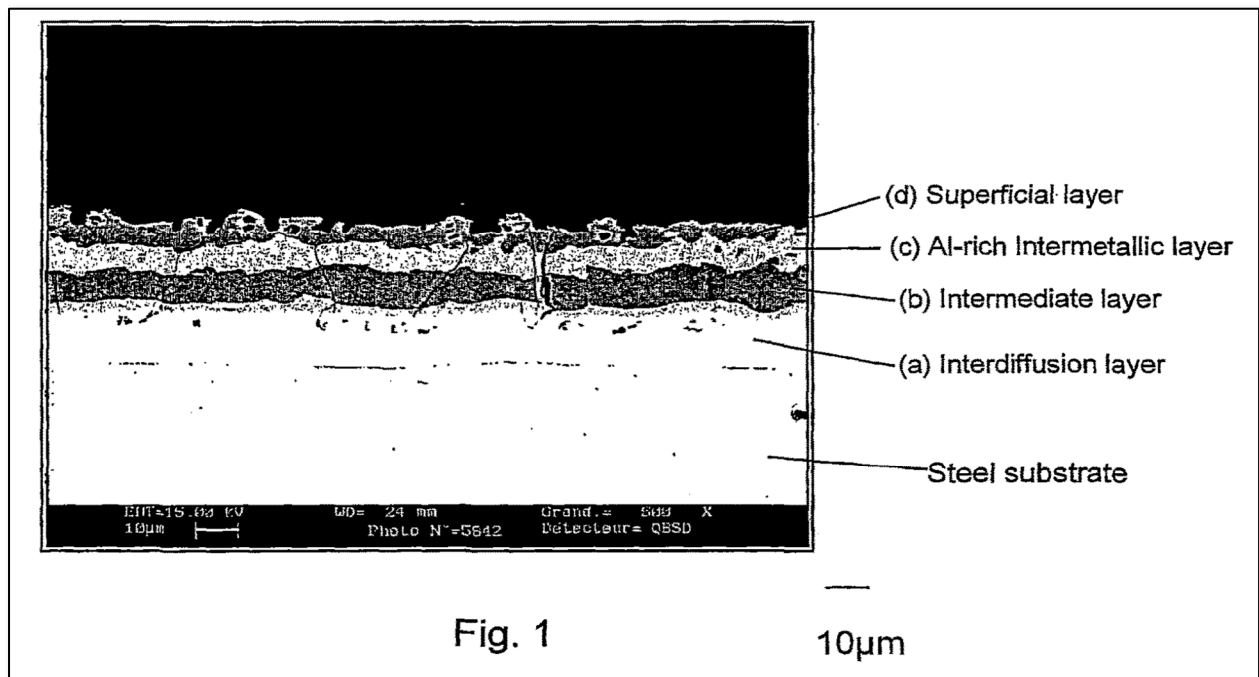
The '227 Patent describes manufacturing methods and structures associated with a “coating” formed by hot-stamping pre-coated steel blanks. The '227 Patent acknowledges that these coatings and their manufacture were already “important, especially in the automotive industry.” EX-1001, 1:41-43. As the Background describes, processing to obtain a coating typically included “[p]re-coating of a steel sheet[], by hot dipping; [h]eating the blanks in order to obtain alloying of the steel substrate with the pre-coating, as well as the austenitizing of the steel; and [h]ot forming followed by rapid cooling of the part in order to obtain predominantly martensitic structures.” EX-1001, 1:45-51.

Starting with this well-established process, the '227 Patent alleges several improvements. EX-1003, 18-20. First, the '227 Patent emphasizes the “importan[ce]” of “control of the homogeneity of the pre-coating thickness over the entire sheet” by “monitor[ing] continuously” the pre-coating thickness. EX-1001, 2:58-60, 5:1. However, the '227 Patent does not claim any pre-coating or homogeneity thereof.

The '227 Patent further notes (i) certain process parameters that are linked to the manufacture of “fully homogeneous martensitic structure[s]” and (ii) advantages of “reduction of sulfur below a critical value.” EX-1001, 3:1-8. But

both low sulfur amounts and “fully martensitic” products were recognized in the art. For example, Takagi, Vaissiere, and Somani each discuss how hot-stamping is tuned to obtain martensitic structures. EX-1016, [0028]; EX-1021, 3, 6; EX-1032, 8.

Finally, the '227 Patent describes that “particularly good weldability [] is associated with a special succession of coating layers on the parts.” EX-1001, 2:64-66. An example coating, which includes four layers, is described for “Example 2” and illustrated in FIG. 1. EX-1001, 12:30-61.



Even if these coating layers were “special,” they were not new. This Petition presents two independent sets of grounds that anticipate and/or render obvious the claimed coating layers.

B. Prosecution History

The only references applied in a rejection during prosecution of the '227 Patent were Cornette and Laurent. EX-1002, 200-203; EX-1003, 21-25. The allowance relied on Cornette's lack of disclosure of different compositions for the four layers illustrated in Cornette's FIG. 22 coating. EX-1002, 534, 576. The two primary references relied on in this Petition – Engels and Takagi – provide precise compositions for four different layers, thereby teaching the sole feature that justified allowance.

C. Level of Ordinary Skill

A person having ordinary skill in the art ("POSITA") at the time of the alleged invention would have had an undergraduate degree in materials science, manufacturing engineering, mechanical engineering, or equivalent knowledge, training, or experience, with two years of experience working in metallurgy. EX-1003, 15.

III. GROUNDS 1A-102 and 1A-103: Claims 1-2, 4-5, 7, 18, and 24-25 are anticipated by Engels and claims 1-2, 4-7, 9-10, 13-15, and 18-25 are obvious over Engels

A. Engels

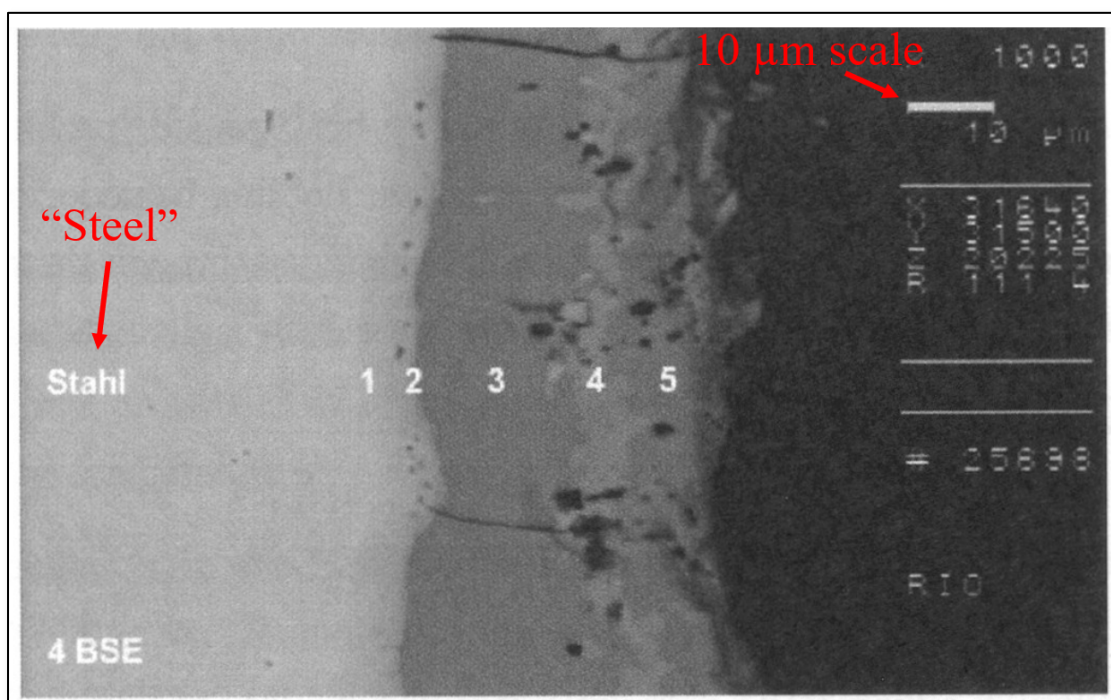
Entitled "*Controlling and Monitoring of the Hot-Stamping Process of Boron-Alloyed Heat-Treated Steels*," Engels provides an overview of hot-stamping as applied to "boron-alloyed steels." EX-1005, 136. Engels notes that "blanks"

having an “Al-Si-coating” (i.e., pre-coating) are “austenitized at temperatures between 900 °C and 950 °C,” “stamped,” and “systematically cooled down under pressure” (i.e., quenched). EX-1003, 26; EX-1005, 137. As a result, a “diffusion layer” (coating) forms, and Engels recognizes that “it is crucial to look for a correctly shaped diffusion layer with regard to layer thickness, porosity and roughness, as this layer will decisively impact the corrosion and welding properties of the hot stamped parts.” EX-1005, 142; EX-1003, 27. Among “parameters which have to be taken into account when setting the temperature profile” are “heating rate,” “total processing time,” “maximum austenitizing temperature,” and “material thickness.” EX-1005, 142.

Engels’ FIG. 5 shows a “cross-section polish of the diffusion layer of a hot-dip aluminum coated boron steel.” EX-1005, 142. “Five phases which differ in their layer thickness and chemical composition can easily be distinguished.” *Id.* These phases and their compositions/thicknesses are shown in Engels’ FIG. 5 and a corresponding table (reproduced below). EX-1005, 143. EX-1003, 28.

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

Engels’ Table



Engels' FIG. 5²

Several aspects of Engels' FIG. 5 and Table bear special comment. First, a scale at the top-right shows a length of 10 μm , permitting the calculation of exact thicknesses from the image itself. EX-1003, 29. Second, the annotation "Stahl" is German for "steel;" this portion of the image depicts the base steel underlying the coating. EX-1006; EX-1003, 29.

Third, “Volume-%” listed in Engels’ Table is a translation error and would have been recognized as such by a POSITA. The German version of Engels describes the compositions as “Masse-%,” which, as described in EX-1006, is correctly and unambiguously translated as “Mass-%,” not “Volume-%.” EX-1006;

² All annotations in the Figures herein are added unless indicated otherwise.

EX-1010, 22. Further, as Dr. Miles explains, the concept of “Volume-%” for distinct elements in a homogenous compound is not well-defined, and “Mass-%” (or, equivalently, weight-%) was and remains by far the most common composition metric among steel researchers. EX-1003, 30. “Volume-%,” by contrast, is an essentially unknown and unused metric in steel research. *Id.* Accordingly, this Petition treats the compositions in Engels’ Table as percentages by mass or, equivalently, weight, as they would have been understood by a POSITA. *Id.*

B. Analysis of Claims

[Ipre]:

1. The preamble is non-limiting

The preamble of claim 1 (“*a hot stamped coated steel product*”) is not limiting. As a rule, “a preamble generally is not limiting when the claim body describes a structurally complete invention [].” *Catalina Mark. Intern. v. Coolsavings.com*, 289 F.3d 801, 809 (Fed. Cir. 2002). Here, the claim body describes a structurally complete apparatus including a “*strip of base steel*” and a “*coating*” having four recited layers, without requiring any reference to the preamble.

Although several exceptions have been recognized, none applies in this case. For example, “clear reliance on the preamble during prosecution to distinguish the

claimed invention from the prior art transforms the preamble into a claim limitation.” *Catalina*, 289 F.3d at 808. This reliance is lacking in the prosecution history of the ’227 Patent. *See* §II.B.

Further, “dependence on a particular disputed preamble phrase for antecedent basis may limit claim scope because it indicates a reliance on both the preamble and claim body to define the claimed invention.” *Catalina*, 289 F.3d at 808. Here, claim 1’s reference to “*the hot stamped coated steel product*” is superfluous and does not indicate a reliance on the preamble to define the invention. Removing the preamble phrase from the body to instead recite that “*said coating of the hot stamped coated steel product has a thickness greater than 30 micrometers*” has exactly the same meaning as if “*the hot stamped steel product*” were retained.

Even if some portion of the preamble is limiting, at least “*hot stamped*” is not limiting. This claim element represents at most a product-by-process element that, absent “structural and functional differences” over prior art imparted by the process, carries no patentable weight. *Amgen v. F. Hoffmann-La Roche*, 580 F.3d 1340, 1370 (Fed. Cir. 2009). Although the ’227 Patent describes how characteristics of the coating depend on **temperature** treatment parameters such as “cooling rate” and “heating rate” (*see, e.g.*, EX-1001, 5:67, 11:6), the ’227 Patent is silent as to any structural difference imparted by “*hot stamp[ing]*.” *See also* EX-

1001, 14:31-39.

2. Collateral estoppel requires a holding that the preamble is non-limiting

The question of whether this preamble is limiting was already answered during IPR proceedings for the '683 Patent (a parent to the '227 Patent), in which claim 1 recited “[a] coated steel stamped product.” EX-1028, 15:21. The Final Written Decision found the preamble non-limiting. EX-1029, 13-15. The Board reasoned that the preamble failed to provide antecedent basis to the body of claim 1, a condition that also applies here. *Id.*, 13. The Board also found that “Patent Owner has not identified any structural feature that differentiates a stamped versus unstamped steel product,” noting that the Specification “attributes the recited four-layer structure to an alliation (i.e., alloying) reaction that occurs ‘during the heat treatment **immediately preceding hot-stamping.**’” *Id.*, 16. Patent Owner’s counsel did not disagree with this characterization. EX-1030, 36:10-12. The Board also found that the preamble did not relate to any “important characteristic[] of the claimed invention” but, rather, only to “conventional” subject matter, weighing **against** the preamble having patentable weight. EX-1029, 14-15. The same reasoning applies here.

Given similarities between this preamble and that of the '683 Patent, the Board’s prior finding is conclusive and should be applied here. “It is well

established that collateral estoppel applies to IPR proceedings.” *Google LLC v. Hammond Dev. Int’l*, 54 F.4th 1377, 1381 (Fed. Cir. 2022). In addition, “[i]t is well established that patent claims need not be identical for collateral estoppel to apply.” *Id.* Rather, “it is the identity of the *issues* that were litigated that determines whether collateral estoppel should apply.” *Ohio Willow Wood Co. v. Alps S., LLC*, 735 F.3d 1333, 1342 (Fed. Cir. 2014). Notably, collateral estoppel applies not only to invalidity issues but also to claim construction issues. *Papst Licensing GMBH & Co. KG v. Samsung Elecs. Am., Inc.*, 924 F.3d 1243, 1252 (Fed. Cir. 2019); *Nestle USA, Inc. v. Steuben Foods, Inc.*, 884 F.3d 1350, 1352 (Fed. Cir. 2018). The case for collateral estoppel is strengthened here because the present IPR is a case of **mutual** issue preclusion, because POSCO and ArcelorMittal were also adverse in the ’683 Patent’s IPR.

Finally, USPTO rules dictate estoppel, as ArcelorMittal “is precluded from taking action inconsistent with the adverse judgment” in the ’683 Patent’s IPR. 37 CFR § 42.73(d)(3). Estoppel applies to all issues that were resolved against ArcelorMittal in the ’683 Patent’s IPR and that overlap with this proceeding.

3. Engels teaches the preamble

Even if the entirety of “*hot stamped coated steel product*” is limiting, Engels’ FIG. 5 depicts a hot stamped coated steel product. EX-1003, 31-35. For example, Engels’ FIG. 5 shows a “diffusion layer” (coating) on underlying “boron

steel” (“Stahl”) that has undergone hot-stamping. EX-1005, 142-143.

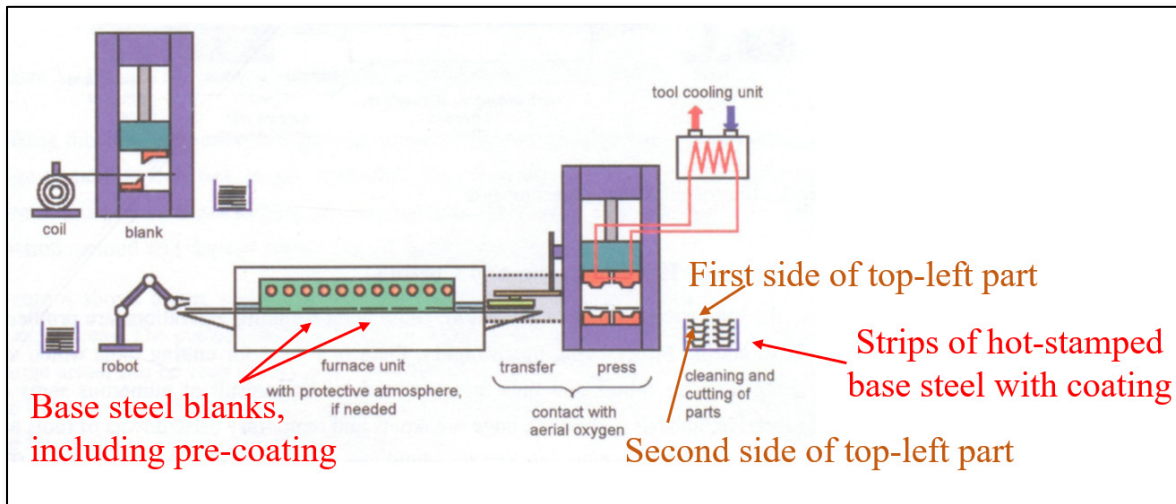
On whether the part of Engels’ FIG. 5 is “hot stamped,” Engels (entitled “Controlling and Monitoring of the **Hot-Stamping** Process of Boron-Alloyed Heat-Treated Steels”³) describes continuous processes in which parts are transferred directly from a furnace (in which austenitization and coating formation occur) into a die to be stamped (or “formed”) and quenched. EX-1005, 137-138. As Dr. Miles notes, in the field of steel metallurgy, these steps were understood as portions of a single, unified process referred to, as a whole, as “hot stamping.” EX-1003, 32. Indeed, as described by Engels, the “[t]ransfer time t_T between furnace and die” is a factor in determining the properties of the resulting part, and other art notes that “[t]he transfer time between the furnace and the die has to be reduced as much as possible,” e.g., to “less than ten seconds.” EX-1005, 141; EX-1019, 167. As Dr. Miles explains, in view of this continuous, unified process that includes immediate transfer to a die for stamping, a POSITA would have understood Engels’ FIG. 5 to illustrate a part that has undergone the entirety of that process, including stamping. EX-1003, 33. Indeed, Engels’ FIG. 5 is described in the context that discusses how the forming and quenching process causes “structural change” in the part. EX-1005, 143. A POSITA “would have naturally understood

³ All emphasis is added except where indicated otherwise.

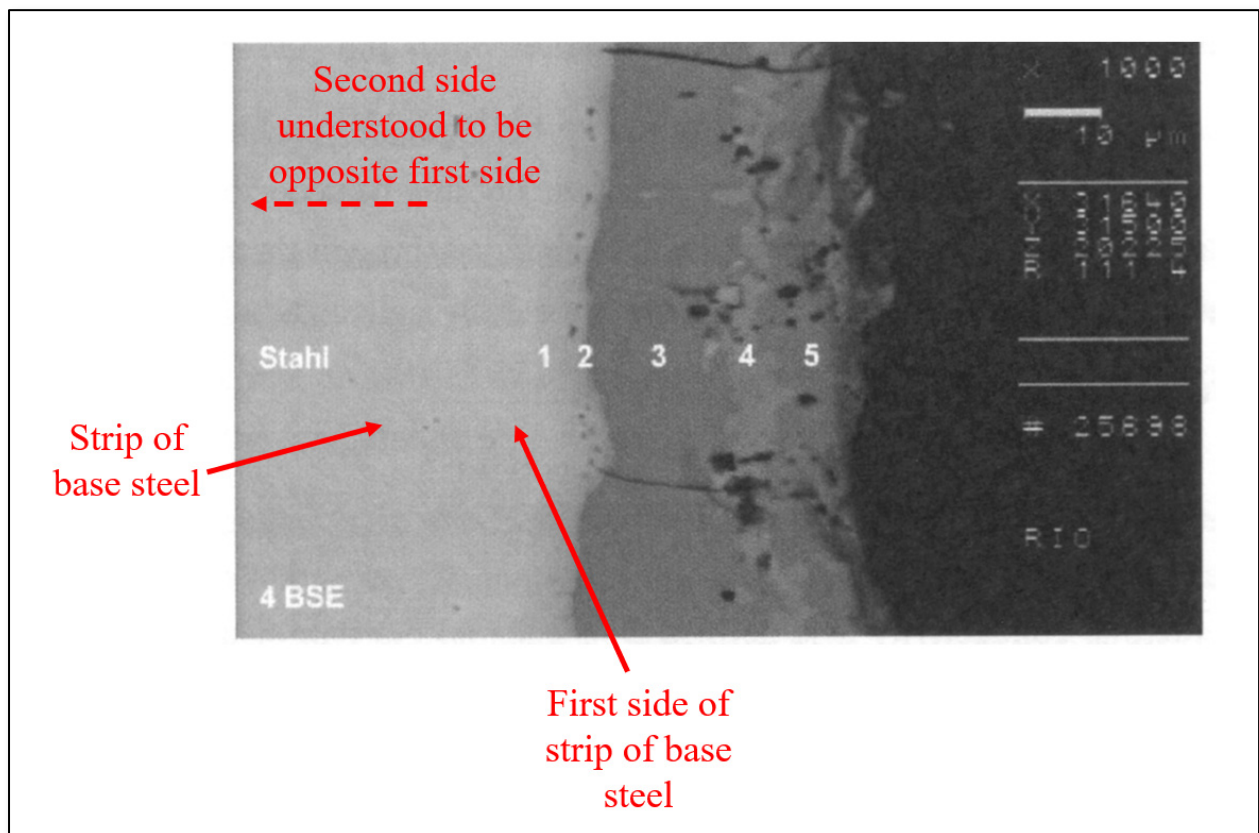
Engels FIG. 5 to depict a hot stamped part that has undergone those structural changes as part of the unified hot-stamping process, not a part whose processing has been arbitrarily arrested mid-way through.” EX-1003, 33. Accordingly, Engels discloses or renders obvious a *hot stamped coated steel product*. *Id*; EX-1003, 34-35.

[1a]:

Engels discloses or renders obvious a strip of base steel having first and second sides. EX-1003, 36. Engels describes blanks (which a POSITA would have understood as being strips of base steel with a pre-coating) having first sides and second sides, as shown in Engels’ FIG. 1 below. EX-1003, 36; EX-1005, 137. The strips of base steel are austenitized and formed to produce hot-stamped parts having the same base steel with first and second sides. EX-1003, 36. A strip of base steel and one of its sides (immediately underlying phase 1) are shown in Engels’ FIG. 5; a POSITA would have understood that there would be a second side opposite the labeled first side. EX-1003, 36.



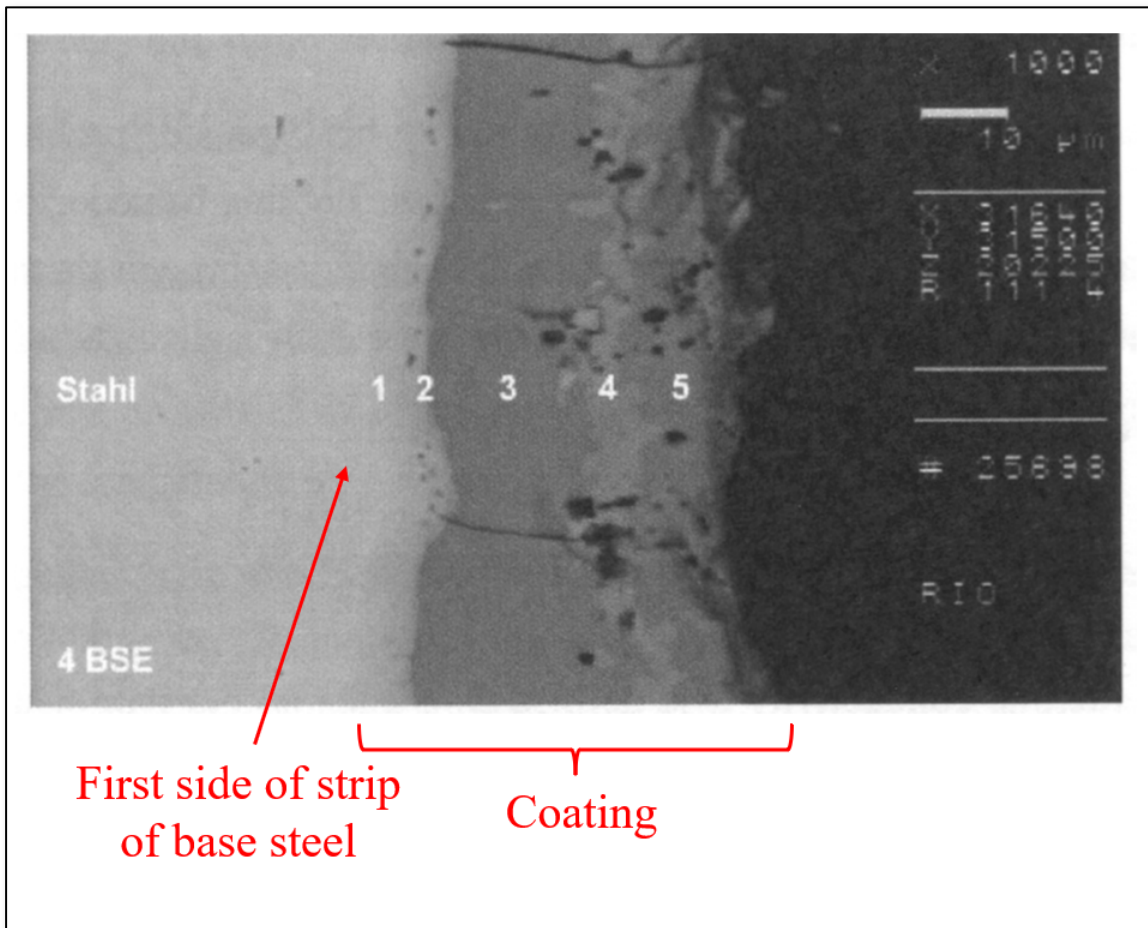
Engels' FIG. 1



Engels' FIG. 5

[1b]:

Engels discloses or renders obvious a coating on the first side of the strip of base steel. EX-1003, 37-44. The coating is a “diffusion layer” having five phases, as shown in annotated Engels’ FIG. 5 below. EX-1005, 142-143.



Engels’ FIG. 5

[1c]:

Engels discloses or renders obvious that the coating results from interdiffusion between the base steel and an aluminum or aluminum alloy pre-coating. Engels’ “diffusion layer” (coating) is formed by heat treatment of “hot-dip

aluminum coated boron steels.” EX-1005, 141-142. “Hot-dip” refers to a process in which a base steel is dipped in a bath of aluminum or aluminum-silicon to form an aluminum or aluminum-silicon pre-coating. EX-1003, 45. A POSITA would have understood Engels to describe specifically an aluminum-silicon pre-coating, based on the descriptions of “Al-Si-coating” and “22MnB5+AS diffusion layer,” where “AS” would have been understood as referring to “aluminum-silicon.” EX-1003, 45; EX-1005, 138, 141.

Engels’ thermal treatment (e.g., “heating rate,” “total processing time,” and “austenitizing temperature,” such as “temperatures between 900 °C and 950 °C”) causes “diffusion” between the material(s) of the pre-coating and the base steel. EX-1005, 136, 142; EX-1003, 46. As a result, Engels’ coating includes various phases composed of varying degrees of iron, aluminum, and silicon. EX-1005, 143. Based on these compositions and Engels’ use of the term “diffusion,” a POSITA would have understood that the coating was formed by interdiffusion between the iron of the base steel and the aluminum and silicon of the “AS” or “Al-Si” pre-coating. EX-1003, 46.

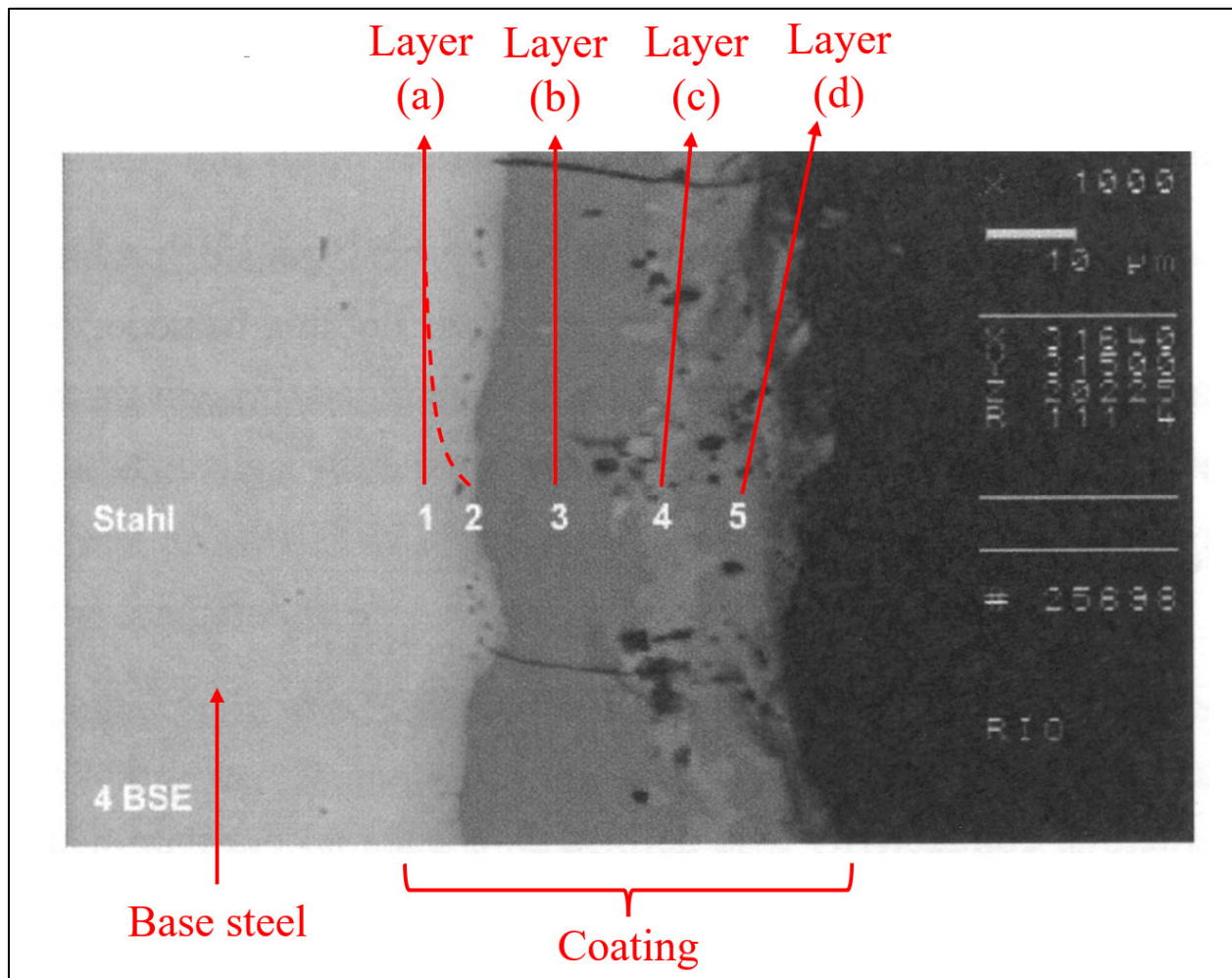
[1d]-[1h]:

Engels discloses or renders obvious that the coating comprises, proceeding from the base steel outwards, (a) an Interdiffusion layer, (b) an Intermediate layer, (c) an Intermetallic layer, and (d) a Superficial layer. Engels’ “diffusion layer”

(coating) includes “five phases which differ in their layer thickness and chemical composition.” EX-1005, 142; EX-1003, 47. As shown in Engels’ FIG. 5, phases 1 (or 1+2) and 3-5 constitute the layers and satisfy the claimed layers according to the following mappings:

- **Phase 1 or 1+2 teaches layer (a) (“Interdiffusion layer”).** As shown in FIG. 5, phase 1 or 1+2 is arranged on the underlying steel. EX-1003, 47.
- **Phase 3 teaches layer (b) (“Intermediate layer”).**
- **Phase 4 teaches layer (c) (“Intermetallic layer”).**
- **Phase 5 teaches layer (d) (“Superficial layer”).**

These phases are included in the coating (“diffusion layer”) and “proceed[] from the base steel outwards.” EX-1003, 48.



Engels' FIG. 5

The '227 Patent does not describe that the names of the layers (i.e., “Interdiffusion,” “Intermediate,” “Intermetallic,” and “Superficial”) denote any particular characteristics of the layers. However, phases 1 (or 1+2), 3, 4, and 5 satisfy the meanings of those terms as proposed by Petitioner during IPR proceedings for the '683 Patent. EX-1031, 22-24; EX-1003, 49.

Further, claim 1 does not recite that the layers must be adjacent to one another, such that arrangement of phase 2 at least partially between phase 1 and

phase 3 is no impediment to the mapping of phase 1 to layer (a) and phase 3 to layer (b). EX-1003, 50. To the extent Patent Owner disputes this mapping, Dr. Miles notes that phase 2 (described by Engels as being very thin and as having an “unmeasurable” composition) would be understood as forming a sub-layer of an overall layer composed of both phases 1 and 2, the overall layer having a composition similar to that provided for phase 1 and a thickness the same as or similar to the disclosed thickness of phase 1 (e.g., within 1 μm of the phase 1 thickness, a thickness difference that would not change the below discussion). EX-1003, 39-44. This interpretation is consistent with the '227 Patent's description that, in one example, layer (a) “is itself composed of two sub-layers.” EX-1001, 12:46. All arguments provided herein based on associating Engels' phase 1 with layer (a) apply equally to this composite layer of phases 1 and 2, and the alternative mapping should be understood as being included in the discussions below.

[li]:

Engels discloses or renders obvious that layers (a)-(d) have different mean compositions. EX-1003, 51-55. Engels' Table provides elemental compositions for each of phases 1 and 3-5, which correspond to layers (a)-(d), respectively. Each of these layers has a different Al composition and a different Fe composition from one another:

Differing Al and Fe compositions

	phase number	layer thickness, μm	Al	Fe	Si	Cr	Mn
			~~Volume-%~~ Mass-%				
Layer (a)	1	5 – 9	7,2	89,2	1,9	0,3	1,4
[Layer (a)]	2	< 1 μm	unmeasurable				
Layer (b)	3	11 – 18	51,4	45,9	1,9	0,1	0,7
Layer (c)	4	3 – 8	33,9	54,3	10,6	0,3	0,9
Layer (d)	5	5 - 11	53,2	44,1	1,9	0,2	0,6

Engels' Table

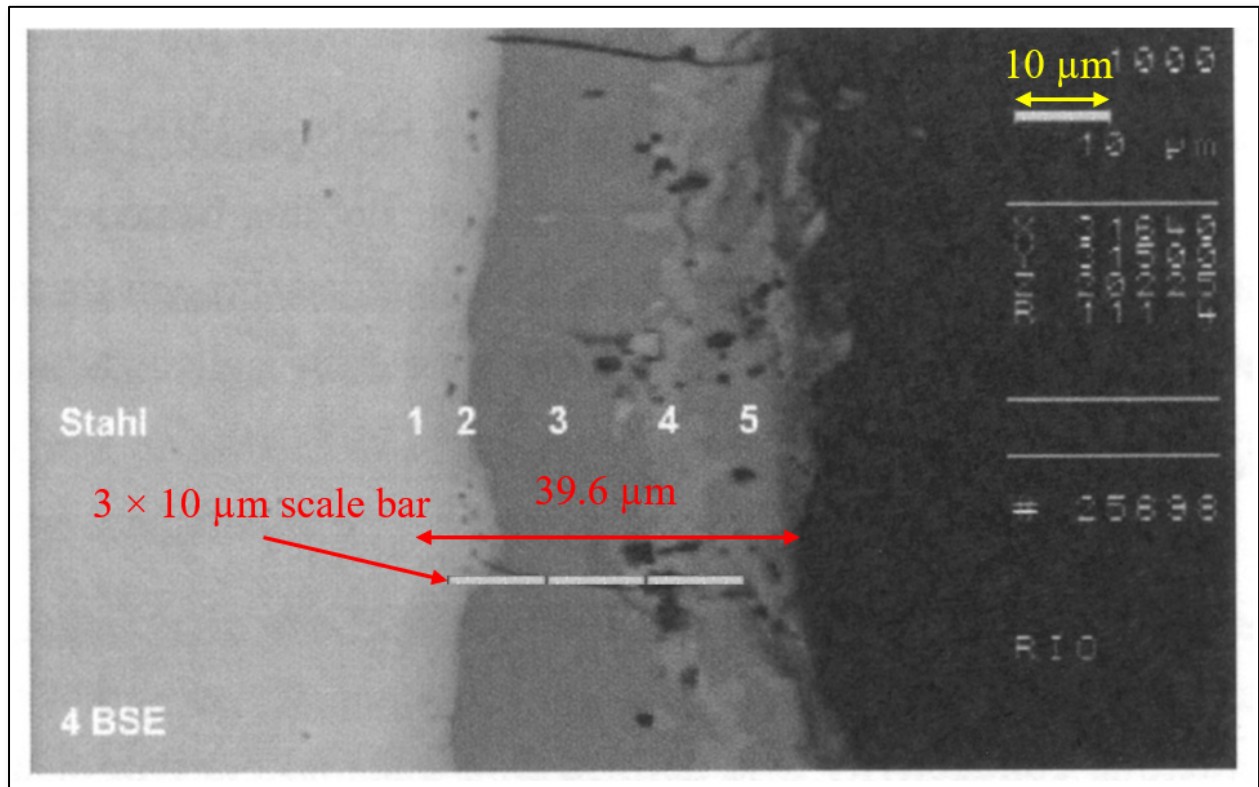
Engels discloses the “chemical composition” of each phase, not explicitly a “mean” composition. However, as explained by Dr. Miles, a POSITA would have understood a disclosure of a composition for a material, phase, or layer in the field of steel metallurgy as a disclosure of a **mean** composition of the material, phase, or layer. EX-1003, 52-55. Absent a statement or suggestion otherwise—which Engels does not include—a POSITA would have understood Engels’ disclosures of compositions to be disclosures of **mean** compositions, thereby satisfying this claim element. *Id.* Dr. Miles notes that “‘mean’ composition is by far the most common way to report a composition and would have been the most accessible measure of a layer’s composition for a POSITA seeking to apply Engels’ teachings to hot-stamped steel.” *Id.*, 54.

Accordingly, Engels’ phases having different compositions disclose or render obvious claimed layers (a)-(d) having different mean compositions.

[1j]:

Engels' coating has a thickness greater than 30 micrometers. Dr. Miles conducted a direct measurement⁴ in Engels' FIG. 5 (shown below) based on the included 10 μm scale. EX-1003, 56-57. This measurement shows a thickness of **39.6 μm** , well beyond the recited 30 μm threshold and, therefore, is sufficient to anticipate claim 1. *Id.* "It is [] an elementary principle of patent law that when, as by a recitation of ranges or otherwise, a claim covers several compositions, the claim is 'anticipated' if one of them is in the prior art." *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 782 (Fed. Cir. 1985).

⁴ Dr. Miles explains that the measurement was conducted based on the shadings in FIG. 5, which, based on Engels' disclosure and his familiarity with imaging using backscattered electrons (BSE) in scanning electron microscopy (SEM), correspond to the different phases of the coating. EX-1003, 38.



Engels' FIG. 5

Alternatively, Engels renders obvious that the coating has a thickness greater than 30 μm based on the thickness ranges in Engels' Table. Combinations of the disclosed ranges result in a total coating thickness greater than 30 μm. For example, assuming that each phase has a value in the middle of the disclosed range (7 μm for phase 1, 14.5 μm for phase 3, 5.5 μm for phase 4, and 8 μm for phase 5), and neglecting any thickness of phase 2, results in a coating thickness of **35 μm**. Even assuming that each phase has a value one-third of the way through its disclosed range (toward the lower end) results in a coating thickness of **31.3 μm**, again satisfying this claim element. EX-1003, 58. Any marginal thickness

contributed by phase 2 would not substantively alter this reasoning where layer (a) is mapped to phases 1+2.

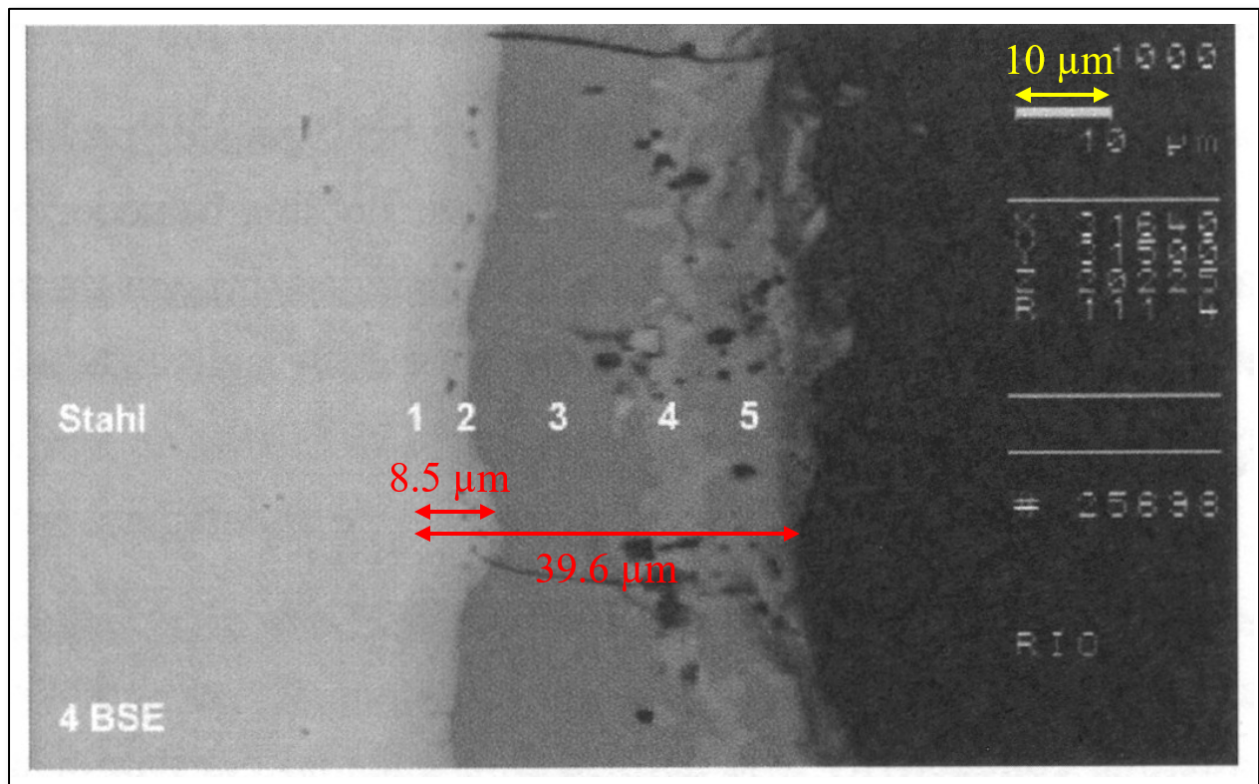
Generally, Engels' Table is equivalent to a disclosure of ranges of total coating thickness from 24 μm (assuming each phase has its lowest-disclosed thickness) to 46 μm (assuming each phase has its highest-disclosed thickness). This range overlaps the claimed range of "greater than 30 micrometers," rendering the claimed range obvious. A presumption of obviousness applies "[w]here a claimed range overlaps with a range disclosed in the prior art." *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311 (Fed. Cir. 2006). This presumption can be overcome if the "prior art teaches away from the claimed range, or the claimed range produces new and unexpected results." *Id.* Here, Engels does not teach away from the claimed range, and, indeed, discloses a specific value within the claimed range. EX-1003, 59. In addition, the '227 Patent does not assert that the claimed range of "greater than 30 micrometers" is associated with any unexpected results relative to the range disclosed by Engels. Although the range is described as "a preferred embodiment," the '227 Patent fails to discuss any particular effects, results, or criticality associated with the range, and does not describe any unexpected results relative to the ranges disclosed by Engels. EX-1001, 6:46-47; EX-1003, 59-60.

Moreover, it would have been obvious to try varying and experimenting

with the coating thickness based on Engels' disclosure that "it is crucial to look for a correctly shaped diffusion layer with regard to **layer thickness** [] as this layer will decisively impact the corrosion and welding properties of the hot stamped parts." EX-1005, 142; EX-1003, 61-63.

[2]:

As disclosed in Engels' Table, phase 1 (corresponding to layer (a)) has a thickness of **5-9 μm** . As noted by Dr. Miles, the minimum thickness of the remaining phases 2-5 or 3-5 (neglecting any thickness of phase 2) is 19 μm , corresponding to a 28 μm -thick coating in the case where phase 1 or 1+2 has its thickest value of 9 μm . Half of 28 μm is **14 μm** , which is larger than **9 μm** . EX-1003, 64. Accordingly, even assuming the thickest-disclosed phase 1 and the thinnest-disclosed other phases, phase 1 or 1+2 satisfies this claim. Further, such a configuration is shown in Engels' FIG. 5, in which the thickness of phase 1 or 1+2 is clearly less than half a total thickness of the coating. EX-1003, 64-65 (Dr. Miles' direct measurement below). Any marginal thickness contributed by phase 2 would not substantively alter this reasoning where layer (a) is mapped to phases 1+2.



Engels' FIG. 5

[4]-[5]:

As disclosed in Engels' Table, phase 1 has a **5-9 μm** thickness, such that all thicknesses satisfy both "**17 micrometers** or less" and "**15 micrometers** or less." Any marginal thickness contributed by phase 2 would not substantively alter this reasoning where layer (a) is mapped to phases 1+2. EX-1003, 66.

[6]:

Engels renders obvious that the coating is 40 μm thick. EX-1003, 67-73. As discussed above in reference to element [1j], Engels' Table discloses ranges of total coating thickness from **24-46 μm**, which includes **40 μm**. Also, the measured

thickness of the coating of Engels' FIG. 5 is **39.6 μm** , very close to the claimed value and certainly close enough to render it obvious. EX-1003, 68. Indeed, as noted by Dr. Miles, other portions of Engels' coating have a thickness greater than 40 μm , such that the coating must have a thickness of exactly 40 μm at least one position. *Id.*, 69. Further, a 0.4 μm difference would have been within manufacturing tolerances, such that a coating described as "40 micrometers thick" would be expected to include at least some portions having a 39.6 μm thickness. *Id.*, 68.

Based on these disclosures, it would have been obvious to a POSITA to experiment with the coating thickness to try and arrive at the claimed value of 40 μm . EX-1003, 70. "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456 (C.C.P.A. 1955). This is particularly true when the art recognizes the parameter as result-effective, as Engels does by noting that "it is crucial to look for a correctly shaped diffusion layer with regard to **layer thickness** [] as this layer will decisively impact the corrosion and welding properties of the hot stamped parts." EX-1005, 142.

Further, a POSITA would have had a reasonable expectation of success in trying various coating thicknesses. Engels teaches four distinct variables ("heating rate," "total processing time," "maximum austenitizing temperature," and "material

thickness”) that tune the coating thickness. EX-1005, 142. Armed with this guidance and the ability to adjust these parameters, it would have been well within the skill of a POSITA to experiment based on Engels’ hot-stamping process to obtain a coating with a thickness of 40 μm (and/or certain relative layer thicknesses, as discussed below). EX-1003, 71.

Finally, although discovery of an optimum value may be non-obvious “where the results of optimizing a variable [] were unexpectedly good (*In re Antonie*, 559 F.2d 618, 620 (CCPA1977)), this exception does not apply to claim 6. The ’227 Patent does not describe any unexpected results or criticality associated with the 40 μm thickness. Nor does the ’227 Patent even describe that the 40 μm thickness is itself an optimum or preferred value: 40 μm simply happens to be the thickness obtained for “Example 2,” whereas the “preferred” range is “greater than 30 micrometers.” EX-1001, 6:46-47, 12:41-42; EX-1003, 72.

[7]:

Claim 7 recites that $\text{Fe}\%(\text{layer (a)}) > \text{Fe}\%(\text{layer (c)}) > [\text{Fe}\%(\text{layer (b)}) \text{ and } \text{Fe}\%(\text{layer (d)})]$. As discussed for claim 1, layers (a), (b), (c), and (d) correspond to Engels’ phases 1 or 1+2, 3, 4, and 5, respectively. As further discussed for claim 1, a POSITA would have understood Engels’ disclosures of “composition[s]” as referring to or rendering obvious mean compositions. EX-1003, 52-54.

Accordingly, Engels’ Table teaches the claimed relative compositions:

$\text{Fe\%}(\text{phase 1}) > \text{Fe\%}(\text{phase 4}) > \text{Fe\%}(\text{phase 3}) > \text{Fe\%}(\text{phase 5})$							
		(Layer (a))		(Layer (c))		(Layer (b))	
phase number	layer thickness, μm	Al	Fe	Si	Cr	Mn	
		~~Volume-%~~ Mass-%					
Layer (a)	1	5 – 9	7,2	89,2	1,9	0,3	1,4
[Layer (a)]	2	< 1 μm	unmeasurable				
Layer (b)	3	11 – 18	51,4	45,9	1,9	0,1	0,7
Layer (c)	4	3 – 8	33,9	54,3	10,6	0,3	0,9
Layer (d)	5	5 - 11	53,2	44,1	1,9	0,2	0,6

Engels' Table

[9]:

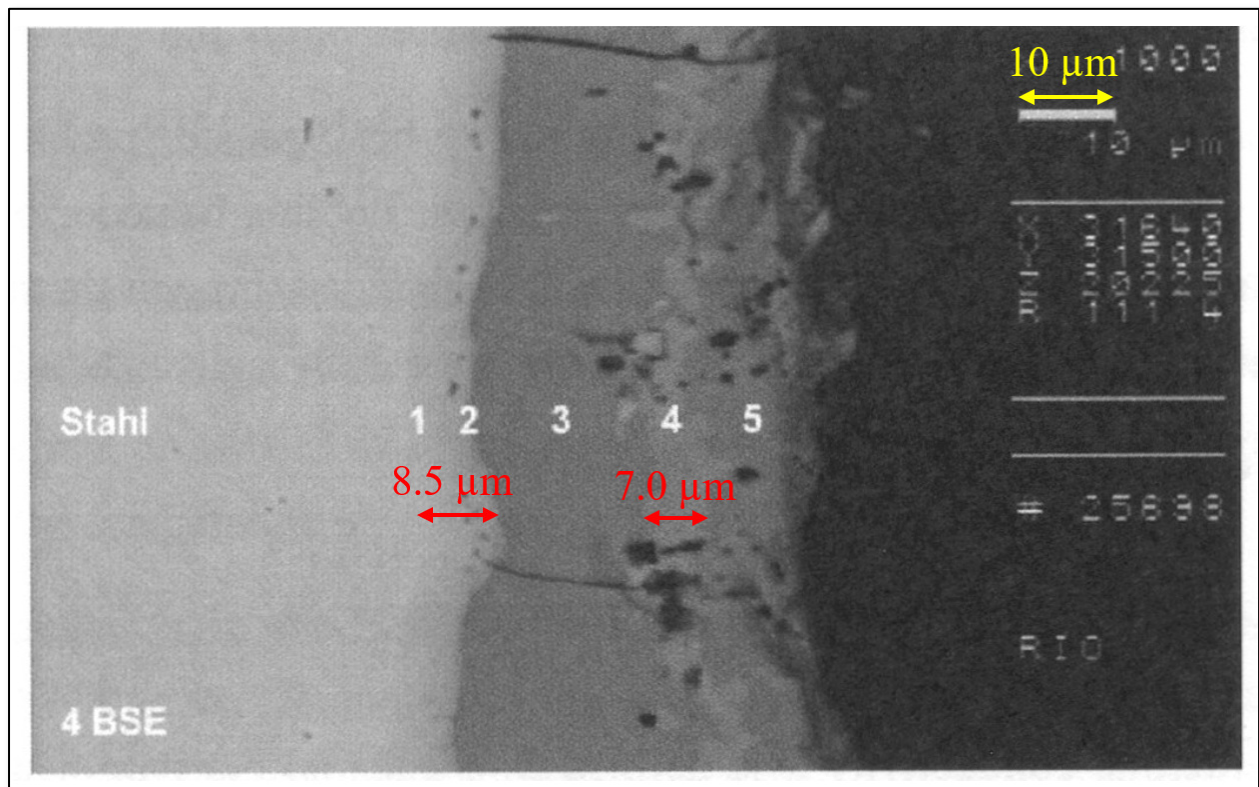
As shown in Engels' Table, phases 1 and 4 (corresponding to layers (a) and (c), respectively) have thickness ranges of **5-9 μm** and **3-8 μm** . Pairs of values from these ranges satisfy the claimed relationship. For example, the midpoints of the ranges (7 μm and 5.5 μm) satisfy this relationship. For reasons similar to those discussed for claim 6, it would have been obvious to a POSITA to experiment with and try various relative thickness values based on Engels' teachings of the importance of layer characteristics, with a reasonable expectation of success based on the adjustment of the tunable parameters described by Engels. EX-1005, 142; EX-1003, 75. The '227 Patent does not describe any benefit to the claimed thickness relationship, and a POSITA would have arrived at it based on values in Engels' Table. Any marginal thickness contributed by phase 2 would not substantively alter this reasoning where layer (a) is mapped to phases 1+2.

Thicknesses in ranges satisfy
thickness(phase 1 – layer (a)) >
thickness (phase 4 – (layer (c)))

phase number	layer thickness, μm	Al	Fe	Si	Cr	Mn
		~~Volume-%~~ Mass-%				
Layer (a) 1	5 – 9	7,2	89,2	1,9	0,3	1,4
[Layer (a)] 2	< 1 μm	unmeasurable				
Layer (b) 3	11 – 18	51,4	45,9	1,9	0,1	0,7
Layer (c) 4	3 – 8	33,9	54,3	10,6	0,3	0,9
Layer (d) 5	5 – 11	53,2	44,1	1,9	0,2	0,6

Engels' Table

Indeed, Dr. Miles' direct measurement (below) shows that layer (a)'s thickness is greater than layer (c)'s thickness. EX-1003, 76.



Engels' FIG. 5

[10]:

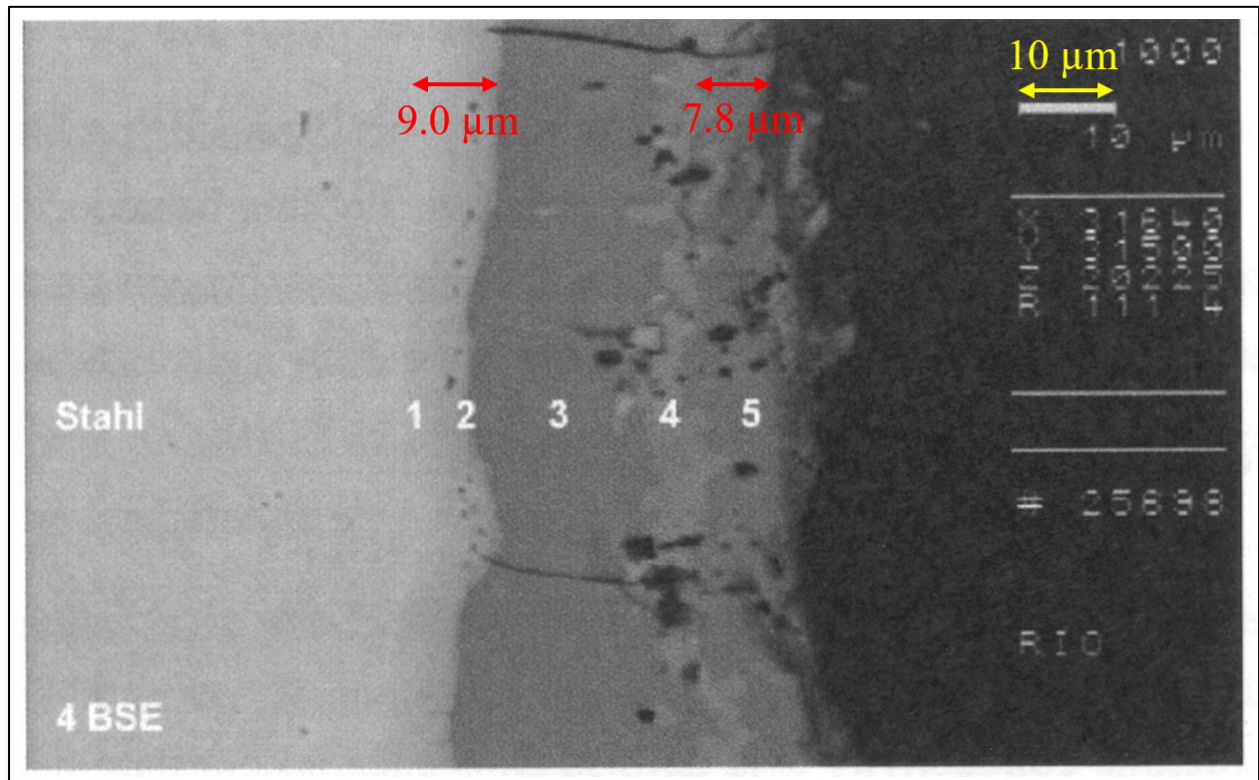
Engels describes that layer (a)'s thickness is greater than layer (d)'s thickness. EX-1003, 77. As shown in Engels' Table, phases 1 and 5 (corresponding to layers (a) and (d), respectively) have thickness ranges of **5-9 μm** and **5-11 μm** , respectively. Pairs of values from these ranges satisfy the claimed relationship (for example, thicknesses of 7 μm and 6 μm , respectively), and, as discussed for claim 9, achieving these relative thicknesses would have involved no more than routine experimentation, guided by Engels' teaching of relevant tunable parameters for modifying the coating. EX-1005, 142. The '227 Patent does not describe any benefit to the claimed thickness relationship, and a POSITA would have arrived at it based on values in Engels' Table. Any marginal thickness contributed by phase 2 would not substantively alter this reasoning when layer (a) is mapped to phases 1+2.

Thicknesses in ranges satisfy
thickness(phase 1 – layer (a)) >
thickness (phase 5 – layer (d))

	phase number	layer thickness, μm	Al	Fe	Si	Cr	Mn
Layer (a)	1	5 – 9	7,2	89,2	1,9	0,3	1,4
[Layer (a)]	2	< 1μm	~~Volume-%~~ unmeasurable				
Layer (b)	3	11 – 18	51,4	45,9	1,9	0,1	0,7
Layer (c)	4	3 – 8	33,9	54,3	10,6	0,3	0,9
Layer (d)	5	5 - 11	53,2	44,1	1,9	0,2	0,6

Engels' Table

Indeed, Dr. Miles's direct measurement (below) shows the claimed thickness relationship. EX-1003, 78.



Engels' FIG. 5

[13]:

For reasons similar to those discussed for claim 9, Engels describes that layer (a)'s thickness is more than twice layer (c)'s thickness. EX-1003, 79. Based on the mapping of Engels phases 1 or 1+2 and 4 to layers (a) and (c), respectively, Engels' Table discloses thickness ranges of **5-9 μm** and **3-8 μm**, respectively. Pairs of values from these ranges satisfy the claimed relationship. For example, a 7 μm phase 1 is more than twice as thick as a 3 μm phase 4. This is corroborated by Dr. Miles' direct measurement in Engels' FIG. 5. EX-1003, 80. Moreover, as discussed for claim 9, achieving these relative thicknesses would have involved no

more than routine experimentation, guided by Engels' teaching of relevant tunable parameters for modifying the coating. EX-1005, 142; EX-1003, 79. The '227 Patent does not describe any benefit to the claimed thickness relationship, and a POSITA would have arrived at it based on values in Engels' Table. Any marginal thickness contributed by phase 2 would not substantively alter this reasoning when layer (a) is mapped to phases 1+2.

[14]: See §IV.C (Ground 1B).

[15]:

Engels renders obvious that the hot stamped coated steel product is fully martensitic. EX-1003, 81. Engels describes that “[hot-stamped] boron steels belong to the group of **martensitic** steels.” EX-1005, 135, 136 (“**martensitic** transformation”).

Although Engels does not expressly describe the resulting product being **fully** martensitic, the difference between “martensitic” and “fully martensitic” is at most a change in degree, which is *prima facie* obvious. EX-1003, 82. “It is a settled principle of law that a mere carrying forward of an original patented conception involving only change of form, proportions, or degree [] is not such an invention as will sustain a patent.” *In re Williams*, 36 F.2d 436, 438 (C.C.P.A. 1929).

Further, Engels counsels that “[c]ooling realized according to TTT diagram”

is a relevant factor for determining a stamped component's "[m]echanical properties." EX-1005, 141. Dr. Miles notes that, in identifying "[c]ooling realized according to TTT diagram," Engels describes the cooling rate as the most important parameter for achieving martensitic transformations. EX-1003, 83; EX-1021, 6; EX-1016, [0028]. Thus, a POSITA would have had a reasonable expectation of success in achieving a "fully martensitic" product based on Engels' "martensitic" product. EX-1003, 83.

[18]:

As discussed at [1e], the Interdiffusion layer is mapped to Engels' phase 1. Phase 1 has weight composition **89.2% Fe, 7.2% Al, and 1.9% Si**, which satisfies the claimed components. EX-1005, 143; EX-1003, 84; *see* §III.A and EX-1003, 30 for interpretation of Engels' composition values as weight percentages. Further, a POSITA would have understood Engels' percentages to be percentages "based on total weight," as implied by the additional disclosure of Cr and Mn content. EX-1003, 85.

[19]:

As discussed at [1f], the Intermediate layer is mapped to Engels phase 3. Phase 3 has weight composition, by total weight, of **45.9% Fe, 51.4% Al, and 1.9% Si**. EX-1005, 143; EX-1003, 86; *see* [18] for this interpretation of Engels' Table.

The Fe% and Si% of Engels phase 3 satisfy the ranges of claim 19, while the Al% is slightly outside of the claimed range (**51.4%** compared to **53-61%**).

However, it is well established that a claimed amount that does not overlap with, but is close to, a prior art amount, is obvious absent evidence of unexpected results or teaching-away. *Titanium Metals*, 778 F.2d at 775; *Haynes Intern., Inc. v. Jessop Steel Co.*, 8 F.3d 1573 (Fed. Cir. 1993); *In re Becket*, 88 F.2d 684 (C.C.P.A. 1937).

Here, the '227 Patent describes no criticality or unexpected results for 53-61% Al compared to 51.4% Al. Thus, the composition of Engels' phase 3 renders obvious the claimed composition. EX-1003, 87-90.

[20]:

Engels' phase 4 (mapped to the Intermetallic layer; *see* [1g]) has weight %, by total weight, of 54.3% Fe, 33.9% Al, and 10.6% Si. EX-1005, 143; EX-1003, 91; *see* [18] for this interpretation of Engels' Table.

Of these values, the Al% is within the claimed range, while the Fe% and the Si% are outside, but close to, the claimed ranges. For similar reasons to those discussed for [19], absent a showing of criticality or unexpected results, the values taught by Engels render obvious the claimed ranges. EX-1003, 92. The '227 Patent fails to describe a "difference in kind and not of degree" resulting from an Fe% of 62% compared to 54.3%, or from a Si% of 6% compared to 10.6%, for a single layer in a four-layer coating. EX-1003, 92-95 (discussing EX-1047, EX-1016, EX-

1033, EX-1035).

[21]:

For the thickness element of this claim, *see* [2]. For the composition, as discussed at [1h], the Superficial layer is mapped to Engels phase 5. Phase 5 has weight composition, by total weight, of **44.1% Fe, 53.2% Al, and 1.9% Si**. EX-1003, 96; *see* [18] for this interpretation of Engels' Table.

[22]-[23]: *See* [19]-[20] above.

[24]-[25]:

In Engels, "hot-stamping of boron-alloyed steels (22MnB5) is used to produce the components," providing "**tensile strengths R_m of up to 1600 MPa.**" EX-1005, 135.

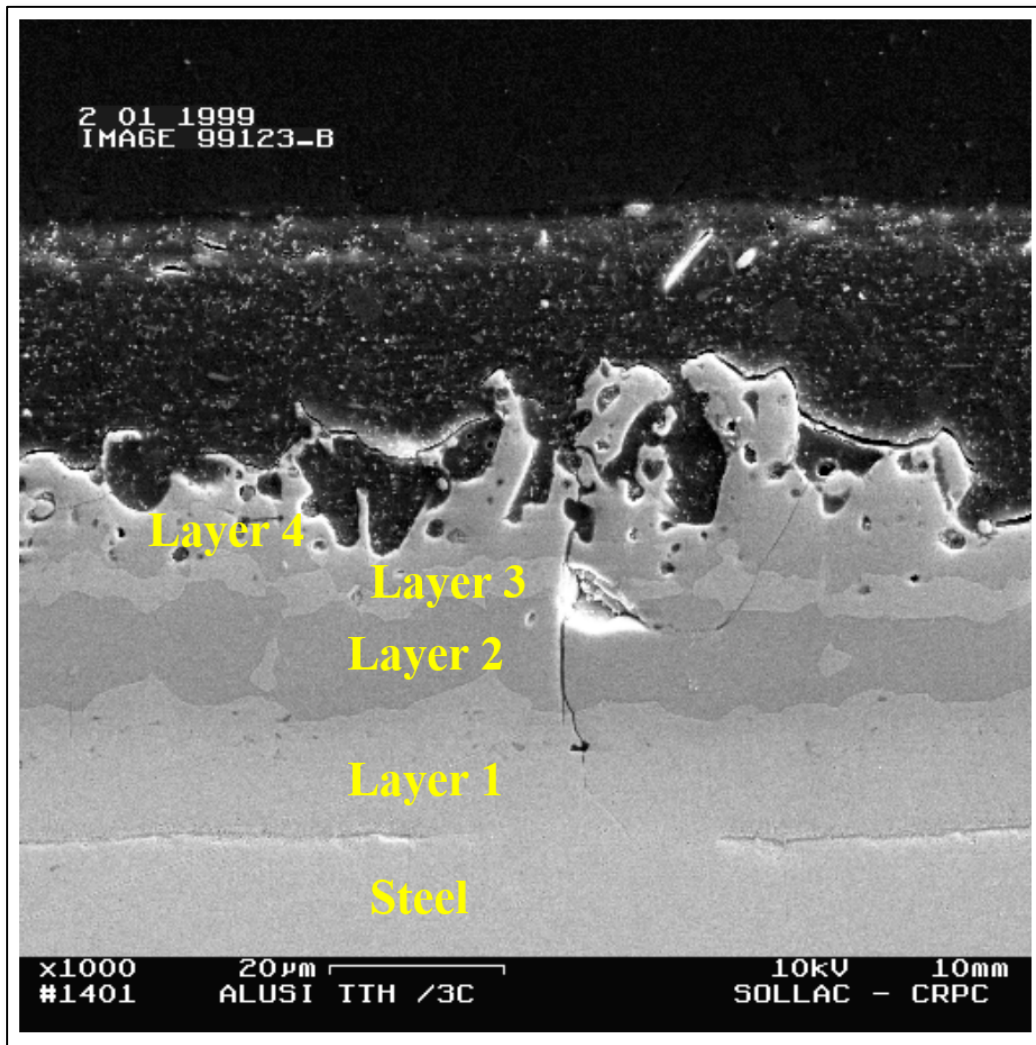
A POSITA would have understood that "tensile strengths R_m of up to 1600 MPa" applies to the part shown in FIG. 5, which features the coating. EX-1003, 98. The coating is "of a hot-dip aluminum coated boron steel," a description matching the "boron steels," such as "22MnB5" with an "Al-Si-coating," with strengths of "up to 1600 MPa." EX-1005, 135-137, 141-142. Moreover, FIG. 5's coating is not discussed in isolation but as part of hot-stamping of boron-alloyed steels having strengths "up to 1600 MPa." EX-1003, 98. Accordingly, a POSITA would have at once envisaged that the coating would be found on such a product, meeting the standard for anticipation. EX-1003, 100. Alternatively, a POSITA would have

found it obvious to apply the strengths to the part having FIG. 5's coating, which is formed on the same steel and processed in the same way. EX-1003, 97-100.

IV. GROUND 1B: Claims 8, 11-14, and 24-25 are obvious over Engels in view of Cornette

A. Cornette

Cornette ("High Strength Steels for Automotive Safety Parts") describes "mechanical testing and different design solutions associated with" certain steel grades. EX-1014, 3; EX-1003, 101-102. "A specific part of [Cornette] deals with a ultra high tensile strength pre-coated boron steel for hot forming." *Id.* Specifically, Cornette uses "USIBOR 1500" steel in hot-stamping (or "hot forming"). *Id.*, 9. A "hot dipped" aluminum-silicon pre-coating with average thickness 25 μm is applied to the steel, and the pre-coated steel is heated at "generally 900°C [for] 5 minutes" and hot-stamped to obtain, based on "alloying reaction between substrate [] and the coating," an "Fe-Al-Si layer [] at the steel surface" that is "typically about 40 μm ." *Id.*, 9. Cornette's FIG. 22 shows the coating ("multiphase alloy layer"), in which four distinct layers are visible. *Id.* As Dr. Miles explains, these four layers constitute the Fe-Al-Si coating, with a base steel region underneath. EX-1003, 102. In IPR proceedings for the '683 Patent, it was found that these layers and the underlying steel form a "stamped product." EX-1029, 32-35; *see* §III.B.1.



Cornette's FIG. 22

B. Combination of Engels and Cornette

It would have been obvious to apply Cornette's process-related disclosure to Engels to obtain a coating having layer compositions at least similar to those described by Engels, with the layer thicknesses described by Cornette. EX-1003, 103. Engels describes hot-stamping with heat treatment generally at "temperatures between 900 °C and 950 °C," and a POSITA would have understood general

ranges of other process parameters based on general knowledge in the art. EX-1003, 103.

To identify specific numerical values of process parameters, a POSITA would have been motivated to consider values used in similar prior art processes such as that of Cornette. EX-1003, 104. It would have been obvious to follow or be generally guided by Cornette's teachings when experimenting with hot-stamping processes, e.g., by using the disclosed "USIBOR 1500" steel (also referenced by Engels) and/or by performing a 900°C austenitization for five minutes using a 25 µm pre-coating. EX-1014, 9-10; EX-1005, 139; EX-1003, 104-105 (comparison of Engels' 22MnB5 steel and USIBOR 1500 steel).

A POSITA would have been further motivated by Cornette's reporting that these parameters provide good results in terms of weldability, corrosion resistance, and mechanical strength. EX-1014, 10; EX-1003, 106. "[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *KSR*, 550 U.S. at 417.

A POSITA would have had a reasonable expectation of success in making the combination. As Dr. Miles notes, "the process parameters noted by Cornette would all have been readily available to a steel metallurgist working on hot-

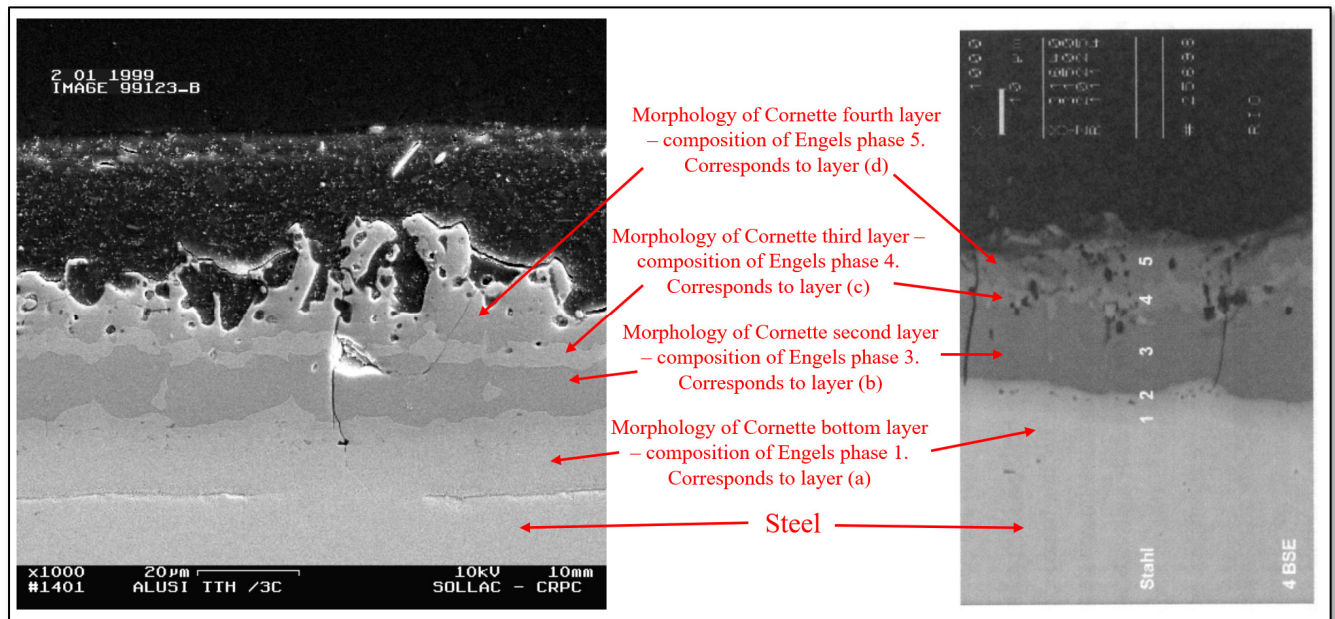
stamping.” EX-1003, 107. And the coatings in Engels and Cornette are similar, e.g., have four primary layers identifiable using electron microscopy and are approximately 40 μm thick (*see* [1j]). *Id.* Moreover, Engels’ temperatures “between 900 °C and 950 °C” suggests that Engels’ FIG. 5 coating was processed under conditions similar to those of Cornette. *Id.*; EX-1014, 3.

Further, as explained by Dr. Miles, other process parameters including “heating rate,” “total processing time,” “maximum austenitizing temperature,” and “material thickness,” as described in Engels, can be tuned to achieve a “correctly shaped diffusion layer.” EX-1005, 142; EX-1003, 108.

Accordingly, it would have been obvious to apply Cornette’s teachings to obtain a “**modified Engels coating**” in which the four layers have the thicknesses and morphologies described by Cornette, and compositions like Engels, as shown below. Guided by Cornette’s teachings, a POSITA would have adjusted the hot-stamping process to arrive at such a layer as a matter of design choice and routine experimentation, and as an example of a layer that it would have been obvious to try manufacturing and testing, given that there are only a finite number of options for the thicknesses of four layers in the four-primary-layer, approximately 40 μm coating disclosed by both Engels and Cornette. EX-1003, 109-110.

As Dr. Miles discusses, it would have been obvious to arrive at the recited coatings in view of the lack of novel process parameters disclosed by the ’227

Patent. He discusses how the process parameters of the '227 Patent (e.g., pre-coating thicknesses, heating rates, temperatures, hold times, and cooling rates) are each disclosed by the prior art. EX-1003, 170-171. For example, the '227 Patent's heating rate range of 4-12°C/s was known as evidenced by Takagi and several other references. EX-1016, [0026] (1-10°C/s), [0037] (8°C/s); EX-1035, 57:1 (5-10°C/s); EX-1039, FIG. 2 (5.2 °C/s and 8°C/s); EX-1003, 153. This and other parameter ranges described by the '227 Patent were general in view of the prior art, and it would have been well within the skill of a POSITA to arrive at the claimed coatings as a result of routine experimentation within the conditions of the prior art. EX-1003, 171.



Modified Engels coating

C. Analysis of Claims

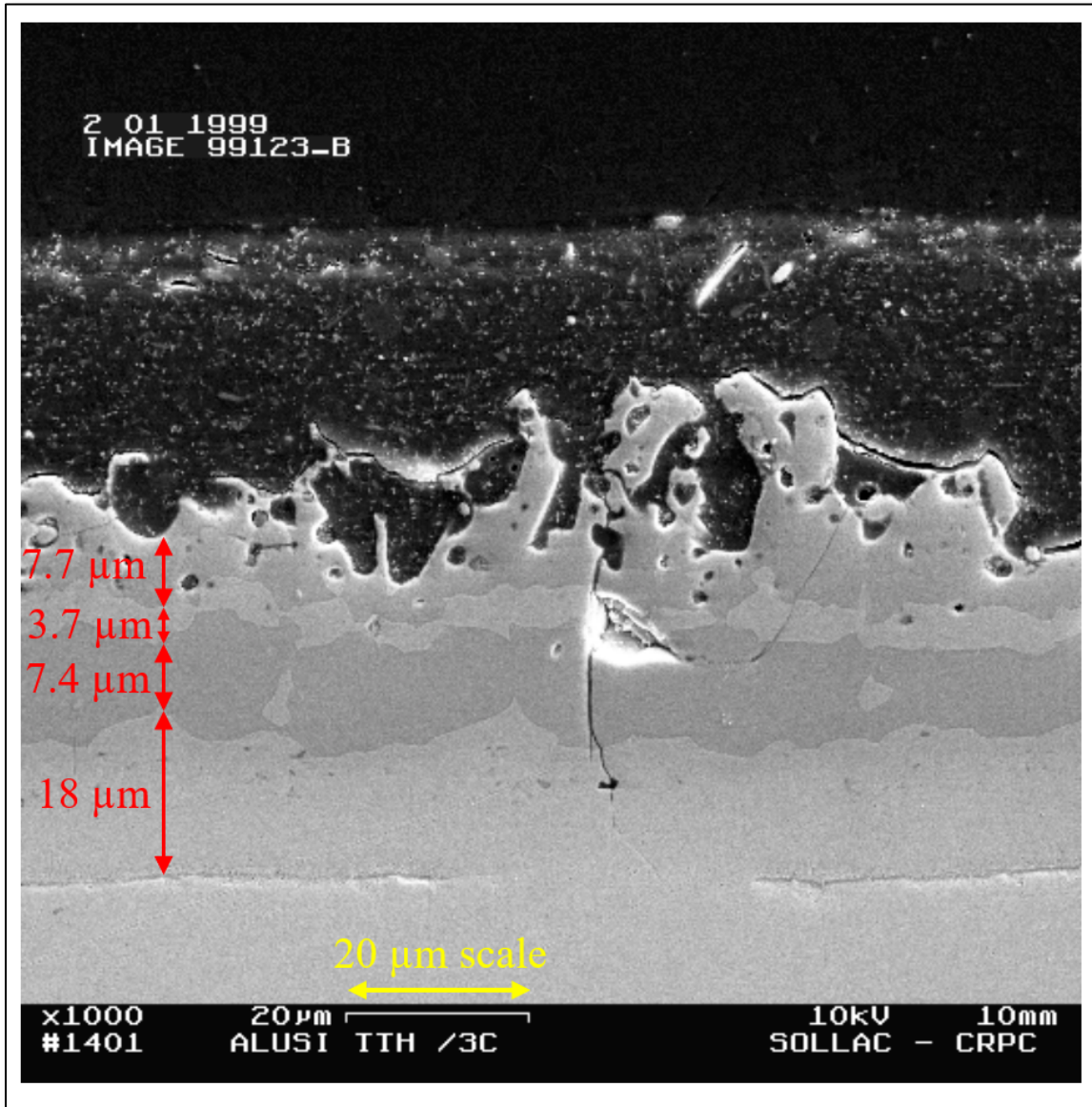
[8]:

In the modified Engels coating (§IV.B), the four layers of Cornette's FIG. 22, proceeding from the steel outward, correspond to layers (a), (b), (c), and (d), respectively, and have compositions similar to Engels' phases 1, 3, 4, and 5, respectively. Dr. Miles discusses that, in view of the similarities between Engels' and Cornette's coatings, and in view of the at least five different elements forming each of the layers, a POSITA would have expected that the layers of the modified Engels coating would differ at least slightly in their compositions in a similar manner to Engels' layers, thereby satisfying claim 1's requirement that "layers (a), (b), (c), and (d) each have a different mean composition from one another." EX-1003, 112.

Further, the modified Engels coating has a thickness of "about 40 μm ," as confirmed by Dr. Miles' measurements of Cornette's FIG. 22, thereby satisfying claim 1's requirement that the coating have "a thickness greater than 30 micrometers." EX-1014, 9; EX-1003, 113. Other elements of claim 1 are satisfied as described in §III.B. EX-1003, 114.

In the modified Engels coating, the deepest layer (corresponding to layer (a)) has a thickness that is greater than a thickness of the third-deepest layer (corresponding to layer (b)). As shown in Cornette's FIG. 22 below, Dr. Miles

performed a measurement and found thicknesses of **18 μm** and **7.4 μm** ,
respectively, for the layers corresponding to layers (a) and (b). EX-1003, 115.

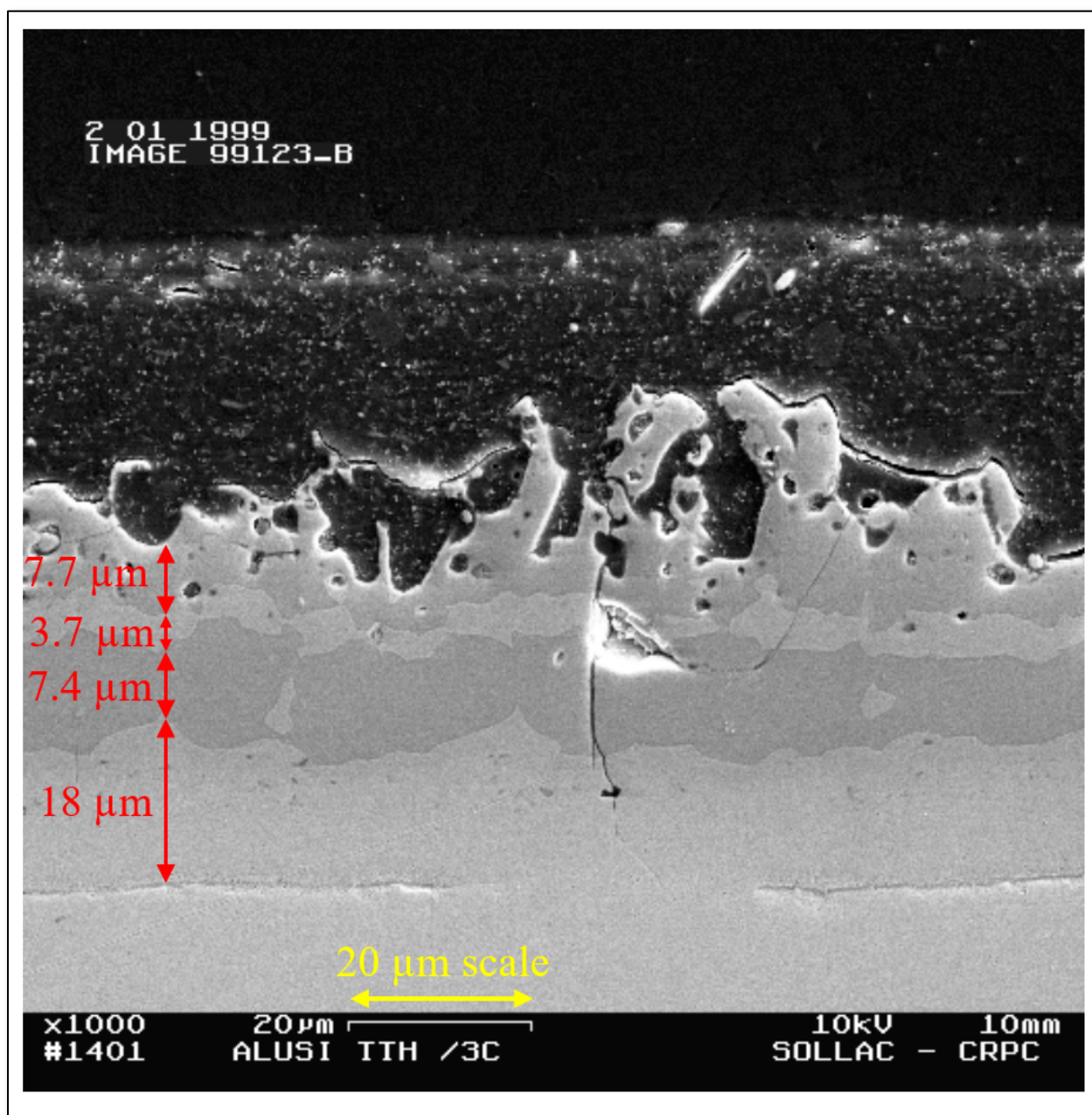


Cornette's FIG. 22

[11]:

Dr. Miles' measurements in Cornette's FIG. 22 indicate that the modified
Engels coating has layer thicknesses of **18 μm** , **7.4 μm** , **3.7 μm** , and **7.7 μm** ,

respectively. EX-1003, 116-117.



Cornette's FIG. 22

[12]:

As discussed for [8] and [11], the modified Engels-Cornette coating has

thicknesses of **18 μm** and **7.4 μm** for the two layers corresponding to layers (a) and (b), respectively. 18 μm is more than twice 7.4 μm . EX-1003, 118.

[13]:

As discussed for [8] and [11], the modified Engels coating has thicknesses of **18 μm** and **3.7 μm** for the two layers corresponding to layers (a) and (c), respectively. 18 μm is more than twice 3.7 μm . EX-1003, 119.

[14]:

As part of the obviousness analysis in §III (Ground 1A-103), Engels renders obvious [14]. EX-1003, 120. Engels' Table teaches that phase 1 (corresponding to layer (a)) has a thickness of 5-9 μm and that phase 5 (corresponding to layer (d)) has a thickness of 5-11 μm . EX-1005, 143. A slight increase in the thickness of phase 1 or 1+2 and/or a slight decrease in the thickness of phase 5 (for example, from 9 μm to 9.5 μm and from 5 μm to 4.5 μm) would result in relative thicknesses satisfying claim 14. A POSITA would have been motivated to vary the thicknesses and would have had a reasonable expectation of success in varying the thicknesses for the reasons discussed in §III.B ([6]). EX-1003, 70-72, 120. Any marginal thickness contributed by phase 2 would not substantively alter this reasoning where layer (a) is mapped to phases 1+2.

Alternatively, as discussed for [8] and [11], the modified Engels-Cornette coating has thicknesses of **18 μm** and **7.7 μm** for the two layers corresponding to

layers (a) and (d), respectively. 18 μm is more than twice 7.7 μm . EX-1003, 121.

[24]-[25]:

Dr. Miles explains that it would have been obvious to use USIBOR 1500 steel taught by Cornette, which would result in a mechanical strength in excess of 1500 MPa when processed according to the parameters described by Engels. EX-1014, 9; EX-1003, 122-124.

As discussed in §IV.B, it would have been obvious to use hot-stamping process parameters described by Cornette, including use of USIBOR 1500 steel. EX-1014, 9. Thus, a POSITA would have arrived at Cornette's "typical values [] obtained after austenitization at 900°C during 5 minutes and cooling in the die" for "pre-coated boron steel," including an ultimate tensile strength ("UTS") of **1510 MPa**. EX-1014, 10. A POSITA would have understood the claims' reference to "mechanical strength" to refer to UTS or a POSITA would have understood UTS to be an example of a "mechanical strength." EX-1003, 99, 123.

Further, a POSITA would have arrived at the mechanical strength in excess of 1500 MPa by using USIBOR 1500 steel and by routine optimization of the austenitization process using the result-effective parameters identified by Engels and Cornette, which "typically" provide a UTS of **1510 MPa**. EX-1005, 141; EX-1014, 10; EX-1003, 124. As Dr. Miles explains, a POSITA would have understood that the name "USIBOR 1500" derives from tensile strengths of 1500 MPa or

higher achievable using the steel. *Id.*

V. GROUND 1C: Claims 3, 8-11, and 18-23 are obvious over Engels in view of Takagi

An overview of Takagi is provided in §IX.A.

A. Analysis of claims

[3]:

Engels does not expressly provide hardness values that correspond to the compositions for phases 1, 3, 4, and 5. However, a POSITA has an “expectation that compounds similar in structure will have similar properties.” *In re Payne*, 606 F.2d 303, 313 (C.C.P.A. 1979). As Dr. Miles discusses, with “similar thermal histories,” this expectation would have accorded with widely-understood principles of steel metallurgy. EX-1003, 126. The compositions of Engels’ phases and the corresponding layers of Takagi are very similar, and, as Dr. Miles notes, the thermal histories of the coatings, too, are similar. EX-1003, 125-128. It follows that a POSITA would have expected Engels’ phases to have hardnesses similar to those of Takagi.

Starting with those hardnesses, it would have been obvious to experiment with process parameters of Engels’ coating to achieve hardness values in the claimed ranges. Engels and Takagi provide a roadmap for doing so: Engels describes that properties of the coating depend on the “[t]emperature profile” (e.g.,

“heating rate,” “total processing time,” “maximum austenitizing temperature,” and “material thickness”), and Takagi describes (i) how layer hardness depends on Fe composition and (ii) how Fe composition can be controlled “by controlling the raised temperature of the heating and the holding time at the raised temperature.” EX-1005, 141-142; EX-1016, [0019]-[0021]. Given this guidance and similarities between the layer compositions of Engels and Takagi, it would have been obvious and well within the skill of a POSITA to obtain the claimed hardness values by routine experimentation, for example, by experimenting with the thermal parameters identified by Engels guided by Takagi’s more-specific temperature disclosures. EX-1003, 129. “[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.” *In re Aller* at 456.

Further, the art recognizes layer hardness as an important parameter to be optimized. For example, Takagi describes the importance of having a “thick soft layer” near the base steel to “prevent[] cracks,” and also the importance of having a “hard outermost layer [] for maintaining good contact with a welding gun in spot welding.” EX-1016, [0017], [0024]. Dr. Miles notes other examples of the art’s recognition of specific hardness values in the coating as result-effective. EX-1003, 130. Accordingly, a POSITA would have been motivated to experiment with the layer hardnesses, e.g., by trying Takagi’s hardness values and similar values, to

arrive at hardness values in the claimed ranges. EX-1003, 131. This reasoning holds despite Takagi's silence as to the load used for measuring hardness. EX-1003, 132. *See* §IX.E.

[8]-[11]:

Takagi describes that the coating includes an inner “soft layer” having a “thickness [] equal to or greater than 50% of the total thickness of the alloy coating layer,” this “thick soft layer extending from a level at or near the boundary with the steel substrate, to or beyond the middle in the depth of the coating layer.” EX-1016, [0017]. Through this, it would have been obvious to apply Takagi's teachings to Engels to cause Engels' corresponding innermost layer—phase 1—to have a thickness at least 50% of the thickness of the coating. EX-1003, 133-134. This satisfies the claimed thickness relationships of [8]-[11]. *Id.*, 135.

According to Takagi's Table 1, each of Takagi's Nos. 1, 4, and 5 have an innermost layer satisfying the above condition (*see* “SOFTER RANGE” column), and a POSITA would have been motivated to try applying Takagi's corresponding temperatures and hold times to obtain a similarly-proportioned inner layer in Engels, thereby achieving additional benefits offered by Takagi (e.g., crack prevention and “corrosion resistance” associated with the thickness of the innermost layer). EX-1016, [0017], Table 1; EX-1003, 134. Elsewhere, Takagi discloses process parameters, including heating rate, forming temperature, and

cooling rate. EX-1016, [0026]-[0027], [0037]. Takagi discusses physical mechanisms underlying the formation of the thick, innermost layer, which, together with the disclosed process parameters, would have provided a POSITA with a reasonable expectation of success in making the modification. EX-1003, 134-135. *See also* [18]-[23] below for discussion of the obviousness of the Engels-Takagi combination.

[18]-[23]:

Takagi describes that several hot-stamped coatings, including Nos. 1 and 4, provide desirable formability, corrosion resistance, and weldability. EX-1016, Table 1. Takagi associates these advantages with certain coating characteristics, including innermost layer hardness and thickness, intermediate layer Al%, and outermost layer Fe%. EX-1016, [0017]-[0025]; EX-1003, 136-138.

Dr. Miles discusses that, per his analysis, Takagi's Inner, Inter 2, Inter 3, and Outer layers correspond to Engels' phases 1, 3, 4, and 5, based on layer-by-layer comparisons of Takagi's and Engels' layers and positioning within the coatings. EX-1003, 40-44, 139. Thus, a POSITA would have applied Takagi's teachings to the respective layers of Engels. *Id.*

A POSITA would have been motivated and found it obvious to optimize the composition of Engels' phases 1, 3, 4, and/or 5 (that is, to modify one, multiple, or all of those compositions) to that of the corresponding layers of Takagi's Nos. 1

and 4 coatings, to achieve the formability, corrosion resistance, and weldability benefits. EX-1003, 140. As discussed for claims 3 and 8-11 and by Dr. Miles, this modification would have constituted merely discovery of the optimum composition by routine experimentation, with a reasonable expectation of success based on Takagi's teachings and close similarities between Takagi's and Engels' processes/coatings. EX-1003, 127-129, 133-134, 140.

Further, as discussed in §IV.B, the process parameter ranges (including heating rate) disclosed by the '227 Patent are each described in the prior art, such that it would have been obvious for a POSITA to arrive at the claimed coatings by routine experimentation within the general conditions of the prior art. EX-1003, 170-171.

The resulting modified phases 1, 3, 4, and/or 5 satisfies or renders obvious claims 18-23, as discussed in §IX.E. For the thickness element of [21], *see* [2] and [21] in §§III.B and IX.E. EX-1003, 141.

VI. GROUND 1D: Claims 15-17 are obvious over Engels in view of Hein

An overview of Hein is provided below in §IX.B.

A. Analysis of claims

[15]:

As discussed in §III.B, Engels discloses benefits of “martensitic

transformation.” EX-1005, 136. Hein provides additional teachings relevant to claim 15, disclosing that the “martensitic transformation” is obtained with a “cooling speed between 50°C/s and 100°C/s.” EX-1019, 164. This disclosure would have reinforced the reasonable expectation of success in achieving a “fully martensitic” structure from Engels’ “martensitic” structure, thereby further rendering obvious claim 15. EX-1003, 142.

[16]-[17]:

Hein uses a specific steel (“Usibor 1500 P”) that provides “numerous” “technical and economic advantages,” including “an ultimate tensile strength of 1400 MPa to 1600 MPa.” EX-1019, 164-165. A POSITA would have found it obvious to use this steel in Engels’ hot-stamped product. EX-1003, 143.

Hein’s proportions satisfy or overlap with the ranges recited in claims 16-17, rendering those ranges obvious. EX-1003, 144. This is further corroborated by EX-1050, Table 1. *Id.*

VII. GROUND 1E: Claim 15 is obvious over Engels in view of Vaissiere

A. Vaissiere

Vaissiere describes “development of the pre-coated boron steel associated with the hot stamping.” EX-1021, 3; EX-1003, 145. To obtain an “increase of the mechanical properties,” Vaissiere describes that “[t]he critical [minimum]

quenching speed enabling a **completely martensitic structure** [] is 27°C/s.” *Id.*, 3, 6.

B. Combination of Engels and Vaissiere and Analysis of /15/:

It would have been obvious to apply Vaissiere’s teachings to the steel part of Engels to obtain a “*fully martensitic*” structure. Engels itself motivates such a structure, describing that “martensitic steels [] stand out for their good hardenability.” EX-1005, 135, 136. Given that Vaissiere discloses the condition for obtaining such a structure (a “critical quenching speed [of] 27°C/s” and the use of “pre-coated USIBOR 1500” steel which is “optimized for the stability of its quenchability”), and given that this accords with Engels’ disclosure that “cooling” influences the “[m]echanical properties,” it would have been obvious to optimize the cooling speed (e.g., at least 27°C/s) to obtain Vaissiere’s “**completely martensitic structure**,” “**pure martensite**,” and “**totally martensitic structure**.” EX-1021, 5-6, 9; EX-1003, 146-147.

VIII. GROUND 1F: Claims 16-17 are obvious over Engels in view of Laurent

A. Laurent

Laurent describes “steel sheet[s]” having compositions that “ensur[e] a very high mechanical resistance after thermal treatment.” EX-1023, 1:47-62. Laurent discusses elemental components of the steel and how those components improve performance. *Id.*, 4:18-33. Laurent’s components “allow hardening in the

stampers” and the “mechanical characteristics [] of the sheet [] allow [] a deep stamping.” *Id.*, 2:50, 4:30. A POSITA would have understood this disclosure to indicate that the steels of Laurent are well-suited for hot-stamping processes. EX-1003, 148.

B. Combination of Engels and Laurent and Analysis of [16]-[17]

It would have been obvious to use the steel compositions of Laurent in Engels. This would have constituted “mere substitution of one element [the Laurent steel] for another [the “22MnB5” steel of Engels] known in the field.” *KSR*, 550 U.S. at 416; EX-1005, 135, 141, 149; EX-1003, 149-150. A POSITA would have been motivated by Laurent’s discussion of the advantages of such a steel, including advantages of the particular elements and concentrations noted in §VIII.A. 22MnB5 and Laurent’s steel have generally similar compositions, such that the substitution of one for the other would have constituted a minor modification within the general conditions of what was already in use. EX-1003, 149-150.

The “preferabl[e]” “steel composition by weight” of Laurent satisfies or renders obvious [16]-[17]. EX-1023, 1:66-2:10; EX-1003, 151-152.

IX. GROUND 2A: Claims 1-25 are obvious over Takagi in view of Hein and GMW14400

A. Takagi

Takagi describes steel parts with “Al-Si-Fe alloy layer[s].” EX-1016, [0005]. In Takagi, “a heat resisting hot-dip aluminum-coated steel sheet containing Si in a coating layer is heated at a rate of 1-10° C./sec to a temperature in the temperature range of 900-950° C., and held at that raised temperature for a holding time [] of 2-8 minutes.” *Id.*, [0026]. “The forming operation into a desired shape is started in the temperature range of 700-800° C. After the forming operation, the shaped sheet is cooled rapidly.” *Id.*, [0028]. A POSITA would have understood that this is a hot-stamping process. EX-1003, 153.

Takagi describes that “[d]uring the growth of the Al-Si-Fe alloy layer by the heat treatment, mutual diffusion between Al coating and steel substrate layer produces various Al-Si-Fe ternary intermetallic compounds []. The Al-Si-Fe alloy layer formed by the heat treatment has a layered structure made up of these intermetallic compounds, and offers advantages of formability, corrosion resistance and weldability.” EX-1016, [0016]. Table 1 provides manufacturing methods, compositions, and hardness values for multiple layers of coatings obtained using five different combinations of temperature and hold time. Nos. 1 and 4 in Table 1 are coatings having five distinct layers. EX-1003, 154.

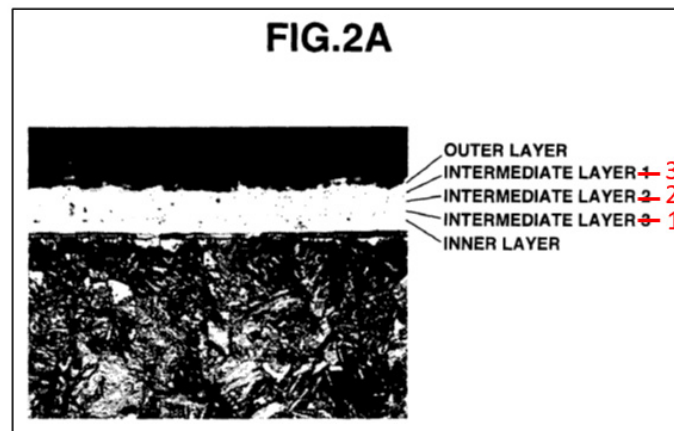
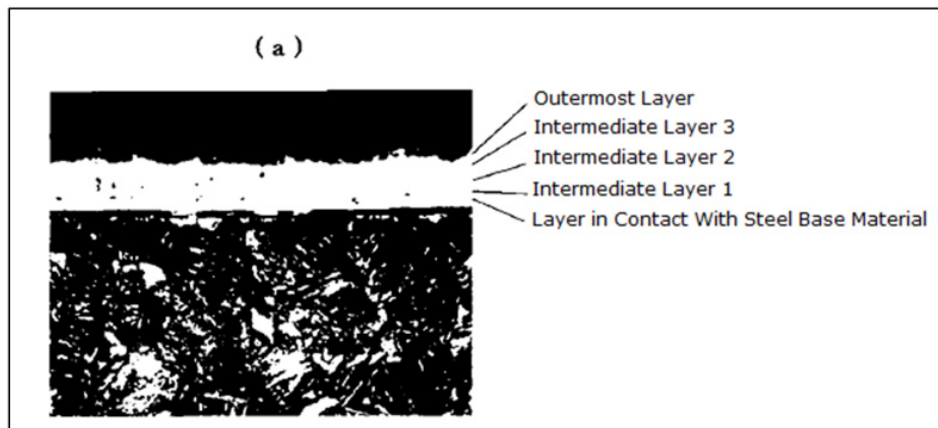
Coatings with five layers

TABLE 1

No.	PRODUCTION		COATING LAYER STRUCTURE & COMPOSITION (%)						STEEL BASE HARDNESS (Hv)	COATING LAYER HARDNESS (Hv)			OXIDE WEIGHT (mg/dm ²)	FORMABILITY	CORROSION RESISTANCE	WELDABILITY
	RAISED TEMPERATURE (°C)	HOLD TIME (min.)	COMPONENT & HARDNESS	INNER	INTER 1	INTER 2	INTER 3	OUTER		SOFTTEST	AVERAGE	SOFTER RANGE (%)				
1	920	3	Al	7.7	31.0	48.4	31.6	54.8	450	310	415	51	300	○	○	○
			Si	2.0	3.9	1.2	5.7	0.8								
			Fe	89.6	65.9	50.1	62.0	44.5								
			Hv	310	360	750	700	800								
2	900	2	Al	27.2	48.4	31.6	—	54.9	415	380	455	22	275	×	○	○
			Si	4.1	1.2	5.7	—	0.8								
			Fe	67.2	50.1	61.9	—	44.1								
			Hv	380	760	720	—	810								
3	930	10	Al	9.4	—	—	—	11.6	400	305	385	78	550	○	×	×
			Si	1.3	—	—	—	1.8								
			Fe	88.4	—	—	—	85.7								
			Hv	305	—	—	—	410								
4	950	5	Al	6.0	27.8	51.9	30.4	47.4	440	280	400	59	385	○	○	○
			Si	1.5	4.3	0.6	5.3	2.2								
			Fe	90.7	66.7	46.8	63.1	49.8								
			Hv	280	340	720	690	800								
5	900	4	Al	3.2	54.5	33.4	—	54.5	440	300	410	56	335	○	○	○
			Si	0.4	2.5	15.3	—	6.8								
			Fe	94.3	42.7	51.4	—	38.4								
			Hv	300	740	700	—	810								

Takagi's Table 1

In Table 1, layers Inner, Inter 1, Inter 2, Inter 3, and Outer are arranged from the base steel outwards. EX-1003, 155. Takagi's FIG. 2A erroneously shows the opposite order for intermediate layers 1-3. FIG. 2(a) of the original Japanese patent filing, JP3738754, shows the correct order, which accords with the order presented in Table 1. EX-1018; EX-1003, 155. The drawing from the JP filing, along with a corrected version of the US drawing, are shown below.



Top: translation of FIG. 2(a) of JP3738754

Bottom: corrected FIG. 2A of Takagi

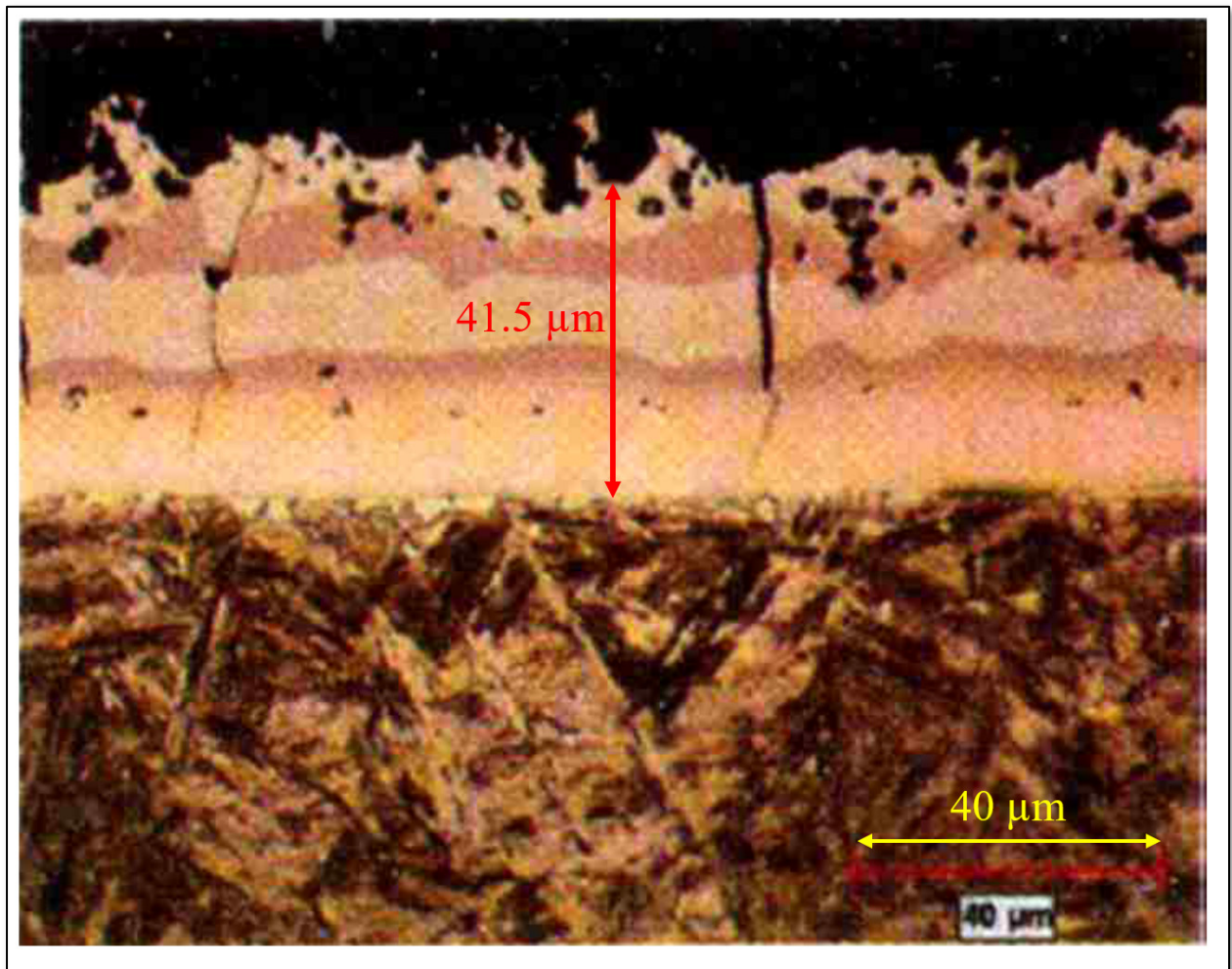
B. Hein

Hein is titled “Hot Stamping of USIBOR 1500 P: Part and Process Analysis Based on Numerical Simulation.” Hein uses “Usibor 1500 P,” a “precoated boron steel, with a metallic coating of aluminium-silicon [] of approximately 25 $\mu\text{m}/\text{side}$.” EX-1019, 164. The steel is “hot-stamp[ed]” by “heating blanks until complete austenitization (900°C to 950°C, during 4 to 10 minutes)” and “transferr[ing] very quickly on a press for the stamping.” *Id.*, 163. “The quenching

[] is carried out just after the forming, the heat being absorbed by the closed die (cooling speed between 50°C/s and 100°C/s).” *Id.*, 164. “During the heat treatment in the furnaces, this protective coating is transformed into an alloyed layer made of Fe-Al-Si, [] highly adherent on the substrate and with good corrosion properties.” *Id.*, 165; EX-1003, 156.

Hein’s FIG. 4 shows “[s]tructure of the alloyed layer Al-Fe-Si after hot-stamping” with five layers. EX-1019, 165.⁵ Five layers can be distinguished. EX-1003, 157. The included 40 µm scale in this figure permits the calculation of exact thicknesses for the coating as a whole and for each layer. *Id.* For example, Dr. Miles’ measurements indicate, for one possible measurement point, a total coating thickness of 41.5 µm. *Id.*

⁵ Measurements and depictions of Hein FIG. 4 are drawn from EX-1020, a higher-resolution color version of EX-1019, in German.



Hein's FIG. 4

C. GMW14400

GMW14400 is a specification published by General Motors and designed to inform steel makers of the requirements of steel to be used in GM vehicles. Steel manufacturers follow this specification to supply vehicle parts to GM. EX-1003, 158-159. The specification “covers the requirements for low carbon, heat-treatable boron steel used in the manufacture of structural parts requiring heat treatments to achieve high strength.” EX-1026, 1. “Part sections [] supplied under this standard

shall be made by austenitizing a pre cut blank, hot stamping the heated blank and rapid cooling (quenching) the stamped part in the die or via water quenching.” *Id.*

GMW14400 requires a “20 to 33” μm Al-Si pre-coating “[p]rior to hot-stamping” where coating thickness “[f]ollowing hot-stamping” is “>35” μm . EX-1026, 7. GMW14400 also requires a certain chemical composition of the base steel. *Id.*, 2; EX-1003, 159.

D. Combination of Takagi, Hein, and GMW14400

Takagi describes a pre-coating thickness of 10-20 μm . EX-1016, [0035]. A POSITA would have expected a thickness increase with heat treatment on the order of about “50%.” EX-1025, 5:17-20; EX-1003, 160. As a result, using a 20 μm pre-coating, a POSITA would have expected Takagi to obtain a coating of 30 μm or more, as evidenced by GMW14400, which uses a 20-33 μm pre-coating to obtain a coating > 35 μm . EX-1026, 7; EX-1003, 160.

Further, the market clearly demanded a certain thickness as evidenced by GMW14400, and a POSITA would have found it obvious to implement Takagi’s coating thickness to meet such demand as identified in GMW1400’s specification, adjusting parameters (e.g., pre-coating thickness and heat treatment parameters) as needed. EX-1003, 161-162. *KSR*, 550 U.S. at 402, 419. Such adjustments would have been well within the POSITA’s skill and would have been achievable with a reasonable expectation of success. EX-1003, 161-162.

To achieve this goal, the POSITA would have identified Hein as teaching process parameters that, when employed in hot-stamping, produce a coating having a thickness of approximately 40 μm , satisfying GMW14400's >35 μm requirement. EX-1003, 163. Based on this disclosure, the POSITA would have found it obvious to try modifying Takagi's processes based on Hein's and/or GMW1440's process parameters to obtain such a coating. Independent of the teachings of GMW14400, a POSITA would have been motivated by Hein's disclosure that Hein's steel and process parameters provide benefits including high tensile strength and yield strength, a lack of springback, and a "highly adherent" coating with "good corrosion properties." EX-1019, 164-165; EX-1003, 163. Such modifications would have entailed nothing more than "mere application of a known technique to a piece of prior art ready for the improvement." *KSR*, 550 U.S. at 401.

A POSITA would have found it obvious to try a pre-coating thickness of "25 $\mu\text{m}/\text{side}$ " as described by Hein, and to try a pre-coating thickness range of "20 to 33" μm as described by GMW14400. EX-1019, 164; EX-1026, 7; EX-1003, 164. The POSITA also would have found it obvious to try varying the pre-coating composition, e.g., by trying the 90 Al% aluminum-silicon pre-coating described by Hein and the 85-95 Al% aluminum-silicon coating bath described by GMW14400. EX-1019, 164; EX-1026, 6; EX-1003, 165. A POSITA further would have found it

obvious to try varying the base steel, e.g., by trying a steel having compositions disclosed by GMW1440 and by trying Hein's USIBOR 1500 steel. EX-1019, 164; EX-1026, 2; EX-1003, 166. A POSITA would have found it obvious to try varying the heating parameters described by Takagi, e.g., within the thermal process windows described by Hein. EX-1019, 163-164; EX-1003, 167. All of these parameters were recognized as result-effective in the art, and the corresponding experimentation was within the skill of a POSITA. EX-1003, 164-167. Moreover, a POSITA would have had high confidence that the modifications would be successful: the heating profiles used for Takagi's parts are all within or close to the temperature and time ranges disclosed by Hein, and a modified pre-coating thickness of, e.g., 25 μm represents a small modification compared to Takagi's range. EX-1016, FIG. 4; EX-1019, 163; EX-1003, 168.

Based on the routine experimentation, a POSITA would have arrived at various coatings with layers having various thicknesses and compositions. For example, a POSITA would have arrived at **"modified Takagi coatings No. 1 and No. 4"** having, for each of their five layers, the layer composition described for Takagi's Nos. 1 and 4 coatings (or similar composition), and having the layer thickness and morphology shown in Hein's FIG. 4 (or similar thickness and morphology). Dr. Miles notes that obtaining those compositions and thicknesses would require experimentation. EX-1003, 169. However, given (i) the knowledge

that both Takagi's and Hein's processes result in the formation of five-layer coatings, (ii) the relatively small increase in pre-coating thickness associated with a modification of Takagi based on Hein's pre-coating thickness (only from 20 μm to 25 μm), (iii) the art's recognition that layer characteristics (e.g., hardness and corrosion resistance) depend on layer composition, and (iv) the art's recognition of the relevant process parameters for modifying layer compositions and thicknesses, the manufacture of the modified coatings would have been obvious. EX-1016, [0019]-[0026]; EX-1003, 169.

The modified Takagi coatings Nos. 1 and 4 are members of a wide class of coatings that are rendered obvious by Takagi, Hein, and GMW14400. EX-1003, 170. Insofar as any aspects of the coating layers are the result of specific heating or pre-coating parameters, Dr. Miles explains that a POSITA would have arrived at such layers by routine experimentation. EX-1003, 170. He bases this opinion on a comparison between the values disclosed in the '227 Patent and those in Takagi, Hein, and GMW14400. The values are generally identical or very similar, and the '227 Patent includes no disclosure to suggest an unexpected criticality that would place any of the claimed layer parameters outside the bounds of routine experimentation. EX-1003, 170. As Dr. Miles states, "[w]hen comparing the '227 Patent to the prior art, a POSITA would have seen very similar processes being applied to very similar steel parts." EX-1003, 170-171. This statement includes the

described heating rates, which, as discussed in §IV.B, are disclosed by at least three references. EX-1003, 171.

Parameter	'227 Patent	'227 Patent Example 2	Takagi	Hein	GMW14400
Pre-coating thickness (μm)	20 – 30	---	10 – 20	25	20 - 33
Heating rate (°C/s)	4 - 12	10	8; 1-10	---	---
Temperature (°C)	880 - 940	920	920, 950	900 – 950	---
Hold time (min)	< 3 – 13	< 6	3, 5	< 4 – 10	
Cooling rate (°C/s)	> 30, or > 50		20 – 100	50 – 100	

E. Analysis of Claims

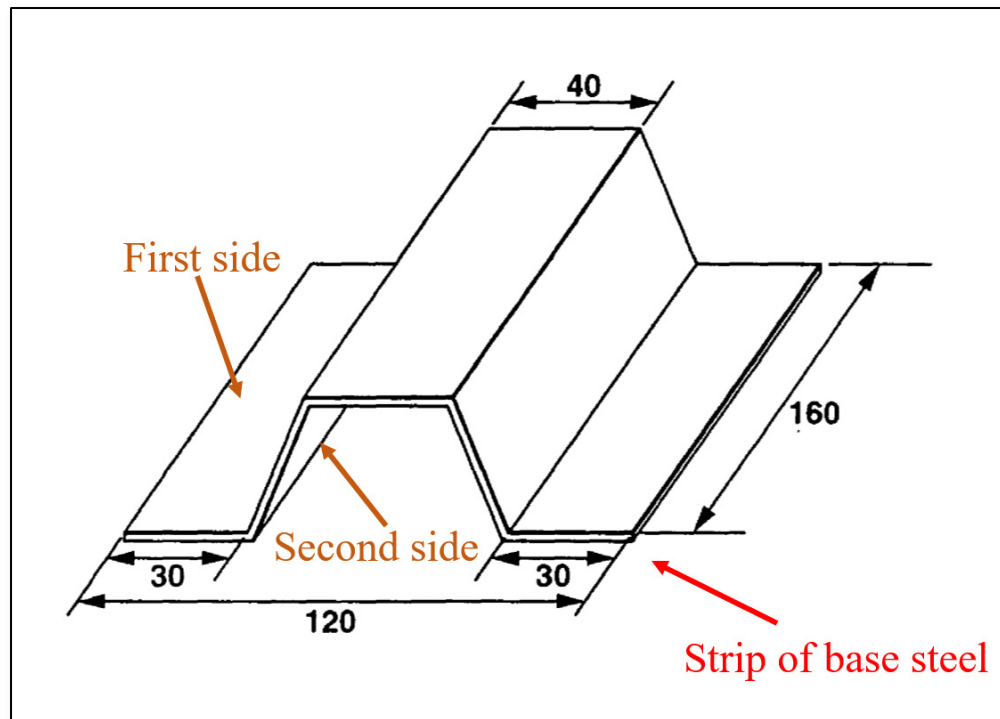
[Ipre]:

As discussed in §III.B, this preamble (or the “hot stamped” portion) is non-limiting.

The modified Takagi provides hot-stamped coated steel products. Takagi describes that, in the “[t]est [p]rocedure” used for producing the Nos. 1 and 4, “[f]rom the [] hot-dip aluminum-coated steel sheet, a flat plate [] was cut out, heat-treated [] and **formed into a shape** shown in FIG. 1.” EX-1016, [0036]. “Form[ing]” refers to stamping. EX-1003, 172. Further, Hein’s FIG. 4 shows a “[s]tructure of the alloyed layer Al-Fe-Si **after hot-stamping**.” EX-1019, 165.

[1a]:

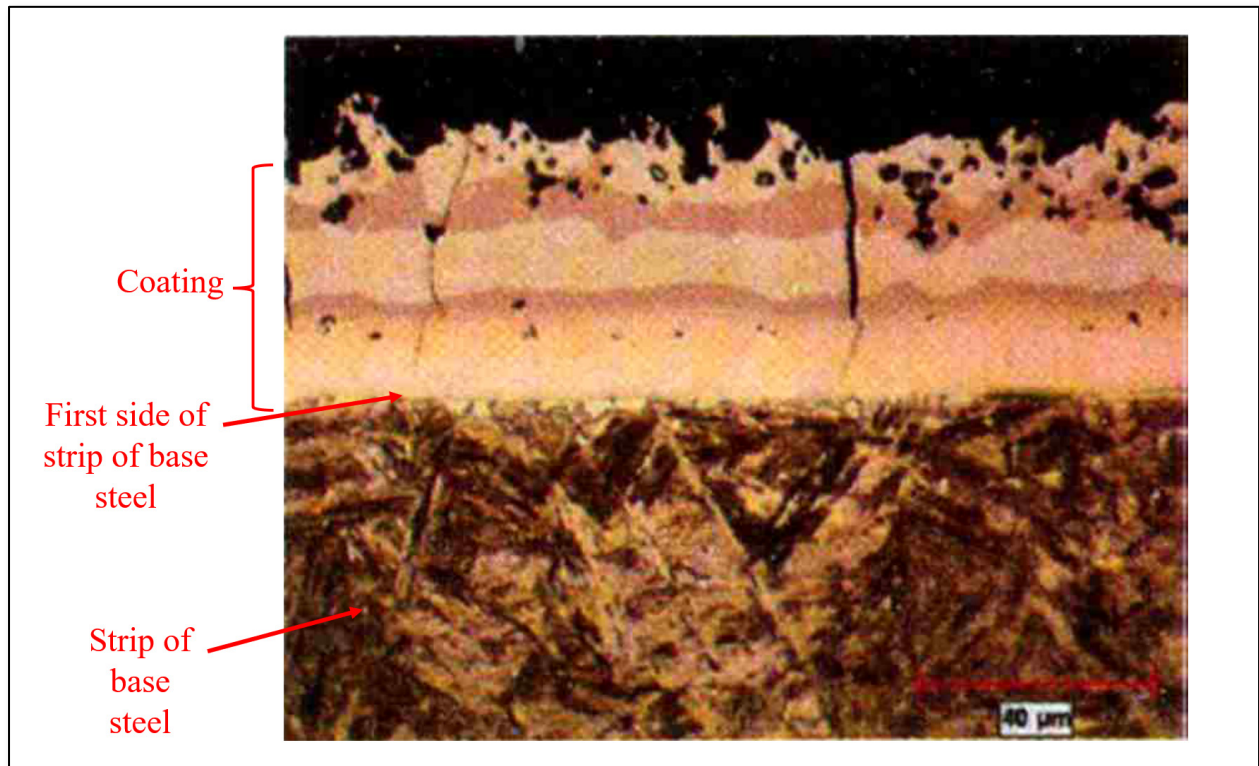
The modified Takagi parts comprise a strip of base steel having a first side and a second side. These sides are shown in Takagi's FIG. 1, which illustrates the "shape" of the hot-stamped parts of Takagi Nos. 1 and 4. This shape is obtained by "form[ing]" a "**flat plate**." EX-1016, [0036]. The "base steel," and its two sides, would be underneath a coating. EX-1003, 173.



Takagi's FIG. 1

[1b]:

Hein's FIG. 4 shows an example of a coating which, as discussed in §IX.D, corresponds to the modified Takagi coatings Nos. 1 and 4. EX-1003, 174.



Hein's FIG. 4

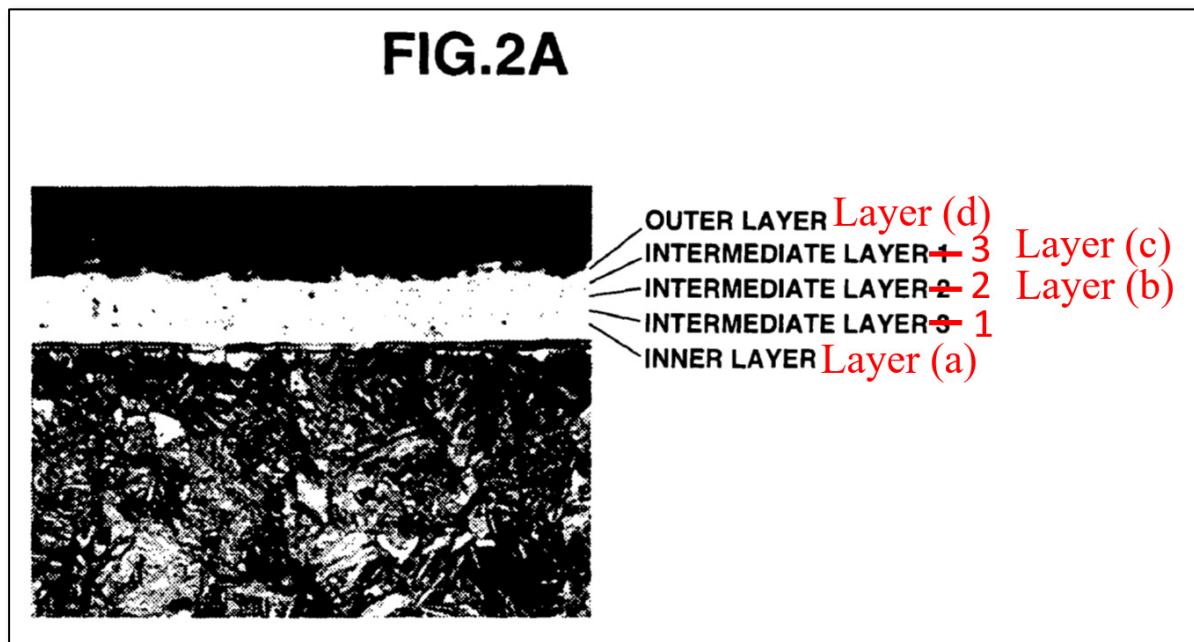
[1c]:

The modified Takagi coatings result from interdiffusion between the base steel and the aluminum or aluminum alloy pre-coating. EX-1003, 175. Takagi describes that “[d]uring the growth of the Al-Si-Fe alloy layer by the heat treatment, **mutual diffusion between Al coating and steel substrate layer** produces various Al-Si-Fe ternary intermetallic compounds.” EX-1016, [0016].

[1d]-[1h]:

The modified Takagi coatings include five layers corresponding to the Inner, Inter 1, Inter 2, Inter 3, and Outer layers of Takagi's Table 1. At least the **Inner**,

Inter 2, Inter 3, and Outer layers of the modified Takagi Nos. 1 and 4 coatings teach layers (a), (b), (c), and (d), respectively. The Inner, Inter 2, Inter 3, and Outer layers proceed “from the base steel outwards,” as shown in Takagi’s FIG. 2A. EX-1003, 176.



Takagi’s FIG. 2A

The compositions and thickness/morphology of the modified Takagi layers, in association with the corresponding layers of the '227 Patent, are shown in annotated Takagi’s Table 1 and Hein’s FIG. 4. EX-1003, 177.

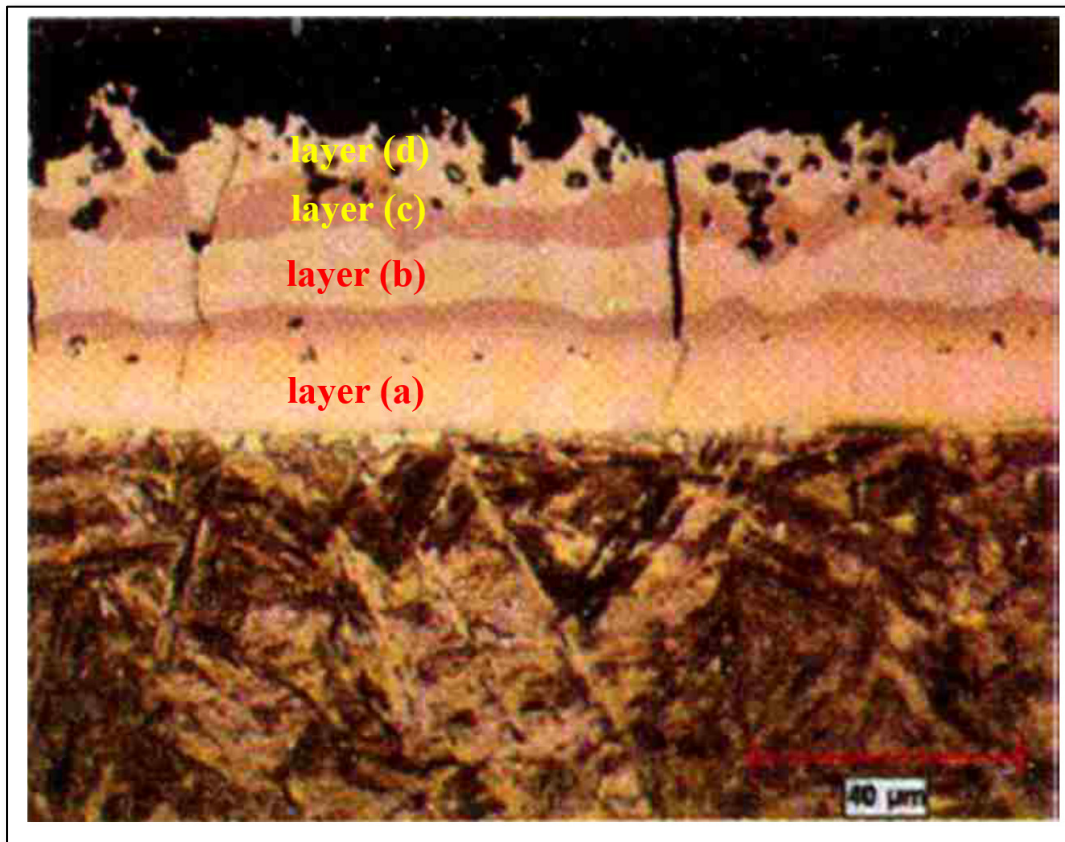
Corresponding layers of '227 Patent

(a) (b) (c) (d)

TABLE 1

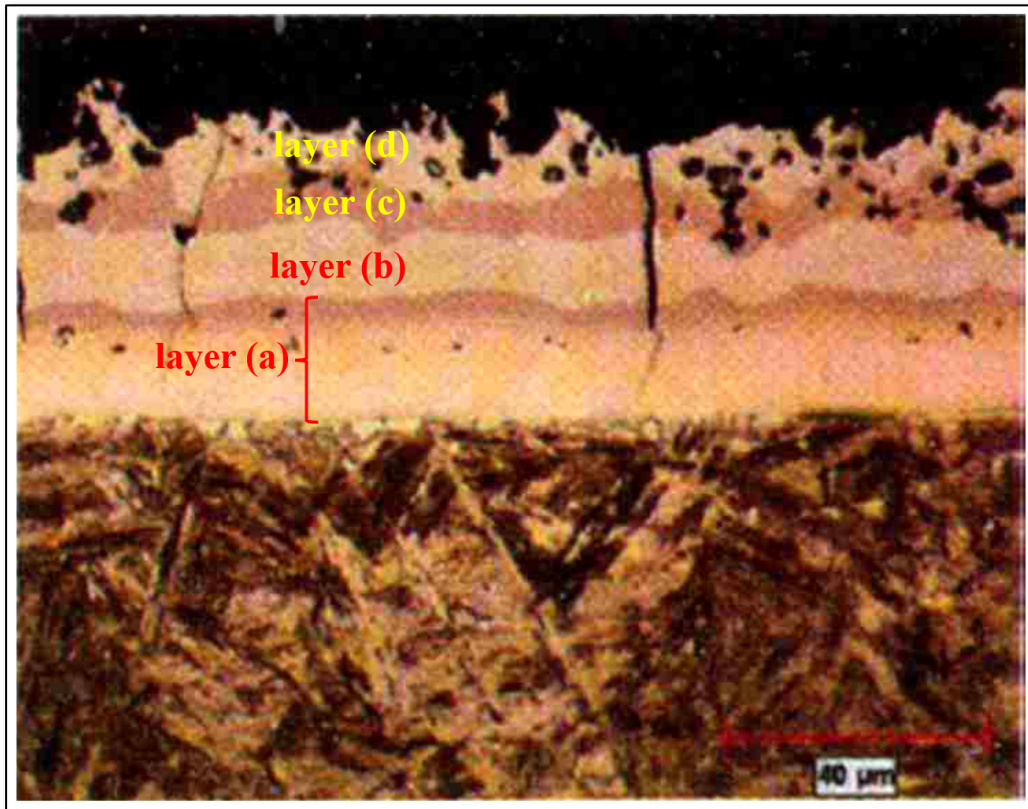
No.	PRODUCTION		COMPONENT & HARDNESS	COATING LAYER STRUCTURE & COMPOSITION (%)					STEEL BASE HARDNESS (Hv)	COATING LAYER HARDNESS (Hv)			OXIDE WEIGHT (mg/dm ²)	FORMABILITY	CORROSION RESISTANCE	WELDABILITY
	RAISED TEMPERATURE (°C)	HOLD TIME (min.)		INNER	INTER 1	INTER 2	INTER 3	OUTER		SOFTTEST	AVERAGE	SOFTER RANGE (%)				
1	920	3	Al	7.7	31.0	48.4	31.6	54.8	450	310	415	51	300	○	○	○
			Si	2.0	3.9	1.2	5.7	0.8								
			Fe	89.6	65.9	50.1	62.0	44.5								
			Hv	310	360	750	700	800								
2	900	2	Al	27.2	48.4	31.6	—	54.9	415	380	455	22	275	×	○	○
			Si	4.1	1.2	5.7	—	0.8								
			Fe	67.2	50.1	61.9	—	44.1								
			Hv	380	760	720	—	810								
3	930	10	Al	9.4	—	—	—	11.6	400	305	385	78	550	○	×	×
			Si	1.3	—	—	—	1.8								
			Fe	88.4	—	—	—	85.7								
			Hv	305	—	—	—	410								
4	950	5	Al	6.0	27.8	51.9	30.4	47.4	440	280	400	59	385	○	○	○
			Si	1.5	4.3	0.6	5.3	2.2								
			Fe	90.7	66.7	46.8	63.1	49.8								
			Hv	280	340	720	690	800								
5	900	4	Al	3.2	54.5	33.4	—	54.5	440	300	410	56	335	○	○	○
			Si	0.4	2.5	15.3	—	6.8								
			Fe	94.3	42.7	51.4	—	38.4								
			Hv	300	740	700	—	810								

Takagi's Table 1



Hein's FIG. 4

Alternatively, **Inner and Inter 1** of the modified Takagi Nos. 1 and 4 coatings **together** teach the Interdiffusion layer (layer (a)). This mapping would be consistent with one example of the '227 Patent's disclosure for the reasons discussed in §III. EX-1003, 178.



Hein's FIG. 4

All arguments provided herein that rely on associating the Inner layer with layer (a) apply equally to this composite layer of the Inner and Inter 1 layers, and that alternative mapping should be understood as being included in the discussions below. EX-1003, 178.

[1i]:

The Inner, Inter 2, Inter 3, and Outer layers of the modified Takagi coatings have different mean compositions. EX-1003, 179. Takagi's Table 1 shows the different compositions. As discussed in §IX.D, the layers of the modified Takagi coatings have compositions the same as or similar to these compositions. See §III.B for a discussion of why a POSITA would have interpreted Takagi's "percent by mass" as a "mean" composition. EX-1016, [0020]; EX-1003, 52-54.

Corresponding layers of '227 Patent

(a) (b) (c) (d)

TABLE 1

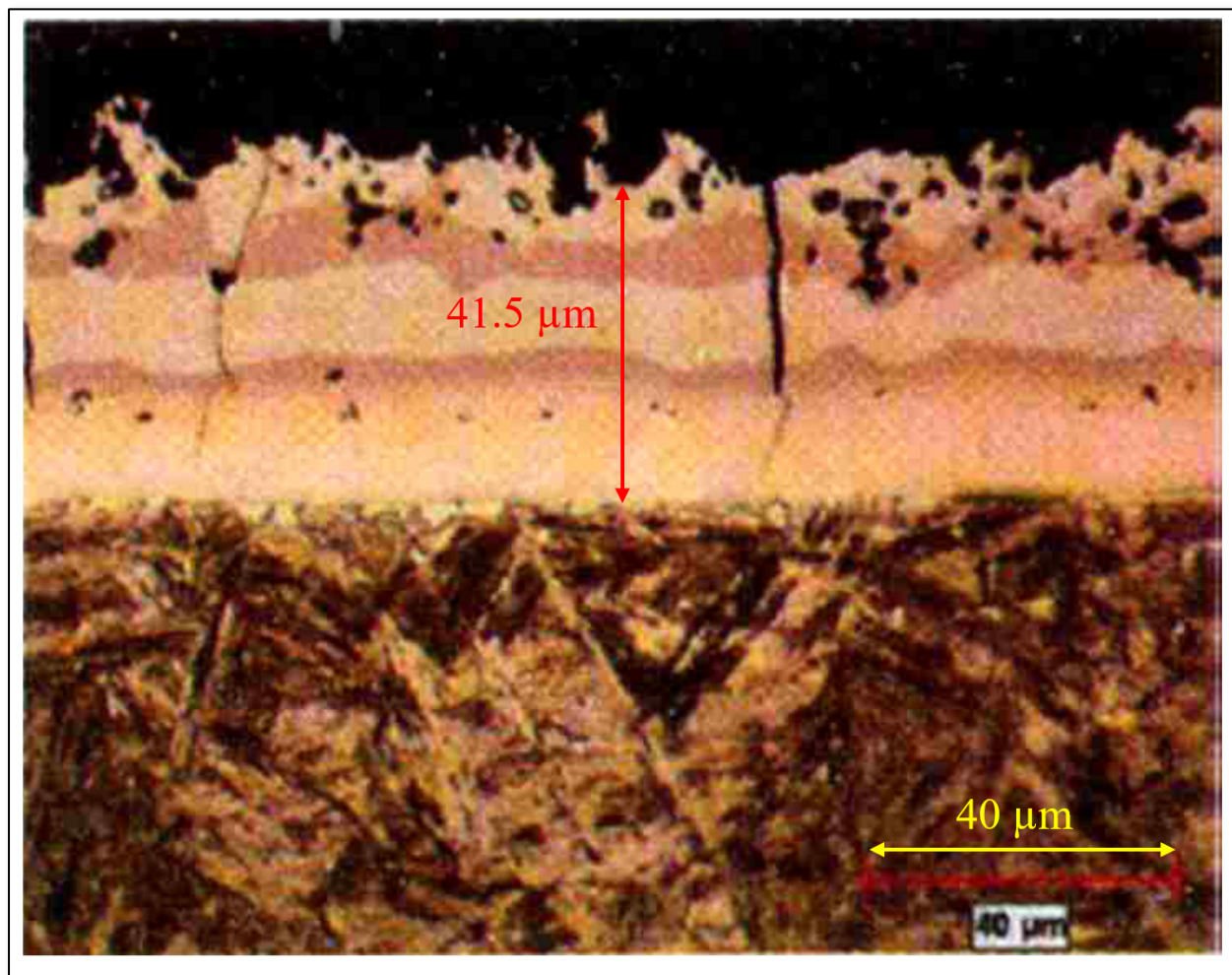
No.	PRODUCTION		COATING LAYER STRUCTURE & COMPOSITION (%)					STEEL BASE HARDNESS (Hv)	COATING LAYER HARDNESS (Hv)			OXIDE WEIGHT (mg/dm ²)	FORMABILITY	CORROSION RESISTANCE	WELDABILITY	
	RAISED TEMPERATURE (°C)	HOLD TIME (min.)	COMPONENT & HARDNESS	INNER	INTER 1	INTER 2	INTER 3		OUTER	SOFTTEST	AVERAGE					SOFTER RANGE (%)
1	920	3	Al	7.7	31.0	48.4	31.6	54.8	450	310	415	51	300	○	○	○
			Si	2.0	3.9	1.2	5.7	0.8								
			Fe	89.6	65.9	50.1	62.0	44.5								
			Hv	310	360	750	700	800								
2	900	2	Al	27.2	48.4	31.6	—	54.9	415	380	455	22	275	×	○	○
			Si	4.1	1.2	5.7	—	0.8								
			Fe	67.2	50.1	61.9	—	44.1								
			Hv	380	760	720	—	810								
3	930	10	Al	9.4	—	—	—	11.6	400	305	385	78	550	○	×	×
			Si	1.3	—	—	—	1.8								
			Fe	88.4	—	—	—	85.7								
			Hv	305	—	—	—	410								
4	950	5	Al	6.0	27.8	51.9	30.4	47.4	440	280	400	59	385	○	○	○
			Si	1.5	4.3	0.6	5.3	2.2								
			Fe	90.7	66.7	46.8	63.1	49.8								
			Hv	280	340	720	690	800								
5	900	4	Al	3.2	54.5	33.4	—	54.5	440	300	410	56	335	○	○	○
			Si	0.4	2.5	15.3	—	6.8								
			Fe	94.3	42.7	51.4	—	38.4								
			Hv	300	740	700	—	810								

Inner, Inter 2, Inter 3, and Outer layers have different compositions

Takagi's Table 1

[1j]:

As discussed in §IX.D, the modified Takagi coatings have thicknesses the same as or similar to that of Hein's FIG. 4. Dr. Miles' measurements indicate that the Hein FIG. 4 coating has a thickness of 41.5 μm . EX-1003, 180.

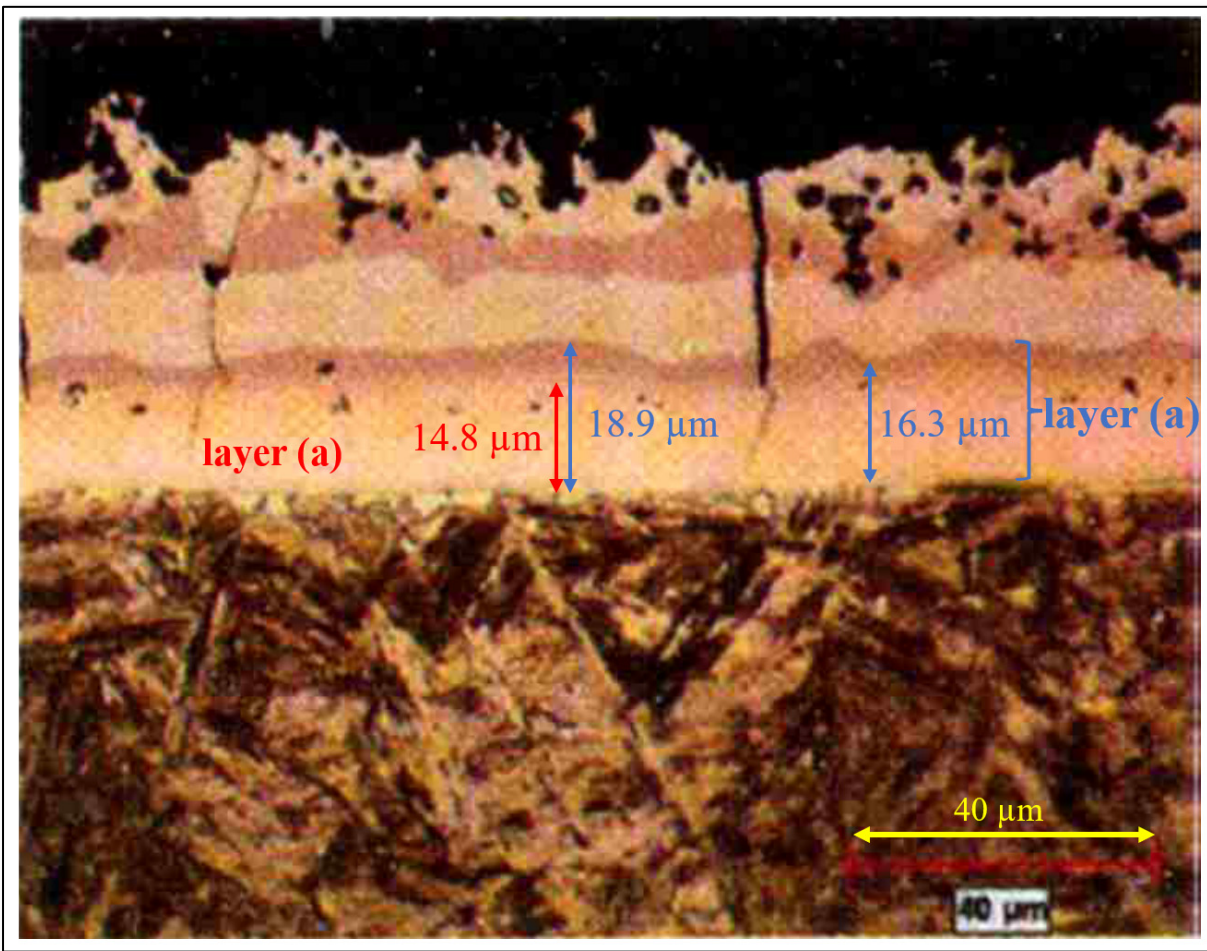


Hein's FIG. 4

[2]:

As discussed in §IX.D, the layers of the modified Takagi coatings have thicknesses the same as or similar to those of Hein's FIG. 4. Dr. Miles' measurements indicate that the deepest layer of the Hein FIG. 4 coating has a thickness of **14.8 μm**, which is less than half of the **41.5 μm** thickness of the coating. EX-1003, 181-182.

When Inner and Inter 1 are together applied as layer (a), the composite layer has a measured thickness of **18.9 μm** or **16.3 μm**, which satisfies claim 2. EX-1003, 183.



Hein's FIG. 4

In Takagi, “there is formed a less hard or soft layer [] at or near the boundary between the steel and coating. [T]he thickness of this soft layer is made **equal to or greater than 50% of the total thickness of the alloy coating layer.**” EX-1016, [0017]. This range abuts the claimed range and renders it obvious. EX-1003, 183; *In re Brandt*, 886 F.3d 1171 (Fed. Cir. 2018).

[3]:

The layers of the modified Takagi coatings have hardnesses the same as or

similar to the hardnesses disclosed in Takagi's Table 1, and these are within or close to the recited hardness ranges. EX-1003, 184.

A POSITA would have expected the layers of the modified Takagi coatings to have hardness values the same as, or similar to, the corresponding layers of the Takagi coatings. EX-1003, 185. Takagi itself discusses a direct correlation between layer composition and layer hardness, noting a target Fe% range that provides a target layer hardness. EX-1016, [0020]. Because the modified Takagi layers have compositions the same as or similar to the disclosed Takagi layers, and would have been processed under generally similar conditions, the hardnesses would be the same or similar. EX-1003, 185.

Starting from those hardnesses, it would have been obvious to experiment with the hardnesses of the modified Takagi coatings to achieve hardnesses in the claimed ranges. EX-1003, 186. "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller* at 456. This rule is particularly applicable here, based on the motivation provided by Takagi's discussion of (i) the importance of individual-layer hardness for coating performance, (ii) how the layer hardness depends on the layer composition, and (iii) how layer hardness and composition can be tuned by adjusting heating rate, heating temperature, and hold time. EX-1016, [0019]-[0026]; EX-1003, 186; §IX.A. As Dr. Miles notes, the

difference between Takagi's hardnesses and those in claim 3 are minor: at most 7.5% for the modified No. 1 coating, and at most 11% for the modified No. 4 coating. EX-1003, 186.

Although claim 3 recites an "HV50g hardness" (that is, a "hardness measured using a 50g load"), Takagi does not disclose the load used to obtain the values in Table 1. EX-1003, 187. In some cases, "the measured hardness may depend on the load," particularly when the load is less than 100g. *Id.* However, Dr. Miles provides several reasons why Takagi's ambiguity on this point "does not change [his] assessment that a POSITA would have found the recited hardnesses obvious." EX-1003, 188-196.

First, Dr. Miles explains that "the most obvious choice of load for a POSITA to use in measuring the hardnesses would have been either 50g, or a load providing a hardness value substantially matching that provided by 50g." EX-1003, 188. He cites several references demonstrating a small number of possible loads. *Id.* As he explains, "given widespread recognition in the art that hardness can depend on load, the POSITA would have consulted existing literature to identify a load providing reliable results" and would have found 50g to be a suitable and obvious option. *Id.*, 188-190. Dr. Miles further states that "based on the literature, even if Takagi's hardnesses were measured using a somewhat smaller load down to 20g, I would expect them to differ less than 10% from hardnesses measured using 50g

loads.” *Id.*, 191-192.

Additionally, Dr. Miles points out that “the specific numbers recited in claim 3, even with the recited load, can be given little weight. Vickers hardness measurements on thin layers are notoriously unreliable, with results varying substantially from tool-to-tool and even user-to-user for the same tool. [] For this very reason, POSITAs typically report hardnesses not as absolute values but comparatively within a given part []. In terms of what would have been practically achievable to measure in 2006, a POSITA would have interpreted claim 3 merely as reciting a general pattern of hardness – soft, hard, medium, and hard – as one moves from the base steel to the coating surface. [] Takagi’s coatings exhibit the same pattern and even quantitatively similar hardness ratios to those of claim 3.” EX-1003, 193-194.

Further, Takagi’s layer compositions (corresponding to the layer compositions of the modified Takagi coatings) are sufficiently similar to those disclosed in the ’227 Patent, and Takagi’s layers were processed in a manner sufficiently similar to those of the ’227 Patent, to render obvious the claimed hardnesses. EX-1003, 195-196. The hardnesses of claim 3 appear to derive from “Example 2” of the ’227 Patent. EX-1003, 195. The Takagi compositions and the Example 2 compositions are very similar to one another. *Id.*

As such, a *prima facie* case of obviousness exists for the claimed hardnesses.

In re Best, 562 F.2d 1252, 1255 (C.C.P.A. 1977). Here, the prior art compositions are very similar to the Example 2 compositions and were obtained using substantially similar process parameters, as explained by Dr. Miles. EX-1003, 170, 186, 195. As he notes, “hardness is a function of **composition** and **thermal history**. It follows that the layers of the Takagi-Hein-GMW14400 coating would have had the same or substantially the same hardnesses as those of the ’227 Patent’s Example 2 and, thus, of claim 3.” EX-1003, 196.

[4]-[5]:

As discussed at [2], Dr. Miles’ measurements indicate that the deepest layer of the Hein FIG. 4 coating (and, accordingly, the Inner layers of the modified Takagi coatings) has a thickness of **14.8 μm**. EX-1003, 197. If Patent Owner argues that the thicknesses are not explicitly disclosed, it would have been obvious to try varying the thickness of the layer to obtain a slightly thinner layer, thereby satisfying the claimed thickness ranges. *Id.* Similar arguments apply as given for [19] and [20] in §III.B, with layer thickness substituted for layer composition. EX-1003, 197.

When the Inner and Inter 1 layers are together applied as layer (a), the composite layer has a measured thickness of **18.9 μm** or **16.3 μm** (*see* [2] above), which renders obvious the claimed thicknesses absent evidence of criticality or unexpected results. EX-1003, 198.

[6]:

As discussed at [1j], GMW14400 requires a thickness greater than 35 μm , and Dr. Miles' measurement of Hein's FIG. 4 coating gives a value of **41.5 μm** , very close to and rendering obvious the recited value. EX-1003, 199-200. Similar arguments apply as given for [6] in §III.B.

[7]:

Engels describes the claimed mean iron compositions. EX-1003, 74. As discussed for claim 1, the Inner, Inter 2, Inter 3, and Outer layers of the modified Takagi coatings correspond to the Interdiffusion, Intermediate, Intermetallic, and Superficial layers, respectively. These layers have the relative compositions, as shown in Takagi's Table 1. Further, as discussed in §III.B, a POSITA would have understood Takagi's disclosures of "percent by mass" as "mean" compositions. EX-1016, [0020]; EX-1003, 201.

Corresponding layers of '227 Patent

(a) (b) (c) (d)

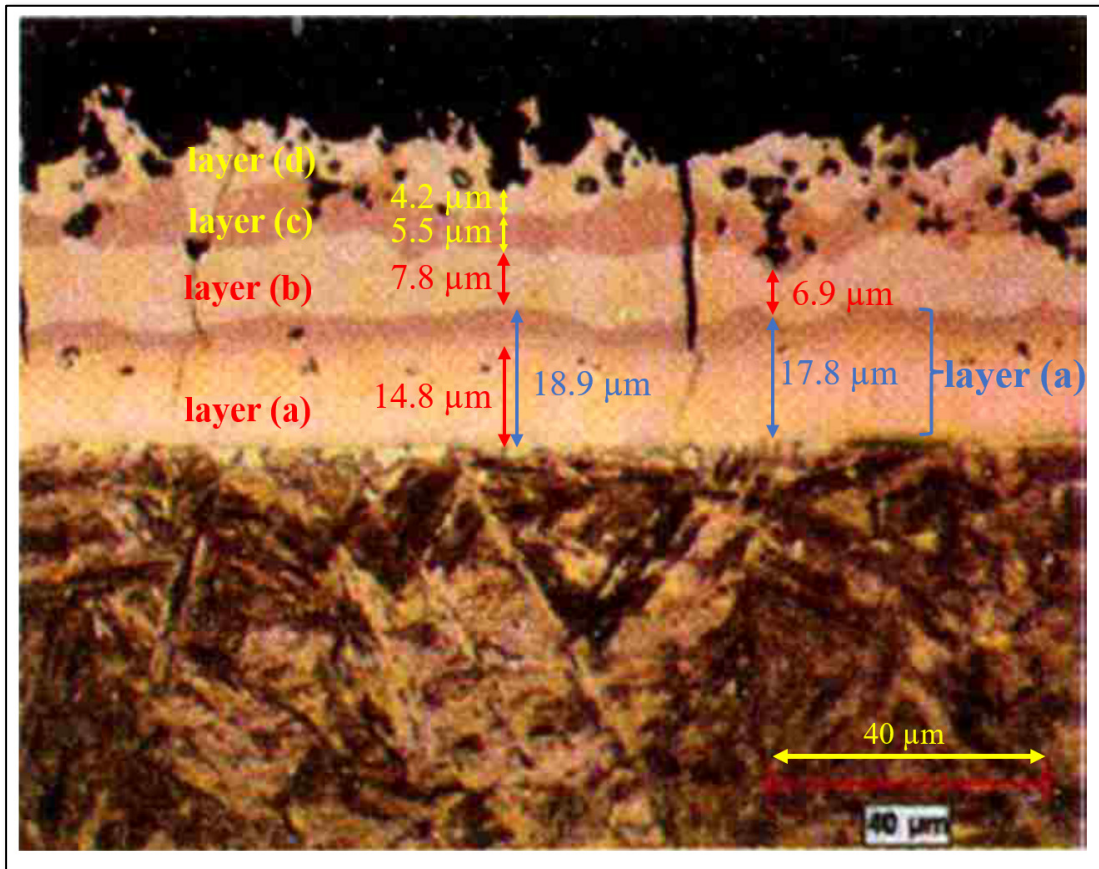
TABLE 1

No.	PRODUCTION		COMPONENT & HARDNESS	COATING LAYER STRUCTURE & COMPOSITION (%)					STEEL BASE HARDNESS (Hv)	COATING LAYER HARDNESS (Hv)			OXIDE WEIGHT (mg/dm ²)	FORMABILITY	CORROSION RESISTANCE	WELDABILITY
	RAISED TEMPERATURE (°C)	HOLD TIME (min.)		INNER	INTER 1	INTER 2	INTER 3	OUTER		SOFTTEST	AVERAGE	SOFTER RANGE (%)				
1	920	3	Al	7.7	31.0	48.4	31.6	54.8	450	310	415	51	300	○	○	○
			Si	2.0	3.9	1.2	5.7	0.8								
			Fe	89.6	65.9	50.1	62.0	44.5								
			Hv	310	360	750	700	800								
2	900	2	Al	27.2	48.4	31.6	—	54.9	415	380	455	22	275	×	○	○
			Si	4.1	1.2	5.7	—	0.8								
			Fe	67.2	50.1	61.9	—	44.1								
			Hv	380	760	720	—	810								
3	930	10	Al	9.4	—	—	—	11.6	400	305	385	78	550	○	×	×
			Si	1.3	—	—	—	1.8								
			Fe	88.4	—	—	—	85.7								
			Hv	305	—	—	—	410								
4	950	5	Al	6.0	27.8	51.9	30.4	47.4	440	280	400	59	385	○	○	○
			Si	1.5	4.3	0.6	5.3	2.2								
			Fe	90.7	66.7	46.8	63.1	49.8								
			Hv	280	340	720	690	800								
5	900	4	Al	3.2	54.5	33.4	—	54.5	440	300	410	56	335	○	○	○
			Si	0.4	2.5	15.3	—	6.8								
			Fe	94.3	42.7	51.4	—	38.4								
			Hv	300	740	700	—	810								

Fe%(Inner) > Fe%(Inter 3) > [Fe%(Inter 2) and Fe% (Outer)]
(Layer (a)) (Layer (c)) (Layer (b)) (Layer (d))

Takagi's Table 1

[8]-[14]:



Hein's FIG. 4

Dr. Miles' measurements in Hein's FIG. 4 indicate thicknesses for the layers corresponding to layers (a), (b), (c), and (d) of **14.8 μm, 7.8 μm and 6.9 μm, 5.5 μm, and 4.2 μm**, respectively. EX-1003, 202-203. These thicknesses satisfy claims 8-14. For claim 12, the 6.9 μm thickness of layer (b) is applied. As discussed in §IX.D, attaining any of these relative thicknesses would have required no more than routine experimentation with recognized result-effective variables. EX-1003, 204.

When Inner and Inter 1 are together applied as layer (a), the combined layer has thickness **18.9 μm** or **16.3 μm** , which also satisfies claims 8-14 in combination with the other measured thicknesses discussed above. The combined layer has thickness **17.8 μm** at the position at which 6.9 μm was measured, also satisfying claims 8, 11, and 12 with respect to 6.9 μm . EX-1003, 205.

[15]:

See §§III.B and VI.A. Hein's disclosure of a "martensitic transformation" in conjunction with a "cooling speed between 50°C/s and 100°C/s" renders obvious a "fully martensitic" structure. EX-1003, 206; EX-1019, 164.

[16]-[17]:

GMW14400's steel compositions satisfy or overlap all composition ranges in [16]-[17]. EX-1026, 2;⁶ EX-1003, 207-211. It would have been obvious to use these steel compositions to satisfy General Motors' requirements. EX-1003, 207. A POSITA would have been further motivated by the recognition that the values in GMW1400 are in agreement with the "Maximum-%" for C, Mn, Si, Cr, Ti, and B described by Hein for USIBOR 1500 steel, which provides "numerous" "technical

⁶ As Dr. Miles discusses, a POSITA would have understood that the "0.010 max. %" nitrogen disclosed by GMW14400 is an "impurit[y] inherent in processing." EX-1003, 208.

and economic advantages [] for the manufacturers and the hot-stampers.” EX-1019, 164, 165.

GMW1440’s lack of disclosure of a Ti% range would have suggested to a POSITA that Ti would be present in small quantities if at all, such that this disclosure teaches a steel with Ti% of less than 0.1%. EX-1003, 210.

The obviousness of these compositions is further evidenced by EX-1050, Table 1. EX-1003, 211.

[18]:

As taught in Takagi’s Table 1, the Inner layers of Nos. 1 and 4 have compositions of, or similar to, **89.6% Fe, 7.7% Al, 2.0% Si**, and **90.7% Fe, 6.0% Al, 1.5% Si**, respectively. EX-1003, 212.

Further, Takagi’s percentages are “mass %,” equivalent to weight %. EX-1016, [0020]; EX-1003, 213. As discussed for [18] in §III.B, a POSITA would have understood the disclosed mass/weight % to be based on **total** mass/weight. *Id.*

[19]:

As taught in Takagi’s Table 1, the Inter 2 layers of Nos. 1 and 4 have compositions of, or similar to, **50.1% Fe, 48.4% Al, 1.2% Si**, and **46.8% Fe, 51.9% Al, 0.6% Si**, respectively. These values are within the recited ranges except for No. 1 Al% (deviation of 4.6%), No. 1 Fe% (deviation of 3.1%), and No. 4 Al% (deviation of 1.1%). As discussed for [19] and [20] in §III.B, and as discussed by

Dr. Miles, the disclosed compositions render obvious the claimed compositions.

EX-1003, 214-216.

[20]:

As taught in Takagi's Table 1, the Inter 3 layers of Nos. 1 and 4 have compositions of, or similar to, **62.0% Fe, 31.6% Al, 5.7% Si, and 63.1% Fe, 30.4% Al, 5.3% Si**, respectively. EX-1003, 217.

[21]:

For the thickness, *see* [2] above. For the composition elements, as taught in Takagi's Table 1, the Superficial layers of Nos. 1 and 4 have compositions of, or similar to, **44.5% Fe, 54.8% Al, 0.8% Si, and 49.8% Fe, 47.4% Al, 2.2% Si**, respectively. All of the No. 1 values are within the recited ranges. The No. 4 values deviate from the recited ranges by 2.8%, 5.6%, and 0.2% for Fe%, Al%, and Si%, respectively. Absent evidence of criticality or unexpected results, these values render obvious the claimed ranges as discussed for [19] and [20] in §III.B. EX-1003, 218-219.

[22]-[23]: *See* [19]-[20] above.

[24]-[25]:

Hein teaches benefits of using USIBOR 1500 steel, teaches desirability of "high strength," and describes that hot-stamping such a steel, using the particular heating and quenching parameters described by Hein, provides "an ultimate tensile

strength [UTS] of **1400 Mpa to 1600 MPa**,” a range substantially overlapping with the claimed range. EX-1019, 163, 164. Further, GMW14400 requires a minimum tensile strength of 1475 MPa after hot-stamping. EX-1026, Table 3. It would have been obvious for a POSITA to seek to satisfy the requirements of GMW14400 and, with the foreknowledge that strengths of up to 1600 MPa were attainable based on Hein, manufacture the modified Takagi parts with a UTS in excess of 1500 MPa. EX-1003, 220.

X. GROUND 2B: Claim 15 is obvious over Takagi in view of Hein, GM14400, and Vaissiere

A. Combination of Takagi, Hein, GM14400, and Vaissiere and Analysis of /15/:

Vaissiere describes that “pre-coated USIBOR 1500” steel (the same type as Hein) “is transformed, at the end of forming, into **pure martensite** thus giving very high mechanical characteristics to then finished part.” EX-1021, 9. In Vaissiere, “[t]he critical [minimum] quenching speed enabling a **completely martensitic structure** [] is **27°C/s**.” EX-1021, 6. This requirement is satisfied by Hein’s disclosed “cooling speed **between 50°C/s and 100°C/s**” and by nearly all of Takagi’s “cooling rate” range of **20°C/s to 100°C/s**. EX-1019, 164; EX-1016, [0028]; EX-1003, 221 As discussed in §VII.B, it would have been obvious to apply Vaissiere’s teachings – which already accord with those of Takagi and Hein – to obtain a fully martensitic structure. EX-1003, 221-222.

XI. GROUND 2C: Claims 16-17 are obvious over Takagi in view of Hein, GM14400, and Laurent

A. Combination of Takagi, Hein, GM14400, and Laurent and analysis of [16]-[17]

As discussed in §VIII.B, a POSITA would have found it obvious to try using a steel as disclosed by Laurent to realize “very high mechanical resistance after thermal treatment.” EX-1023, 1:47-62; EX-1003, 223. The “preferabl[e]” “composition by weight” of Laurent’s steel satisfies or renders obvious [16]-[17]. EX-1023, 1:66-2:10; EX-1003, 223.

XII. DISCRETIONARY CONSIDERATIONS

A. 35 U.S.C. §325(d)

Discretionary denial under *Advanced Bionics* is not warranted.

The references applied against claim 1 – Engels for anticipation/obviousness and the Takagi-Hein-GMW14400 combination – were not applied in rejections during prosecution of the ’227 Patent. *See* EX-1002. As noted in §II.B, only Cornette and Laurent were applied in rejections, and these references are cited here only as secondary references against dependent claims.

The Examiner’s failure to apply Engels, Takagi, Hein, and GMW14400 during prosecution was erroneous, such that part 2 of the *Advanced Bionics* framework is not satisfied. Each of Engels, Takagi, Hein, and GMW14400 was listed on an Information Disclosure Statement (IDS) during prosecution. EX-1002,

186, 192, 230, 236. However, these references were not used as the basis for any rejection and the Examiner did not discuss them. None of Engels, Takagi, Hein, and GMW14400, nor the obviousness of the Challenged Claims in view of these references, was ever addressed during prosecution.

The Examiner apparently failed to appreciate, e.g., how Engels' and Takagi's disclosure of the compositions of each layer in a multi-layer coating would remedy Cornette's alleged failure to explicitly disclose layers having different mean compositions, which was the focus of arguments during prosecution. EX-1002, 532-535, 576. Nor did the Examiner consider that Engels' FIG. 5 shows a coating with a thickness greater than 30 μm , as recited in claim 1. The omission of these references from any applied rejection and failure to consider their teachings constitutes material error.

XIII. FEES

Please charge Deposit Account No. 06-1050 for any fees.

XIV. CONCLUSION

The Challenged Claims should be canceled.

XV. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Petitioner, POSCO Co., Ltd. is the real party-in-interest. VinFast Auto, LLC, VinFast Auto Ltd., VinFast USA Distribution, LLC, Vingroup USA, LLC, and

VinFast Trading and Production JSC are additional real parties-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates, or petitions for *inter partes* review for the '227 Patent. The '227 Patent is the subject of a number of civil actions including: *Certain High-Strength Aluminum or Aluminum Alloy-Coated Steel, and Automotive Products and Automobiles Containing Same*, Inv. No. 337-TA-1402 (ITC) filed April 17, 2024; and *ArcelorMittal v. VinFast Auto, LLC et al*, 2-24-cv-03128 (CDCA) filed April 16, 2024.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

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D. Service Information

Please address all correspondence and service to the address listed above.

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Respectfully submitted,

Dated September 6, 2024

/Jeremy J. Monaldo/

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter partes* Review totals 13,837 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated September 6, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on September 6, 2024, a complete and entire copy of this Petition for *Inter partes* Review, Power of Attorney, and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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