

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.: 58281-0003IP2
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

Declaration of Dr. Michael Miles

TABLE OF CONTENTS

I.	ASSIGNMENT.....	1
II.	BACKGROUND	1
	A. Educational Background.....	2
	B. Career History & Relevant Industry Participation	2
III.	MATERIALS REVIEWED	4
IV.	DESCRIPTION OF THE RELEVANT TIMEFRAME, THE RELEVANT FIELD, AND A PERSON OF ORDINARY SKILL IN THE ART	4
V.	SUMMARY OF THE '227 PATENT	5
VI.	GROUND 1A: Claims 1-15 and 18-25 are obvious over Takagi in view of Cornette.....	9
	A. Takagi	9
	B. Cornette.....	12
	C. Combination of Takagi and Cornette	15
	D. Analysis of Claims.....	27
	1. Claim 1	27
	2. Claim 2	38
	3. Claim 3	40
	4. Claim 4	51
	5. Claim 5	52
	6. Claim 6	53
	7. Claim 7	55
	8. Claim 8	56
	9. Claim 9	58
	10. Claim 10	59
	11. Claim 11	59
	12. Claims 12-14	60
	13. Claim 15	61
	14. Claim 18	62
	15. Claim 19	63

16.	Claim 20	66
17.	Claim 21	66
18.	Claims 22-23	67
19.	Claims 24-25	67
VII.	GROUND 1B: Claims 16-17 are obvious over Takagi in view of Cornette and Laurent	69
A.	Laurent	69
B.	Combination of Takagi-Cornette and Laurent.....	69
C.	Analysis of Claims 16-17	71
VIII.	GROUND 1C: Claim 15 is obvious over Takagi in view of Cornette and Vaissiere.....	72
A.	Vaissiere.....	73
B.	Combination of Takagi-Cornette and Vaissiere and Analysis of Claim 15: 73	
IX.	GROUND 1D: Claims 1-11 and 15-25 are obvious over Takagi in view of GMW14400	74
A.	GMW14400	74
B.	Combination of Takagi and GMW14400	75
C.	Analysis of Claims.....	76
1.	Claims 1, 3, 7, 15, 18-23	76
2.	Claim 2	77
3.	Claims 4-5	77
4.	Claim 6	78
5.	Claims 8-11	78
6.	Claims 16-17	78
7.	Claims 24-25	80
X.	GROUND 1E: Claims 16-17 are obvious over Takagi in view of GMW14400 and Laurent.....	80
A.	Combination of Takagi, GMW14400, and Laurent	80

B.	Analysis of Claims.....	81
XI.	GROUND 1F: Claim 15 is obvious over Takagi in view of GMW14400 and Vaissiere.....	82
A.	Combination of Takagi, GMW14400, and Vaissiere and Analysis of claim 15.....	82
XII.	GROUND 2A: Claims 1-2, 4-15, and 18-25 are obvious over Suehiro in view of Cornette	82
A.	Suehiro	82
B.	Combination of Suehiro and Cornette	85
C.	Analysis of Claims.....	90
1.	Claim 1	90
2.	Claim 2	97
3.	Claims 4-5	100
4.	Claim 6	101
5.	Claim 7	102
6.	Claim 8	103
7.	Claims 9-11	105
8.	Claims 12-14	105
9.	Claim 15	106
10.	Claim 18	108
11.	Claim 19	110
12.	Claim 20	113
13.	Claim 21	115
14.	Claims 22-23	117
15.	Claims 24-25	117
XIII.	GROUND 2B: Claim 3 is obvious over Suehiro in view of Cornette and Takagi	118
A.	Analysis of Claim 3	118
XIV.	GROUND 2C: Claims 16-17 are obvious over Suehiro in view of Cornette and Laurent	122
A.	Combination of Suehiro-Cornette and Laurent	122

B.	Analysis of Claims 16-17	123
XV.	GROUND 2D: Claim 15 is obvious over Suehiro in view of Cornette and Vaissiere.....	123
A.	Analysis of Claim 15	123
XVI.	GROUND 2E: Claims 1-2 and 4-25 are obvious over Suehiro in view of GMW14400	124
A.	Combination of Suehiro and GMW14400.....	124
B.	Analysis of Claims.....	124
1.	Claims 1, 7, 15, 18-25	124
2.	Claims 16-17	125
3.	Claims 2, 4-6, 8-14.....	125
XVII.	GROUND 2F, 2G, 2H: Claim 3 is obvious over Suehiro in view of GMW14400 and Takagi, claims 16-17 are obvious over Suehiro in view of GMW14400 and Laurent, and claim 15 is obvious over Suehiro in view of GMW14400 and Vaissiere	126
XVIII.	CLAIM INTERPRETATION	126
XIX.	LEGAL PRINCIPLES.....	126
A.	Anticipation.....	126
B.	Obviousness	127
XX.	CONCLUSION.....	128

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-1006-13	[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	[Reserved]

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	Excerpts from 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 EX-1045 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 (“Nishibata”)
EX-1051	Ahindra Ghosh, “Secondary Steelmaking, Principles and Applications” (2001)
EX-1052	U.S. Patent Publication No. 2004/0238080
EX-1053	M. Suehiro, et al, “Properties of Aluminum-coated Steels for Hot-forming,” Nippon Steel Technical Report No. 88, July 2003
EX-1054	Japanese counterpart of EX-1053
EX-1055	Translation of EX-1054 and Declaration of Accuracy (“Suehiro”)
EX-1056	J.-P. Laurent, “Hot formed Pre-coated boron steels: A solution of the resistance-formability’s dilemma?” 1 st European Conference of Experts, Hot Forming and Casting Technologies for Lightweight Automobile Design, 27/28 November 2003
EX-1057	OPPOSITION TO RESPONDENTS’ MOTION TO COMPEL OR IN THE ALTERNATIVE TO STRIKE, <i>Certain High-Strength Aluminum or Aluminum Alloy-Coated Steel, and Automotive Products and Automobiles Containing Same</i> , Inv. No. 337-TA-1402 (ITC)(December 2, 2024)
EX-1058	Declaration of June Ann Munford - #3

I, Dr. Michael Miles, of Springville, UT, declare that:

I. ASSIGNMENT

1. I have been retained by POSCO (“Petitioner”) in connection with the above-captioned petition for Inter Partes Review (“IPR”) of U.S. Patent No. 11,326,227 to Pascal Drillet et al. (“the ’227 patent”). I understand the ’227 Patent is currently assigned to ArcelorMittal (“Patent Owner”). I have been asked to provide my independent analysis of the ’227 Patent based on the prior art publications cited in this declaration. I was previously engaged by Petitioner as an expert in IPR2019-01275, relating to U.S. Patent No. 9,708,683 (EX-1028), which is a parent patent to the ’227 Patent. I have also provided an analysis relating to the ’227 Patent in IPR2024-01377.

2. I have been asked by Petitioner to offer opinions regarding the ’227 Patent, including the unpatentability of claims 1-25 (which I may refer to subsequently as the “Challenged Claims”) in view of certain prior art. This declaration sets forth the opinions I have reached to date regarding these matters.

3. I am being compensated by Petitioner at my standard hourly consulting rate for my time spent on this matter. My compensation is not contingent on the outcome of the IPR or on the substance of my opinions.

4. I have no financial interest in Petitioner or Patent Owner.

II. BACKGROUND

A. Educational Background

5. I earned a B.S. degree in Metallurgical Engineering in 1989 from the University of Idaho. I then earned my M.S. degree in Metallurgical Engineering in 1991 from the Ohio State University. I earned my Ph.D. degree in Materials Science and Engineering from Ecole des Mines de Paris in 1995. My M.S. research was focused on the formability of sheet metal alloys, including several steel alloys, an aluminum alloy, and a brass alloy. My Ph.D. work involved the modeling of hot forming processes, especially forging, where the heat transfer between the tools and the workpiece were taken into account.

B. Career History & Relevant Industry Participation

6. I joined Brigham Young University (BYU), in Provo, UT, in 2001 as an assistant professor in the manufacturing engineering technology program. At BYU, I became an associate professor in 2007 and a full professor in 2013. I served as program chair of the manufacturing engineering technology program from 2009 – 2016. I am currently a professor in the manufacturing engineering department (there was a program change in 2019) at BYU. My research focus is on the forming and fabrication of metal alloys, with emphasis on microstructure/formability relationships and the welding/joining of dissimilar alloys.

7. I have been funded by the National Science Foundation nine times on

various research topics related to forming and joining of sheet metal alloys, including microstructure/formability relationships in steels containing retained austenite. I have also received funding from the Department of Energy (dissimilar metals joining) and NASA (friction stir welding of aluminum alloys). In all of these projects, I have mentored students in carrying out the research, collaborated with companies and National Labs (General Motors, Honda, Megastir Technologies, Oak Ridge National Lab), and worked with these teams to publish our results in archival journals.

8. Prior to joining BYU, I worked as a project engineer from 1995 to 1996 at Pechiney Research Center in Voreppe, France. From 1996 to 1998, I was a tooling engineer and a project engineer for American National Can (a subsidiary of Pechiney) in Elk Grove Village, Illinois. From 1998 to 1999, I was an engineering manager for American National Can in Whitehouse, Ohio, then assumed the role of assistant plant manager from 2000 to 2001 at the same facility for Rexam PLC (American National Can was purchased by Rexam).

9. I am an inventor listed in the following United States Patents: End Closure with Improved Openability (US 6,024,239), Three-body joining using friction stir processing techniques (US 8,157,154), Friction bit joining using a friction rivet (US 9,764,375), and Systems and methods for friction bit joining (US 11,697,173). A listing of the year, patent number, and patent title is found in my

Curriculum Vitae included in Appendix A. I am also a listed inventor on several international patents.

10. Additional information regarding my background, qualifications, and presentations is included as part of my curriculum vitae.

11. It is for at least these reasons that I am an expert in sheet metal forming and the microstructure/property relationships that influence formability, including phase transformations that occur during the forming of advanced high strength sheet steels for automotive manufacturing.

III. MATERIALS REVIEWED

12. In forming my opinions, I have reviewed the '227 Patent and considered relevant portions of each of the documents listed in the Exhibit List above and the other references cited in my declaration. In reaching my opinions, I have relied upon my experience in the field and also considered the viewpoint of a person of ordinary skill in the art as of December 2005, which I understand is the alleged date of conception of the '227 Patent. As explained below, I am familiar with the level of skill of a person of ordinary skill in the art regarding the relevant technology at issue as of that time

IV. DESCRIPTION OF THE RELEVANT TIMEFRAME, THE RELEVANT FIELD, AND A PERSON OF ORDINARY SKILL IN THE ART

13. I understand that the '227 Patent claims a priority date of October 30,

2006. However, I am informed that Patent Owner claims a date of conception of December 2005. For the purposes of my analysis, I have used the December 2005 date as the relevant date for my analysis of the prior art.

14. I considered several factors to determine the skill level of a person of ordinary skill in the art of the '227 patent in December 2005, including the types of problems encountered in the art, the solutions to those problems, the pace of innovation in the field, the sophistication of the technology, and the education level of active workers in the field.

15. Based on my knowledge, expertise, and the prior art cited in the '227 Patent, it is my opinion that a person of ordinary skill in the field of the '227 Patent would have had at least an undergraduate degree in materials science, manufacturing engineering, mechanical engineering, or equivalent knowledge, training, or experience, with at least two years of experience working in metallurgy.

16. Unless noted otherwise, when I state that something would be known or understood by one skilled in the art, or a skilled artisan, or a person having ordinary skill in the art ("POSITA"), I am referring to a person with this level of education and experience at the time of the alleged invention, which I am assuming to be in or around December 2005.

V. SUMMARY OF THE '227 PATENT

17. I have reviewed and will now summarize the '227 Patent. The '227 Patent purports to provide novel 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; [t]rimming or cutting for obtaining blanks; [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.

18. Starting with this well-established process, the '227 Patent alleges several improvements. 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.

19. The '227 Patent further notes (i) certain process parameters that are linked to the manufacture of “fully homogeneous martensitic structure[s]” and (ii) the advantages of “reduction of sulfur below a critical value.” EX-1001, 3:1-8. But, as will be demonstrated below, both the claimed low sulfur amounts and the claimed “fully martensitic” products were recognized in the art. For example,

Takagi, Vaissiere, and Somani each provide a detailed discussion of how the hot-stamping process can be tuned to obtain martensitic structures. EX-1016, [0028]; EX-1021, 3, 6; EX-1032, 8.

20. 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 of the claimed coating, which includes four layers, is described with respect to the manufacturing process of “Example 2” and illustrated in FIG. 1 of the '227 Patent, reproduced below. EX-1001, 12:30-61.

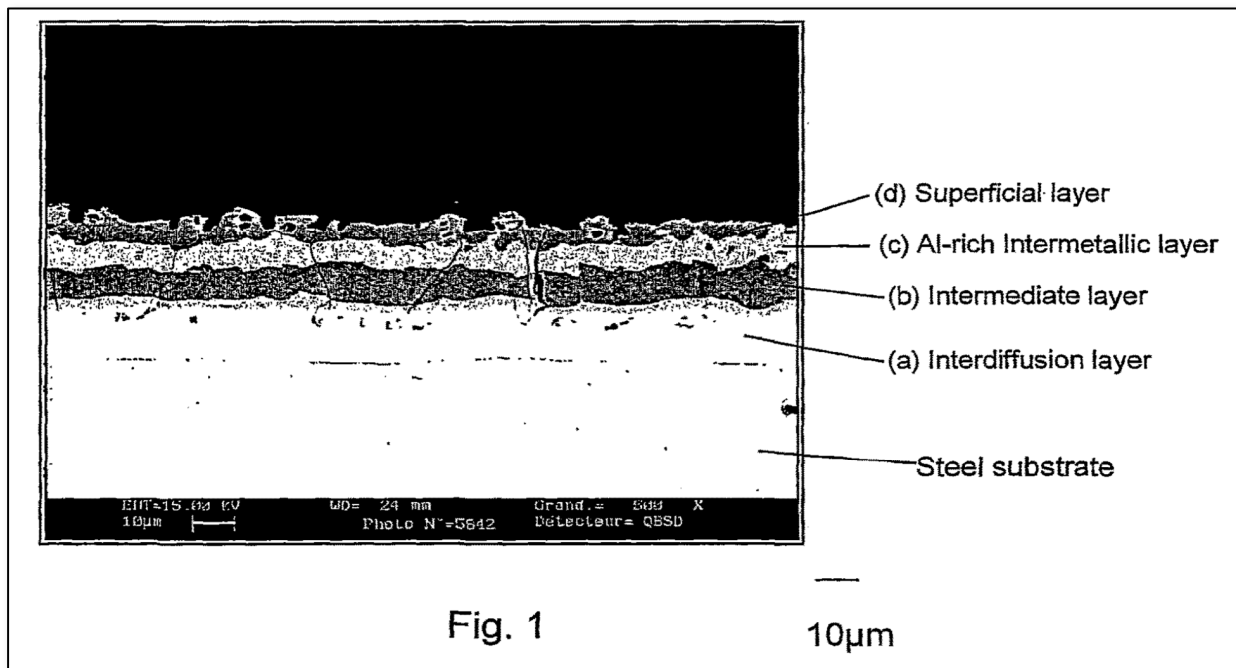


FIG. 1 of the '227 Patent

21. I have reviewed relevant portions of the file history of the '227 Patent (EX-1002). Prosecution focused on the compositions of the layers recited in claim 1, and Patent Owner relied heavily on the proceedings of the IPR for the '683

Patent, with which I am familiar based on my own participation. In that prior IPR, the claims of the '683 Patent were found to be invalid, in part because different “layers” were interpreted as not having to be composed of different materials. EX-1029, 20. Here, claim 1 recites that the layers “*each have a different mean composition from one another.*”

22. An initial Office Action, following a Restriction Requirement, rejected the sole independent claim as anticipated by Cornette. The Examiner pointed to Cornette’s FIG. 22 as showing four layers with a total thickness satisfying the claim’s recitation of a “*thickness greater than 30 micrometers,*” an element also found in claim 1 of the '227 Patent. EX-1002, 200. In reference to the claim’s recitation that “*layers (a), (b), (c), and (d) each have a different mean composition from one another,*” the Examiner further argued that these “different colorations of the respective layers [in Cornette] indicate that the respective layers have different compositions.” *Id.*, 201. Several dependent claims were rejected over a combination of Cornette and Laurent. *Id.*, 203.

23. In response, the applicant cited the IPR proceedings of U.S. Patent No. 9,708,683 (“the '683 Patent”), during which Patent Owner’s expert testified that the “shade and tone” of the layers in Cornette’s FIG. 22 were insufficient to demonstrate that the layers had different compositions. EX-1002, 534.

24. The Examiner then issued a Notice of Allowance, stating that “[t]he

Office is unable to determine if the materials within the respective layers of the prior art are different materials through a visual examination of the figures provided in the prior art.” EX-1002, 576.

25. To summarize, the only references applied in a rejection during prosecution of the '227 Patent were Cornette and Laurent. The allowance relied on Cornette's lack of disclosure of the compositions of the four layers illustrated in Cornette's FIG. 22 coating. By contrast, the two primary references that I reviewed for this Declaration –Takagi and Suehiro– provide precise compositions for four- and five-layer coatings, thereby teaching the sole feature that justified allowance.

VI. GROUND 1A: Claims 1-15 and 18-25 are obvious over Takagi in view of Cornette

A. Takagi

26. Takagi is directed to 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 (or duration) of 2-8 minutes.” *Id.*, [0026]. “After the heat treatment..., the steel sheet is carried from a heating furnace to a forming press.” *Id.*, [0027]. “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.

27. 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, while No. 5 has four distinct layers.

TABLE 1

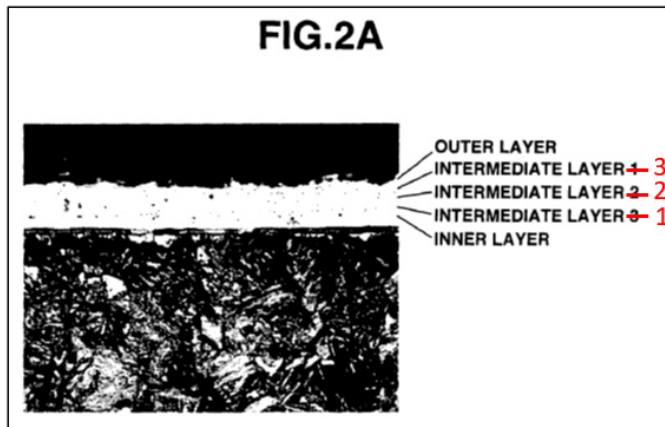
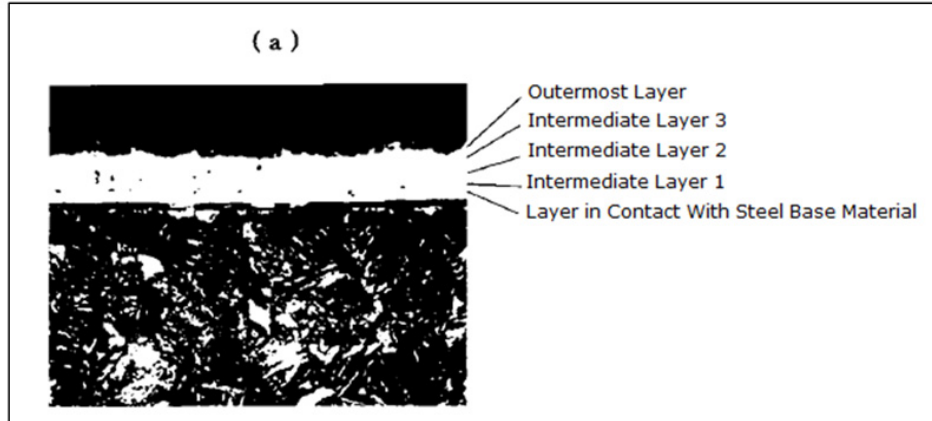
No.	PRODUCTION		COATING LAYER STRUCTURE & COMPOSITION (%)						STEEL BASE HARDNESS (Hv)	COATING LAYER HARDNESS (Hv)			OXIDE WEIGHT (mg/dm ²)	FORMABILITY	CORROSION RESISTANCE	WELDABILITY
	RAISED TEMPERATURE (°C)	HOLD TIME (min.)	COMPONENT & HARDNESS	INNER	INTER 1	INTER 2	INTER 3	OUTER		SOFTTEST	AVERAGE	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								

Coatings with five layers

Coating with four layers

Annotated Takagi Table 1

28. In Table 1, layers Inner, Inter 1, Inter 2, Inter 3, and Outer are arranged from the base steel outwards. Takagi 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. The drawing from the JP filing, along with a corrected version of the US drawing, are shown below.



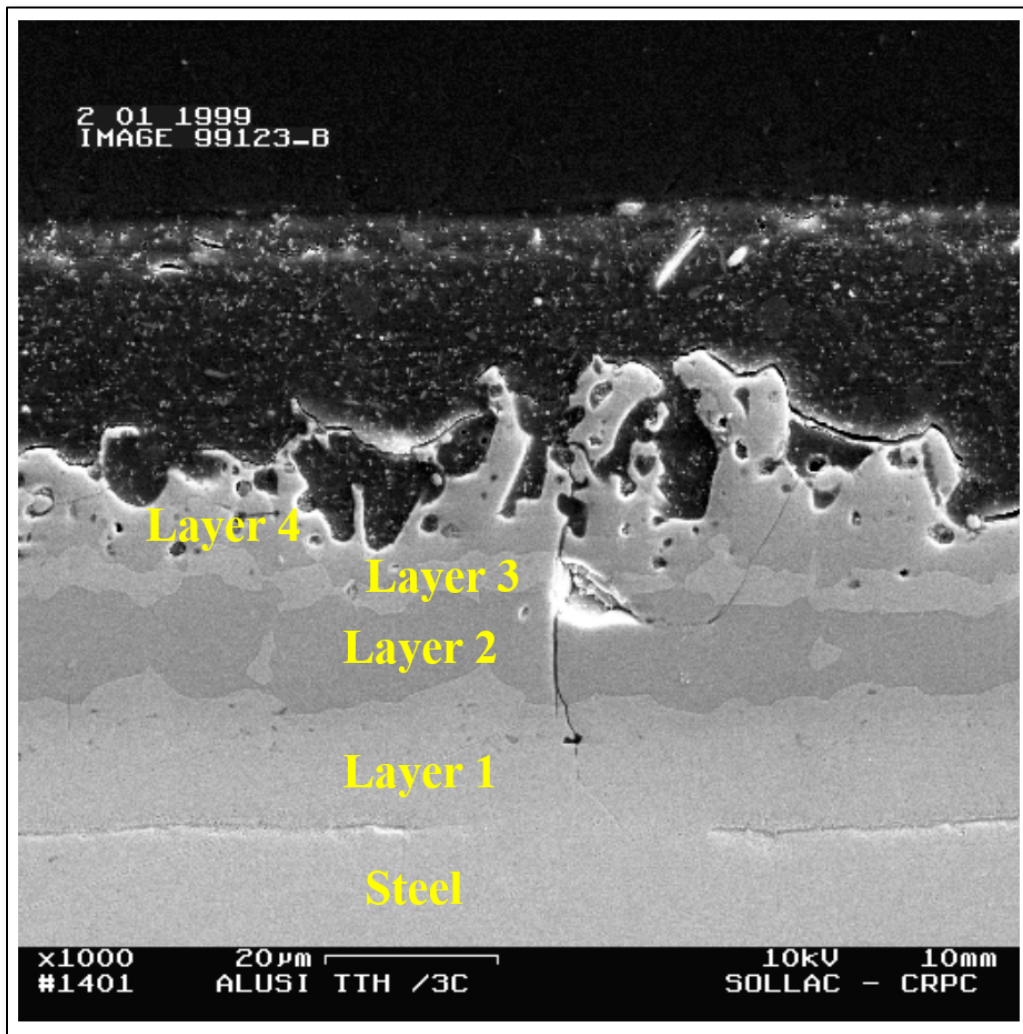
Top: translation of FIG. 2(a) of JP3738754

Bottom: corrected FIG. 2A of Takagi

B. Cornette

29. Cornette (“High Strength Steels for Automotive Safety Parts”) describes “mechanical testing and different design solutions associated with” certain steel grades. EX-1014, 3. “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 an “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 (a “multiphase alloy layer”), in which four distinct layers are visible. *Id.* These four layers constitute the Fe-Al-Si coating, with a base steel region underneath. 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.



Annotated Cornette FIG. 22

30. Some of my analysis for IPR2024-01377 involved measurements of coating and layer thickness in Cornette FIG. 22. While working on the present Declaration, I identified that many of those measurements were moderately incorrect. It appears that my measurements were based on a copy of Cornette FIG. 22 that had had its aspect ratio unintentionally altered, potentially due to image resizing during preparation of annotated drawings. The difference between the

correct and incorrect measurements was not large and would not have changed my conclusions in that matter. The measurements in this Declaration have been confirmed for accuracy.

C. Combination of Takagi and Cornette

31. Takagi discloses a pre-coating thickness of 10-20 μm but does not explicitly disclose a post hot-stamping coating thickness corresponding to that pre-coating thickness. EX-1016, [0035]. Based on Cornette, a POSITA would have expected Takagi's post hot-stamping coating thickness to be 30 μm or more. Cornette discloses a post hot-stamping coating thickness of "about 40 μm " corresponding to a pre-coating thickness of 25 μm , an increase of 60%. EX-1014, 9. When this factor is applied to Takagi's 20 μm pre-coating thickness, the expected coating thickness would be **32 μm** . This relationship is corroborated by FR2833504 ("FR Laurent"), which describes that alloying of a pre-coating "generally corresponds to a 50% increase" in thickness for the resulting coating, which would result in a **30 μm** coating thickness if applied to Takagi's 20 μm pre-coating thickness. EX-1025, 5:17-20. This relationship is further evidenced by GMW14400, which uses a "20 to 33" μm pre-coating to obtain a coating "> 35 μm ," suggesting a 75% increase in thickness from pre-coating to coating (assuming that a 20 μm pre-coating corresponds to a 35 μm coating). EX-1026, 7. As such, Cornette can be applied as evidencing Takagi's teaching of a 32 μm post

hot-stamping coating thickness, without requiring modification of Takagi's coatings.

32. Further, beyond teaching a post hot-stamping coating thickness of 32 μm corresponding to Takagi's pre-coating thickness, Cornette illustrates that it would have been obvious to a POSITA to focus on the pre-coating thickness and the thickness of the coating after hot-stamping as parameters to be varied and optimized. In my review, I identified a number of prior art documents that attest to the importance of layer thickness for determining its properties and effectiveness. Cornette itself notes that "[t]he average [pre-coating] layer thickness showing the best compromise between corrosion protection and weldability is 25 μm " and links this "best" pre-coating thickness to a "typical" thickness of the alloyed "Fe-Al-Si" layer of "about 40 μm at the steel surface." EX-1014, 9. As a POSITA would have understood, Cornette's discussion of the "best compromise between corrosion protection and weldability" is clearly in reference to coatings, not pre-coatings, because the coating of a hot-stamped part, not the pre-coating, is what will be welded and what will protect against corrosion. As such, Cornette's discussion can equivalently be expressed as "[t]he average [pre-coating] layer thickness [that, when hot-stamped, produces a resulting coating with] the best compromise between corrosion protection and weldability is 25 μm , [and that resulting coating is] typically about 40 μm ." Guided by this description, a POSITA would certainly

have been motivated to obtain relatively thick coatings (e.g., with a thickness of about 40 μm) in order to obtain the “best compromise between corrosion protection and weldability,” based on which it would have been obvious to try the 25 μm that Cornette describes provides that thickness.

33. Similarly, Certified Translation of JP2004-244704 (“Maki”) notes that “[a] thickness of 20 μm or more is preferred because a thicker layer responsible for corrosion resistance results in greater overall corrosion resistance and a longer material life. Although there are no particular restrictions on the upper limit, the plating thickness is preferably no more than 60 μm due to the upper limit on plating thickness that can be stably produced using the hot-dip plating method.” EX-1034, [0013]. Further, GMW14400 requires a coating thickness of “>35” μm in order to provide vehicle parts to General Motors. EX-1026, 7.

34. I am informed that, when the prior art recognizes a certain parameter as result-effective, it would have been obvious to a POSITA to optimize that parameter. I am also informed that a parameter is “result-effective” when its variation or adjustment achieves a recognized result. Here, the references identified above demonstrate that a POSITA would have found it obvious to try varying and experimenting with different coating thicknesses in order to obtain a thickness recognized by the art as beneficial. For example, it would have been obvious for a POSITA to seek to obtain a coating thickness of “about 40 μm ” by using a pre-

coating thickness of “25 μm ” as taught by Cornette, in order to achieve “the best compromise between corrosion protection and weldability.” EX-1014, 9. Further reinforcing the obviousness of this combination, these values of Cornette are within the ranges specified as desirable by Maki and GMW14400. EX-1034, [0013]; EX-1026, 7.

35. A POSITA would have had a reasonable expectation of success in combining Takagi with Cornette to obtain thicker coatings, e.g., coatings of about 40 μm . Cornette’s pre-coating thickness of 25 μm represents only a 25% difference compared to the 20 μm pre-coating thickness described by Takagi, a relatively small change. And, as discussed above, Cornette and FR Laurent are in agreement on the efficacy of adjusting pre-coating thickness to modify coating thickness. As such, obtaining the desired coating thickness would have entailed nothing more than applying Cornette’s known techniques and parameters to Takagi to obtain a predictable result.

36. As to the possible effect on layer compositions of adjusting process parameters to achieve a thicker coating, the art does not suggest that the compositions in the ’227 Patent would be outside the scope of reasonable experimentation and optimization. The art is in general agreement on the layer compositions obtained by typical hot-stamping processes, and these compositions match or are similar to those of the ’227 Patent. For Takagi and Suehiro, *see* the

discussions below related to layer composition. Other documents, too, agree. The Laurent Presentation discloses, for a coating with a thickness of about 30 μm , a superficial layer (layer (d)) composition of 45% Fe, 53% Al, 1.3% Si; an intermetallic layer (layer (c)) composition of 65% Fe, 29% Al, 4% Si; and a diffusion layer (layer (a)) composition of 90.4% Fe, 6.2% Al, 2.1% Si. EX-1056, 7. These compositions are similar to those of Takagi, Suehiro, and the '227 Patent for the corresponding layers. As another example, Engels discloses, for a coating with a thickness of about 40 μm , a superficial layer (layer (d)) composition of 44.1% Fe, 53.2% Al, 1.9% Si; an intermetallic layer (layer (c)) composition of 54.3% Fe, 33.9% Al, 10.6% Si; an intermediate layer (layer (b)) composition of 45.9% Fe, 51.4% Al, and 1.9% Si; and a diffusion layer (layer (a)) composition of 89.2% Fe, 7.2% Al, 1.9% Si. EX-1005, 9. These values, too, agree with those of other references and the '227 Patent.

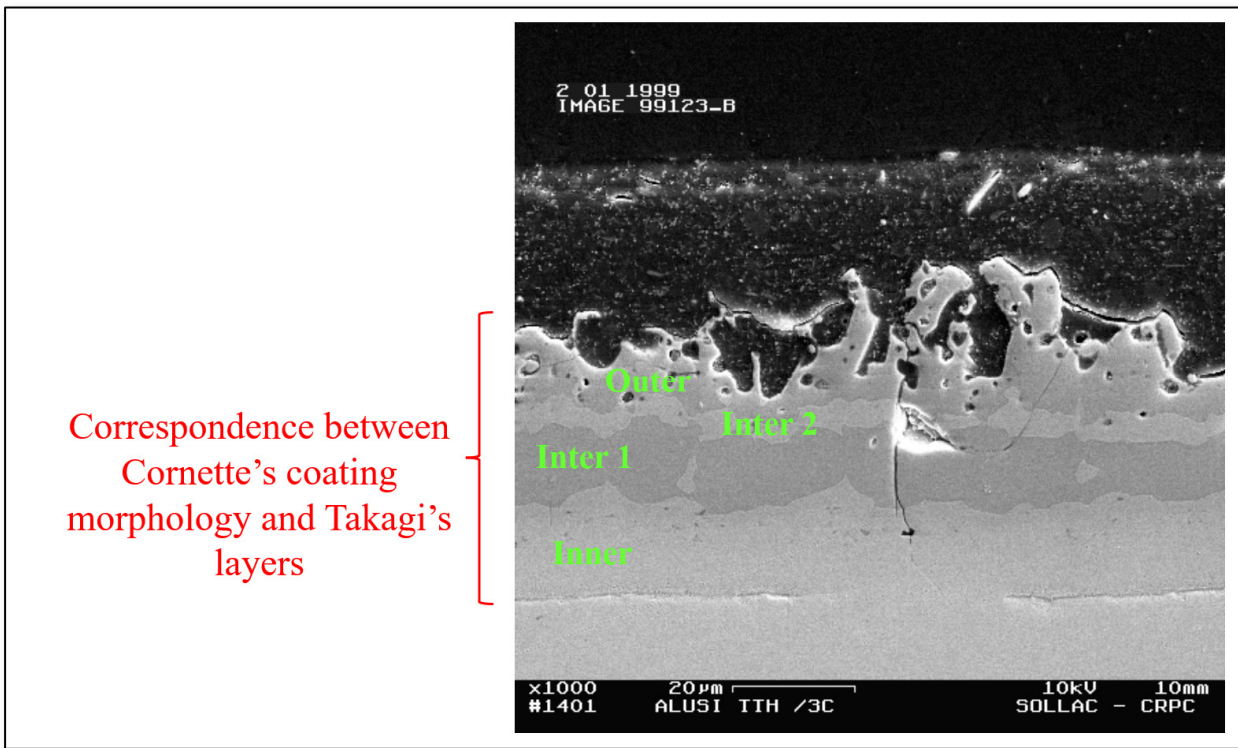
37. Thus, the claimed composition elements merely reflect the expected result of performing hot-stamping on a pre-coated steel using widely-agreed-upon process parameters, rather than representing a new or unexpected result. Therefore, it would have been within the skill of a POSITA to, with a reasonable expectation of success, adjust coating characteristics (such as achieving a coating thickness greater than 30 μm , modulating layer thickness/morphology, and the like) while also achieving the claimed layer compositions.

38. It would also have been obvious to experiment by modifying other aspects of Takagi's hot-stamping process based on Cornette's disclosure. For example, it would have been obvious to try using, as the base steel, the USIBOR 1500 steel noted by Cornette, which provides "excellent mechanical properties of the material after the press hardening process with good corrosion protection." EX-1014, 9. And the POSITA would have found it obvious to try varying the various heating parameters described by Takagi, e.g., within the thermal process window ("Heating 5-10 min. 880-950°C" or "generally 900°C, 5 minutes") described by Cornette. EX-1014, 9. For example, Takagi recognizes each of heating rate, heating temperature, rate of primary cooling, forming temperature, and quenching rate as result-effective. EX-1016, [0019] and [0026]-[0037]. In experimenting and/or modifying Takagi based on Cornette, a POSITA would have been motivated by Cornette's disclosure that these process parameters (represented, for example, by Cornette's FIG. 22 coating) provide "good results" for weldability, have "good capacity" for corrosion resistance, and are offer desirable paint adherence. EX-1014, 10-11. A POSITA would have had a reasonable expectation that these modifications would be successful: for example, Cornette's heating temperatures and times are within the ranges disclosed by Takagi. EX-1016, [0047]. Moreover, the corresponding experimentation was well within the reach and skill of a POSITA, e.g., by appropriately configuring the austenitization

furnace and quenching die.

39. As a result, based on the foregoing 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 coatings having, for each of their four or five layers, the layer composition described for Takagi's No. 1, 4, or 5 coatings (or similar composition), and having Cornette's total coating thickness of "about 40 μm ," or, as another example, the 32.3 μm thickness shown in Cornette FIG. 22 (*see* [1j] below). EX-1014, 9. As discussed above in this section, it would have been obvious to achieve this coating thickness, and other coating thicknesses in a similar range, at least by varying the pre-coating thickness, e.g., using a pre-coating thickness of about 25 μm , as taught by Cornette. As such, in view of Cornette, it would have been obvious to obtain coatings with thicknesses greater than 30 μm , as recited in claim 1.

40. Further, in view of their similar four-layer structures, a POSITA would have arrived at a **Takagi-Cornette No. 5 coating** such that the coating would have the layer thicknesses and morphologies shown in Cornette FIG. 22 (or similar thicknesses and morphologies). This correspondence of the layer thicknesses/morphologies for the Takagi-Cornette No. 5 coating is shown in annotated Cornette FIG. 22 below.



Annotated Cornette FIG. 22

41. Certainly, obtaining the foregoing compositions and coating thickness (and, in the case of the Takagi-Cornette No. 5 coating, the layer thicknesses and morphologies of Cornette FIG. 22) would require experimentation and some degree of trial and error, within the finite number of possible experimental values for some or all of the foregoing thermal treatment parameters and within reasonable expected variation for the relationship between pre-coating thickness and coating thickness. Modification of one parameter (e.g., to obtain a thicker coating) might affect another parameter (e.g., layer composition). However, handling these expected complications would have been well within the bounds of

routine experimentation for a metallurgist, based on Takagi's and Cornette's disclosures. Given (i) the relatively small increase in pre-coating thickness associated with a modification of Takagi based on Cornette's pre-coating thickness (only from 20 μm to 25 μm), (ii) the art's recognition that layer characteristics (e.g., hardness and corrosion resistance, as discussed by Takagi) depend directly on layer composition, (iii) the art's clear recognition of the most relevant process parameters for modifying layer compositions and thicknesses, and (iv) in the case of the Takagi-Cornette No. 5 coating, the fact that both Takagi's No. 5 coating and Cornette's coating include four layers, the manufacture of the modified coatings would have been obvious. EX-1016, [0019]-[0026].

42. As a result, the No. 1, 4, and 5 coatings (whether the No. 1, 4, and 5 coatings modified to have Cornette's thicknesses, or the No. 5 coating modified to have the layer morphology of Cornette FIG. 22) are members of a wide class of coatings that are rendered obvious by Takagi in view of Cornette or GMW14400. For example, insofar as any aspects of the coating layers described in the '227 Patent may be the result of specific heating parameters or pre-coating parameters, a POSITA would have arrived at such layers by routine experimentation. This conclusion is based on a comparison between the values disclosed in the '227 Patent and those in the prior art. The values are generally identical or very similar, and the '227 Patent includes no disclosure to suggest an unexpected criticality in

any of these parameters that would place any of the claimed layer parameters outside the bounds of routine experimentation. When comparing the '227 Patent to the prior art, a POSITA would have seen very similar processes being applied to very similar steel parts. EX-1001, 5:17-18, 6:63-67, 7:1, 7:10-14, 7:41-45, 11:11-14, 12:32-40; EX-1016, [0026], [0028], [0037], Table 1; EX-1014, 9; EX-1055, [02], [07], [14]-[15], [18], FIG. 3.

Parameter	'227 Patent	'227 Patent Example 2	Takagi	Cornette	Suehiro
Pre-coating thickness (μm)	20 – 33	---	10 – 20	25	---
Heating rate (°C/s)	4 - 12	10	8; 1-10	---	~8 ¹ , 10
Temperature (°C)	880 - 940	920	900, 920, 950	880-950; 900	900, 950
Hold time (min)	< 3 – 13	< 6	3, 4, 5; 2-8; 2-10	< ² 5 – 10; 5	0.5; 3
Cooling rate (°C/s)	> 30, or > 50		20 – 100; 30	---	> 20, > 30

43. As such, a POSITA would have had a reasonable expectation that Cornette's and Takagi's teachings could be combined to obtain thicker coatings,

¹ Based on "2 min" heating time to reach "950°C". EX-1055, 4.

² "<" in this table indicates that the disclosed time includes both the heating ramp-up time and the hold time.

e.g., coatings having the 32.3 μm or “about 40 μm ” thickness of Cornette.

44. Certainly, layer thickness/morphology and composition may be associated with one another. For example, based on my experience, a POSITA would expect that a given change to austenitization temperature might affect both coating and/or layer thickness **and** the composition of one or more layers, such that a POSITA would have had to exercise care when performing experimentation, e.g., to generally retain a multi-layer structure with target hardness and corrosion resistance as taught by Takagi.

45. However, this type of optimization was well-established and would have constituted merely routine optimization in the field. I note, for example, Takagi’s clear description of how the high-temperature diffusion process proceeds to form a multi-layer coating. EX-1016, [0019].

46. With respect to the Takagi-Cornette combination, based on visual inspection, Cornette’s innermost layer, mapped to layer (a) below, may include a shading gradient suggestive of two sub-layers. To the extent Cornette FIG. 22 is interpreted in this manner, the combination of Takagi and Cornette can also yield Takagi-Cornette No. 1 and 4 coatings having the layer compositions of Takagi and the layer thicknesses and/or morphologies of Cornette FIG. 22’s five total layers, of which two are sub-layers in the innermost layer. My discussions below that rely on Cornette’s layer thicknesses and/or morphology are compatible with and should

be understood to include this mapping.

47. From my experience during IPR proceedings for the '683 Patent, I am aware that the heating rates disclosed in the '227 Patent were a focus of some discussion. Heating rates were also discussed in detail during prosecution of the '227 Patent. EX-1002, 16-20. With respect to the heating rates, I will briefly note that the disclosed preferential heating rate range of "4 [to] 12°C./s" encompasses Takagi's disclosed heating rates of 8°C/s and 1-10°C/s; encompasses the heating rate of "10°C/s" disclosed by Suehiro; encompasses the heating rate range of 5-10°C/s disclosed by WO02/103073; and encompasses the heating rates from 20°C to 700°C disclosed in FIG. 2 of EX-1039, which I measure to be 5.2 °C/s and 8°C/s.³ EX-1001, 7:13-24; EX-1016, [0026], [0037]; EX-1055, FIG. 3; EX-1035, 57:1; EX-1039, FIG. 2. I can find no evidence that any of the foregoing temperature or coating parameters disclosed by the '227 Patent represented an invention or novel insight. These 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.

³ For the EX-1039 value, I measured the average heating rate over the 20°C to 700°C range based on the curves in FIG. 2.

D. Analysis of Claims

1. Claim 1

[Ipre]: A hot stamped coated steel product, which comprises:

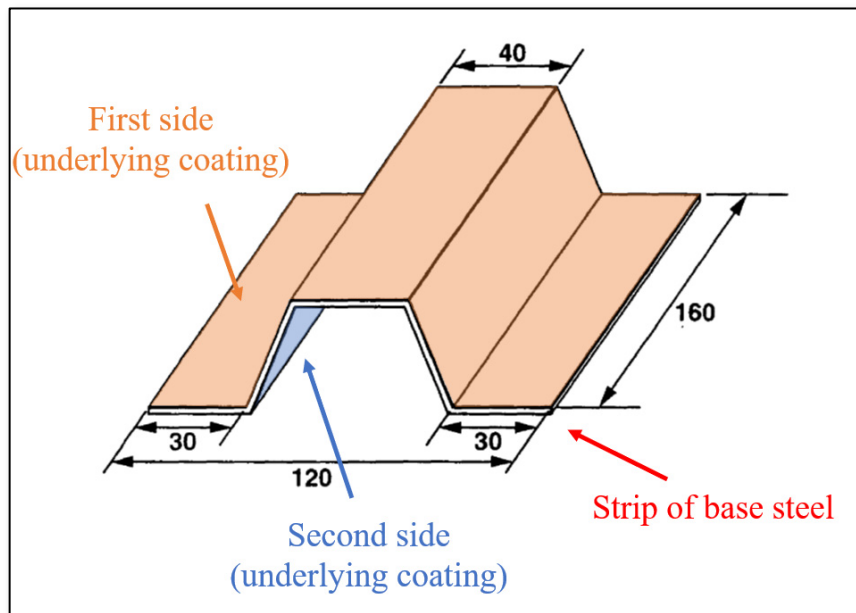
48. Even in the absence of this preamble, claim 1's body describes a structurally complete apparatus. Takagi's parts are "hot stamped coated steel product[s]" or "hot stamped coated steel stamped blanks."⁴ Takagi describes that, in the "[t]est [p]rocedure" used for producing Takagi's samples, "[f]rom the [] **hot-dip aluminum-coated** [i.e., precoated]" 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, because the blanks are "formed" into a part by the stamping. Further, as discussed above in the description of Cornette, Cornette throughout refers to "hot stamping," and Cornette FIG. 22 illustrates a hot-stamped, coated product. EX-1014, 9-11.

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

49. Takagi's No. 1, 4, and 5 parts include a strip of base steel having a first side and a second side. These sides are shown, for example, in Takagi FIG. 1, which illustrates the "shape" of the hot-stamped parts of Takagi No. 1, 4, and 5.

⁴ Drawing upon the definition of "product" provided in the '227 patent. EX-1001, 14:56.

This shape is obtained by “form[ing]” a “flat plate.” EX-1016, [0036]. The “base steel” of the FIG. 1 part, and its two sides, are underneath a coating, the coating formed by “hot-dip[ping],” e.g., “immersing a strip continuously in a bath of molten aluminum” (or aluminum-silicon). EX-1016, [0013]. In FIG. 1, the visible surfaces are surfaces of the coating, but a POSITA would have understood that a strip of base steel with two sides was under the coating. This is corroborated by Cornette, which describes the presence of a “base material” or “substrate” of “boron steel.” EX-1014, 9.

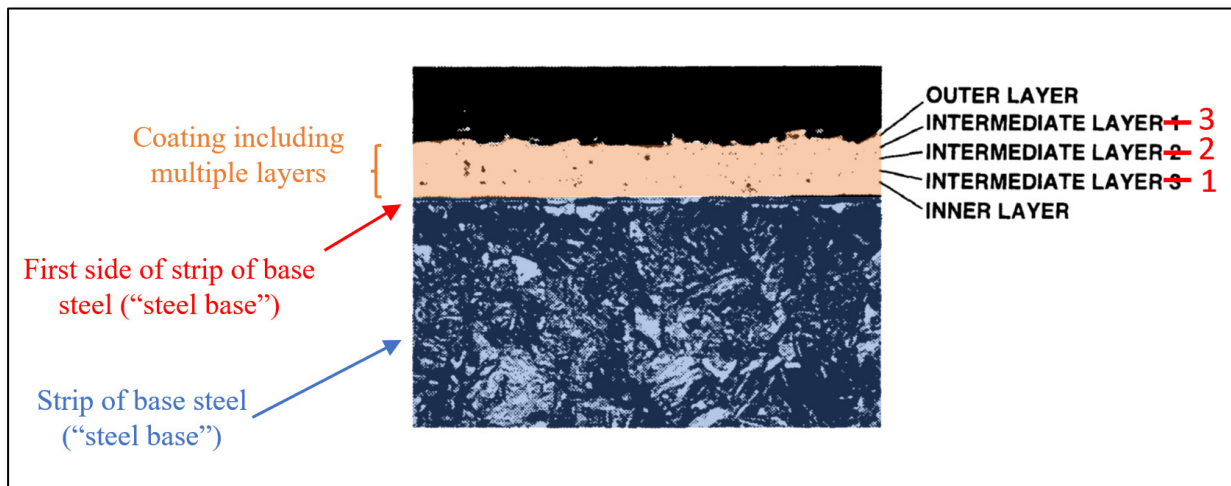


Annotated Takagi FIG. 1

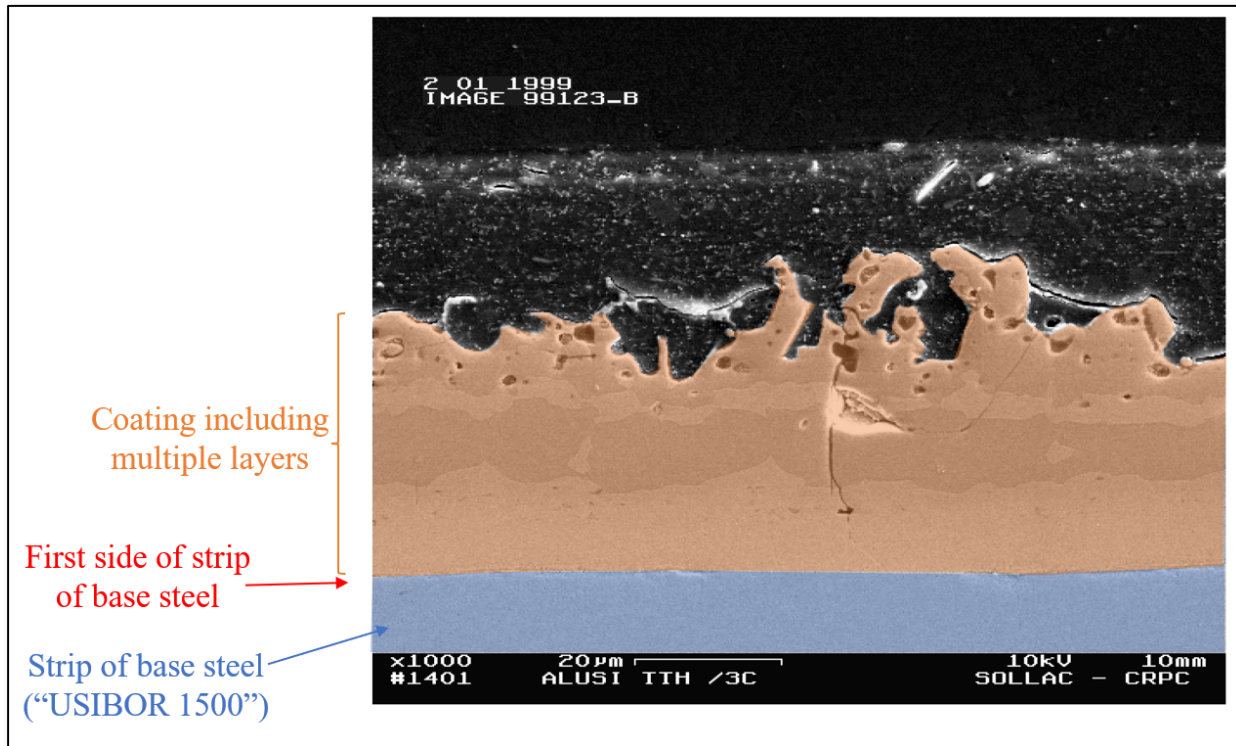
[1b]: a coating on at least one of said first side of said strip of base steel and said second side of said strip of base steel, wherein:

50. Takagi’s parts include the recited coating. These coatings are

illustrated, for example, in Takagi FIG. 2A. For combination with Cornette, such a coating is also shown in Cornette's FIG. 22 coating, which corresponds to the Takagi No. 5 coating as a Takagi-Cornette coating as discussed above.



Takagi FIG. 2A (annotated and corrected)



Cornette FIG. 22 (annotated)

[1c]: (i) said coating results from interdiffusion between said base steel and an aluminum or aluminum alloy pre-coating,

51. Takagi's coatings result from interdiffusion between the base steel, and an aluminum or aluminum alloy pre-coating. For example, 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]. Similarly, Cornette describes an "alloying reaction between substrate (iron) and the coating (aluminum – silicon) which leads to a hard multiphase alloy layer." EX-1014, 9. A POSITA would have

understood this “alloying reaction” to be equivalent to or involve interdiffusion.

[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,

52. Takagi alone and/or as modified by Cornette discloses the recited layers (a)-(d). As one example, as shown in annotated Takagi FIG. 2A below, the **Inner, Inter 2, Inter 3, and Outer layers** of each of the Takagi (or Takagi-Cornette) No. 1 and 4 coatings teach the recited layers (a), (b), (c), and (d), respectively, with these layers “proceeding from the base steel outwards” as recited in claim 1. As another example, the **Inner, Inter 1, Inter 2, and Outer layers** of the Takagi (or Takagi-Cornette) No. 5 coating (which lacks an Inter 3 layer) teach the recited layers (a), (b), (c), and (d), respectively. These mappings are summarized in the table below. A POSITA would have understood that other mappings are also possible.

Takagi layer	No. 1 and 4 mapping	No. 5 mapping
Outer	Layer (d)	Layer (d)
Inter 3	Layer (c)	--
Inter 2	Layer (b)	Layer (c)
Inter 1	--	Layer (b)
Inner	Layer (a)	Layer (a)

53. The compositions of the coatings' layers, in association with the corresponding layers of the '227 Patent, are shown in the annotated Takagi Table 1 below.

Corresponding layers of '227 patent

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	280	760	720	—	810								
3	930	10	Al	(a)	—	(b)	(c)	(d)	400	305	385	78	550	○	×	×
			Si	—	—	—	—	—								
			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								

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

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

Takagi Table 1 (annotated)

54. Alternatively, for the No. 1 and 4 coatings, the “interdiffusion layer” can correspond to the Inner and Inter 1 layers together, such that the two layers are sub-layers of the interdiffusion layer. Based on my review of the literature, this is a

common characteristic of the coatings of hot-stamped steels: a deepest layer of the coating may include two sub-layers, depending on the exact thermal process to which the coating was subjected. For example, the presence of a sub-layer or gradient structure in the deepest layer is shown in both Cornette FIG. 22 and Suehiro FIG. 12, where Suehiro itself identifies that layer as including two layers (layers (4) and (5)). EX-1014, FIG. 22; EX-1055, FIGS. 12-13. This structure is also illustrated by Engels, which shows an innermost layer composed of a measurable phase 1 and a very thin, “unmeasurable” second phase. EX-1005, 9, FIG. 5.

55. Takagi also suggests this structure. Of Takagi’s five samples, Nos. 1 and 4 include five layers, whereas Nos. 2 and 5 include four layers. EX-1016, FIG. 4. A comparison of the compositions of the layers of these coatings strongly suggests that the “missing” layer of Nos. 2 and 5 would be the equivalent of the Inter 1 layers of Nos. 1 and 4, such that the Inter 1 layers of Nos. 2 and 5 corresponds to the Inter 2 layers of Nos. 1 and 4 based on their composition and location within the coating. That is, Takagi’s disclosure, when viewed alongside the other available art, would have suggested to a POSITA that the Inner layer of the No. 5 sample may include two sub-layers that are, in the No. 1 and 4 samples, differentiated as Inner and Inter 1 layers.

Similar compositions between
Inter 2 of Nos. 1, 4 and Inter 1 of Nos. 2,5

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								

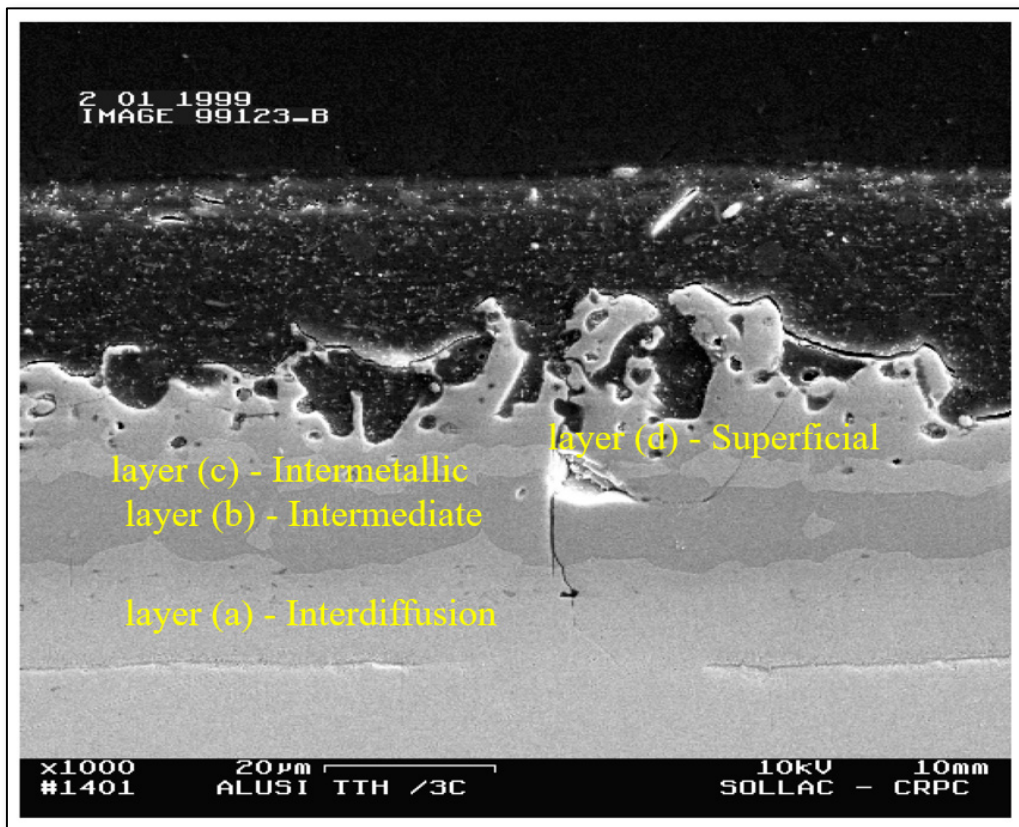
Annotated Takagi Table 1

56. In fact, this physical phenomenon is also indicated by the '227 Patent's disclosure that the interdiffusion layer "is itself composed of two sub-layers," although the claims of the '227 Patent lack any requirement that the "interdiffusion layer" or "layer (a)" be composed of two sub-layers." EX-1001, 12:46.

57. In the case where Takagi's two inner layers are together interpreted as one layer, the mappings are as shown below.

Takagi layer	Alternative No. 1 and 4 mapping
Outer	Layer (d)
Inter 3	Layer (c)
Inter 2	Layer (b)
Inner + Inter 1	Layer (a)

58. For the Takagi-Cornette No. 5 coating in which Takagi's layers have the thicknesses and/or morphologies of Cornette's corresponding layers, or similar thicknesses and/or morphologies, the mapping is illustrated below.



Annotated Cornette FIG. 22

[1i]: wherein layers (a), (b), (c), and (d) each have a different mean composition from one another,

59. Layers (a)-(d) in Takagi's coatings have different mean compositions

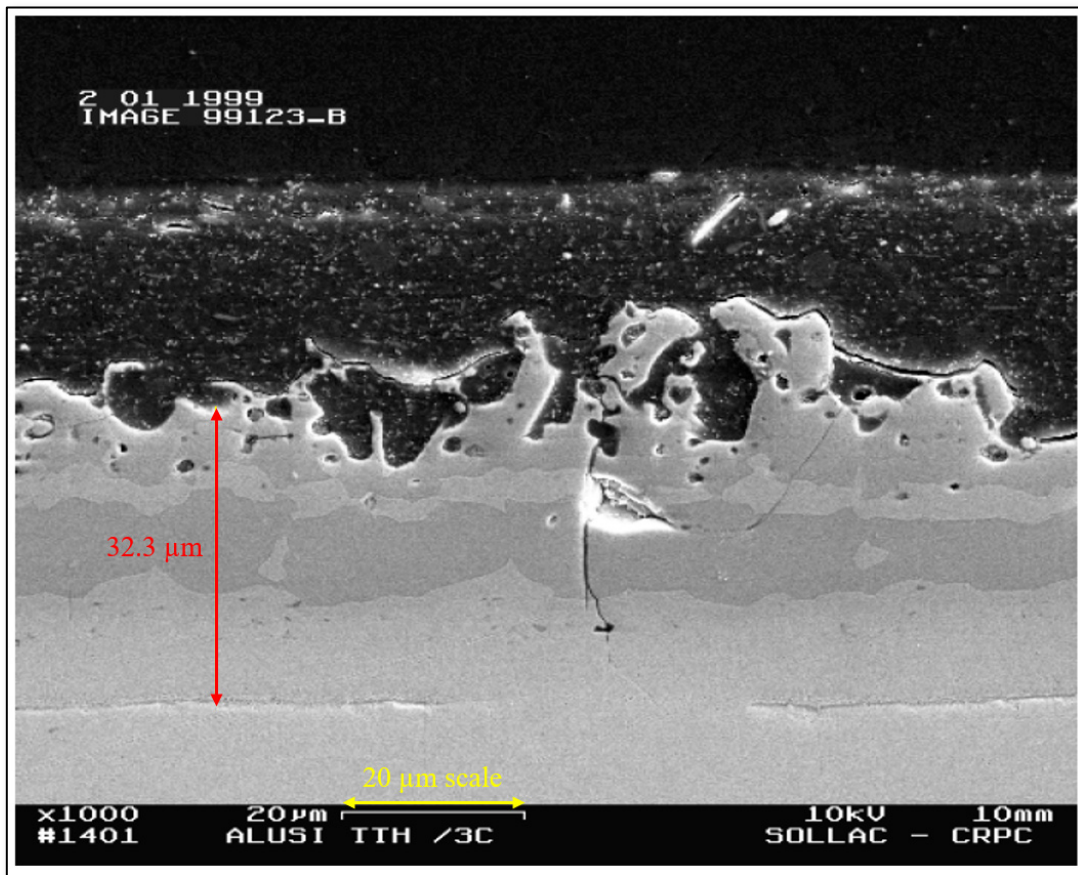
from one another. Takagi Table 1 illustrates that, for each of the Nos. 1, 4, and 5 coatings, the elemental “mass %” is different for different layers. Based on Takagi’s description that the percentages in Table 1 are “percent by mass,” a POSITA would have understood that these percentages refer to “mean” compositions. EX-1016, [0020]. In the field of steel metallurgy, a disclosure of a composition for a material, phase, or layer implicitly is, and would have been understood as, a disclosure of a mean composition of the material, phase, or layer. Absent a statement or suggestion otherwise—which Takagi does not provide—a POSITA would have understood Takagi’s disclosures of compositions to be disclosures of mean compositions, thereby satisfying this claim element.

[1j]: wherein said coating of the hot stamped coated steel product has a thickness greater than 30 micrometers.

60. Takagi alone and/or in view of Cornette teaches a coating thickness greater than 30 μm . As discussed above, applying Cornette’s thickness increase of 60% to Takagi’s 20 μm pre-coating thickness results in a thickness of **32 μm** , greater than 30 μm . EX-1014, 9; EX-1016, [0035]. Further, in reference to the Takagi-Cornette combination, the Takagi-Cornette No. 1, 4, and 5 coatings are modified to have thicknesses similar to Cornette’s part, e.g., 32.3 μm or “about 40 μm ,” satisfying the recitation of “greater than 30 micrometers.” For example, based on Cornette, it would have been obvious to a POSITA to try varying process

parameters such as thermal parameters and/or pre-coating thickness, as a matter of routine experimentation, to arrive at a coating having the thickness of the coating shown in Cornette FIG. 22. Based on the scale included in that drawing, the thickness of that coating, for at least one measurement position, is approximately **32.3 μm** . This measurement is shown in the annotated drawing below. The measurement was performed by using the common “ImageJ” software to determine a pixel-to-distance conversion using the 20 μm scale, and then applying that conversion to a vertical line through Cornette’s coating.

61. I note further that the ’227 Patent fails to describe any criticality associated with a coating thickness “greater than 30 micrometers.” The ’227 Patent describes the benefit of a **pre-coating** thickness of “20-33 micrometers” (a range that overlaps Takagi’s range and encompasses Cornette 25 μm pre-coating), but provides no discussion or justification relating to the “preferred embodiment [in which] the total thickness of layers (a) to (d) is greater than 30 micrometers.” EX-1001, 5:20-25, 6:46-47. Certainly the ’227 Patent includes no suggestion of any criticality associated with the particular threshold of 30 μm .

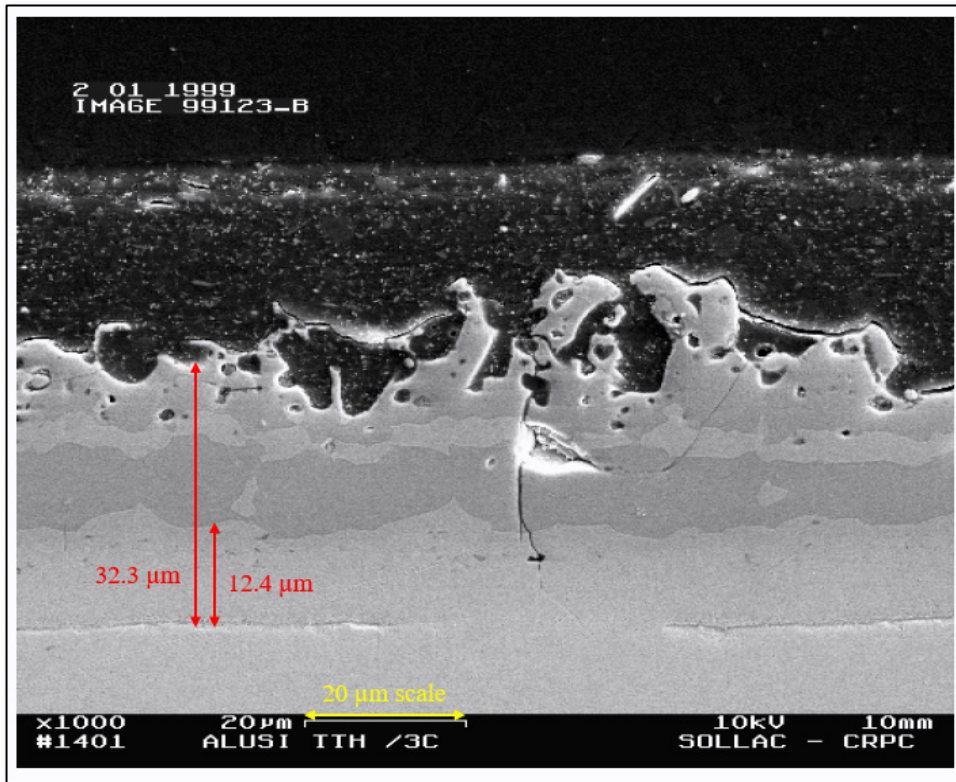


Cornette FIG. 22 (annotated)

2. 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.*

62. Takagi's coating, modified to have the layer thicknesses of Cornette's FIG. 22 coating as discussed in §VI.C, has a layer (a) thickness that is less than half the coating thickness. For example, for one position, the FIG. 22 coating has a measured deepest-layer (layer (a)) thickness of 12.4 μm , much less than half its total measured thickness of 32.3 μm .



Annotated Cornette FIG. 22

63. Takagi alone also renders obvious this claim element. Takagi describes that “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]. I am informed that a range abutting a claimed range renders obvious that range. That situation applies here, because a thickness of 50% of (half) the coating thickness abuts the claimed range of less than half the coating thickness. Nor does the '227 Patent assert or evidence any criticality or unexpected results associated with the claimed range.

3. 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, $\pm 10\%$.

64. The layers of Takagi's coatings have hardnesses within or close to the recited hardness ranges, rendering obvious those ranges. Takagi Table 1, in conjunction with the layer mappings discussed in §VI.C, demonstrates that layers (a)-(d) have hardness of 310 (within range), 750 (deviation of 7.5%), 700 (within range), and 800 (deviation of 1.3%) for the No. 1 coating; 280 (deviation of 3.5%), 720 (deviation of 11.1%), 690 (within range), and 800 (deviation of 1.3%) for the No. 4 coating; and 300 (within range), 740 (deviation of 8.7%), 700 (within range), and 810 (within range) for the No. 5 coating. EX-1016, Table 1.

'227 Patent layer	Claimed range (HV50g)	Takagi No. 1 hardness (Hv)	Takagi No. 4 hardness (Hv)	Takagi No. 5 hardness (Hv)
(a)	290 – 410	310 (Inner)	280 (Inner)	300 (Inner)
(b)	810 - 1100	750 (Inter 2)	720 (Inter 2)	740 (Inter 1)
(c)	522 – 715	700 (Inter 3)	690 (Inter 3)	700 (Inter 2)
(d)	810 - 1100	800 (Outer)	800 (Outer)	810 (Outer)

65. 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. I am advised that, where 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. This rule seems particularly applicable here, in view of the motivation provided by Takagi's detailed discussion of the importance of individual-layer hardness for coating performance, Takagi's discussion of how the layer hardness depends on the layer composition, and Takagi's discussion of how layer hardness and composition can be tuned by adjusting heating rate, heating temperature, and hold time. EX-1016, [0019]-[0026].

66. For example, Takagi discusses the importance of having a “soft layer [] at or near the boundary between the steel and coating” and a “hard outermost layer” and correlates layer hardness to iron and aluminum concentration in each layer. EX-1016, [0017], [0019], [0024]. Further, the differences between Takagi's hardnesses and those in claim 3 are minor: at most 7.5% for the No. 1 coating, at most 11% for the No. 4 coating, and at most 8.7% for the No. 5 coating differences that would be well within the range of routine experimentation. All of these factors suggest to me that it would have been obvious and well within the skill of a POSITA to obtain the recited hardnesses with a reasonable expectation of success.

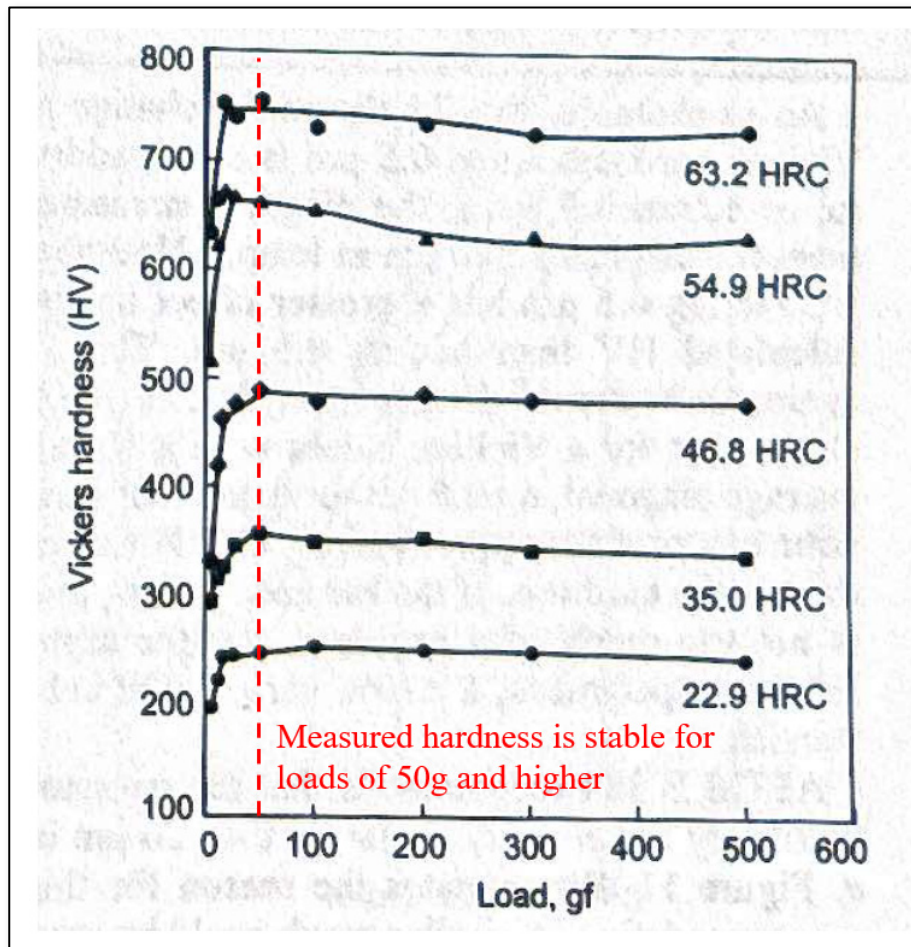
67. Also, to the extent Takagi's process were modified based on Cornette

(e.g., to change the pre-coating thickness and/or thermal parameters), a POSITA would expect the layers of the modified Takagi coatings to have hardness values the same as, or similar to, the corresponding layers of the Takagi coatings. 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.

68. There is one more factor to consider when comparing Takagi and the '227 Patent. While 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. In a Vickers hardness test, the “load” refers to the mass or force used to form an indentation that indicates the hardness. Further, a POSITA would have been aware that, in some cases, the measured hardness may depend on the load, particularly in cases in which the load is less than 100g. This effect is sometimes referred to as the “indentation size effect (ISE).” However, Takagi’s ambiguity on this point does not change my assessment that the recited hardnesses are obvious.

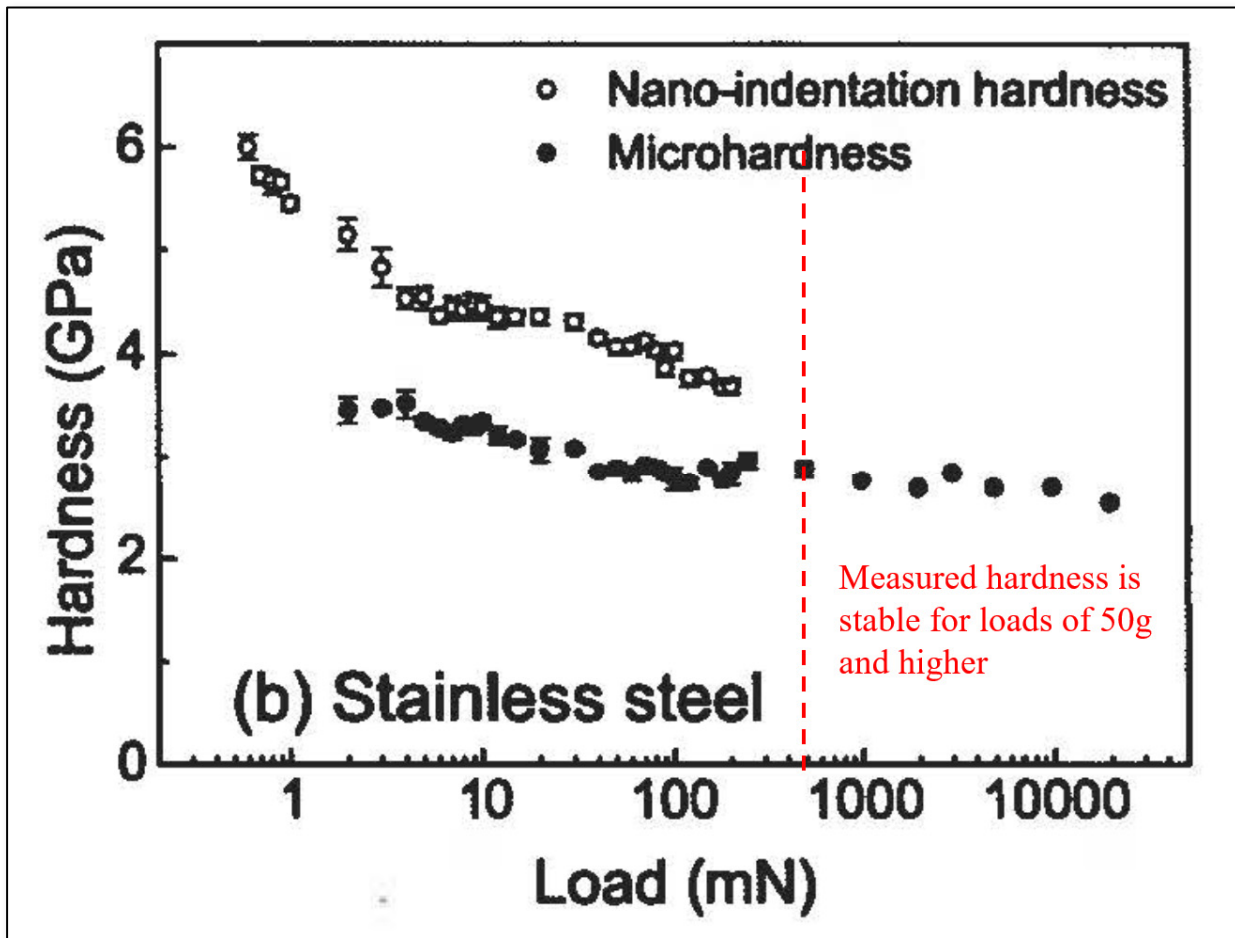
69. First, the most obvious choice of load for a POSITA to use in measuring the hardnesses would have been either 50g, or a load providing a

hardness value substantially matching that provided by 50g. Although loads can theoretically be selected arbitrarily, my own experience suggests that, in practice, among loads in the range where hardness might depend on load, a POSITA using standard test equipment would have almost certainly chosen from among a small number of possible loads, those being or primarily being 5g, 10g, 20g, 25g, 50g, and 100g. *See, e.g.,* EX-1041, 5; EX-1044, 7; EX-1040, FIG. 13. In addition, 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. The references with which a POSITA would have been familiar suggest that, for microindentation and nanoindentation measurements on steel, loads of 50g and higher provide relatively similar hardness measurements. For example, EX-1040 FIG. 13, illustrating measured Vickers hardness for steel test blocks using test forces from 5-500 gf, shows the hardness generally stabilizing for loads of 50 g and higher:



Annotated EX-1040 FIG. 13

70. And EX-1043's plot of microindentation measurements on stainless steel also shows relatively stable results for loads of 50 g and higher (50 gf is about 490 mN):

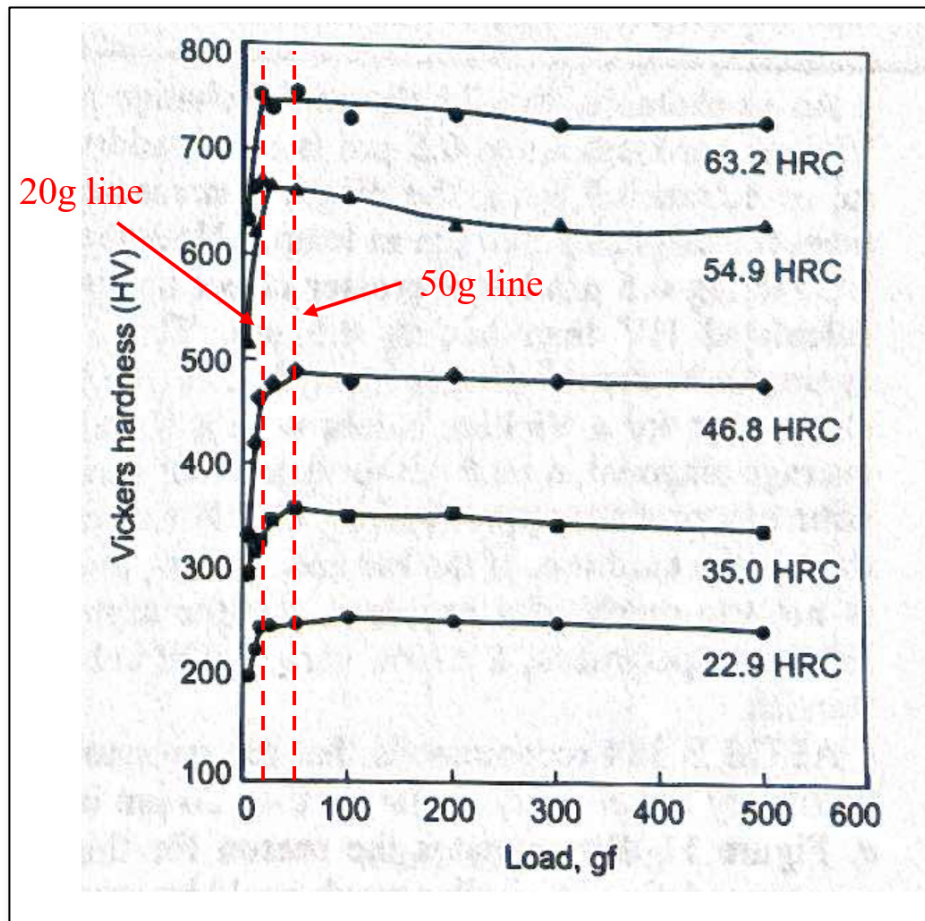


Annotated EX-1043 FIG. 2(b)

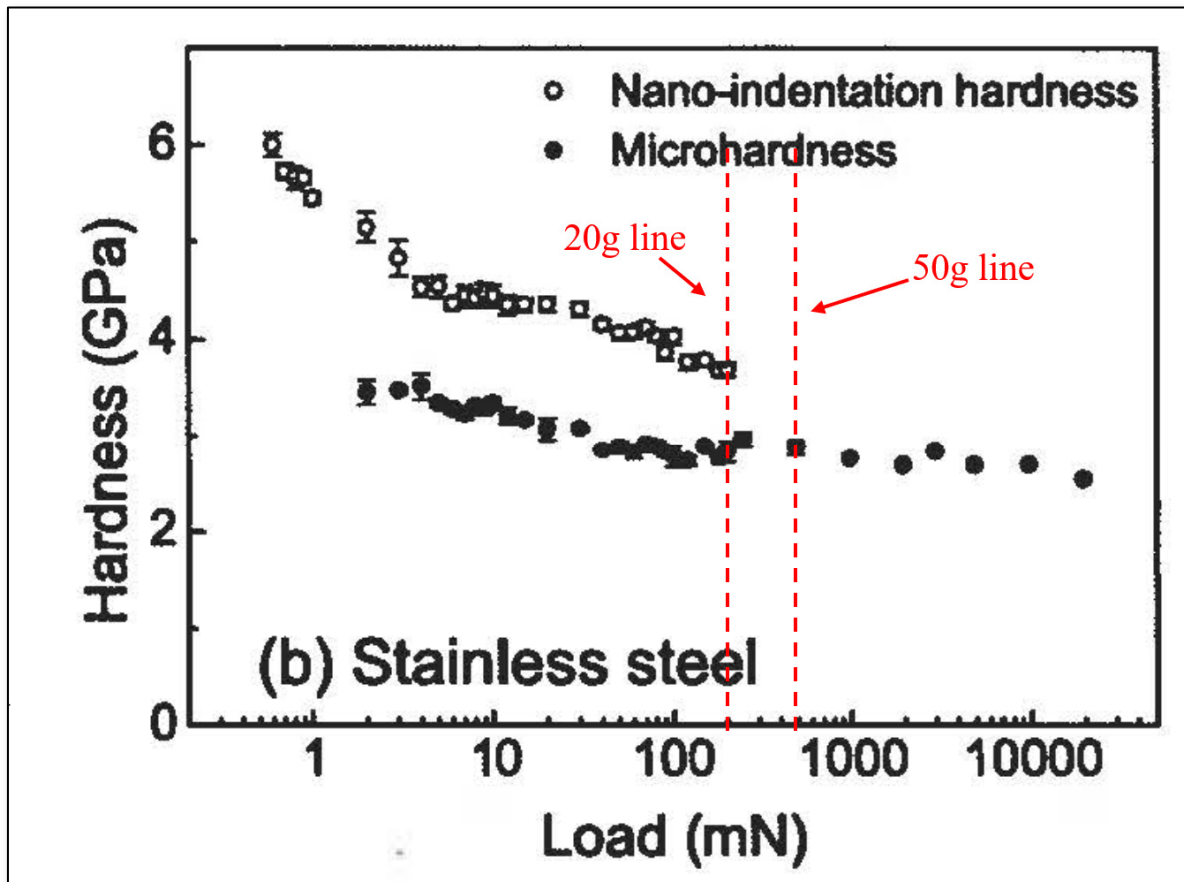
71. It is my assessment that a POSITA, following this literature, would have either (i) selected 50g, in which case Takagi's hardness values are directly applicable to those of the '227 Patent, or (ii) selected a load higher than 50g (such as 100g or 200g), in which case the literature suggests that the measured hardness would be very similar to an HV50g hardness. This latter choice would be consistent with the loads of 100g and 200g used in other hot-stamping-related documents I identified. *See* EX-1035's use of a 100g load for measurement of

Vickers hardness in a cross-section of a hot-stamped steel sheet (EX-1035, 53:28-31) and EX-1046's use of a 200g load for measurement of quenched, martensitic USIBOR 1500 steel (EX-1046, 4).

72. Moreover, based on the literature, even if Takagi's hardnesses were measured using a somewhat smaller load down to 20g, a POSITA would have expected them to differ less than 10% from hardnesses measured using 50g loads. This is evidenced in EX-1040 FIG. 13 and EX-1043 FIG. 2(b).



Annotated EX-1040 FIG. 13

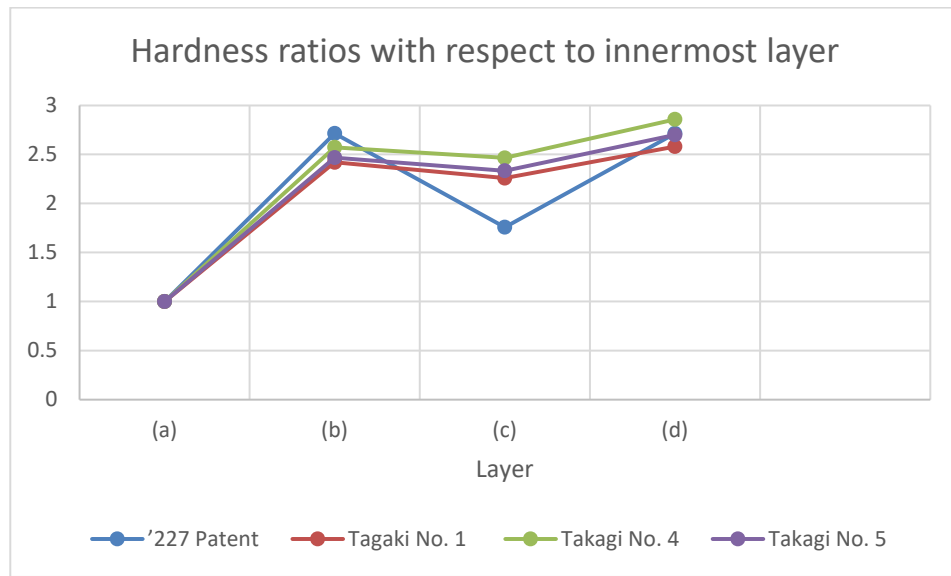


Annotated EX-1043 FIG. 2(b)

73. As such, I believe that the Hv hardness values disclosed by Takagi are almost certainly representative of HV50g hardness values, for example, to within 10% at most. Given the lack of criticality or unexpected results associated with the recited hardnesses, and given the reasonable expectation of success discussed above for achieving those hardnesses, the reasoning provided above for the obviousness of claim 3 applies equally whether Takagi's hardnesses are interpreted as HV50g hardnesses or are modified slightly to account for the use of a different load.

74. In addition, independent of the above reasoning, 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. EX-1040, 3. For this very reason, POSITAs typically report hardnesses not as absolute values but comparatively within a given part. For example, it is common for a POSITA to measure the hardness along a profile extending through a welded joint between two metal parts. In such cases, what the POSITA would typically report is the relative hardness of the joint region compared to areas adjacent to the joint, then extending into the base material that was not affected by the joining process. As such, the relative hardnesses provide information about the mechanical properties of the material after joining.

75. 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 with respect to the innermost layer to those of claim 3, as shown below (for the '227 Patent values, the chart uses the midpoints of the claimed ranges). For this additional reason, claim 3 is obvious over Takagi in view of Cornette.



76. As an additional reason for the obviousness of claim 3, the layer compositions disclosed by Takagi (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. The hardnesses of claim 3 appear to derive from "Example 2" of the '227 Patent. As shown in the table below, the Takagi compositions and the Example 2 compositions are very similar to one another.

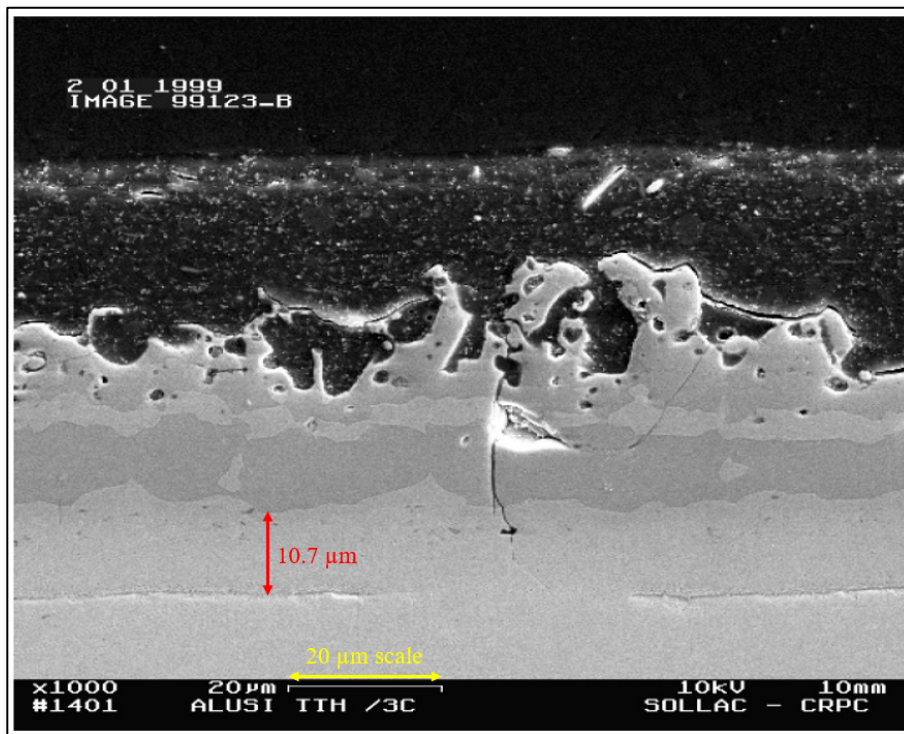
Layer	'227 Patent Example 2 Composition	Takagi No. 1 Composition	Takagi No. 4 Composition	Takagi No. 5 Composition
(a)	7 Al% 3 Si% 90 Fe%	7.7 Al% 2.0 Si% 89.6 Fe%	6.0 Al% 1.5 Si% 90.7 Fe%	3.2% Al 0.4% Si 94.3% Fe
(b)	57 Al% 1 Si% 43 Fe%	48.4 Al% 1.2 Si% 50.1 Fe%	51.9 Al% 0.6 Si% 46.8 Fe%	54.5% Al 2.5% Si 42.7% Fe
(c)	31 Al% 4 Si% 65 Fe%	31.6 Al% 5.7 Si% 62.0 Fe%	30.4 Al% 5.3 Si% 63.1 Fe%	33.4% Al 15.3% Si 51.4% Fe
(d)	54 Al% 1 Si% 45 Fe%	54.8 Al% 0.8 Si% 44.5 Fe%	47.4 Al% 2.2 Si% 49.8 Fe%	54.5% Al 6.8% Si 38.4% Fe

77. I am advised that, where the claimed and prior art products are identical or substantially identical, or are produced by identical or substantially identical processes, the claimed product is obvious absent evidence to the contrary. Here, the prior art compositions are very similar to the Example 2 compositions and were obtained using substantially similar process parameters, as I discussed in §VI.C. Hardness is a function of **composition** and **thermal history**. It follows that the layers of the Takagi-Cornette coatings would have had the same or substantially the same hardnesses as those of the '227 Patent's Example 2 and, thus, of claim 3.

4. 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.

78. Takagi's coating, modified to have the layer thicknesses of Cornette's FIG. 22 coating as discussed in §VI.C, has a layer (a) thickness of 17 μm or less. For example, at one position, as shown below, this layer has a measured thickness of 10.7 μm . *See also* discussion of claim 2 above, illustrating a measured thickness of 12.4 μm at a different position. Nor does the '227 Patent allege or evidence any criticality or unexpected results associated with the claimed range.



Annotated Cornette FIG. 22

5. 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.

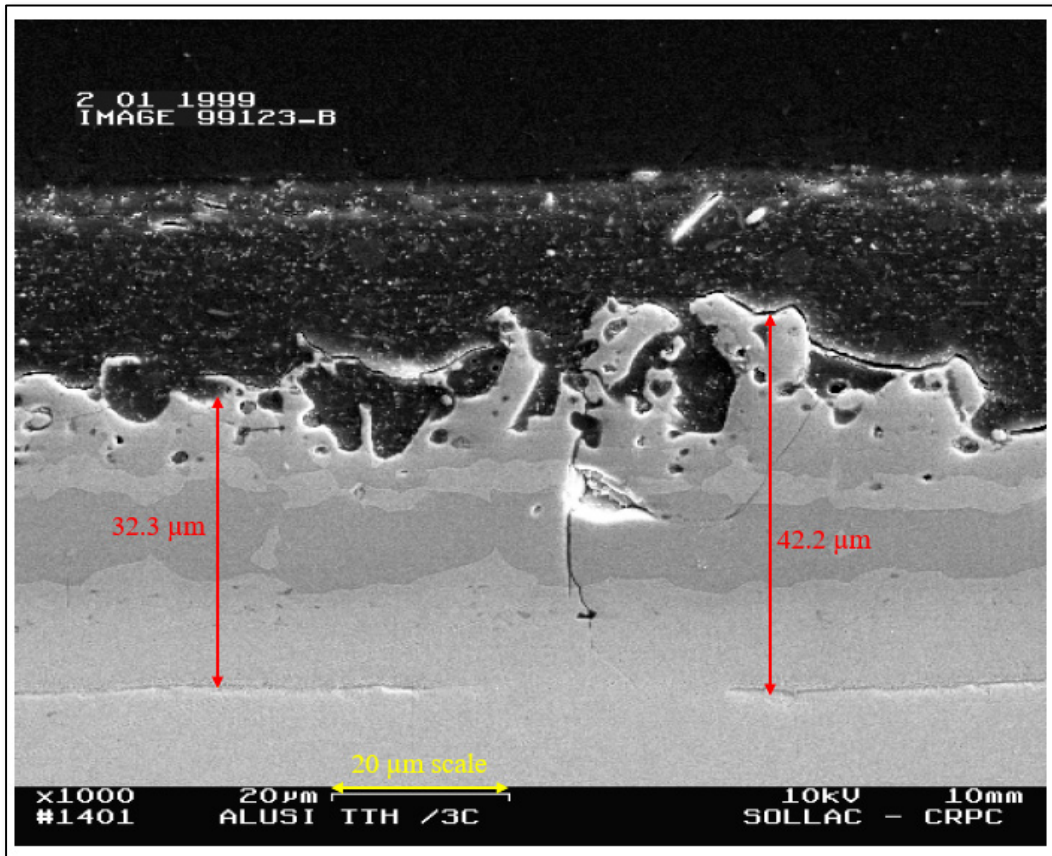
79. See discussion of claim 2 and 4 above. The '227 Patent does not

allege or evidence any criticality or unexpected results associated with the claimed range.

6. Claim 6

[6]: The hot stamped coated steel product according to claim 4, wherein the coating is 40 micrometers thick.

80. Takagi's coating, modified to have the layer thicknesses of Cornette's FIG. 22 coating as discussed in §VI.C, has a coating thickness of 40 μm . For example, Cornette FIG. 22, besides illustrating a coating thickness of 32.3 μm as discussed above, also discloses a coating thickness of 42.2 μm , at a different measurement position. Because the coating thickness is a physical, continuous quantity, it follows that the thickness must be exactly 40 μm at at least one position.



Annotated Cornette FIG. 22

81. In addition, it would have been obvious to arrive at a 40 μm thickness based on Cornette. As discussed for claim 1, it would have been obvious to form the Takagi-Cornette coatings with the thickness described by Cornette, that is, “**about 40 μm .**” The coatings of the Takagi-Cornette combination, having this “about 40 μm ” thickness, render obvious the claimed thickness of “40 micrometers” in conjunction with claim 4’s recitation of the layer (a) thickness, particularly as Cornette FIG. 22 directly shows a layer satisfying both of those claims. *See* discussion at §VI.C relating to the obviousness of this combination and

the reasonable expectation of success of a POSITA in making the combination.

82. Further, although I am advised that discovery of an optimum value may be non-obvious where the results of optimizing a variable were unexpectedly good, 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 the '227 Patent's "Example 2," whereas the "preferred" range is "greater than 30 micrometers." EX-1001, 6:46-47, 12:41-42.

7. 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 begin less than the third mean iron composition.

83. The No. 1, 4, and 5 coatings have mean iron compositions satisfying claim 7, as shown below. EX-1016, Table 1.

For each coating, Fe%(layer (a)) > Fe%(layer (c)) > [Fe%((layer (b)) and Fe% (layer (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	2.2	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	(a)	—	(b)	(c)	(d)								
			Hv	—	—	—	—	—								
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								

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

Annotated Takagi Table 1

8. 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).

84. It would have been obvious to form Takagi's coatings with a thickness of layer (a) that is greater than a thickness of layer (b). First, Takagi teaches the desirability of having a thickness of a "soft layer" "at or near the boundary between the steel and the coating" where "the 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 "thick soft layer extending from a level at or near

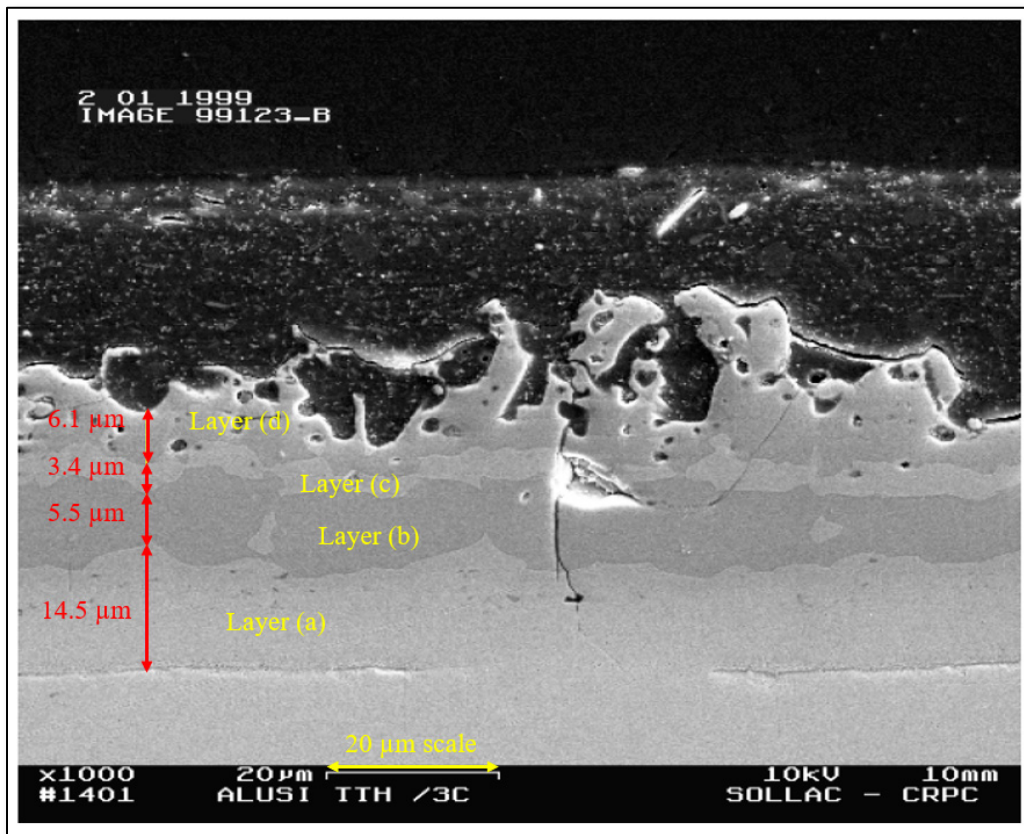
the boundary with the steel substrate, to or beyond the middle in the depth of the coating layer is effective for preventing progress of crack and securing sufficient corrosion resistance.” *Id.*

85. It would have been obvious for a POSITA to apply these teachings to obtain coatings having an innermost layer (i.e., layer (a)) having a thickness greater than 50% of the total thickness. For example, Takagi’s Table 1 suggests that each of the No. 1, 4 and 5 coatings have an innermost layer satisfying this condition (as indicated by the “SOFTER RANGE” column showing a soft innermost layer being greater than 50% of the coating), and a POSITA would have been motivated to try applying, and experimenting based on, Takagi’s corresponding temperatures and hold times to obtain a similarly-proportioned inner layer. EX-1016, Table 1. Elsewhere, Takagi discloses other detailed process parameters, including heating rate, forming temperature, and cooling rate associated with obtaining this layer characteristic. EX-1016, [0026]-[0027], [0037]. As such, obtaining a layer (a) constituting at least 50% of the coating thickness would have constituted nothing more than routine optimization within the general conditions already set forth by Takagi. Further, the ’227 Patent does not allege or evidence any criticality or unexpected results associated with the claimed thickness relationship.

86. With layer (a) being at least 50% of the total thickness of the No. 1, 4, and 5 coatings, layer (a) would necessarily be greater than a thickness of layer (b)

(e.g., greater than a thickness of the Inter 1 or Inter 2 layers of the coating).

87. In addition, Takagi's coating, modified to have the layer thicknesses of Cornette's FIG. 22 coating as discussed in §VI.C, satisfies claim 8. As reflected in the annotated Cornette FIG. 22 below, one measured thickness of the innermost layer (corresponding to layer (a)) is **14.5 μm** , which is greater than a measured thickness of **5.5 μm** for the next layer (corresponding to layer (b)).



Annotated Cornette FIG. 22

9. 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).

88. See claim 8. Layer (a) having a thickness of at least 50% of the coating, as taught by Takagi, would have a thickness greater than a thickness of layer (c). Further, the Takagi-Cornette No. 5 coating has measured thicknesses for layers (a) and (c) of **14.5 μm** and **3.4 μm** , respectively, thereby rendering obvious claim 9. Further, the '227 Patent does not allege or evidence any criticality or unexpected results associated with the claimed thickness relationship.

10. 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).

89. See claim 8. Layer (a) having a thickness of at least 50% of the coating, as taught by Takagi, would have a thickness greater than a thickness of layer (d). Further, the Takagi-Cornette No. 5 coating has measured thicknesses for layers (a) and (c) of **14.5 μm** and **6.1 μm** , respectively, thereby rendering obvious claim 10. Further, the '227 Patent does not allege or evidence any criticality or unexpected results associated with the claimed thickness relationship.

11. 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).

90. See claims 8-10.

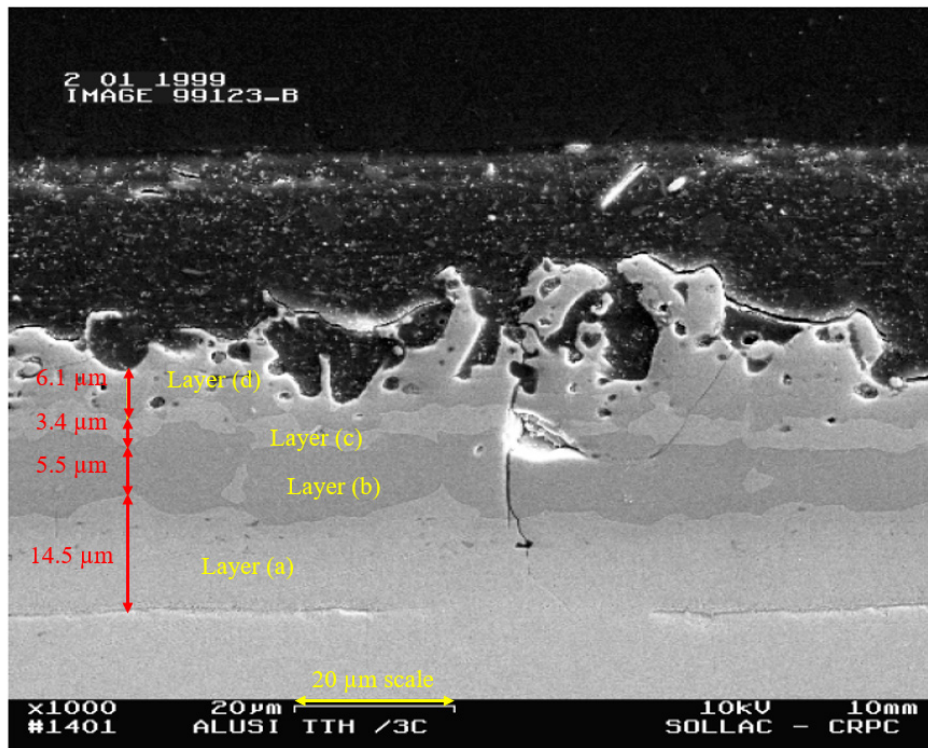
12. Claims 12-14

[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).

[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).

[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).

91. See claims 8-10. The Takagi-Cornette No. 5 coating has measured thicknesses for layers (a), (b), (c), and (d) of **14.5 μm , 5.5 μm , 3.4 μm , and 6.1 μm** , respectively. EX-1014, FIG. 22. 14.5 μm is more than twice 5.5 μm , 3.4 μm , and 6.1 μm . Further, the '227 Patent does not allege or evidence any criticality or unexpected results associated with the claimed thickness relationships.



Annotated Cornette FIG. 22

13. Claim 15

[15]: *The hot stamped coated steel product according to claim 1, wherein the hot stamped coated steel product is fully martensitic.*

92. Takagi in view of Cornette renders a fully martensitic product. Takagi suggests the desirability of obtaining a martensitic steel and discloses specific processing parameters for obtaining such a steel, describing that “[w]hen the forming operation is started at a temperature lower than 700° C., the quenching temperature is too low for martensitic transformation. When the cooling rate after the forming operation is slower than 20° C./sec, the transformation to martensite is insufficient, and the diffusion of Fe proceeds too much.” EX-1016, [0028]. It

would have been obvious to a POSITA to apply these cooling parameters to hot-stamping to obtain a martensitic steel, as a matter of simply applying known techniques and parameters to obtain a predictable result.

93. Takagi does not disclose that these parameters result in a **fully** martensitic structure. However, the difference between “martensitic” and “fully martensitic” is at most a change in degree, and my understanding is that differences in degree are obvious, absent countervailing evidence.

94. Further, the cooling rate disclosed by Takagi as being required for a martensitic transformation (at least 20°C/sec, or a range of “20-100° C./sec”) is similar to the cooling rate of at least 30°C/sec described by the ’227 Patent. EX-1016, [0028]; EX-1001, 7:44-46. Indeed, Takagi’s implemented thermal treatment uses a cooling rate of 30°C/sec. Based on Takagi’s suggestion of the desirability of martensite and teaching that the cooling rate is a result-effective variable for controlling the martensitic transformation, it would have been obvious for a POSITA to optimize the cooling rate to obtain a fully martensitic structure.

14. 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.

95. As taught in Takagi’s Table 1, the Inner layers of Nos. 1 and 4 have

compositions of **89.6% Fe, 7.7% Al, 2.0% Si**, and **90.7% Fe, 6.0% Al, 1.5% Si**, respectively, within the claimed range.

96. The Inner layer of the No. 5 coating has a composition of **94.3% Fe, 3.2% Al, 0.4% Si**. EX-1016, Table 1. These iron and silicon compositions are within the claimed range, whereas the Al% differs by 0.8% from the 4% of claim 11. Takagi's Al% value, which is close to the claimed range, renders obvious the claimed range for the reasons discussed below for claim 19.

97. Further, Takagi's percentages are "mass %," which is equivalent to weight % because weight and mass are related by a constant factor that cancels out when calculating mass/weight proportions. EX-1016, [0020]. A POSITA would have understood these percentages to be based on total weight. For example, the composition percentages for each layer do not sum to 100%, suggesting that the percentages are based on a total weight and not, for example, limited to consideration of Fe, Al, and Si.

15. 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.

98. The intermediate layer corresponds to the Inter 2 layer of the Takagi/Takagi-Cornette No. 1 and 4 coatings and the Inter 1 layer of the

Takagi/Takagi-Cornette No. 5 coating. These layers have compositions, respectively, of or similar to (i) **50.1% Fe, 48.4% Al, 1.2% Si**, (ii) **46.8% Fe, 51.9% Al, 0.6% Si**, and (iii) **42.7% Fe, 54.5% Al, 2.5% Si**. These values are within the recited ranges except for No. 1 Al% (deviation of 4.6%), No. 1 Fe% (deviation of 3.1%), No. 4 Al% (deviation of 1.1%), and No. 5 Si% (deviation of 0.5%).

99. These compositions render obvious the claimed compositions. I am informed that a claimed amount that does not overlap with, but is close to, a prior art amount, is obvious absent countervailing evidence such as unexpected results. Here, the '227 Patent describes no criticality or unexpected results for the claimed ranges compared to Takagi's very similar values. Based on my metallurgical experience, a POSITA would not expect there to be any qualitative difference in layer properties between, for example, a 53% Al layer and a 51.9% Al layer, or between a 2% Si layer and a 2.5% Si layer.

100. Moreover, a POSITA would have been motivated to experiment with various Al%, Fe%, and Si% to arrive at the claimed compositions. First, a POSITA would have naturally understood that the concentrations of components in a layer would be relevant for determining properties of that layer. In addition, Takagi describes both Fe% and Al% as result-effective, noting specifically Fe%'s relationship to hardness and Al%'s relationship to corrosion resistance. EX-1016,

[0020]-[0021]. Takagi also describes the physical mechanism behind layer formation and how “the diffusion quantity of Fe [can be] varied” (which would correspond to control of Al%, Fe%, and Si%) “by controlling the raised temperature of the heating and the holding time at the raised temperature.” EX-1016, [0019]. This emphasis on layer composition as a parameter to be tuned would have been corroborated by (i) Maki’s disclosure that Al% at least partially determines corrosion resistance, (ii) WO02/103073’s disclosure that Si% and Al% modulate layer hardness, workability, weldability, and/or corrosion resistance, and (iii) the Laurent Presentation’s detailed measurements of layer composition within a hot-stamped coating. EX-1034, [0012]; EX-1035, 25:21-28, 29:3-7, 31:6-12; EX-1056, 7. By varying the parameters noted by Takagi and Cornette (e.g., heating rate, heating temperature, holding time, and the like), it would have been obvious for a POSITA to arrive at the claimed compositions as a result of routine experimentation of result-effective variables.

101. Also, the above differences in Al%, Fe%, and Si% (e.g., the difference between 51.9% and 53%) would have been well within manufacturing tolerances and measurement accuracy for a micron-scale layer in a thin, multi-layer coating. Layers would never be perfectly uniform, and the composition of the layer would be expected to vary from part-to-part and within a given part. And the disclosed compositions would have been obtained by Scanning Electron

Micrograph Energy Dispersion Spectroscopy (SEM-EDS), for which, in which experience, measured element compositions can vary by a percentage or more. Indeed, based on my professional and academic experience, a POSITA would not have expected there to be any such qualitative difference in properties, as the differences in composition are not greater than many ranges given for nominal steel compositions, which can routinely span 20% or more. *See, e.g., EX-1047, Table 1.*

102. Based on the above reasoning, Takagi's disclosed compositions render obvious the compositions of claim 19.

16. 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.

103. As taught in Takagi's Table 1, the Inter 3 layers of Nos. 1 and 4 have compositions of **62.0% Fe, 31.6% Al, 5.7% Si**, and **63.1% Fe, 30.4% Al, 5.3% Si**, respectively, values within the claimed range.

17. 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.

104. As taught in Takagi's Table 1, the Outer layers of Nos. 1, 4, and 5 have compositions of **44.5% Fe, 54.8% Al, 0.8% Si; 49.8% Fe, 47.4% Al, 2.2% Si; and 38.4% Fe, 54.5% Al, 6.8% 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. For No. 5, the Al% is within the claimed range, while the Fe% differs by 0.6% and the Si% differs by 4.8%. Absent evidence of criticality or unexpected results, these values render obvious the claimed ranges as discussed for claim 19.

18. Claims 22-23

105. See claims 19-20.

19. Claims 24-25

[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.

[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.

106. Takagi in view of Cornette renders obvious mechanical strengths in excess of 1500 MPa. First, it would have been obvious to use the well-known

USIBOR 1500 steel taught by Cornette, motivated by Cornette's disclosure that this steel provides "excellent mechanical properties of the material after the press hardening process with good corrosion protection." EX-1014, 9. It would also have been obvious to use, or optimize based on, Cornette's hot-stamping thermal parameters, such as "austenitization at 900°C during 5 minutes and cooling in the die." EX-1014, 10. The POSITA would also have been guided by Takagi's disclosure that high strength is provided when the hold temperature is at least 900 °C and that strength can be "enhance[d]" using certain cooling rates and temperatures at the start of forming (stamping). EX-1016, [0026], [0028].

107. By optimization of these parameters within the general conditions of the art, it would have been obvious for a POSITA to arrive at Cornette's mechanical strength of **1510 MPa**, which is described by Cornette as "typical." EX-1014, 10. Indeed, a POSITA would have understood that the name of Cornette's "USIBOR 1500" steel derives from the tensile strengths of 1500 MPa or higher achievable using the steel. A POSITA would have known that USIBOR 1500 is called "USIBOR 1500" specifically because the steel can achieve mechanical strength at or in excess of 1500 MPa. The convention for all alloys in the advanced high strength steel (AHSS) category is to use UTS as part of the name. For example, a dual phase steel with nominal UTS of 980 is referred to in the industry as DP 980. A transformation-induced plasticity steel (TRIP) with UTS

of 1180 is referred to in the industry as TRIP 1180. Hot stamped boron steels are in the upper range of AHSS alloys, and use the same convention, where the mechanical strength of the material is provided as UTS (e.g., USIBOR 1500). As such, a POSITA would have had a reasonable expectation of success in achieving the recited strengths.

VII. GROUND 1B: Claims 16-17 are obvious over Takagi in view of Cornette and Laurent

A. Laurent

108. 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. EX-1023, 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. This disclosure indicates that the steels of Laurent are well-suited for hot-stamping processes.

B. Combination of Takagi-Cornette and Laurent

109. It would have been obvious to use the steel compositions of Laurent as the base steel when applying Takagi and Cornette. While Takagi discloses certain characteristics of a “[b]ase material” including a “steel sheet,” Takagi does not disclose elemental concentrations of the base steel. EX-1016, [0046]. As such, a POSITA would have looked to Laurent to teach the base steel composition. 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 and Laurent's description that the disclosed compositions "make[] it possible to obtain high mechanical characteristics which may exceed 1500 MPa for mechanical resistance." EX-1023, 2:46-50. For example, Laurent describes that certain "[c]hromium, manganese, boron, and carbon" concentrations are used "for their effect on hardenability" and that the disclosed manganese, chromium, and boron concentrations are "optimized from the point of view of weldability." EX-1023, 4:19-33. And a POSITA would have had a reasonable expectation of success in using Laurent's base steel, given that Laurent discloses the steel in the specific context of hot-stamping ("stamping" and "hot-shaping"), the method applied by Takagi and Cornette. EX-1023, 2:46-61.

110. In view of Cornette's disclosure of certain compositions for a "USIBOR 1500" steel, the use of Laurent's steel instead of Cornette's would have constituted a minor substitution. Indeed, Cornette's steel (USIBOR 1500) and Laurent's steel have generally similar compositions, such that the substitution of one for the other would have constituted only a minor modification within the general conditions of what was already in use.

Element	Cornette (USIBOR 1500) Composition (%)	Laurent Composition (%)
C	$0.2 \leq C\% \leq 0.25$	$0.20\% < C < 0.5\%$
Mn	$1.1 \leq Mn\% \leq 1.35$	$0.8\% < Mn < 1.5\%$
Si	$0.15 \leq Si\% \leq 0.35$	$0.1\% < Si < 0.35\%$
Cr	$0.15 \leq Cr\% \leq 0.3$	$0.01\% < Cr < 1\%$
Ti	$0.02 \leq Ti\% \leq 0.05$	$Ti < 0.1\%$
Al	$0.02 \leq Al\% \leq 0.06$	$Al < 0.1\%$
P	--	$P < 0.05\%$
S	≤ 0.008	$S < 0.03\%$
B	$0.002 \leq B\% \leq 0.004$	$0.0005\% < B < 0.01\%$

C. Analysis of Claims 16-17

[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: $0.15\% < \text{carbon} < 0.5\%$; $0.5\% < \text{manganese} < 3\%$; $0.1\% < \text{silicon} < 0.5\%$; $0.01\% < \text{chromium} < 1\%$; $\text{titanium} < 0.2\%$; $\text{aluminum} < 0.1\%$; $\text{phosphorus} < 0.1\%$; $\text{sulfur} < 0.05\%$; $0.0005\% < \text{boron} < 0.08\%$; a remainder being iron and impurities inherent in processing.

[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: $0.15\% < \text{carbon} < 0.25\%$, $0.8\% < \text{manganese} < 1.8\%$, $0.10\% < \text{silicon} < 0.35\%$, $0.01\% < \text{chromium} < 0.5\%$, $\text{titanium} < 0.1\%$ $\text{aluminum} < 0.1\%$ $\text{phosphorus} < 0.1\%$

0.002% < boron < 0.005%, a remainder being iron and impurities inherent in processing.

111. The “preferabl[e]” steel “composition by weight” of Laurent disclosed at the top of col. 2 satisfies or renders obvious claims 16-17. EX-1023, 1:66-2:10. For example, it would have been obvious to optimize compositions within the ranges disclosed by Laurent, to arrive at values within the ranges of claims 16-17. I am informed that a recited range overlapping with or lying inside a range disclosed by the prior art is obvious, absent countervailing evidence such as unexpected results, which have not been alleged or evidenced here.

Element	[16] composition	[17] composition	Laurent composition (col.2)
C	0.15% < C < 0.5%	0.15% < C < 0.25%	0.20% < C < 0.5%
Mn	0.5% < Mn < 3%	0.8% < Mn < 1.8%	0.8% < Mn < 1.5%
Si	0.1% < Si < 0.5%	0.10% < Si < 0.35%	0.1% < Si < 0.35%
Cr	0.01% < Cr < 1%	0.01% < Cr < 0.5%	0.01% < Cr < 1%
Ti	Ti < 0.2%	Ti < 0.1%	Ti < 0.1%
Al	Al < 0.1%	Al < 0.1%	Al < 0.1%
P	P < 0.1%	P < 0.1%	P < 0.05%
S	S < 0.05%	S < 0.05%	S < 0.03%
B	0.0005% < B < 0.08%	0.002% < B < 0.005%	0.0005% < B < 0.01%
Remainder	“iron and impurities inherent in processing”	“iron and impurities inherent in processing”	“iron and impurities inherent in processing”

VIII. GROUND 1C: Claim 15 is obvious over Takagi in view of Cornette and Vaissiere

A. Vaissiere

112. Vaissiere describes “development of the pre-coated boron steel associated with the hot stamping.” EX-1021, 3. 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 Takagi-Cornette and Vaissiere and

Analysis of Claim 15:

[15]: The hot stamped coated steel product according to claim 1, wherein the hot stamped coated steel product is fully martensitic.

113. It would have been obvious to apply Vaissiere’s teachings to Takagi and Cornette to obtain a “fully martensitic” structure. Vaissiere describes that “pre-coated USIBOR 1500, optimized for the stability of its quenchability, is transformed, at the end of forming, into **pure martensite** thus giving very high mechanical characteristics to then [sic] finished part.” EX-1021, 9. A POSITA would have been motivated to obtain these high mechanical characteristics by using the pre-coated USIBOR 1500 steel described by Vaissiere (in agreement with Cornette) and by using the thermal parameters described by Vaissiere as providing the “pure martensite.”

114. Specifically, it would have been obvious to follow Vaissiere’s

teaching that “[t]he critical quenching speed enabling a **completely martensitic structure**, under these conditions, is **27°C/s**.” EX-1021, 6. That is, a POSITA would have found it obvious to use the known technique of cooling with at least this quenching speed, to improve the similar Takagi-Cornette parts and obtain the predictable result of a “completely martensitic structure” with “high mechanical characteristics.” EX-1021, 9. Notably, this quenching speed is within the range of at least 20°C/sec described by Takagi as providing a martensitic structure, such that the combination with Vaissiere would have constituted only optimization within the range already taught by Takagi. EX-1016, [0028]. For example, a POSITA would have naturally tried increasing the cooling rate if the microstructure obtained after quenching in the die were not fully martensitic, based on the existing recognition that cooling rate is a key parameter for obtaining martensite.

115. As a result of this obvious optimization, a POSITA would have arrived at the “**completely martensitic structure**,” “**pure martensite**,” and “**totally martensitic structure**” described by Vaissiere. EX-1021, 5-6, 9.

IX. GROUND 1D: Claims 1-11 and 15-25 are obvious over Takagi in view of GMW14400

A. GMW14400

116. GMW14400 is a material specification published by General Motors

and designed to inform steel makers of the requirements of steel to be used in GM vehicles. Steel manufacturers were required to follow this specification to supply vehicle parts to GM. 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.*

117. 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.

B. Combination of Takagi and GMW14400

118. GMW14400 is applied at least as a substitute for Cornette, as applied in Grounds 1A-1C, to teach and motivate a coating thickness “>35” μm . EX-1026, 7; GMW14400 teaches that a coating thickness “>35” μm can be achieved by using a pre-coating thickness (“[p]rior to hot-stamping”) of “20 to 33” μm , a range that overlaps with Takagi’s pre-coating thickness range of 10-20 μm . EX-1016, [0035]; EX-1026, 7. As such, GMW14400 is applied as evidencing Takagi’s teaching of coating thicknesses greater than 30 μm .

119. Further, GMW14400 demonstrates strong market motivation and demand to achieve such a thickness, as steel researchers and manufacturers would have been highly motivated to conform to General Motors' requirements. Accordingly, to the extent Takagi fails to explicitly teach a coating thickness greater than 30 μm , it would have been obvious to modify Takagi to have such a thickness, in view of GMW14400. For example, it would have been obvious for a POSITA to experiment with the pre-coating thickness in the range of "20 to 33" μm specified by GMW14400, with this range representing only a very small to moderate increase in pre-coating thickness compared to Takagi's 20 μm . EX-1016, [0035]; EX-1026, 7. *See* §VI.C for discussion of the well-established and predictable link between pre-coating thickness and coating thickness. Accordingly, in view of GMW14400, a POSITA would have had a reasonable expectation of success in achieving coating thicknesses greater than 30 μm , e.g., the ">35" μm coating thicknesses disclosed by GMW14400.

C. Analysis of Claims

1. Claims 1, 3, 7, 15, 18-23

120. *See* discussion for Ground 1A, with GMW14400's evidence of coating thicknesses greater than 30 μm , and GMW14400's motivation and teachings on how to obtain coating thicknesses greater than 30 μm , substituted for Cornette's.

2. 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.

121. See discussion of claim 2 for Ground 1A. Takagi's teaching of a thickness range abutting that of claim 2 renders obvious the claimed range.

3. Claims 4-5

[4]: The hot stamped coated steel product according to claim 1, wherein said layer (a) has a thickness of 17 micrometers or less.

[5]: The hot stamped coated steel product according to claim 1, wherein said layer (a) has a thickness of 15 micrometers or less.

122. It would have been obvious to achieve a layer (a) thickness of 17 μm or less, or 15 μm or less, based on Takagi and GMW14400. A POSITA forming a coating with about 35 μm thickness (to satisfy GMW14400) and an Inner layer with thickness "greater than or equal to 50% of a thickness of the" coating (as taught by Takagi), would obtain a layer (a) with a thickness of 17.5 μm . EX-1016, [0005]; EX-1026, 7. Both 17 μm and 15 μm are obvious in view of 17.5 μm , for example, based on routine optimization of the layer thickness (recognized by Takagi as result-effective). EX-1016, [0017]. Indeed, the differences between 17.5 μm and 17 or 15 μm are less than the location-to-location variation observed for the innermost layer in various documents illustrating a multilayer coating. EX-

1014, FIG. 22; EX-1055, FIG. 12; EX-1005, FIG. 5; EX-1019, FIG. 4. As such, even a layer with a nominal “thickness” of 17.5 μm would be expected to have thicknesses of 15 or 17 μm at one or more positions.

4. Claim 6

[6]: The hot stamped coated steel product according to claim 4, wherein the coating is 40 micrometers thick.

123. In applying GMW14400 to Takagi, it would have been obvious to optimize the coating thickness within the “>35” μm range disclosed by GMW14400, thereby arriving at a 40 μm thickness. EX-1026, 7. It would also have been obvious to have a corresponding layer (a) thickness of 20 μm based on Takagi (that is, making the layer (a) thickness half the total coating thickness), in comparison to which the “17 μm or less” range of claim 4 (from which claim 6 depends) is obvious as a result of routine optimization.

5. Claims 8-11

124. See claims 8-11 for Ground 1A. Takagi teaches an Inner layer with thickness “greater than or equal to 50% of a thickness of the” coating, corresponding to a layer (a) satisfying claims 8-11. EX-1016, [0005].

6. Claims 16-17

125. GMW14400’s steel compositions satisfy or overlap all composition ranges in claims 16-17, rendering obvious those compositions. EX-1026, 2. It

would have been obvious to use these steel compositions to satisfy General Motors' requirements.

126. The "0.010 max. %" nitrogen disclosed by GMW14400 would have been understood by a POSITA as an "impurit[y] inherent in processing." If too much nitrogen is present, the nitrogen will bond with boron, which is a critical element needed to increase hardenability. In the art, we generally seek to minimize the amount of nitrogen, which is considered to be an impurity. Further, the disclosure of "steel" in GMW14400 would have been understood by a POSITA as disclosing that the remainder of the material would be composed of iron and any trace impurities, iron being the primary component of steel.

127. Further, 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%. For example, because GMW14400 does not teach the inclusion of Ti and [16]-[17] recite ranges that include 0% Ti, GMW14400 teaches a Ti% within the claimed range.

Element	[16] composition	[17] composition	GMW1440 composition
C	0.15% < C < 0.5%	0.15% < C < 0.25%	0.20 to 0.25% C
Mn	0.5% < Mn < 3%	0.8% < Mn < 1.8%	1.00 to 1.35% Mn
Si	0.1% < Si < 0.5%	0.10% < Si < 0.35%	0.15 to 0.35% Si
Cr	0.01% < Cr < 1%	0.01% < Cr < 0.5%	0.11 to 0.35% Cr
Ti	Ti < 0.2%	Ti < 0.1%	[none (satisfied)]
Al	Al < 0.1%	Al < 0.1%	0.010 min. % Al
P	P < 0.1%	P < 0.1%	0.025 max. %
S	S < 0.05%	S < 0.05%	0.010 max. %
B	0.0005% < B < 0.08%	0.002% < B < 0.005%	0.0015 to 0.005 wt. %
Remainder	“iron and impurities inherent in processing”	“iron and impurities inherent in processing”	iron (implicit); 0.010 max. % N

7. Claims 24-25

128. GMW14400’s “Hot-Stamped Product Mechanical Requirements” dictate a “Tensile Strength” in a range from 1300 to 1700 MPa. EX-1026, 6. It would have been obvious for a POSITA to obtain these strengths to satisfy these requirements. A POSITA would have had a reasonable expectation of success in achieving these strengths based on Takagi’s guidance with respect to forming high-strength steels. EX-1016, [0026]-[0028].

X. GROUND 1E: Claims 16-17 are obvious over Takagi in view of GMW14400 and Laurent

A. Combination of Takagi, GMW14400, and Laurent

129. For reasons discussed in §VII.B for the Takagi-Cornette-Laurent combination, it would have been obvious for a POSITA to try using Laurent's base steel when applying Takagi and GMW14400. Notably, Laurent's compositions are similar to those of GMW14400, as shown below, such that this substitution would have been only a minor modification. EX-1026, 2; EX-1023, 1:66-2:10.

B. Analysis of Claims

130. See §VII.C. Laurent's compositions (top of col. 2) satisfy or render obvious the compositions of claims 16-17. EX-1023, 1:66-2:10.

Element	[16] composition	[17] composition	GMW1440 composition	Laurent composition (col.2)
C	0.15% < C < 0.5%	0.15% < C < 0.25%	0.20 to 0.25% C	0.20% < C < 0.5%
Mn	0.5% < Mn < 3%	0.8% < Mn < 1.8%	1.00 to 1.35% Mn	0.8% < Mn < 1.5%
Si	0.1% < Si < 0.5%	0.10% < Si < 0.35%	0.15 to 0.35% Si	0.1% < Si < 0.35%
Cr	0.01% < Cr < 1%	0.01% < Cr < 0.5%	0.11 to 0.35% Cr	0.01% < Cr < 1%
Ti	Ti < 0.2%	Ti < 0.1%	--	Ti < 0.1%
Al	Al < 0.1%	Al < 0.1%	0.010 min. % Al	Al < 0.1%
P	P < 0.1%	P < 0.1%	0.025 max. %	P < 0.05%
S	S < 0.05%	S < 0.05%	0.010 max. %	S < 0.03%
B	0.0005% < B < 0.08%	0.002% < B < 0.005%	0.0015 to 0.005 wt. %	0.0015% < B < 0.01%
Remainder	"iron and impurities inherent in processing"	"iron and impurities inherent in processing"	iron (implicit); 0.010 max. % N	"iron and impurities inherent in processing"

XI. GROUND 1F: Claim 15 is obvious over Takagi in view of GMW14400 and Vaissiere

A. Combination of Takagi, GMW14400, and Vaissiere and Analysis of claim 15

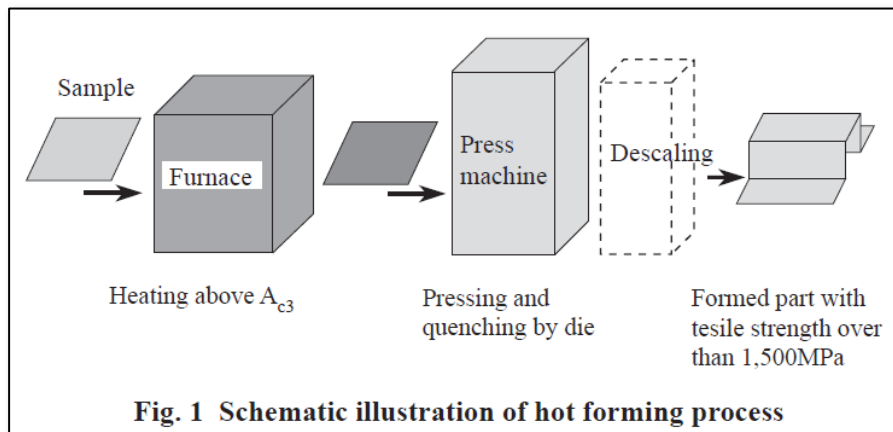
131. *See* §VIII.B for the Takagi-Cornette-Vaissiere combination. In view of Takagi’s teaching of the desirability of martensitic steel and Vaissiere’s teaching of both the desirability of “pure martensite” to obtain “very high mechanical characteristics,” it would have been obvious to apply Vaissiere’s “critical quenching speed” to obtain a “completely martensitic structure. EX-1016, [0028]; EX-1021, 6, 9.

XII. GROUND 2A: Claims 1-2, 4-15, and 18-25 are obvious over Suehiro in view of Cornette

A. Suehiro

132. Like the ’227 Patent, Suehiro is directed to “forming methods including mold quenching, hot forming, hot stamping, and hot pressing ... to obtain parts with a strength of about 1500 MPa.” EX-1055, [02]. As part of a license agreement with Arcelor (a predecessor of ArcelorMittal) regarding Arcelor’s “USIBOR1500, an aluminum-plated product,” Nippon Steel Corporation “has been studying manufacturing technologies and the product characteristics of the USIBOR1500” and issued Suehiro to “report[] the results of our study on various properties of aluminum-plated steel sheets for hot forming applications .” EX-1055, [2].

133. Suehiro outlines the hot forming method that was “already in practical use” and was the same as that of the '227 Patent. EX-1055, [3]. Referring to FIG. 1 (reproduced below), the method starts with “heat[ing]” “steel sheets” “to a temperature in the austenite range [such as] 850°C or higher,” and then “the steel sheet is taken out of the furnace and transported to a press machine, where it is pressed with a mold at room temperature and quenched at the same time.” EX-1055, [03].



Suehiro FIG. 1

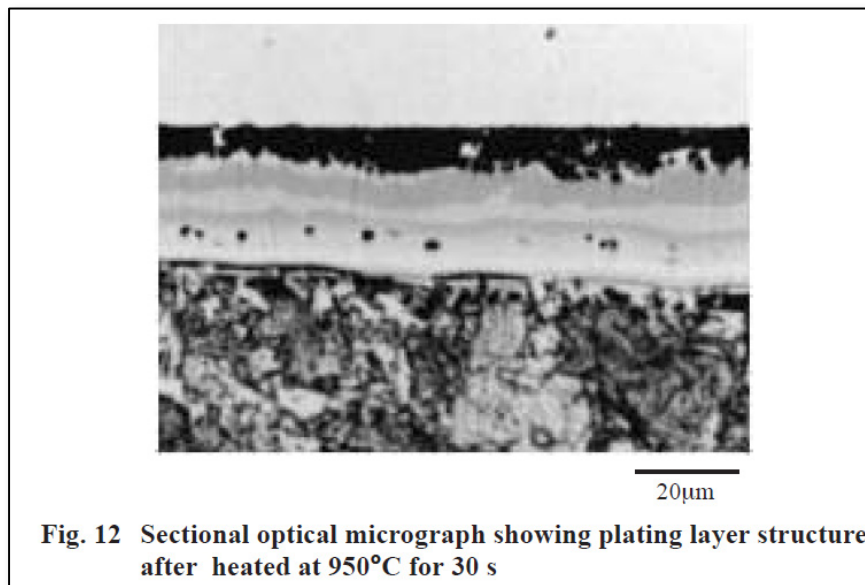
134. Suehiro recognizes the desirability of an aluminized steel sheet for “excellent hardenability” and “excellent heat resistance” and identifies a high-level chemical composition of the aluminized steel. EX-1055, [05], Table 1.

Table 1: Composition of Steel Sheets Used in the Study (mass%)

C	Mn	Cr	B
0.22	1.2	0.15	0.002

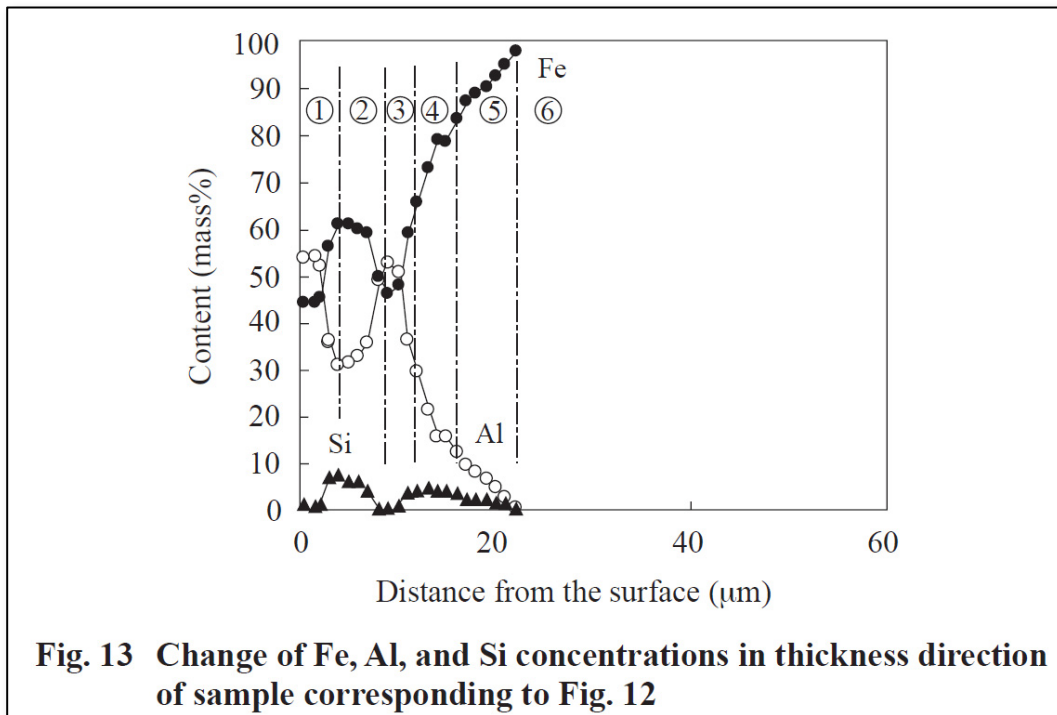
Suehiro Table 1

135. Similar to the '227 Patent, Suehiro shows an example of an Fe-Al-Si alloy layer structure of the steel sheet product after hot forming. EX-1055, [14]-[15]. In particular, Suehiro's "Figure 12 shows the alloying state after holding at 950°C for 0.5 min, and Figure 13 shows the results of SEM-EDS measurements of Fe, Al, and Si concentrations in the surface plating layer in the direction of the plate thickness." EX-1055, [14]-[15]. FIG. 12 shows a total coating thickness of about 22 μm .⁵



Suehiro FIG. 12

⁵ For clarity, this Declaration draws on figures from EX-1053, which are higher-quality than, but otherwise identical to, the corresponding figures of the translated document EX-1055.



Suehiro FIG. 13

B. Combination of Suehiro and Cornette

136. In relation to claim limitation [1h], in view of Cornette, a POSITA would have been motivated and found it obvious to adjust the coating thickness of Suehiro to be greater than 30 μm , for reasons discussed in §VI.C. For example, a POSITA would have been motivated to increase the coating thickness, compared to Suehiro's coating thickness of about 22 μm , to achieve the "typical" thickness of "about 40 μm " that Cornette describes is associated with "the best compromise between corrosion protection and weldability." EX-1014, 9.

137. And, as discussed in §VI.C, the prior art is replete with recognition of coating thickness as a result-effective variable, all of which would have caused a

POSITA to try varying the coating thickness, including pursuing thicker coatings.

In view of this objective, a POSITA would have identified Cornette as a reference that teaches thicker coatings, such as “about 40 μm ” or 32.3 μm . EX-1014, FIG.

22. Based on Cornette’s disclosure, a POSITA would have found it obvious to try modifying Suehiro’s processes based on Cornette’s process parameters and conditions in order to obtain such a coating, for example, by trying Cornette’s “25 μm ” pre-coating thickness and/or by trying, and experimenting based on, Cornette’s disclosed thermal parameters. EX-1014, 9, FIG. 21.

138. A POSITA would have had confidence that these modifications would be successful, because the processes disclosed in Suehiro and Cornette are consistent with one another, such as use of the same precoated steel (e.g., both using USIBOR 1500 steel) and similar heating temperatures and times (e.g., “[h]eating 5-10 min. 880-950 $^{\circ}\text{C}$ ” in Cornette and “850 $^{\circ}\text{C}$ or higher” or 950 $^{\circ}\text{C}$ for 2.5-7 mins⁶ in Suehiro with a 3 min holding time). EX-1021, 9, FIG. 21; EX-1055,

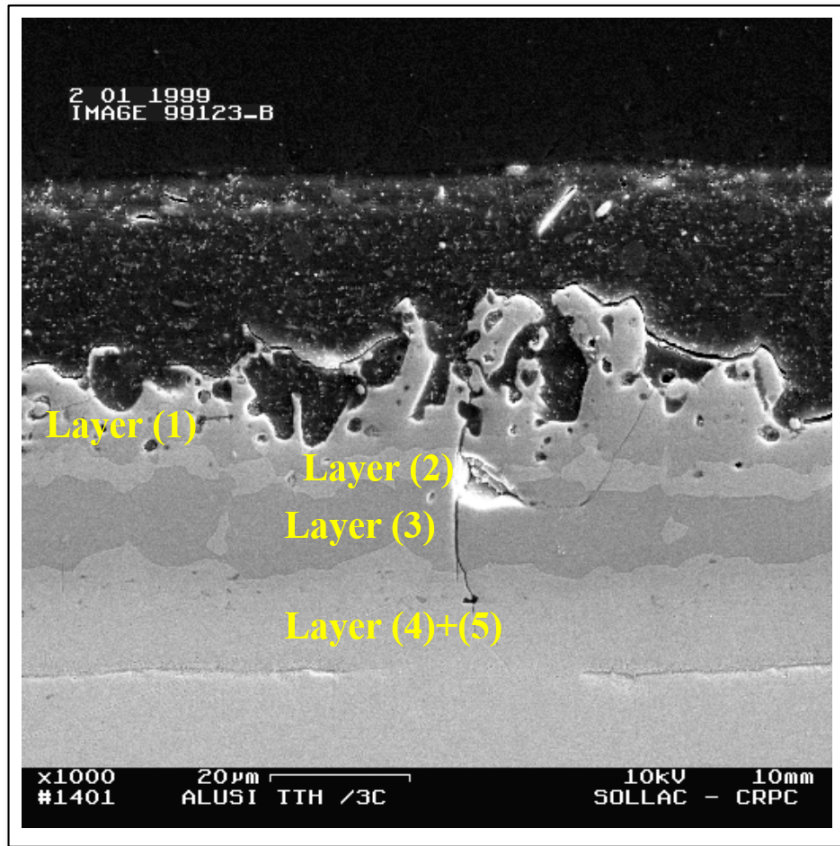
⁶ Suehiro discusses the time (e.g., “180s,” “0.5 min,” or “5 min”) for holding an aluminized steel at a predetermined temperature (e.g., “950 $^{\circ}\text{C}$ ”), separately from a heating phase, namely “the time required to reach the holding temperature” “in an electric furnace under atmospheric conditions,” which is “approximately 2 minutes.”

[14]-[16]. As such, modification of Suehiro based on Cornette would have constituted only a minor modification within the general conditions of what was already in use by Cornette. And, as noted in §VI.C, a POSITA would have also been aware of a direct correlation between pre-coating thickness and coating thickness. EX-1025, 5:17-20. Further, Suehiro and Cornette together identify the key parameters of interest for adjusting coating characteristics, including “[h]eating rate,” “[h]olding time,” pre-coating thickness, and temperature, with similar values to those disclosed by the ’227 Patent and by other references. EX-1055, FIG. 3; EX-1014, 9. *See* §VI.C. Therefore, adjustments to achieve a thicker coating, such as the thicknesses disclosed by Cornette, would have been well within the skill of POSITA and would have been achievable with a reasonable expectation of success. The modifications to Suehiro would have entailed nothing more than applying Cornette’s known techniques and parameters to Suehiro to obtain a predictable result.

139. As a further modification, for reasons discussed in §VI.C for the Takagi-Cornette combination, it would have been obvious, and within the skill of a

EX-1055, [14]-[16], FIG. 3. Therefore, the total heating time would be calculated as the sum of the heating phase (“approximately 2 min”) and the holding time (e.g., “180s,” “0.5 min,” or “5 min”).

POSITA, in modifying Suehiro's coating based on Cornette, to arrive at layer characteristics (e.g., layer thickness and/or morphology) matching, or similar to, those shown in Cornette FIG. 22. For example, as a result of routine experimentation and optimization, it would have been obvious to arrive at Suehiro's layers (1)-(5) with the thicknesses and/or morphologies of Cornette's corresponding layers, as shown below. Layers (4)-(5), as depicted in Suehiro FIG. 12, appear as one layer with a shading gradient, such that these layers together can be mapped to Cornette's innermost layer, which exhibits a similar shading gradient. This agrees with my discussion in §VI.C that hot-stamped coatings often have an innermost layer composed of two sub-layers, and that Cornette's inner layer, which appears to exhibit a shading gradient, may be composed of two sub-layers.



Annotated Cornette FIG. 22

140. Similar to my discussion for the Takagi-Cornette combination, the foregoing Suehiro-Cornette coating, in which Cornette's thickness and layer characteristics are applied to Suehiro's layer compositions, is a member of a wide class of coatings that are rendered obvious by Suehiro in view of Cornette. In view of the similar compositions and heating parameters across the references and the '227 Patent, and based on what would have constituted routine experimentation for a POSITA, a POSITA would have had a reasonable expectation of success in achieving these coatings.

141. For example, insofar as any aspects of the coating layers described in the '227 Patent may be the result of specific heating parameters or pre-coating parameters, a POSITA would have arrived at such layers by routine experimentation. This conclusion is based on a comparison between the values disclosed in the '227 Patent and those in the prior art. The values are generally identical or very similar, and the '227 Patent includes no disclosure to suggest an unexpected criticality in any of these parameters that would place any of the claimed layer parameters outside the bounds of routine experimentation. When comparing the '227 Patent to the prior art, a POSITA would have seen very similar processes being applied to very similar steel parts. EX-1001, 5:17-18, 6:63-67, 7:1, 7:10-14, 7:41-45, 11:11-14, 12:32-40; EX-1016, [0026], [0028], [0037], Table 1; EX-1014, 9; EX-1055, 2-4.

C. Analysis of Claims

1. Claim 1

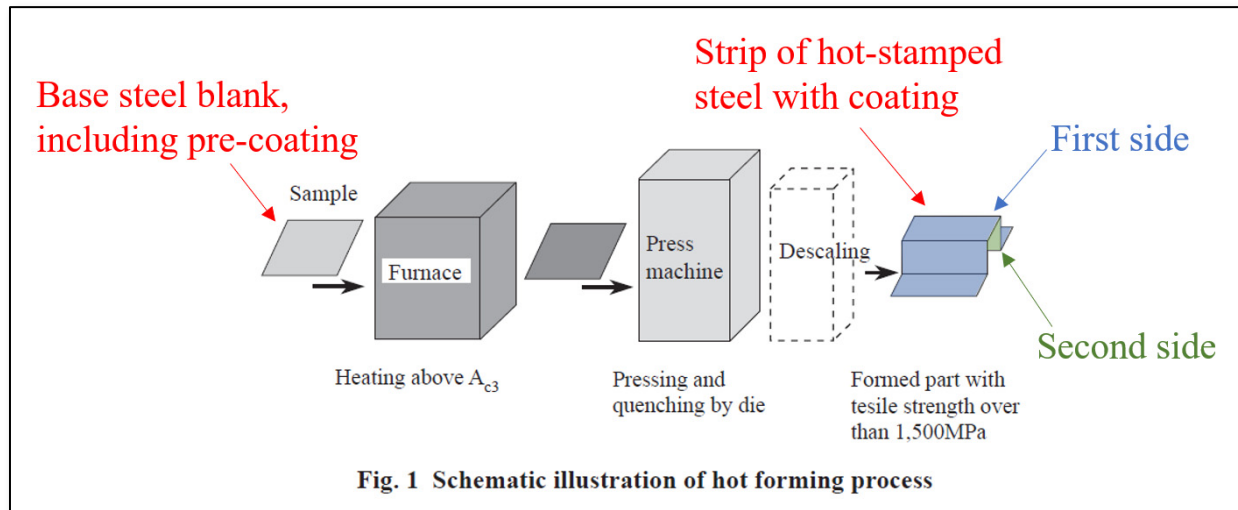
[Ipre]: A hot stamped coated steel product, which comprises:

142. Suehiro's "hot stamp[ed]," "quench[ed]" "steel sheets" formed from "coated" steel are "hot stamped coated steel product[s]" or "hot stamped coated steel stamped blanks." EX-1055, [02], Title.

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

143. Suehiro's "hot stamp[ed]," "quench[ed]" "steel sheets" are "strips of

base steel having a first side and a second side.” EX-1055, [02]. For example, in its description of the hot stamping process, Suehiro illustrates blanks having first sides and second sides, as shown in annotated FIG. 1 below.



Annotated Suehiro FIG. 1

[1b]: 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:

144. Suehiro’s “layered alloy phase” “after holding at 950°C for 0.5 min” is 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.” EX-1055, [15].

[1c]: (i) said coating results from interdiffusion between said base steel and an aluminum or aluminum alloy pre-coating

145. Suehiro’s “layered alloy phase” “results from interdiffusion between said base steel and an aluminum or aluminum alloy pre-coating.” EX-1055, [15].

For example, Suehiro describes that the alloy layer structure derives from “an aluminum plating containing 10% Si” and that, as the steel sheets are heated, “Al diffuses.” EX-1055, [14]-[16].

146. Suehiro describes that “at a heating rate obtained in an electric furnace, a Fe-Al alloy layer with a high melting point is formed during heating and quickly reaches the surface layer, so the melt does not adhere to the furnace material.” EX-1055, [14]. “As alloying progresses, a layered alloy phase with the Al and Fe concentrations shown in the figure is formed.” *Id.* Based on this description, a POSITA would have understood that Suehiro’s layer structure (coating) was formed by interdiffusion between the iron of the base steel and the aluminum and silicon of the pre-coating.

[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

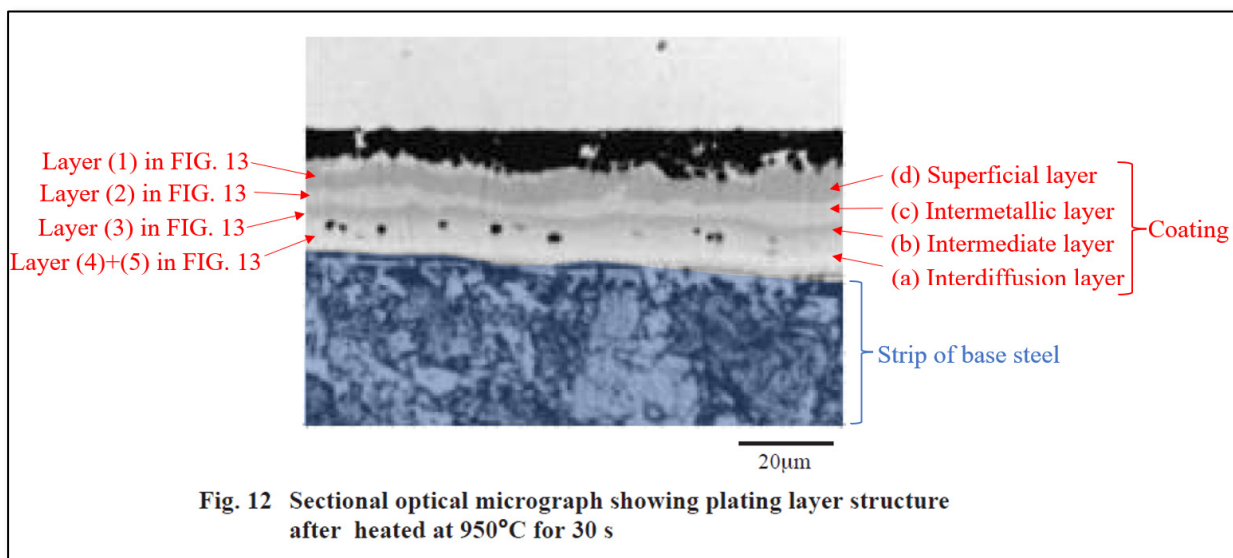
[1h]: (d) a Superficial layer,

147. Suehiro’s “layered alloy phase ” includes, proceeding from the base steel outwards, (a) an Interdiffusion layer, (b) an Intermediate layer, (c) an Intermetallic layer, and (d) a Superficial layer. EX-1055, [15]. Suehiro describes

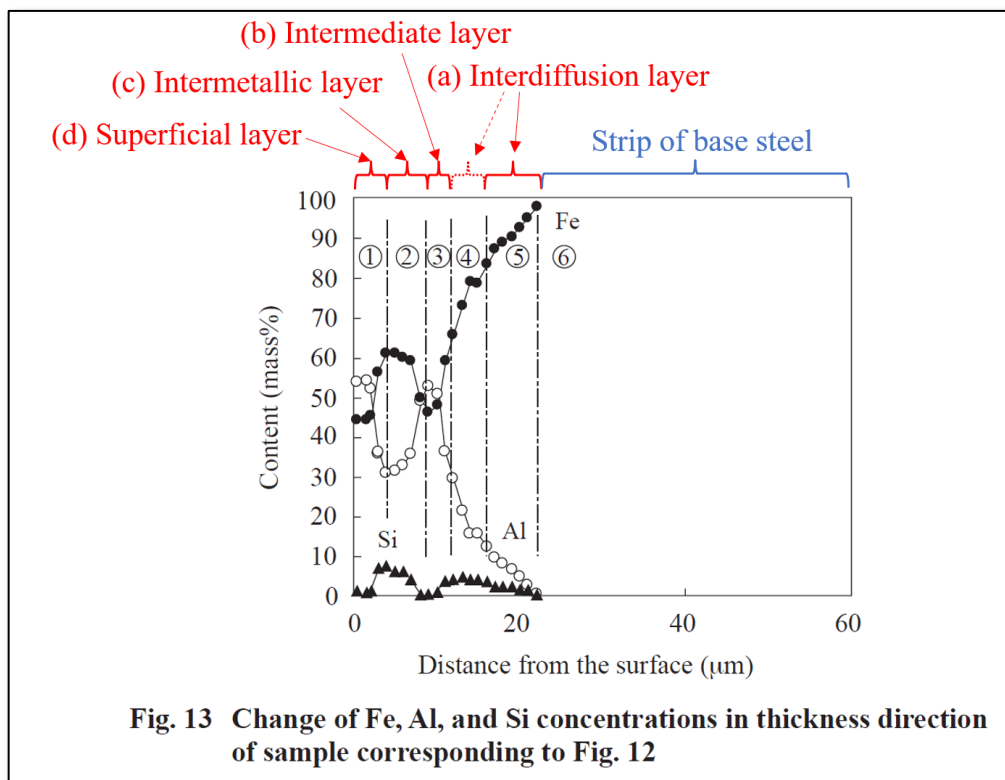
that this “alloy phase consists of five layers.” EX-1055, [15]. These five layers are labeled by Suehiro in FIG. 13. At least four layers are also visible in FIG. 12, based on their different shadings. The innermost visually-defined layer has a shading gradient that suggests it encompasses layers (4) and (5) together, with layer (4) less visually distinct. As a result, and consistent with an example in the ’227 Patent as discussed in §VI.D.1, Suehiro’s layer (4) would be understood as forming a sub-layer of an overall layer composed of both layers (4) and (5).

148. Of the layers:

- Layer (5) (alternatively, layers (4) and (5) together) teaches layer (a) (the “Interdiffusion layer”). As shown in FIG. 12, layer (5) is arranged directly on the underlying steel.
- Layer (3) teaches layer (b) (the “Intermediate layer”).
- Layer (2) teaches layer (c) (the “Intermetallic layer”).
- Layer (1) teaches layer (d) (the “Superficial layer”).



Annotated Suehiro FIG. 12

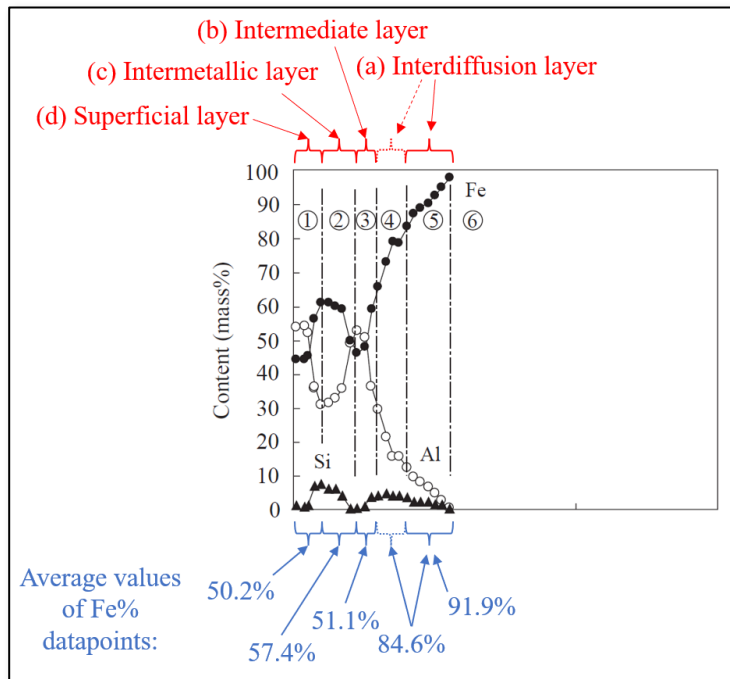


Annotated Suehiro FIG. 13

[1i]: wherein layers (a), (b), (c), and (d) each have a different mean composition from one another,

149. Layers (a)-(d) in Suehiro's coatings have different mean compositions from one another. The datapoints within each layer in FIG. 13 can be averaged with one another to obtain values indicative of mean elemental compositions.⁷ The obtained compositions differ from one another. For example, the averaged values indicative of mean iron composition are 91.9% for layer (5) or 84.6% for layers (4)+(5) (Interdiffusion), 51.1% for layer (3) (Intermediate), 57.4% for layer (2) (Intermetallic), and 50.2% for layer (1) (Superficial). EX-1055, FIG. 13.

⁷ All datapoints were included in my averaging calculations, except for the apparently doubled datapoint corresponding to an Al% of about 36.1% in layer (1).



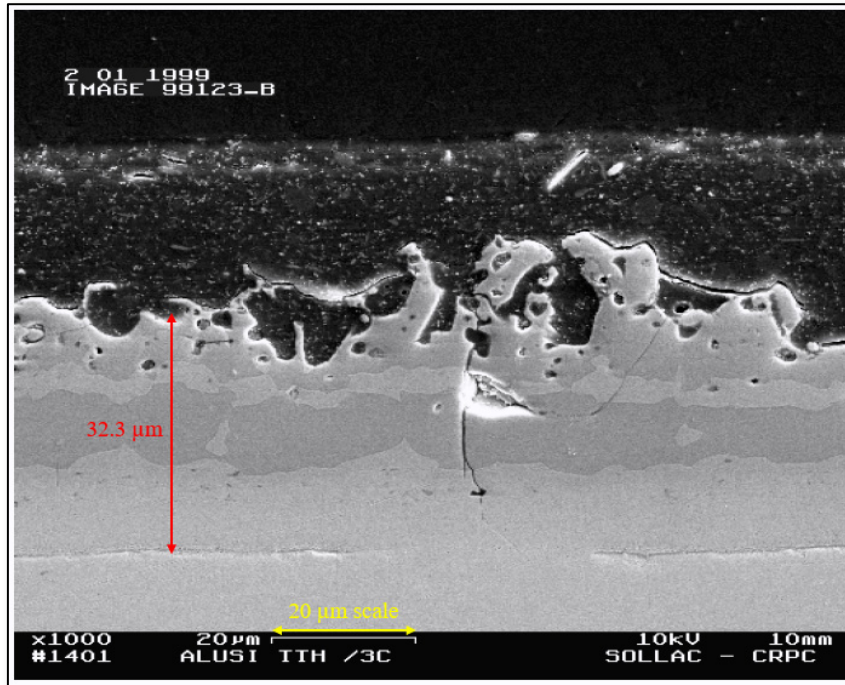
Annotated Suehiro FIG. 13

150. For this and other data derived from Suehiro FIG. 13 discussed here, I used the tool at “<https://plotdigitizer.com/app>”, which allowed me to calibrate data coordinates based on Suehiro’s axes and axes labels. Based on this calibration, numerical values for each datapoint could be extracted with a high degree of accuracy using the same tool, by clicking on the datapoint in a magnified version of the imported FIG. 13.

[1j]: wherein said coating of the hot stamped coated steel product has a thickness greater than 30 micrometers.

151. As discussed above (§XII.B), in view of Cornette, it would have been obvious for the Suehiro coating to be modified to have a thickness greater than 30 μm . For example, it would have been obvious to arrive at a modified coating

having a thickness such as the “typically about 40 μm ” taught by Cornette or the approximately 32.3 μm thickness shown in Cornette FIG. 22.



Annotated Cornette FIG. 22

2. 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.*

152. FIG. 13 illustrates that Suehiro's layer (5) (corresponding to layer (a)) has a thickness of 6.2 μm in comparison to a total coating thickness of 22.2 μm , significantly less than half the total thickness. I used the image measurement tool noted above to measure layer thickness using the delineating lines in FIG. 13. It would have been obvious to arrive at a layer (5) that also has a thickness less than

half the coating thickness, when the coating thickness is increased to greater than 30 μm as taught by Cornette.

153. In view of Suehiro's and Takagi's discussion of the diffusion/alloying process, it would have been within the skill of a POSITA to retain proportional layer thicknesses at least similar to those disclosed by Suehiro, when increasing the coating thickness. Based on my experience and knowledge, it is my belief that the proportional extrapolation of layer thickness based on coating thickness represents a POSITA's reasonable first-order estimate of how such a layer would be formed, or could be formed within the bounds of routine experimentation, when the coating is made thicker. For example, as a first-order estimate, given a layer forming x% of the thickness of a 20 μm coating, a POSITA would expect that obtaining a corresponding layer forming x% of the thickness of a 30 μm coating would have been achievable with a reasonable expectation of success. Elemental diffusion rate is proportional to elemental concentration gradient, so, as the gradient increases (e.g., when a thicker pre-coating is used), individual layers would be formed based on this gradient, resulting in an increase in layer thickness. I would expect this diffusion process to require more time (i.e., a longer thermal treatment) than the diffusion process for thinner pre-coatings, and the experimentation to account for this would have been routine to a POSITA.

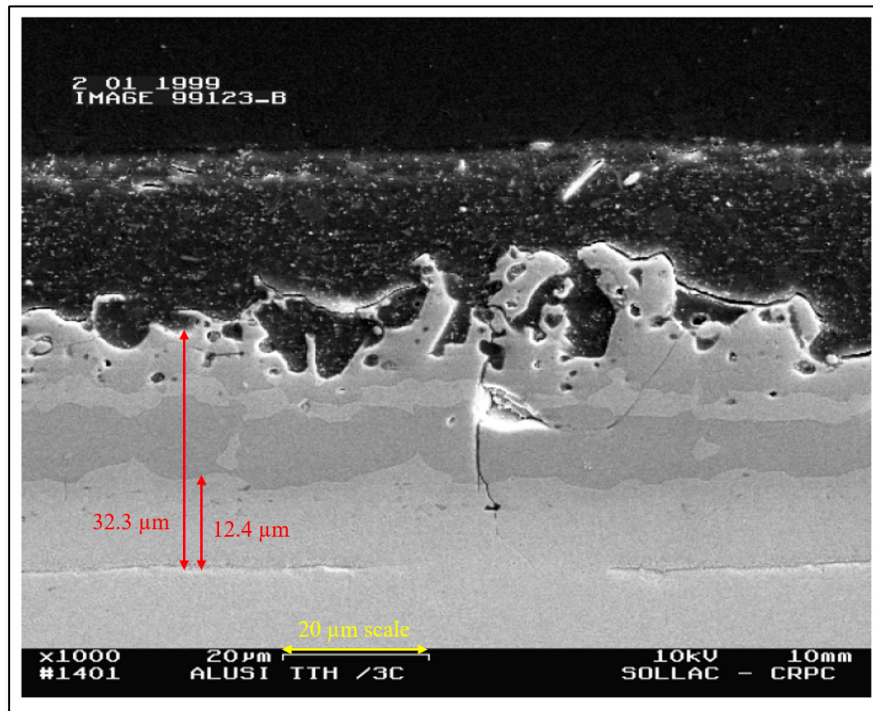
154. As one example experiment, sheet specimens of the base steel (e.g.,

Usibor 1500) could be coated with the same thickness of pre-coating alloy, then placed in a furnace at 900°C for different periods of time (e.g., 4, 4.25, 4.5, 4.75, and 5.0 minutes). After removal from the furnace, the specimens could be sectioned, mounted, and polished for examination under a microscope. The thickness of the coating, and the various layers of the coating, including the interdiffusion layer, could then be measured (as is standard procedure). In this case, the temperature would be the same for each specimen, and, as a result, I would expect the interdiffusion layer, for example, to get progressively thicker as the heating time increases. This and similar experiments would have been within the bounds of routine experimentation for a POSITA. And, a POSITA would have been motivated to optimize the layer thickness based on the art's teaching of layer thickness as an important variable. *See* EX-1016, [0017].

155. As a result of this optimization process (for example, by varying temperature and/or holding time), it would have been obvious for a POSITA to arrive at a layer (a) thickness that is less than half of said thickness of the coating, in agreement with the layer proportion in Suehiro's coating.

156. In addition, for the modification of Suehiro's coating to have layer thicknesses as shown in Cornette FIG. 22, the innermost layer satisfies claim 2. As shown in FIG. 22, the innermost layer (corresponding to layer (a)) has a measured thickness of **12.4 μm** in comparison to a coating thickness of **32.3 μm** , satisfying

this claim.



Annotated Cornette FIG. 22

3. Claims 4-5

[4]: The hot stamped coated steel product according to claim 1, wherein said layer (a) has a thickness of 17 micrometers or less.

[5]: The hot stamped coated steel product according to claim 1, wherein said layer (a) has a thickness of 15 micrometers or less.

157. As discussed for claim 2, Suehiro FIG. 13 illustrates that Suehiro's layer (5) (corresponding to layer (a)) has a thickness of 6.2 μm in comparison to a total coating thickness of 22.2 μm. Applying this thickness proportion to Cornette's 32.3 μm coating results in a layer (a) thickness of **9 um** in the Suehiro

coating modified to have Cornette's coating thickness, satisfying claims 4-5. It would have been obvious, as a matter of routine experimentation and optimization of a result-effective variable, to achieve this or a similar thickness for layer (a) in the modified coating. As I discussed for claim 2, this result – obtaining at least a similar proportional layer thickness when increasing the coating thickness – would have been achievable with a reasonable expectation of success.

158. In addition, for the modification of Suehiro's coating to have layer thicknesses as shown in Cornette FIG. 22, the innermost layer has a measured thickness of **12.4 μm** , satisfying claims 4-5. *See* claim 2.

4. Claim 6

[6]: The hot stamped coated steel product according to claim 4, wherein the coating is 40 micrometers thick.

159. As discussed in §XII.B, it would have been obvious to a POSITA to modify Suehiro's coating to have thicknesses as disclosed by Cornette, e.g., “**about 40 μm** ,” satisfying claim 6. EX-1014, 9. In that case, layer (a), with proportion thickness to that disclosed in Suehiro, would have a thickness of 11.7 μm , also satisfying claim 4. As I discussed for claim 2, this result – obtaining at least a similar proportional layer thickness when increasing the coating thickness – would have been achievable with a reasonable expectation of success.

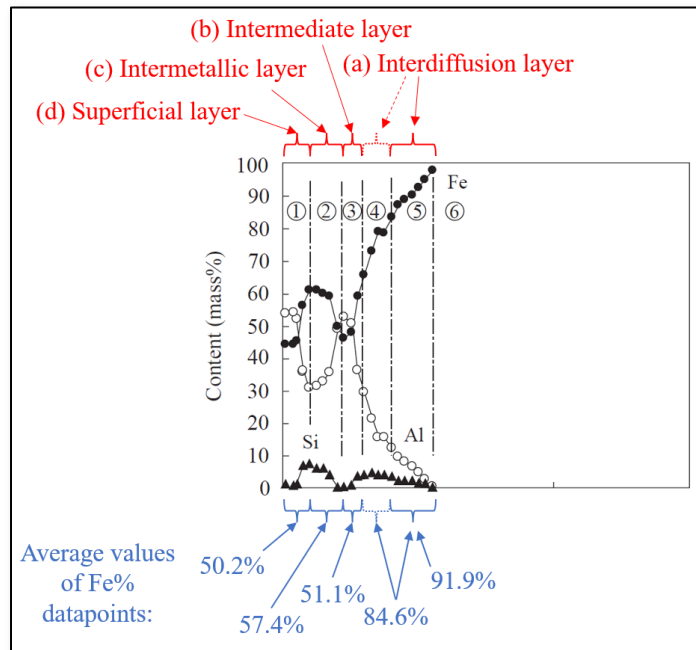
160. Further, for the modification of Suehiro's coating to have layer

thicknesses as shown in Cornette FIG. 22, the imaged coating has a thickness of 40 μm . EX-1014, FIG. 22. *See* claim 6 for Ground 1A (§VI.C).

5. 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 begin [sic] less than the third mean iron composition.

161. As discussed for [1j], the averaged values of the datapoints within each layer in Suehiro FIG. 13 are indicative of mean compositions. This calculation provides values of first through fourth mean iron compositions of 91.9% for layer (5) or 84.6% for layers (4)+(5); 51.1% for layer (3); 57.4% for layer (2); and 50.2% for layer (1). EX-1055, FIG. 13. This combination of values satisfies claim 7.



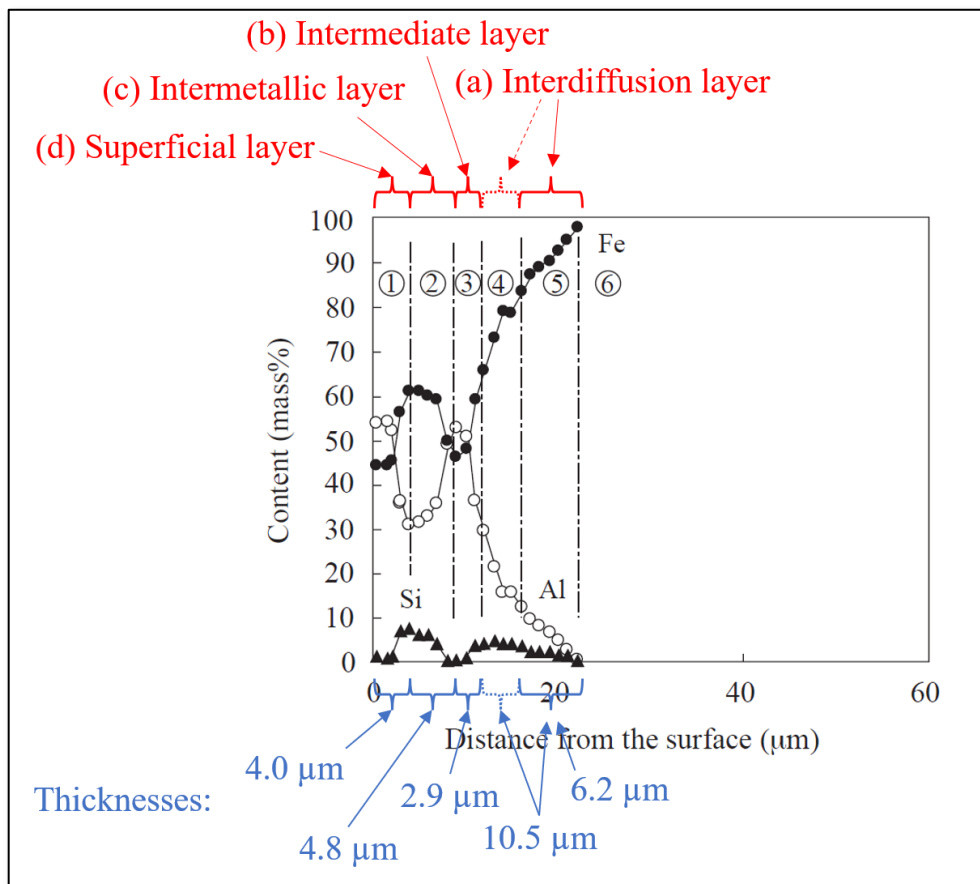
Annotated Suehiro FIG. 13

6. 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).

162. As shown below, layer (a) in Suehiro's coating is the thickest layer, with a thickness of 6.2 μm or 10.5 μm , in comparison to layers (b)-(d) with measured thicknesses of 2.9 μm , 4.8 μm , and 4.0 μm , respectively. EX-1055, FIG. 13. It would have been obvious to form the Suehiro coating, modified to have a thickness greater than 30 μm as taught by Cornette, with the same or similar relative layer thicknesses, thereby satisfying claim 8. These relative layer thicknesses, which constitute merely the retention of Suehiro's relative layer thicknesses while making the overall coating thicker, would have been obvious as

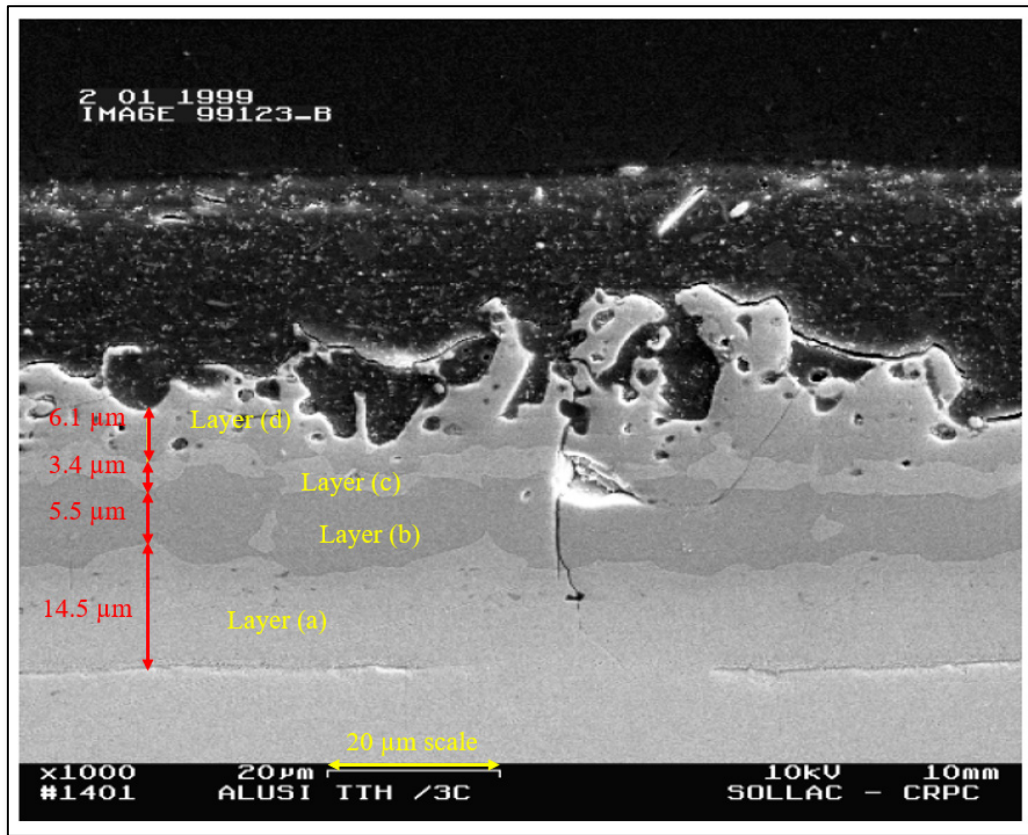
a matter of routine experimentation and optimization of a result-effective variable. *See, e.g.,* Takagi's extensive discussion of how heating parameters can be tuned in order to make the inner layer thicker relative to other layers. EX-1016, [0016]-[0021]. *See also* my discussion for claim 2 in this ground, explaining why and how the achievement of at least similar proportional layer thicknesses, when increasing the coating thickness, would have been obvious.



Annotated Suehiro FIG. 13

163. Further, for the modification of Suehiro's coating to have layer thicknesses as shown in Cornette FIG. 22, the inner layer (layer (a)) has a thickness

of 14.5 μm , compared to 5.5 μm , 3.4 μm , and 6.1 μm for layers (b)-(d). EX-1014, FIG. 22. As such, this modification also renders obvious claim 8.



7. Claims 9-11

164. See claim 8. Both the modification of Suehiro's layers to have the same or similar relative thickness in a modified coating as taught by Cornette, and the modification of Suehiro's layers to have thicknesses as shown in Cornette FIG. 22, satisfy claims 9-11.

8. Claims 12-14

165. See claim 8. Both the modification of Suehiro's layers to have the

same or similar relative thickness in a modified coating as taught by Cornette (where layers (4)+(5) are together applied as layer (a)), and the modification of Suehiro's layers to have thicknesses as shown in Cornette FIG. 22, satisfy claims 12-14. For the former modification, Suehiro's layers (4) and (5), applied together as layer (a), have a thickness of 10.5 μm , more than twice each of 2.9 μm , 4.8 μm , and 4.0 μm , the thicknesses of layers (3), (2), and (1) (corresponding to layers (b), (c), and (d)).

9. Claim 15

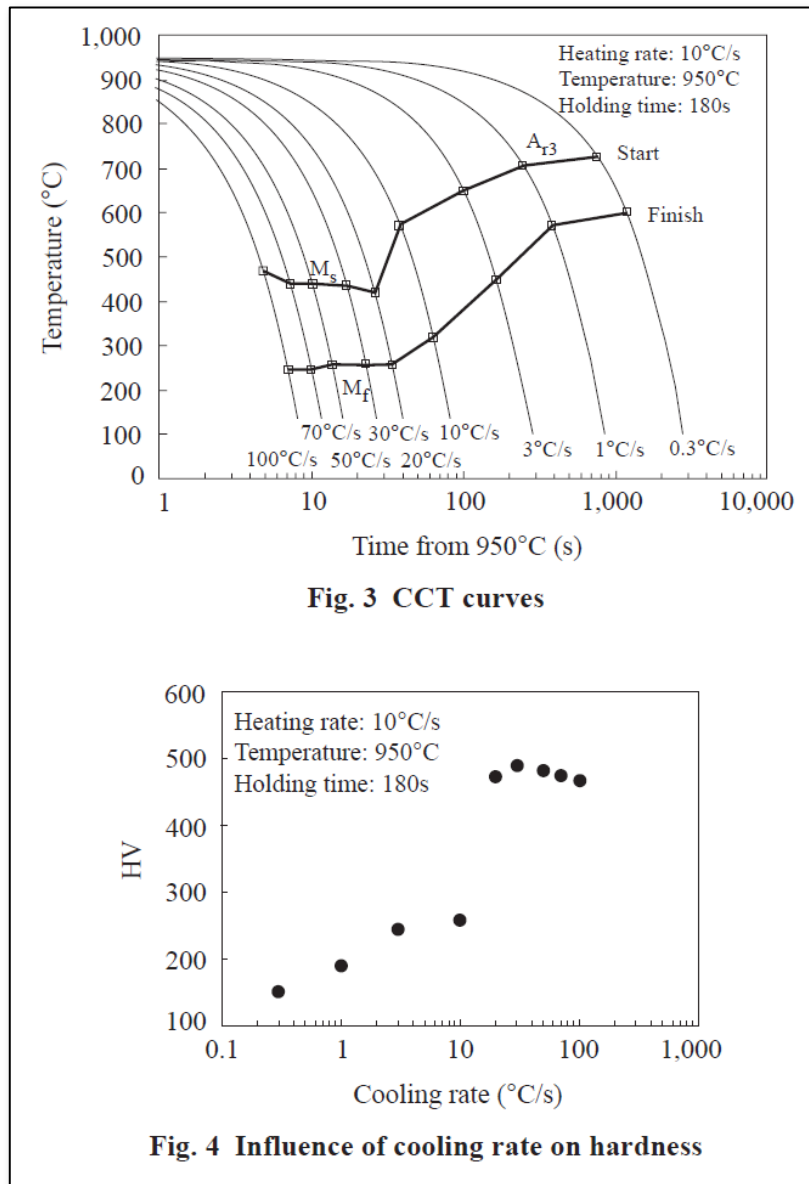
[15]: The hot stamped coated steel product according to claim 1, wherein the hot stamped coated steel product is fully martensitic.

166. Suehiro in view of Cornette renders obvious a fully martensitic product. Suehiro describes that “strength is secured in the martensitic phase by quenching”⁸ and that the “steel sheet is used in a microstructure consisting mainly of the martensitic phase as quenched.” EX-1055, [10]. It would have been obvious to “secure” the strength by obtaining a fully martensitic structure. *See* claim 15 in Ground 1A for discussion on the obviousness of a change in degree from “mainly” martensitic to “fully martensitic.”

⁸ In the corresponding English document, “strength is enhanced through formation of martensite by quenching.” EX-1053, 3.

167. A POSITA would have had a reasonable expectation of success in achieving a fully martensitic product. For example, Suehiro discloses that “a part with uniform strength can be obtained if a **cooling rate of 30°C/s or higher** is ensured” and the “the critical cooling rate was around 20 to 30°C/s” to “avoid transformation to ferrite, pearlite, and bainite during cooling.” EX-1055, [07], [21]. These cooling rates agree with the “more than 30.degree.C./s” disclosed by the ’227 Patent. EX-1001, 7:42-45.

168. Suehiro’s “CCT Curve” (FIG. 3) also demonstrates Suehiro’s recognition of cooling rate as an important parameter to be optimized for purposes of obtaining a high-strength steel. FIG. 4, which “shows the relationship between cooling rate and hardness,” including a significant increase in strength for cooling rates of 30°C/s and above, demonstrates that a POSITA following Suehiro’s teachings would have been led to a fully martensitic structure by optimization of the cooling rate. EX-1055, [07]-[08], FIGS. 3-4.



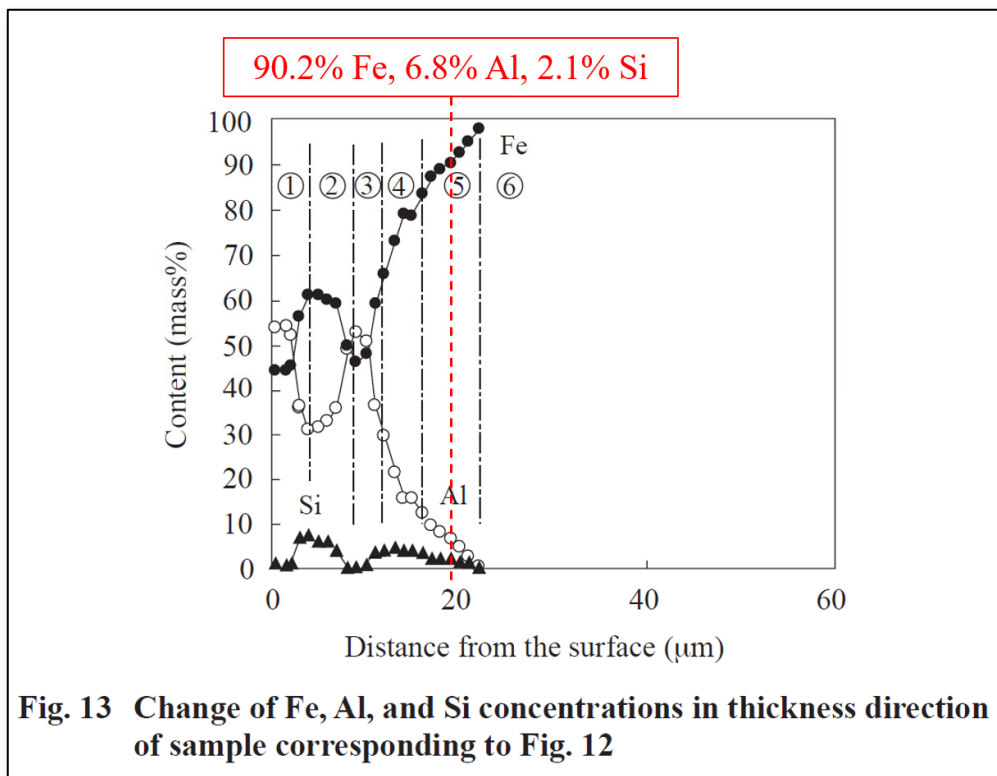
Suehiro FIGS. 3-4

10. 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.

169. Suehiro's layer (5), or layers (4)+(5), which correspond to the

“Interdiffusion layer,” teach the recited composition. For example, for the measurement position indicated in annotated FIG. 13 below, Suehiro’s layer (5) has a “mass%” composition (equivalent to a composition “by weight”) of 90.2% Fe, 6.8% Al, and 2.1% Si, values within the claimed ranges. These values, and the other sets of Fe, Al, and Si concentration disclosed by Suehiro, sum to less than 100%, indicating that these are concentrations “based on total weight.”

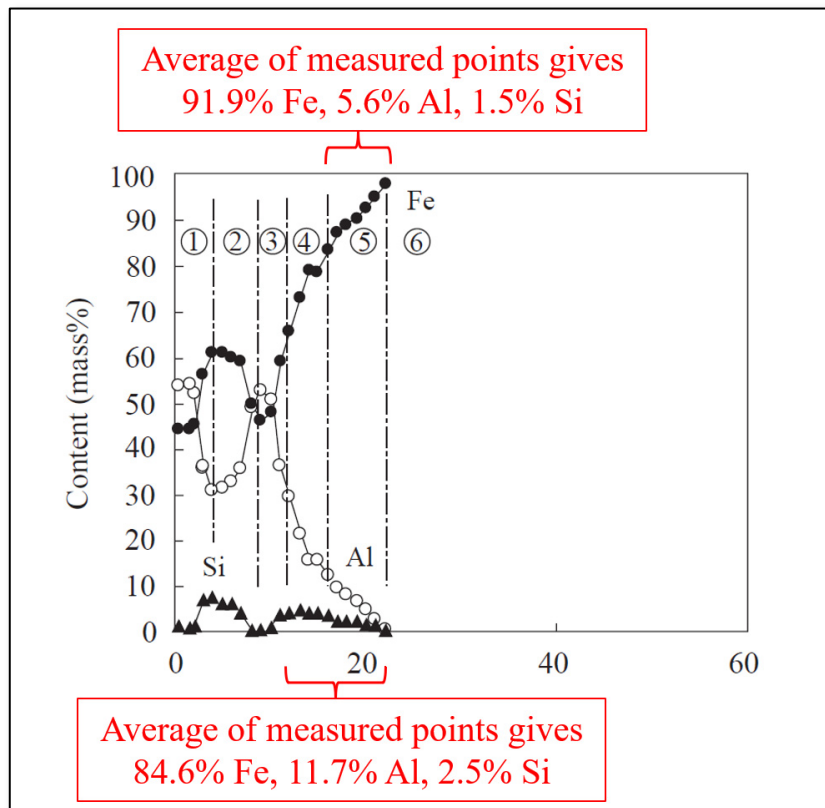


Annotated Suehiro FIG. 13

170. As another measurement of Suehiro’s coating, the measured compositions within each layer can be averaged. Performing this analysis gives a composition of 91.9% Fe, 5.6% Al, 1.5% Si for layer (5), or a composition of

84.6% Fe, 11.7% Al, 2.5% Si for layers (4) and (5) together. EX-1055, FIG. 13.

The layer (5) values are within the claimed range, while the layers (4)+(5) composition has Fe% deviating from the claimed range by 1.4% and Al% deviating from the claimed range by 1.7%. These values, which are close to the claimed range, render obvious the claimed range for reasons discussed for claim 19 in §VI.D (Ground 1A), e.g., in the absence of any alleged criticality, unexpected results, or qualitative difference in properties.



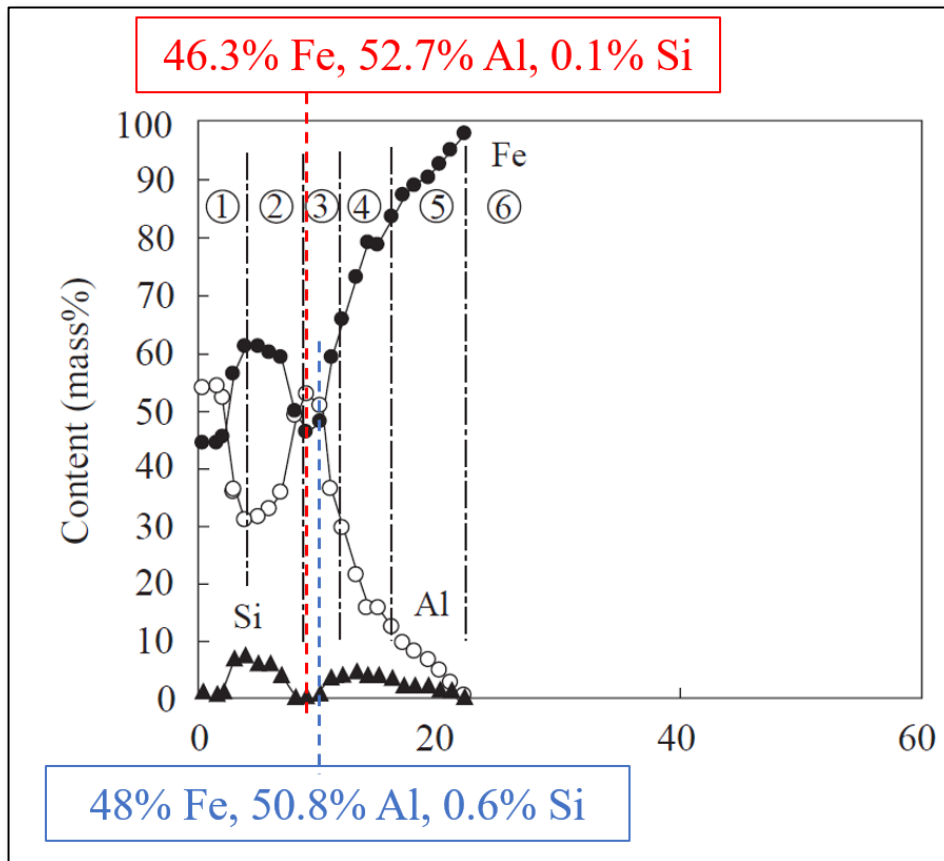
Annotated Suehiro FIG. 13

11. Claim 19

[19]: The hot stamped coated steel product according to claim 18, wherein

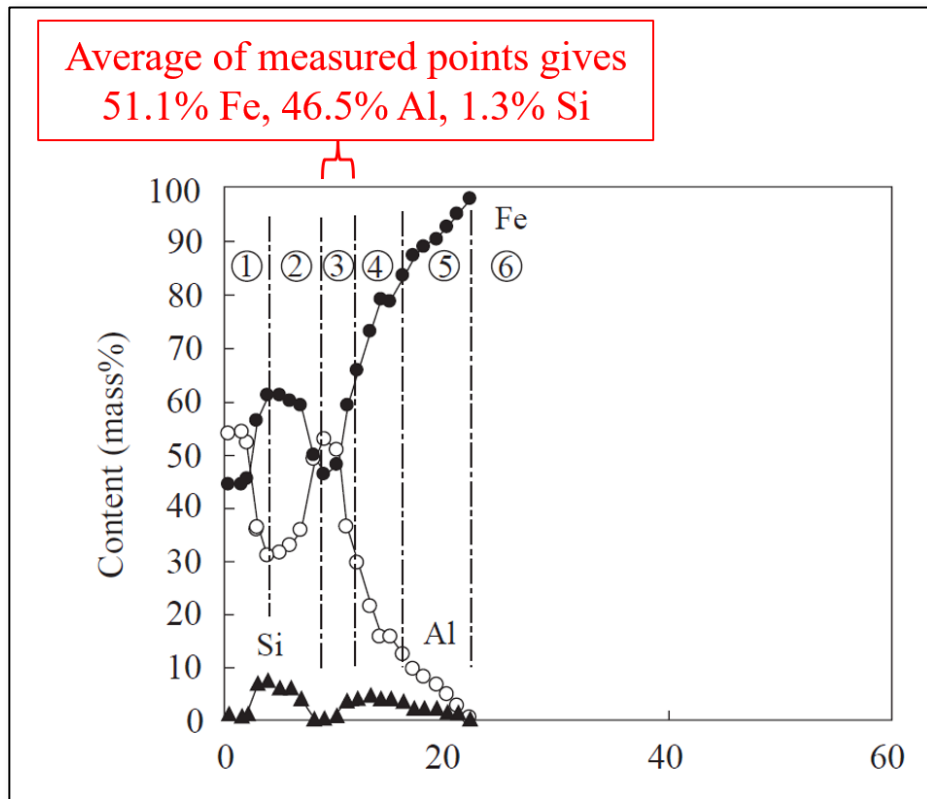
the Intermediate layer comprises the following components by weight based on total weight: 39 to 47% Fe, 53 to 61% Al, and 0 to 2% Si.

171. Suehiro's layer (3), which corresponds to the "Intermediate layer," teaches the recited composition. For example, for the two measurement positions indicated in annotated FIG. 13 below, Suehiro's layer (3) has a composition of 46.3% Fe (within range), 52.7% Al (0.3% deviation), 0.1% Si (within range), or 48% Fe (1% deviation), 50.8% Al (2.2% deviation), 0.6% Si (within range). These values satisfy or render obvious the ranges of claim 19 for reasons discussed in §VI.D.15.



Annotated Suehiro FIG. 13

172. As another measurement of Suehiro's coating, the average of the measured compositions within layer (3) is 51.1% Fe (deviation of 4.1%), 46.5% Al (deviation of 6.5%), 1.3% Si (within range). These values satisfy or render obvious the ranges of claim 19 for reasons discussed in §VI.D.15.



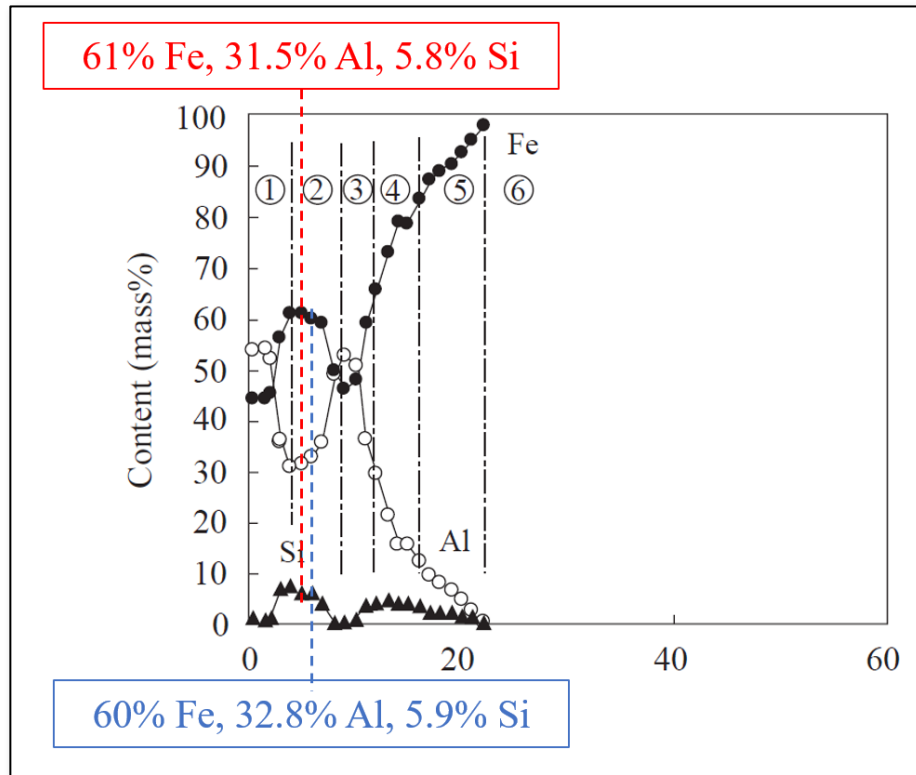
Annotated Suehiro FIG. 13

12. 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.

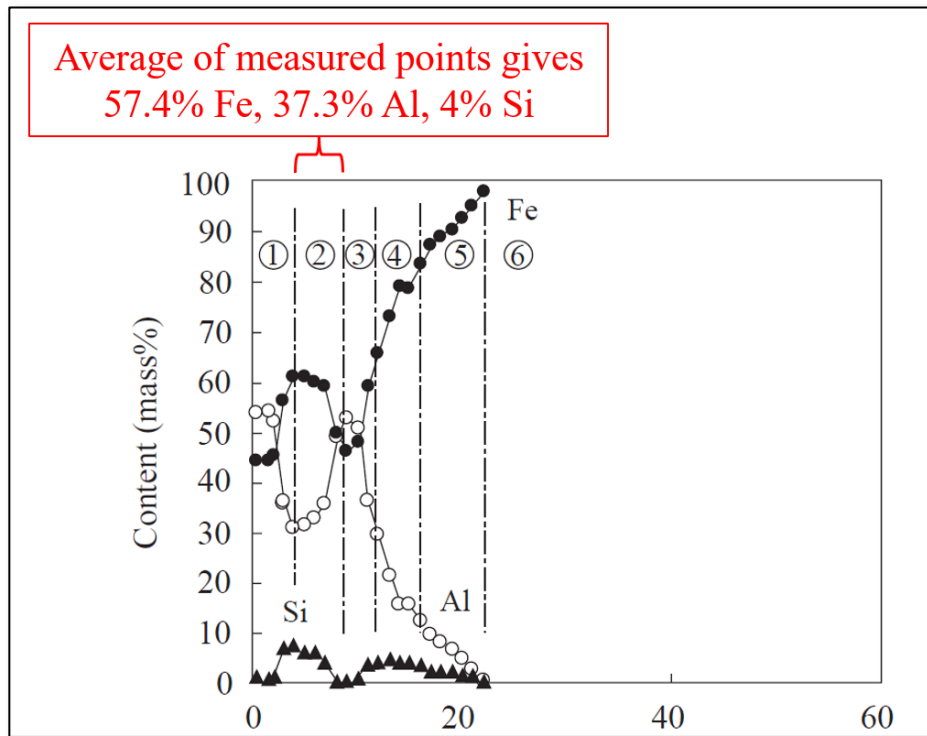
173. Suehiro's layer (2), which corresponds to the "Intermetallic layer," teaches the recited composition. For example, for the two measurement positions indicated in annotated FIG. 13 below, Suehiro's layer (2) has a composition of 61% Fe (1% deviation), 31.5% Al (within range), 5.8% Si (within range), or 60% Fe (2% deviation), 32.8% Al (within range), 5.9% Si (within range). These values

satisfy or render obvious the ranges of claim 20 for reasons discussed in §VI.D.15.



Annotated Suehiro FIG. 13

174. As another measurement of Suehiro's coating, the average of the measured compositions within layer (2) is 57.4% Fe (4.6% deviation), 37.3% Al (3.3% deviation), 4% Si (within range). These values satisfy or render obvious the ranges of claim 20 for reasons discussed in §VI.D.15.



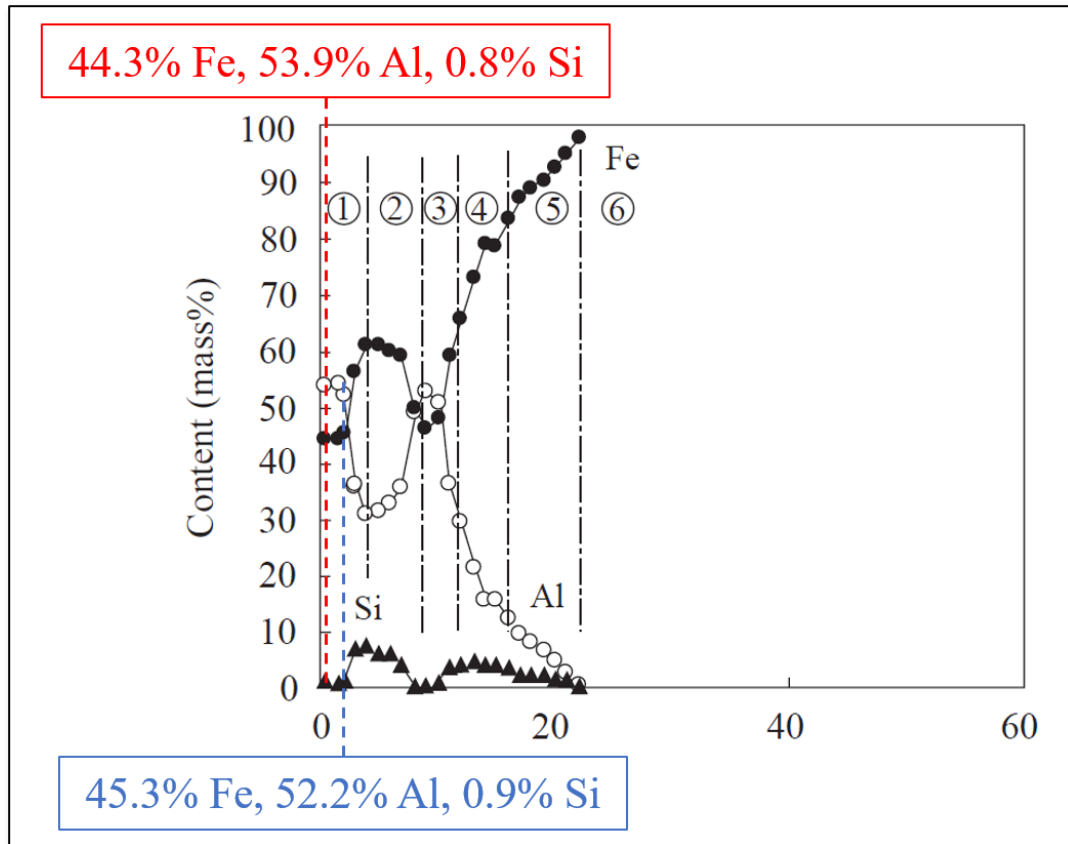
Annotated Suehiro FIG. 13

13. 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.

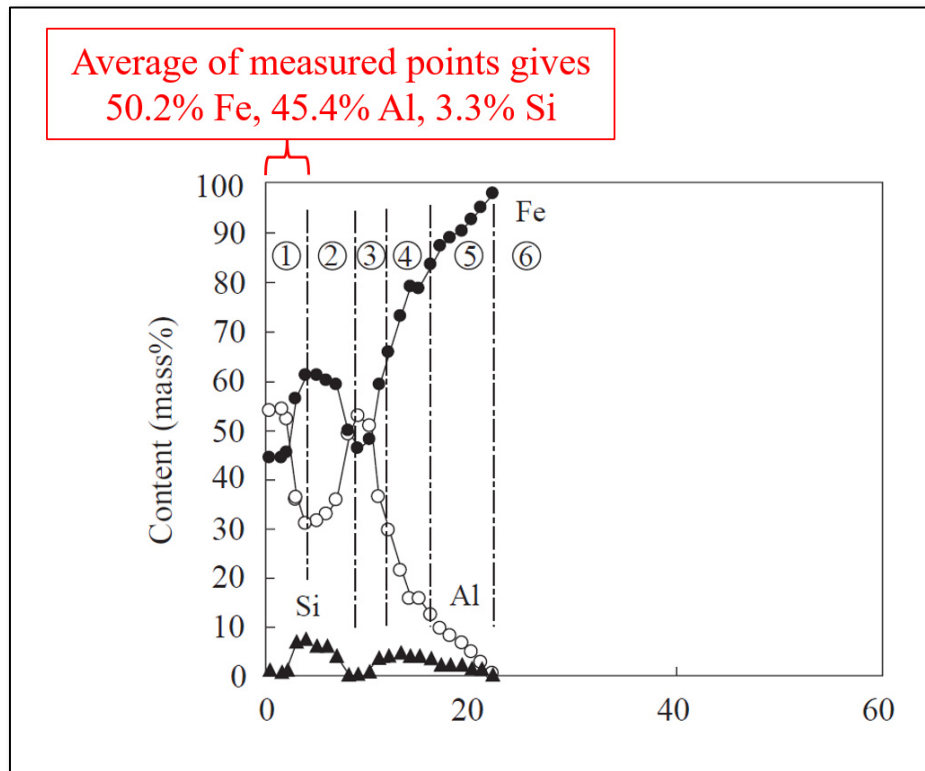
175. Suehiro's layer (1), which corresponds to the "superficial layer," teaches the recited composition. For example, for the two measurement positions indicated in annotated FIG. 13 below, Suehiro's layer (1) has a composition of 44.3% Fe (within range), 53.9% Al (within range), 0.8% Si (within range), or 45.3% Fe (within range), 52.2% Al (0.8% deviation), 0.9% Si (within range).

These values satisfy or render obvious the ranges of claim 21 for reasons discussed in §VI.D.15. With respect to the thickness element of this claim, *see* claim 2 above.



Annotated Suehiro FIG. 13

176. As another measurement of Suehiro's coating, the average of the measured compositions within layer (1) is 50.2% Fe (3.2% deviation), 45.4% Al (7.6% deviation), 3.3% Si (1.3% deviation). These values render obvious the ranges of claim 21 for reasons discussed in §VI.D.15.



Annotated Suehiro FIG. 13

14. Claims 22-23

177. See claims 19-20.

15. Claims 24-25

[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.

[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.

178. Suehiro and Cornette each disclose mechanical strengths in excess of

1500 MPa. For example, Suehiro describes that “strength of 1,500 MPa or more is obtained after quenching in a mold,” that “forming methods including mold quenching, hot forming, hot stamping, and hot pressing have been used to obtain parts with a strength of about 1500 MPa,” and that “after quenching in the mold, the strength is over 1500 MPa.” EX-1055, [01]-[02], [06]. Suehiro also discloses a specific value of “1530 MPa.” EX-1055, [21].

179. See §VI.D.19 (Ground 1A) for discussion of Cornette’s description of mechanical strengths > 1500 MPa and discussion of the strength of the USIBOR 1500 steel disclosed by Suehiro and Cornette, which is named “USIBOR 1500” because it can exhibit strengths of 1500 MPa or higher. EX-1055, [02]; EX-1014, 10.

XIII. GROUND 2B: Claim 3 is obvious over Suehiro in view of Cornette and Takagi

A. Analysis of 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, +/–10%; layer (c) has an HV50g hardness between 580 and 650, +/–10%; and layer (d) has an HV50g harness between 900 and 1000, +/–10%.

180. Although Suehiro provides compositions for layers (1)-(5), Suehiro

does not provide layer-specific hardness values. However, I am informed that a POSITA generally is understood to have an expectation that compounds similar in structure will have similar properties. In the case of alloyed steels, it is not only the composition but also the thermal history that matters. For example, two materials with the same element composition may exhibit quite different physical properties, e.g., based on different phases formed based on the heating and/or cooling which the materials have undergone. However, two materials with similar elemental compositions and similar thermal histories would be expected to have similar properties. This is why the cooling rate discussed in Section VI.B is important for establishing a martensitic structure and obtaining desired mechanical strength.

181. In the case of the Suehiro-Cornette-Takagi combination, the compositions of Suehiro's and Takagi's layers are very similar, as shown in the table below. The Suehiro compositions in this table are the averaged datapoint values extracted from FIG. 13.

Layer	Takagi No. 1	Takagi No. 4	Takagi No. 5	Suehiro	Takagi No. 1, 4, 5 Hardness (Hv)	Claimed Hardness (HV50g)
(a)	7.7 Al% 2.0 Si% 89.6 Fe%	6.0 Al% 1.5 Si% 90.7 Fe%	3.2% Al 0.4% Si 94.3% Fe	5.6 Al% 1.5 Si% 91.9 Fe%	310, 280, 300	290 - 410
(b)	48.4 Al% 1.2 Si% 50.1 Fe%	51.9 Al% 0.6 Si% 46.8 Fe%	54.5% Al 2.5% Si 42.7% Fe	46.5 Al% 1.3 Si% 51.1 Fe%	750, 720, 740	810 - 1100
(c)	31.6 Al% 5.7 Si% 62.0 Fe%	30.4 Al% 5.3 Si% 63.1 Fe%	33.4% Al 15.3% Si 51.4% Fe	37.3 Al% 4 Si% 57.4 Fe%	700, 690, 700	522 - 715
(d)	54.8 Al% 0.8 Si% 44.5 Fe%	47.4 Al% 2.2 Si% 49.8 Fe%	54.5% Al 6.8% Si 38.4% Fe	45.4 Al% 3.3 Si% 50.2 Fe%	800, 800, 810	810 - 1100

182. The thermal histories, too, of Suehiro and Takagi are similar. Takagi discloses heating rates of 8°C/s, heating temperatures of 900-950°C, and holding times of 2-10 minutes. EX-1016, [0037]. Similarly, Suehiro discloses a heating rate of about 8°C/s (based on a “2 min” heating time to reach “950°C”), heating temperatures of 900 and 950°C, and holding times of 0.5 minutes and 3 minutes. EX-1055, [02], [07], [14]-[15], [18], FIG. 3.

183. In view of these similar compositions and thermal histories, a POSITA would have expected Suehiro’s layers to have hardnesses similar to those of Takagi. Starting with those hardnesses, it would have been obvious to experiment with process parameters of the Suehiro-Cornette coating to achieve

hardness values in the claimed ranges. Takagi provides a roadmap for doing so, describing 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-1016, [0019]-[0021]. Given this guidance and similarities between the layer compositions of Suehiro 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 Takagi.

184. 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]. Other art, too, recognizes the importance of hardness values of specific layers within a coating: FR2833504 describes the benefit of a “hardness gradient” in the “alloy layer” for “giv[ing] the part increased fatigue resistance,” and WO02/103073 describes the benefit of including a “soft ferrite layer” in the alloy coating at the interface between the coating and the base steel. EX-1025, 6:11-15; EX-1035, 24:25-35:20. And, indeed, the understanding that hardness in a surface coating would be an important characteristic to be optimized would have been generally understood by steel researchers.

185. Accordingly, a POSITA would have been motivated to experiment with the layer hardnesses, e.g., by trying Takagi's hardness values and values similar to Takagi's hardness values, to arrive at hardness values in the claimed ranges.

186. As discussed above in §VI.D.3, this reasoning holds despite Takagi's lack of disclosure of the load used for measuring hardness.

XIV. GROUND 2C: Claims 16-17 are obvious over Suehiro in view of Cornette and Laurent

A. Combination of Suehiro-Cornette and Laurent

187. For reasons discussed in §VII.B, it would have been obvious to try using Laurent's steel compositions in the hot stamping processes described by Suehiro and Cornette. This would have constituted no more than substitution of one element (the Laurent steel) for another (the USIBOR 1500 steel of Suehiro or Cornette) known in the field. EX-1055, [02]; EX-1014, 9. Further, Laurent's steel composition is similar to those of both Suehiro and Cornette, as shown below, 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-1055, Table 1; EX-1014, 9; EX-1023, 1:66-2:10.

Element	Cornette (USIBOR 1500) Composition (%)	Laurent Composition (%)	Suehiro Composition (%)
C	$0.2 \leq C\% \leq 0.25$	$0.20\% < C < 0.5\%$	0.22
Mn	$1.1 \leq Mn\% \leq 1.35$	$0.8\% < Mn < 1.5\%$	1.2
Si	$0.15 \leq Si\% \leq 0.35$	$0.1\% < Si < 0.35\%$	--
Cr	$0.15 \leq Cr\% \leq 0.3$	$0.01\% < Cr < 1\%$	0.15
Ti	$0.02 \leq Ti\% \leq 0.05$	$Ti < 0.1\%$	--
Al	$0.02 \leq Al\% \leq 0.06$	$Al < 0.1\%$	--
P	--	$P < 0.05\%$	--
S	≤ 0.008	$S < 0.03\%$	--
B	$0.002 \leq B\% \leq 0.004$	$0.0005\% < B < 0.01\%$	0.002

B. Analysis of Claims 16-17

188. See discussion of claims 16-17 for Ground 1B (§VII.C). Laurent’s steel, applied to Suehiro and Cornette as discussed in §XIV.A, satisfies or renders obvious the recited compositions.

XV. GROUND 2D: Claim 15 is obvious over Suehiro in view of Cornette and Vaissiere

A. Analysis of Claim 15

[15]: The hot stamped coated steel product according to claim 1, wherein the hot stamped coated steel product is fully martensitic.

189. It would have been obvious to apply Vaissiere’s teachings to Suehiro and Cornette to obtain a “fully martensitic” structure. See claim 15 for Grounds 1C and 2A (§§VIII.B, XII.C). By optimizing the cooling rate as disclosed by Vaissiere (e.g., a “critical quenching speed enabling a completely martensitic structure [of]

27°C/s,” in agreement with Suehiro’s “critical cooling rate [of] around 20 to 30°C/s”), a POSITA would have arrived at the “completely martensitic structure,” “pure martensite,” and “totally martensitic structure” described by Vaissiere. EX-1021, 5-6, 9; EX-1055, [07].

XVI. GROUND 2E: Claims 1-2 and 4-25 are obvious over Suehiro in view of GMW14400

A. Combination of Suehiro and GMW14400

190. *See* §§ IX.B and XII.B. GMW14400 is applied at least as a substitute for Cornette, as applied in Grounds 2A-2D, to motivate a coating thickness “>35” µm. Based on GMW14400, a POSITA would have been strongly motivated to achieve a coating thickness “>35” µm, as required by GMW14400, in order to satisfy market requirements. EX-1026, 7. For example, it would have been obvious for a POSITA to experiment with the pre-coating thickness in the range of “20 to 33” µm specified by GMW14400. EX-1026, 7. *See* §VI.C for discussion of the well-established and predictable link between pre-coating thickness and coating thickness. Accordingly, in view of GMW14400, a POSITA would have had a reasonable expectation of success in achieving coating thicknesses greater than 30 µm, e.g., the “>35” µm coating thicknesses disclosed by GMW14400.

B. Analysis of Claims

1. Claims 1, 7, 15, 18-25

191. *See* discussion for Ground 2A. GMW14400’s teachings on obtaining

coating thicknesses greater than 30 μm (for example, GMW14400's corresponding pre-coating thickness range) are substituted for Cornette's.

2. Claims 16-17

192. *See* discussion for claims 16-17 for Ground 1D (§IX.C.6). It would have been obvious to use GMW14400's base steel composition, which satisfies or renders obvious those of claims 16-17.

3. Claims 2, 4-6, 8-14

193. *See* discussion for Ground 2A with respect to the thicknesses of Suehiro's layers, based on measurements in Suehiro FIG. 13, when Suehiro's coating is modified to have a thickness greater than 30 μm .

194. When Suehiro's layer (5) thickness of 6.2 μm , for a coating thickness of 22.2 μm , is scaled proportionally to a coating thickness of 35 μm as described by GMW14400, the resulting thickness is 9.8 μm , which satisfies claims 4-5. For claim 6, a coating thickness of 40 μm , within GMW14400's range, would be obvious to arrive at as a matter of routine optimization, in which case the layer (5) thickness would scale to 11.2 μm , also satisfying claim 4. It would have been obvious to retain Suehiro's relative layer thicknesses, or approximate relative layer thicknesses, as coating thickness was increased, thereby satisfying claims 2 and 8-14 as discussed for Ground 2A.

XVII. GROUND 2F, 2G, 2H: Claim 3 is obvious over Suehiro in view of GMW14400 and Takagi, claims 16-17 are obvious over Suehiro in view of GMW14400 and Laurent, and claim 15 is obvious over Suehiro in view of GMW14400 and Vaissiere

195. See discussion of the Suehiro-Cornette-Takagi, Suehiro-Cornette-Laurent, and Suehiro-Cornette-Vaissiere combinations (§§XIII-XV). The same reasoning applies for the combination of Suehiro and GMW14400 with Takagi, Laurent, Vaissiere.

XVIII. CLAIM INTERPRETATION

196. I understand that, for purposes of my analysis in this *inter partes* review proceeding, the terms appearing in the patent claims should be interpreted “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 283(b)...” 37 C.F.R. § 42.100(b). In that regard, I understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by a POSITA. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent’s history of examination before the Patent Office. I also understand that the words of the claims should be interpreted as they would have been interpreted by a POSITA at the time of the invention was made.

XIX. LEGAL PRINCIPLES

A. Anticipation

197. I have been informed that a patent claim is invalid as anticipated under 35 U.S.C. § 102 if each and every element of a claim, as properly construed, is found either explicitly or inherently in a single prior art reference. Under the principles of inherency, if the prior art necessarily functions in accordance with, or includes the claimed limitations, it anticipates.

198. I have been informed that a claim is invalid under 35 U.S.C. § 102(a) if the claimed invention was known or used by others in the U.S., or was patented or published anywhere, before the applicant's invention. I further have been informed that a claim is invalid under 35 U.S.C. § 102(b) if the invention was patented or published anywhere, or was in public use, on sale, or offered for sale in this country, more than one year prior to the filing date of the patent application (critical date).

B. Obviousness

199. I have been informed that a patent claim is invalid as "obvious" under 35 U.S.C. § 103 in light of one or more prior art references if it would have been obvious to a POSITA, taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called "secondary considerations" of non-obviousness, which include: (i) "long felt need" for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results

of the claimed invention, and (iv) “copying” of the claimed invention by others.

200. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason to modify the single prior art reference, or combine two or more references, in order to achieve the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference or references themselves, the knowledge or “common sense” of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

XX. CONCLUSION

201. The findings and opinions set forth in this declaration are based on my work and examinations to date. I may continue my examinations. I may also receive additional documentation and other factual evidence over the course of this IPR that will allow me to supplement and/or refine my opinions. I reserve the right to add to, alter, or delete my opinions and my declaration upon discovery of any additional information. I reserve the right to make such changes as may be deemed

necessary. In signing this declaration, I recognize that the declaration will be filed as evidence in an IPR before the PTAB. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

202. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: 12/23/2024 By:

Dr. Michael Miles
Springville, UT

A handwritten signature in blue ink, appearing to read "Michael Miles", is written over a horizontal line.