

Petition
U.S. Patent No. 10,981,350
UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

RECYCLED PLASTICS INDUSTRIES, LLC
Petitioner

v.

TANGENT TECHNOLOGIES LLC
Patent Owner

Inter Partes Review No.: To Be Assigned
U.S. Patent No. 10,981,350

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,981,350
UNDER 35 U.S.C. § 311 AND 37 C.F.R. § 42.100**

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List of Exhibits

Exhibit No.	Description
RPI1001	U.S. Patent No. 10,981,350 (marked as Exhibit 4 during deposition of Francisco Morales in district court litigation)
RPI1002	USPTO Assignments on the Web for U.S. Patent No. 10,981,350
RPI1003	U.S. Provisional Patent Application No. 62/208,928 (marked as Exhibit 8 during deposition of Francisco Morales in district court litigation)
RPI1004	File History of U.S. Patent No. 10,981,350 (marked as Exhibit 7 during deposition of Francisco Morales in district court litigation)
RPI1005	Declaration of Dr. Karl Englund
RPI1006	<i>Curriculum Vitae</i> of Dr. Karl Englund
RPI1007	Deposition Transcript of Francisco Morales, <i>Tangent Techs., LLC v. Recycled Plastics Indus., LLC</i> , Case No. 1:23-cv-00261-WCG (E.D. Wis. Mar. 12, 2024)
RPI1008	Defendant Recycled Plastics Industries, LLC's Amended Notice of Rule 30(b)(6) Deposition to Plaintiff Tangent Technologies, LLC, <i>Tangent Techs., LLC v. Recycled Plastics Indus., LLC</i> , Case No. 1:23-cv-00261-WCG (E.D. Wis. Mar. 6, 2024) (marked as Exhibit 1 during deposition of Francisco Morales in district court litigation)
RPI1009	E-mail from J. Oehler to J. Zambrzycki (April 19, 2024) regarding <i>Tangent Techs., LLC v. Recycled Plastics Indus., LLC</i> , Case No. 1:23-cv-00261-WCG (E.D. Wis.)
RPI1010	"SMB Extrusion Melt Blender," StaMixCo (2007) (StaMixCo) (marked as Exhibit 10 during deposition of Francisco Morales in district court litigation)
RPI1011	Korean Patent No. 10-1338611 with Certified Translation (Nam)

Exhibit No.	Description
RPI1012	Zumbrunnen, D.A., “Chaotic Advection and Its Application to Extruding Micro- and Nanostructured Plastic Materials,” <i>Applied Plastics Engineering Handbook</i> (2011), 401-415 (Zumbrunnen)
RPI1013	U.S. Patent No. 9,527,341 (Rassi)
RPI1014	Defendant Recycled Plastics Industries, LLC’s Proposed Claim Constructions, <i>Tangent Techs., LLC v. Recycled Plastics Indus., LLC</i> , Case No. 1:23-cv-00261-WCG (E.D. Wis. Apr. 26, 2024)
RPI1015	Plaintiff Tangent Technologies, LLC’s Proposed Constructions for Disputed Claim Terms, <i>Tangent Techs., LLC v. Recycled Plastics Indus., LLC</i> , Case No. 1:23-cv-00261-WCG (E.D. Wis. Apr. 26, 2024)
RPI1016	Gardner, D. J. et al., “Wood-Plastic Composite Technology,” <i>Curr Forestry Rep</i> (June 4, 2015), 1:139-150 (Gardner)
RPI1017	Holden, B., “10 Things You Need To Know About Plastic Lumber,” <i>American Woodworker</i> (May 2005), 54-60 (American Woodworker)
RPI1018	Platt, B. et al., <i>The Healthy Building Network’s Guide to Plastic Lumber</i> (2005) (Platt)
RPI1019	U.S. Patent No. 9,359,762 (Nichols)
RPI1020	Internet Archive Affidavit of Nathaniel Frank-White (May 1, 2024) with Exhibits A-B
RPI1021	Meijer, H.E.H. et al., “On the performance of static mixers: a quantitative comparison,” <i>Progress in Polymer Science</i> (Jan. 1, 2012) 37(10):1333-49 (Meijer)
RPI1022	U.S. Patent No. 3,881,984 (Soda)
RPI1023	Saatdjian, E. et al., “On chaotic advection in a static mixer,” <i>Chemical Engineering Journal</i> (2012), 289-298 (Saatdjian)
RPI1024	Reserved

Exhibit No.	Description
RPI1025	U.S. Patent Application Publication No. 2012/0007277 (Nakamura)
RPI1026	U.S. Patent No. 9,533,444 (Philpot)
RPI1027	U.S. Patent Application Publication No. 2010/0032861 (Pietruczynik)
RPI1028	International Published Patent Application WO 98/52996 (Dorchester)
RPI1029	Kim, J. K. and Pal, Kaushik, <i>Recent Advances in the Processing of Wood-Plastic Composites</i> (2010) (Kim)
RPI1030	Wolcott, M. P. and Englund, K., “A technology review of wood-plastic composites,” <i>33rd International Particleboard Composite Materials Symposium</i> (January 1999), 103-111 (Wolcott)
RPI1031	Sidharta, A., “Wood Plastic Composites (WPCs) as an Alternative to Solid Lumber,” University of British Columbia (2011) (Sidharta)
RPI1032	United States Patent Application Publication No. 2015/0044434 (Kotiadis)
RPI1033	ASTM Standard Specification for Polyolefin-Based Plastic Lumber Decking Boards, D6662-13 (June 2013) (ASTM D6662-13)
RPI1034	Defendant Recycled Plastics Industries, LLC’s Notice of Deposition of Francisco Morales, <i>Tangent Techs., LLC v. Recycled Plastics Indus., LLC</i> , Case No. 1:23-cv-00261-WCG (E.D. Wis. Mar. 6, 2024) (marked as Exhibit 2 during deposition of Francisco Morales in district court litigation)

Exhibit No.	Description
RPI1035	Plaintiff Tangent Technologies, LLC's Initial Disclosures, <i>Tangent Techs., LLC v. Recycled Plastics Indus., LLC</i> , Case No. 1:23-cv-00261-WCG (E.D. Wis. Nov. 30, 2023) (marked as Exhibit 3 during deposition of Francisco Morales in district court litigation)
RPI1036	United States Design Patent No. D819,234 (marked as Exhibit 5 during deposition of Francisco Morales in district court litigation)
RPI1037	United States Design Patent No. D819,235 (marked as Exhibit 6 during deposition of Francisco Morales in district court litigation)
RPI1038	StaMixCo Principles of Operation Webpage Printout (Wayback Machine) (marked as Exhibit 9 during deposition of Francisco Morales in district court litigation)
RPI1039	Excerpts from File History of United States Design Patent No. D819,234 (marked as Exhibit 11 during deposition of Francisco Morales in district court litigation)
RPI1040	Excerpts from File History of United States Design Patent No. D819,235 (marked as Exhibit 12 during deposition of Francisco Morales in district court litigation)
RPI1041	Tangent Residential Materials Brochure (marked as Exhibit 13 during deposition of Francisco Morales in district court litigation)
RPI1042	Plaintiff Tangent Technologies, LLC's First Amended Complaint, <i>Tangent Techs., LLC v. Recycled Plastics Indus., LLC</i> , Case No. 1:23-cv-00261-WCG (E.D. Wis. May 18, 2023) (marked as Exhibit 14 during deposition of Francisco Morales in district court litigation)

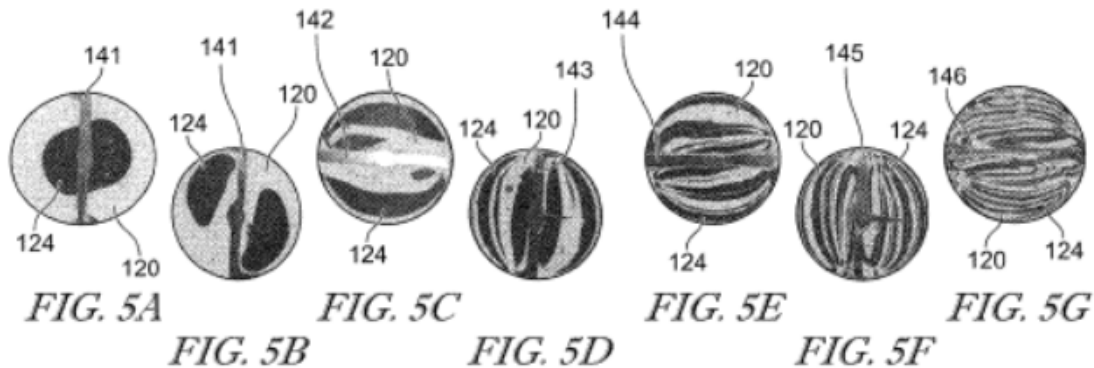
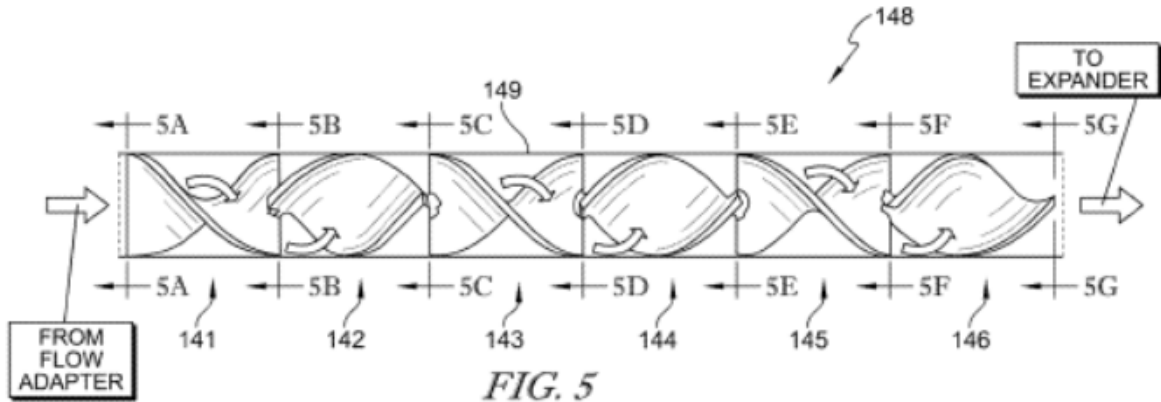
Exhibit No.	Description
RPI1043	Photographs of Surfaces of Three Products (marked as Exhibit 15 during deposition of Francisco Morales in district court litigation)
RPI1044	Photographs of Cross-Sections of Three Products (marked as Exhibit 16 during deposition of Francisco Morales in district court litigation)

Petitioner Recycled Plastics Industries, LLC (“Petitioner”) requests *inter partes* review of Claims 1-24 (“Challenged Claims”) of U.S. Patent No. 10,981,350 (“’350 patent”) (RPI1001), which—excluding Claims 4, 8, and 14—are being asserted by Patent Owner Tangent Technologies LLC (“PO”) (RPI1002) in parallel district court litigation.

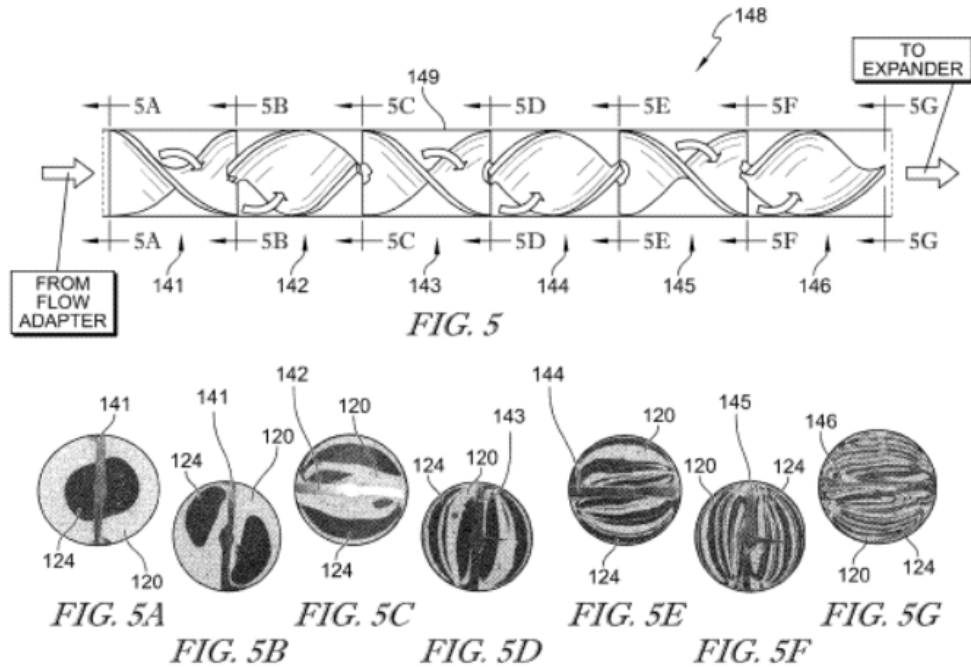
I. Introduction

The ’350 patent is directed to plastic lumber products that are used as a natural wood substitute or replacement, whose sole purportedly inventive aspect is having a simulated wood grain pattern throughout their core. But this “inventive” concept is anything but, and expressly appears in the prior art—indeed, including in prior art that the applicants *reproduced in their specification and knowingly passed off as forming a “key” part of their supposed invention, never revealing to the Patent Office that it was a carbon copy of a disclosure taken from the prior art.*

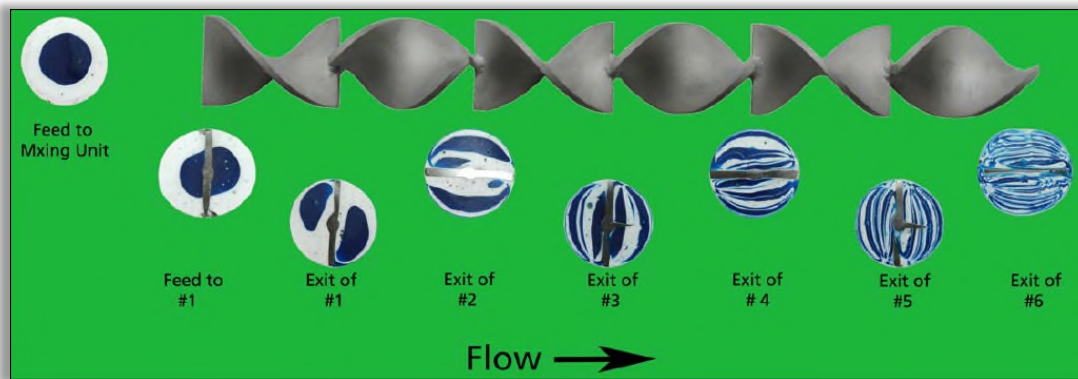
Plastic lumber has been created using several well-known methods, including extrusion, for decades prior to the ’350 patent’s earliest priority date. What the patent purports to do differently is to create synthetic wood having multi-colored, alternating curvilinear polymer layers that extend throughout its core and simulate natural wood-graining. This effect is disclosed as being achieved using the static mixer depicted in Figure 5:



When two differently-colored polymer melts enter the static mixer as shown in Fig. 5A, they will exit the static mixer having the wood-grain pattern shown in Fig. 5G. The combined melt will then pass through a die and be formed into synthetic wood having the same wood-grain pattern throughout its core. The '350 patent's provisional application describes this disclosure in Figure 5 as playing "a key role" in "determining" the claimed wood-grain pattern. But as can be seen below, Figure 5 was copied from the prior art:



(RPI1001, Fig. 5)



(RPI1010, Fig. 20)

Applicants omitted and actively concealed this fact during prosecution, instead representing Figure 5 as forming a key part of their invention's disclosure. They even argued that the '350 patent was the "only" disclosure of the claimed structures, all the while knowing that the figure was copied *from the prior art*. Had the Examiner and the Board known the truth regarding the disclosure in Figure 5,

none of the Challenged Claims would have been allowed. The chickens have finally come home to roost for PO, and Petitioner respectfully requests that the Board find each of the claims unpatentable in view of the StaMixCo prior art that Applicants plagiarized, as discussed further below.

The static mixer and its resulting internal patterns that PO copied from the prior art was not the only known way of producing synthetic wood having multi-colored, alternating curvilinear polymer layers that extend throughout the core of the board and simulate natural wood-graining. As also discussed below, the Zumbrunnen prior art reference describes the use of stir rods to arrive at the same result through chaotic advection and provides an alternative basis for finding the Challenged Claims unpatentable.

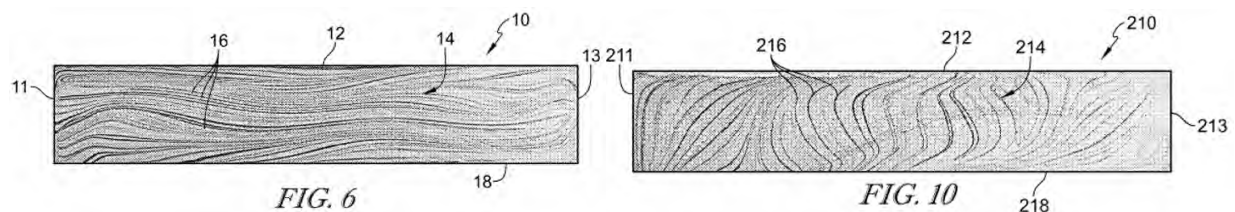
The dependent claims add nothing to escape a finding of unpatentability. Using high density polyethylene (HDPE) polymers (**Claims 6, 12, 22**); removing outer surface layers (**3**) to create a burling pattern (**4**); embossing the surfaces (**5**); using UV inhibitors and foaming agents (**7, 8, 13, 14**); using substantially wood-free materials (**16, 18, 23**); and having certain dimensions (**17, 19**) were all well-known concepts in the synthetic wood industry prior to the '350 patent.

II. Overview of the '350 Patent

A. The Specification's Disclosure of the Claimed Products and the Prior Art Method of Making Them

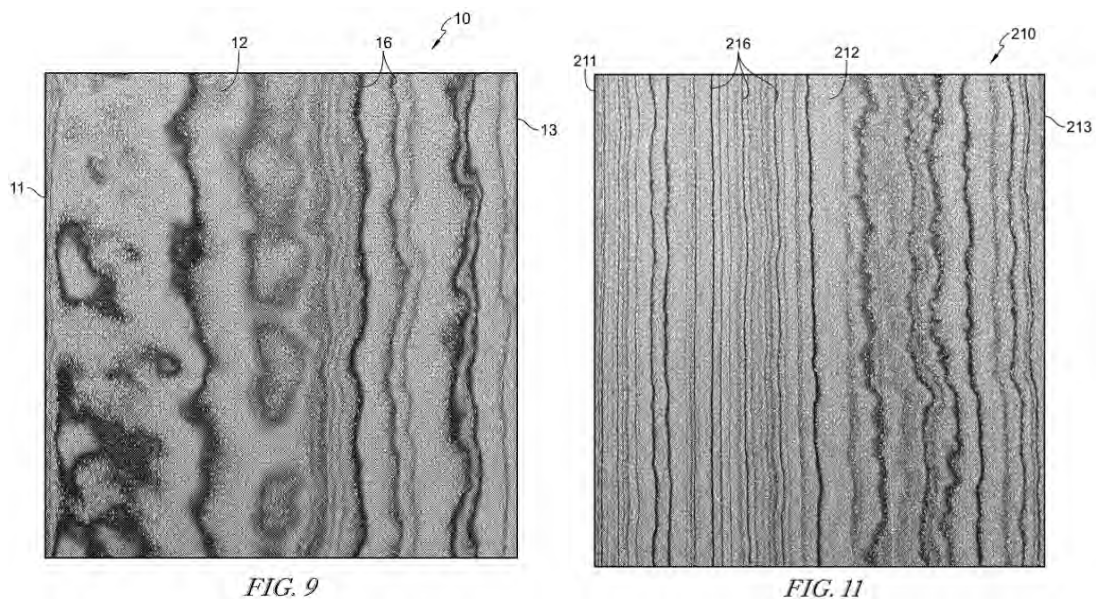
The '350 patent is directed to a “wood-grained polymer substrate [that] includes a plurality of layers of different colors” and is “used as a natural wood substitute or replacement.” RPI1001, Abstract, 1:13-15; *see generally* RPI1005 (Declaration of Dr. Karl Englund), ¶¶38-53. It recognizes that “*numerous...composite and alternative plastic lumber decking products*” have been introduced over the past decade. RPI1001, 1:19-21.¹ These prior art products allegedly lacked “a wood-grain like appearance through [their] core.” RPI1001, 1:50-54, 1:21-37, 2:21-25.

The '350 patent purports to disclose an inventive simulated wood product having a plurality of polymer layers that “alternate within the substrate to form a wood-grained appearance throughout.” RPI1001, 2:30-38. Figures 6 and 10 provide a “sectional view” of two different embodiments, “showing a wood grain pattern” that runs throughout the entire substrate. RPI1001, 2:60-63, 3:4-7, 3:52-54.



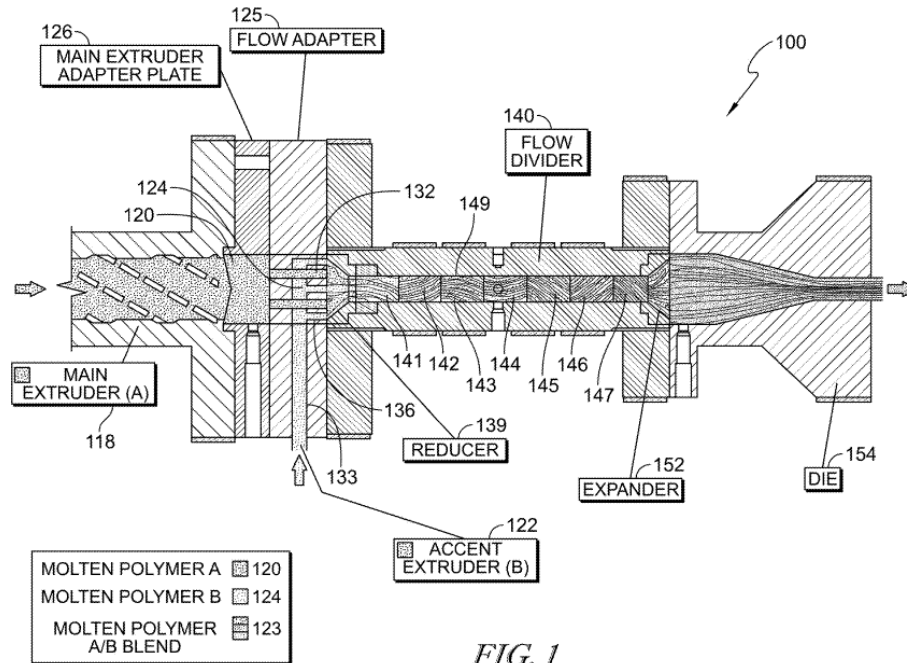
¹ All emphasis added.

These “wood-grained” substrates can have “varying patterns of simulated wood grain which extend through and along” them. RPI1001, 3:25-30. The wood grains “also extend to an outer surface,” e.g., top surface 12, 212, “so that when removal of material occurs, such as through planning or cutting, the multi-tone wood grain effect remains both on the surface 12, 212 as well as with an exposed core 14, 214 of the substrates as suggested in FIGS. 9 and 11.” RPI1001, 3:55-61.

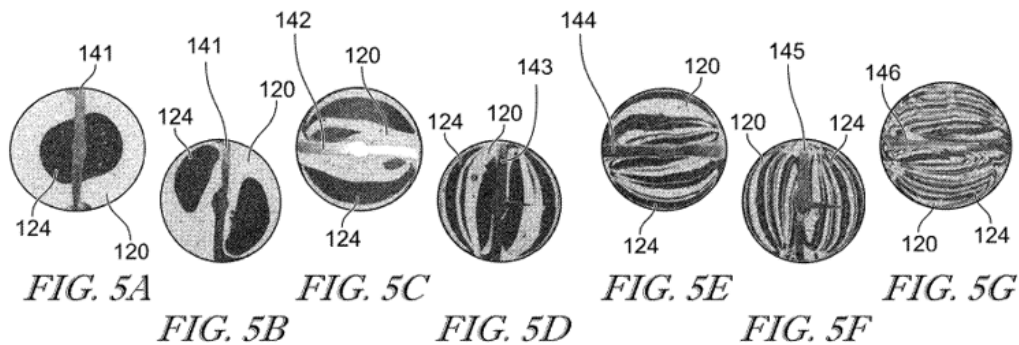
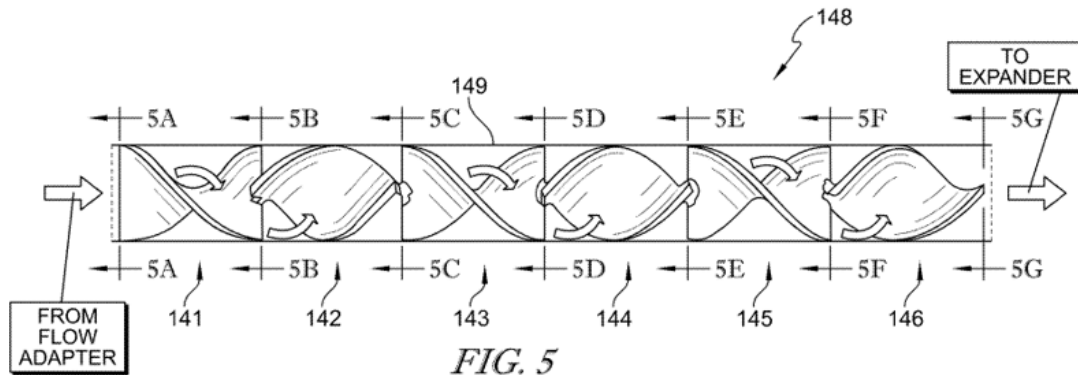


The substrates can be made from recycled HDPE, “having at least two different colorants added thereto to define the wood-grain patterns” and “can include additives, such as UV inhibitors, [and] foaming agents” to achieve “desired colors and material properties, such as durability and strength.” RPI1001, 3:30-39. The substrates also can be “post-processed, such as by planning or embossing, and cut to form various sized boards.” RPI1001, 3:40-43, 3:61-63.

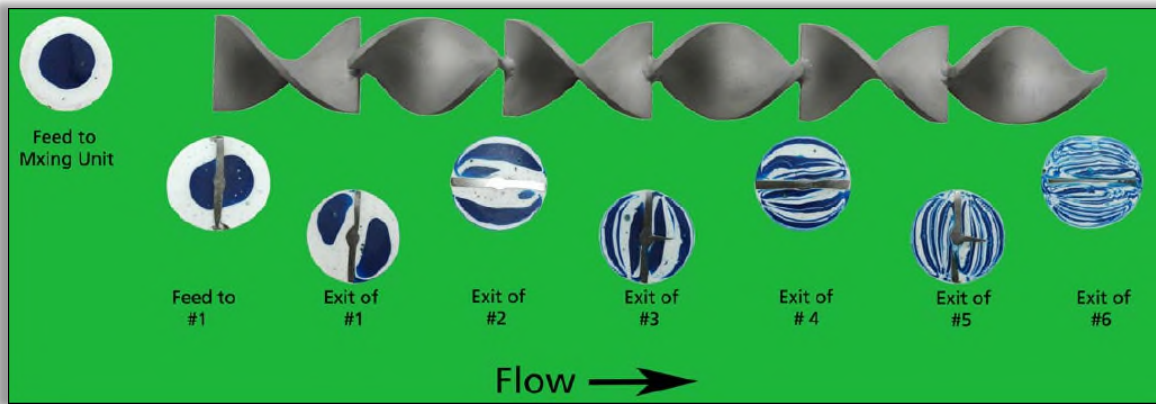
The '350 patent discloses an “extrusion machine 100...in FIG. 1,” for making the claimed products. RPI1001, 4:1-3.



Flow adapter 125 is “configured to initiate the combined flow of first and second polymers 120, 124 through extrusion machine 100.” RPI1001, 4:43-49. The “combined flow...is then directed to flow divider 140 *for formation of the wood grain pattern.*” RPI1001, 4:49-51. The flow divider includes “a plurality of section inserts 141-147...coupled to one another to form a continuous dividing element 148 as suggested in FIG. 5.” RPI1001, 5:31-35.

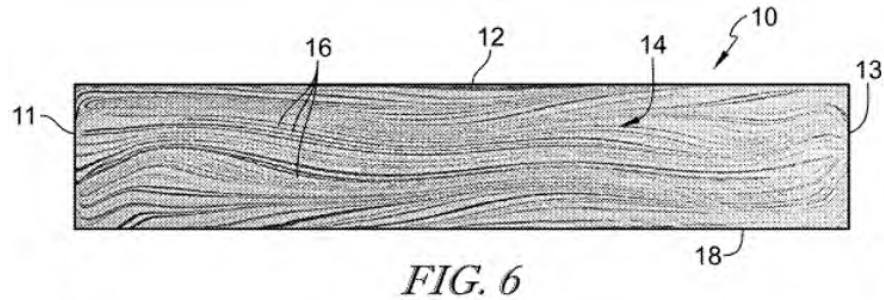
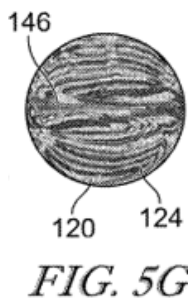


In Provisional Patent Application No. 62/208,928 (“’928 provisional”), to which the ’350 patent claims priority and whose disclosure it incorporates by reference (RPI1001, (60), 1:6-9), the “flow divider” is referred to as a “[s]tatic mixer 40.” RPI1003, ¶¶[0014], [0038-42]. The ’928 provisional discloses that “[d]ifferent style static mixers can be used to create different grain patterns” and that “[p]referably helical static mixers are used as shown in” Figure 7, which corresponds to the ’350 patent’s Figure 5. RPI1003, ¶¶[0039], [0014]. That figure was *copied* wholesale from Figure 20 of the StaMixCo prior art (RPI1010), which Applicants never disclosed to the Patent Office:

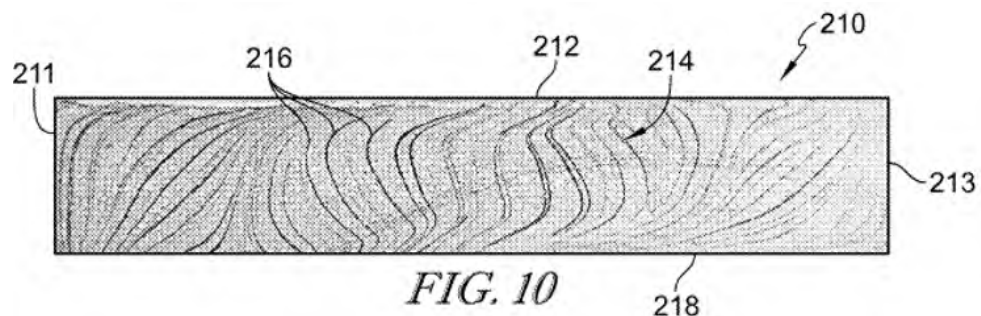
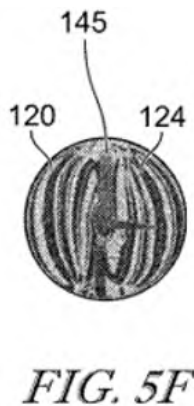


The '928 provisional explains that the “design, orientation and number of element inserts” of the illustrated static mixer “*play a key role in determining the linear graining and streaking aesthetics for a particular profile size and shape.*” RPI1003, ¶[0039]. The '350 patent likewise teaches that “the design, orientation, and number of [the] section inserts” shown in its Figure 5 “*determine the linear graining and layering aesthetics for a particular profile size and shape of*” the substrate. RPI1001, 5:58-61; 5:35-48; 5:66-6:3.

For example, “as suggested in FIGS. 5 and 5G, a horizontal (longitudinal to the substrate) orientation in the final end of the dividing element 148 produces horizontal layers in the flow, which leads to horizontal grains in the final polymer substrate 10 as suggested in FIG. 6.” RPI1001, 5:61-66; 6:24-43; 7:21-27.



“Having the final end of the dividing element 148 oriented vertically produces vertical (transverse to the substrate) layers in the flow, which leads to vertical grains in the final polymer substrate 10 as suggested in FIG. 10.” RPI1001, 5:66-6:3; 6:44-61; 7:27-33.



The combined flow of the layered polymers “exiting section insert 147 enters an expander 152 as shown in FIG. 1,” and the expander “directs the flow into the entry of a die 154 for forming the general profile of polymer substrate 10.” RPI1001, 6:16-23. “Various cross-sectional profiles are possible” and “can be created using the die 154, or through post processing of the boards.” RPI1001, 7:2-7.

B. The Challenged Claims

Independent **Claims 1, 10, 20, and 24** are generally directed to a “simulated natural wood-grained polymer board” (**1, 24**) or “substrate” (**10, 20**) having two alternating sets of differently-colored polymer layers that extend through it along specific dimensions. The substrate of **Claim 10** and the board of **Claim 24** include a “core” or “polymer core,” respectively. The claimed products can be more readily visualized with reference to Figures 6 and 10, as annotated below. RPI1005, ¶¶54-66.

Figure 6 (annotated)

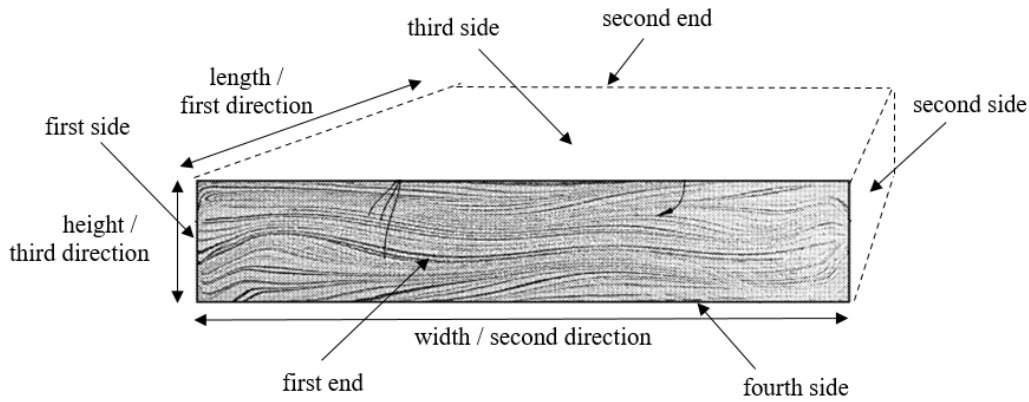
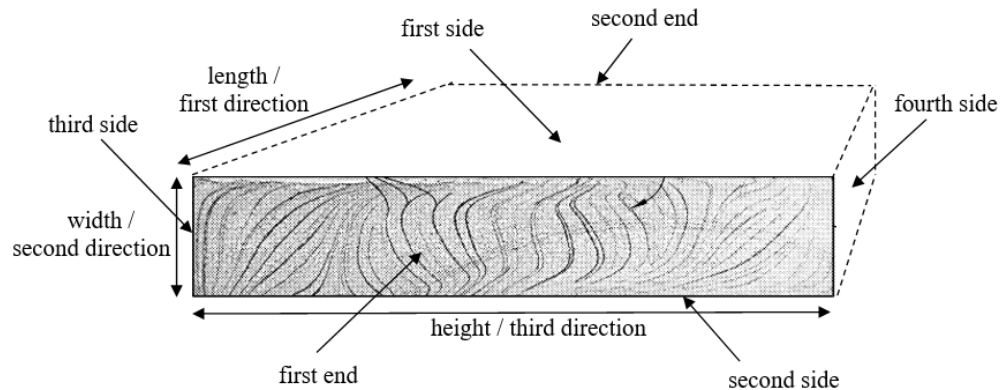


Figure 10 (annotated)



The claimed products require at least two sets of polymer layers containing different colorants from one another, with a majority of each of those two sets of layers “extending along” the entire length/first direction of the board or core (**Claims 1, 24**) or being “substantially continuous along the first direction” (**10, 20**). A “plurality of individual layers of the first and second sets of polymer layers” must “alternate within the” board (**1**), substrate (**20**), or cores thereof (**10, 24**). **Claim 20** requires this alternating to occur “along the third direction.” **Claims 10** and **20** further require the alternating layers “to form a natural wood-grained appearance throughout the” substrate (**20**) or its core (**10**). A plurality of those individual layers must “extend along a substantially uninterrupted curvilinear path originating proximate the first side” and “terminating proximate the second side of the” board (**1**) or its core (**24**). **Claims 10** and **20** similarly require a plurality of individual layers to “extend along a substantially uninterrupted curvilinear path in the second direction originating” either “proximate the first side and terminating proximate the second side” (**10**) or “proximate an outer surface of a first portion of the substrate and terminating proximate an outer surface of a second portion of the substrate” (**20**).

Claims 17 and **19** depend from **1** and **10**, respectively, and recite a third/height dimension along which “the individual layers of the first and second sets of polymer layers” must “alternate within the core of the” board or substrate.

Claims 2, 11, and 21 depend from **1, 10, and 20**, respectively, and require that the “layers of the first set of polymer layers are thinner than the layers of the second set.”

Claim 3 depends from **1** and requires that “a portion of at least one of the first side and second side of the board is removed to expose portions of the first and second sets of polymer layers along the length direction,” while **Claim 4** further requires that these “exposed portions...form a burled grain pattern.”

Claim 5 depends from **1** and recites that “at least one of the first and second sides of the board is embossed with a wood grain pattern.”

Claims 6, 12, and 22 depend from **1, 10, and 20**, respectively, and require that “the first and second sets of polymer layers are formed from high density polyethylene.” **Claims 7 and 13** depend from **6 and 12**, respectively, and require that “the first and second sets of polymer layers further include at least one of a UV inhibitor and a foaming agent.” **Claims 8 and 14** also depend from **6 and 12**, respectively, and require that “one of the first and second sets of polymer layers further includes a foaming agent.”

Claims 9 and 15 depend from **1 and 15**, respectively and require that each board and substrate “is formed to define a polygonal cross-section along [its] length.”

Claims 16, 18, and 23 depend from **6, 12, and 22**, respectively, and recite that “the core is substantially free of natural wood materials.”

C. The Prosecution History

The '350 patent issued from Application No. 15/245,948, which was filed on August 24, 2016, and claims priority to the '928 provisional, filed on August 24, 2015. RPI1001, (21), (60).

Prosecution involved several rejections. See RPI1005, ¶¶67-83; RPI1004. Relevant here, in an Office Action dated July 13, 2018, the Examiner rejected the pending claims as unpatentable over the “Piedboeuf” reference and/or in view of other art. The Examiner found that “Piedboeuf teaches processes for creating color effects in extrudable material” that were “*nearly identical* to the system which forms the [claimed] simulated natural wood-grained polymer board,” with both systems involving “the input of two different materials having two differing colors which are then mixed through a static mixer similar to the one...taught by Piedboeuf, and then extruded to form the board as shown in Figures 1 and 5-5G.” RPI1004, 199-201. Piedboeuf’s Figures 1 and 3 illustrate the point:

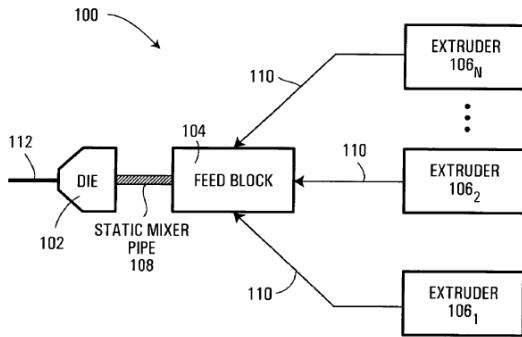


FIG. 1

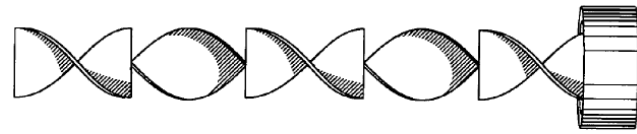


FIG. 3

RPI1004, 200.

Applicants disputed that the Piedboeuf process “would ultimately result” in the claimed structures, and argued that Piedboeuf “*fail[s] to show these specific structures.*” RPI1004, 250. Applicants also argued that the Examiner “fails to describe how” a POSITA “could arrive at the claimed structures simply by reviewing” Piedboeuf “*without...the benefit of hindsight bias from the disclosure of the present application,*” which Applicants argued to be the “only” teaching of the claimed structures. RPI1004, 250-51. The Examiner thereafter again rejected all pending claims, citing the same art. RPI1004, 255-85. Applicants appealed, repeating their arguments. RPI1004, 297-302, 323-41.

Applicants never disclosed during prosecution that the “key” disclosure in Figure 5 of how the claimed structures were made was not their invention but was copied from the StaMixCo prior art. Applicants knew this all along. RPI1007, 211:3-

214:4, 219:16-220:4.² Indeed, they did not even identify StaMixCo in numerous IDS filings during several years after filing the '928 provisional. It was not until February 27, 2018, nearly three years later, that Applicants finally referenced a StaMixCo webpage, which included only a partial disclosure of the StaMixCo prior art relied on here, in an IDS. RPI1004 at 131. But they still continued to argue that their disclosure in the specification is the “only” teaching of the claimed structures, concealing the fact that their own “key” disclosure was actually copied from the StaMixCo prior art and holding it out as part of their own invention. RPI1004 at 250-51, 297-302; *see* RPI1005, ¶¶71-83.

The Board accepted Applicants’ arguments and reversed the Examiner’s rejection of the claims, leading to a Notice of Allowability. RPI1004, 396, 403-05.

D. Person of Ordinary Skill in the Art

A POSITA would have at least a bachelor’s degree in materials science, chemistry, or chemical engineering and at least five years of experience in the field of polymers or plastics processing. Additional education could substitute for professional experience or vice versa. RPI1005, ¶¶22-23.

² RPI1007 is the deposition transcript of Francisco Morales, a named inventor and one of PO’s co-founders and executives. RPI1007, 9:4-18, 36:13-38:8.

E. Claim Construction

Claim terms in IPRs “shall be construed using the same claim construction standard...used...in a civil action.” 37 C.F.R. § 42.100(b); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). The “common standard does not mandate that all claim construction disputes submitted to the district court must also be aired here,” but rather “only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.” *Google LLC v. Hammond Dev. Int’l, Inc.*, No. IPR2020-00081, 2021 WL 2288174, at *7 (P.T.A.B. June 4, 2021), *rev’d in part on other grounds*, 54 F.4th 1377 (Fed. Cir. 2022); *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (approving Board decision not to construe claim language where construction is not material to dispute) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)); *Chanel, Inc. v. Molo Design, Ltd.*, No. IPR2022-00544, 2023 WL 5153646, at *5 (P.T.A.B. Aug. 9, 2023) (“We see no reason to incentivize petitioners to create claim construction issues that have no bearing on the challenges in the Petition.”).

In view of the prior art asserted in the grounds below, the only claim term that requires construction is “**burled grain pattern**” (**Claim 4**). RPI1005, ¶¶84-92. The specification does not define this term but explains that “a thin layer can be removed from each outer surface 12” of the substrate or board, “such as by planning, to expose

the wood grain pattern 16 as suggested in FIG. 9,” which represents a “burling effect.” RPI1001, 6:39-43, 3:1-3.

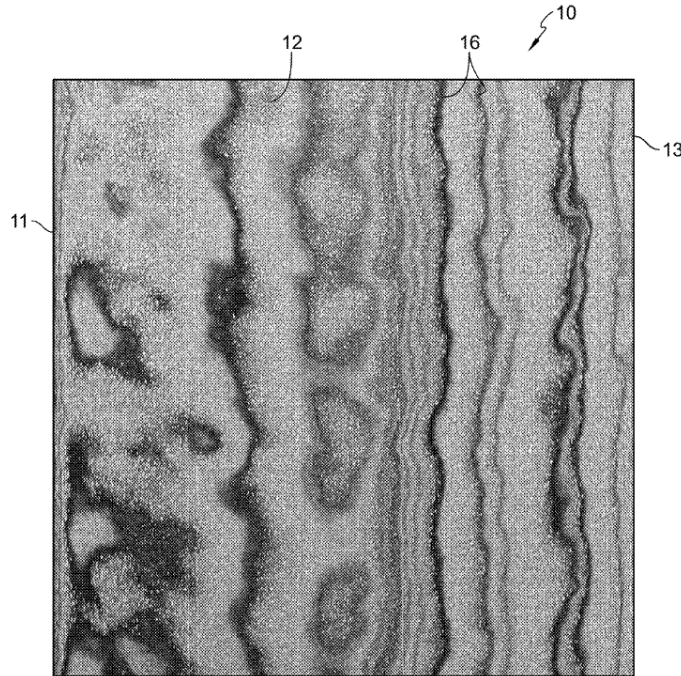
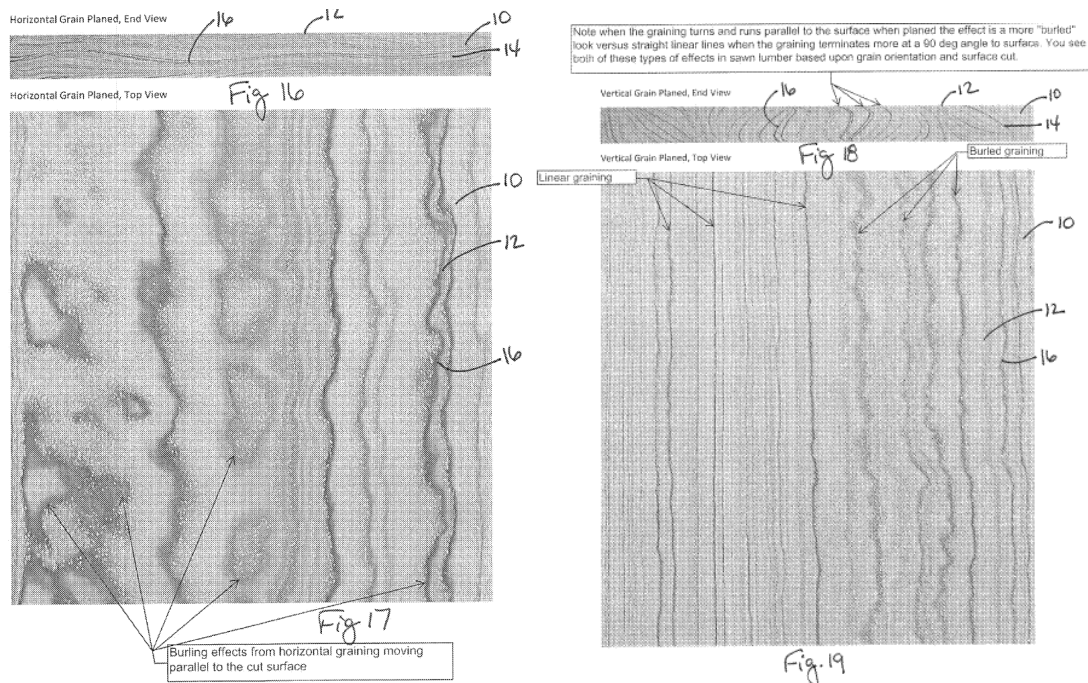


FIG. 9

The '928 provisional similarly points to examples of “burled graining effects from planning the surface of the board” in Figures 17 and 19 (RPI1003, [0024-0026]):



The notes to these figures distinguish “burled” graining as resulting from “when the graining turns and runs parallel to the surface when planed,...versus straight linear lines when the graining terminates more at a 90 deg angle to surface.” RPI1003, 10. A POSITA would have therefore understood “burled grain pattern” to mean a “grain pattern resulting from planing the surface.” RPI1005, ¶¶84-92. This is consistent with how Mr. Morales understood the term. RPI1007, 163:21-165:17 (explaining that this term refers to having “wood grain below the surface” that is seen when the surface is planed off, with no additional processing required).

Although the parties recently exchanged proposed claim constructions for additional terms in the district court (see RPI1014, RPI1015),³ “no issue turns on

³ PO initially argued that no terms require construction. RPI1009.

[the Board’s] construction of [those] limitation[s]” here and they therefore need not be construed. *Allstate Ins. Co. v. Atos*, No. IPR2021-01209, 2023 WL 1096682, at *5 (P.T.A.B. Jan. 24, 2023). Petitioner notes that it has argued in the district court, and reserves the right to continue doing so, that two terms are indefinite: (1) **“wood-grained”/“wood grain”** and (2) **“substantially uninterrupted curvilinear path [in the second direction] originating [from] proximate the...and terminating proximate the...”** RPI1014, 2.

Regarding term (1), because the prior art asserted in this Petition “explicitly discloses” the “wood-grained”/“wood grain” limitation, no construction of this term is required to resolve any issue herein notwithstanding its indefiniteness. *See Halliburton Energy Servs., Inc. v. U.S. Well Servs., LLC*, IPR2021-01316, 2023 WL 2597810, at *6 n.4 (P.T.A.B. Feb. 17, 2023) (Board addressing invalidity challenge despite concluding “high pressure” term was indefinite where prior art explicitly disclosed that term).

Similarly, regarding term (2), because the prior art asserted in this Petition either discloses curved⁴ paths of polymer layers having *no* interruptions across the

⁴ The parties appear to agree in the district court that if term (2) is not found indefinite, then the “curvilinear” portion should mean “curved.” RPI1014, 2; RPI1015, 1-2.

entire width of the board, or curved paths of polymer layers that are *identical* to the claimed polymer layer paths disclosed in the '350 patent, no claim construction of the term “substantially uninterrupted curvilinear path [in the second direction] originating [from] proximate the...and terminating proximate the...” is required to resolve any issue herein notwithstanding its indefiniteness. *See Chanel*, IPR2022-00544, 2023 WL 5153646, at *5 (“the issues of infringement and indefiniteness before the district court may require a more developed claim construction than is needed to resolve the issue of patentability here”).

III. Statutory Grounds of Challenge

Ground	Basis
1	Claims 1-4, 6, 9-12, 15, 17, 19-22, 24: obvious over Nam in view of StaMixCo
2	Claims 5, 7-8, 13-14, 16, 18, 23: obvious over Nam in view of StaMixCo , and further in view of Rassi
3	Claims 1-4, 6, 9-12, 15-24: obvious over Zumbrunnen
4	Claims 5, 7-8, 13-14: obvious over Zumbrunnen in view of Rassi

IV. Overview of the Technology and the Cited Art

A. Background of the Art

As the '350 patent recognizes, and Mr. Morales (a named inventor) admitted, numerous “composite and alternative plastic lumber decking products” have been introduced “over the past decade” preceding the '350 patent’s priority date. RPI1001, 1:15-30; RPI1007, 15:12-18:14, 30:25-31:20; RPI1005, ¶¶24-27. One

commonly known method for producing plastic lumber products was extrusion, which involves melting and combining polymers with colorants and other additives, and pushing them through a die to shape them into boards. RPI1001, 1:38-40, 2:4-24; RPI1007, 15:12-18:14, 30:25-31:20; RPI1005, ¶¶28-29. It was also known that either using a static mixer or through other methods of promoting chaotic advection, the polymer melts could be partially blended before passing through a die to impart various patterns to the extruded products, including wood-grain patterns. RPI1007, 201:25-203:11, 218:24-220:4, 220:16-221:14, 222:12-23, 223:5-224:16; RPI1005, ¶¶30-34. The helical static mixers disclosed in the '350 patent had been in use for decades prior. RPI1007, 202:21-203:11, 211:13-214:4, 218:24-220:14, 222:12-23, 223:5-224:16, 225:1-228:7; RPI1005, ¶¶30, 34.

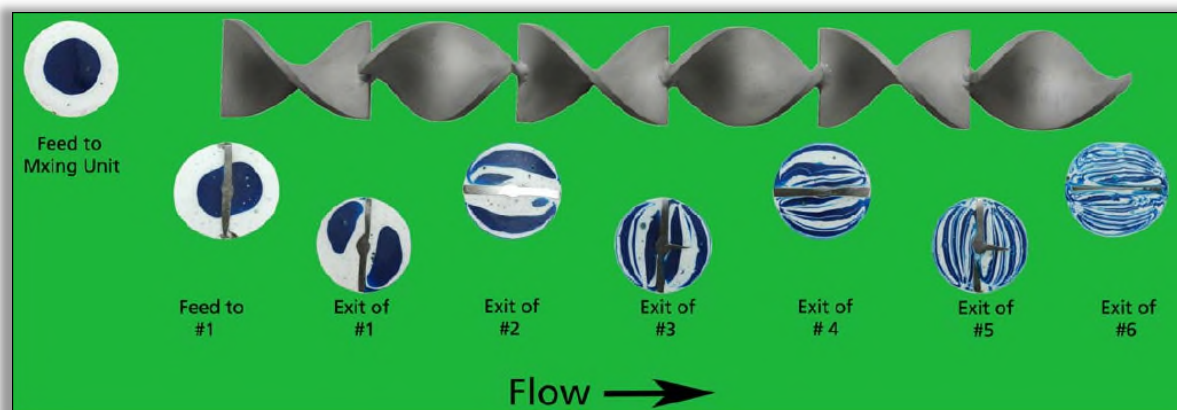
It was also known that colorants could be added during extrusion to emulate a wood grain appearance on the board's surface. RPI1001, 1:31-2:3; RPI1007, 88:13-19, 104:2-105:1; RPI1005, ¶33. Creating multi-colored patterns within the core of simulated wood was also known. RPI1001, 2:4-24; RPI1007, 104:2-105:1; RPI1005, ¶¶32-34. The colors used were design choices and the product of reasonable experimentation. RPI1007, 122:10-123:5; RPI1005, ¶33. HDPE was the most commonly used polymer in creating plastic lumber prior to August 2015. RPI1007, 19:23-20:2, 20:4-11, 20:20-21:20, 33:24-34:5, 60:6-15, 106:6-11, 118:23-120:3, 120:5-23, 121:18-122:8, 130:12-24; RPI1005, ¶36. Additives such as UV

inhibitors and foaming agents were also known and used in creating simulated wood. RPI1007, 22:2-26:5, 34:20-36:2, 60:6-61:4, 64:19-65:14, 124:23-125:12; RPI1005, ¶37. It was also known that various decorative or other finishing steps could be applied to plastic lumber, such as cutting or planing it like real wood, and embossing its surface to enhance the texture. RPI1001, 1:34-37, 1:62-65; RPI1007, 24:3-24, 35:2-10, 98:2-12. 126:8-14; RPI1005, ¶35.

B. Cited Art References

1. *StaMixCo* (RPI1010)

StaMixCo discloses several static mixer designs for use in “the extrusion of viscous polymers.” RPI1010, 1. The mixers are “installed just in front of the extruder die.” RPI1010, 2. Before entering the die, “[m]olten polymer...flows through the static mixer,” whose mixing elements continuously divide and recombine the material. *Id.* One of those mixers is a helical static mixer:



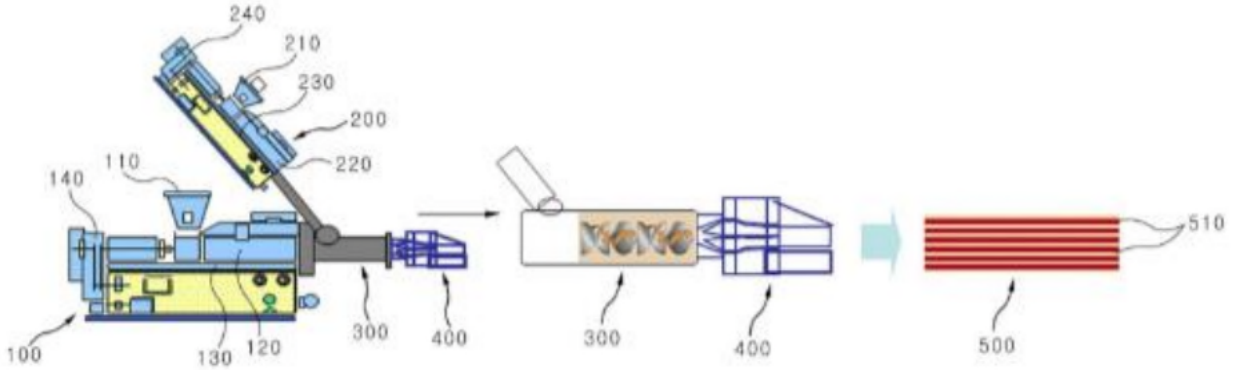
RPI1010, Fig. 20; *id.*, 10. Figure 20 above is identical to Figure 5 of the '350 patent and was copied by Applicants. Figure 20 illustrates “[b]lue and white viscous

resin...[being] pumped through six...static mixing elements,” with “cross-sectional cuts...made at the outlet of each mixing element.” RPI1010, 10. The melt contains progressively more layers as it passes each mixing element. *Id.* The differently colored layers alternate with one another in either a horizontal or vertical orientation depending on the orientation of the last mixing element through which they passed. *Id.* This design has been used with extruders for over 37 years. *Id.*, 10; RPI1005, ¶¶96-97.

StaMixCo is a printed publication copyrighted in 2007, having a version date of February 9, 2007. RPI1010, 12. StaMixCo has been publicly available for download from the <http://stamixco-usa.com> website since at least as early as February 2009. RPI1020, 1-2, 7-24. Mr. Morales testified that he received a copy of StaMixCo from the StaMixCo company, and that he also ran across similar materials on the Internet on his own, prior to August 2015. RPI1007, 212:17-214:4, 218:24-221:14, 222:12-226:4. StaMixCo is prior art. 35 U.S.C. §102(a)(1)(post-AIA).

2. Nam (RPI1011)

Nam discloses a “manufacturing apparatus and method of synthetic wood having striped grain, and synthetic wood manufactured from the same” having a “striped grain on both the surface and interior,” as shown in Figure 3. RPI1011, [0001].



Id., Fig. 3, [0017], [0020], [0027]. Nam is concerned with “plastic” and “petrochemical” products and raw materials, and their improvement. *Id.*, [0005], [0007], [0018]. It teaches separately melting polymer mixtures of two different colors and extruding each into a static mixer. *Id.*, [0011-0012], [0014-0015], [0020-25]. As the melted material passes through each mixing element, it forms into alternating layers:

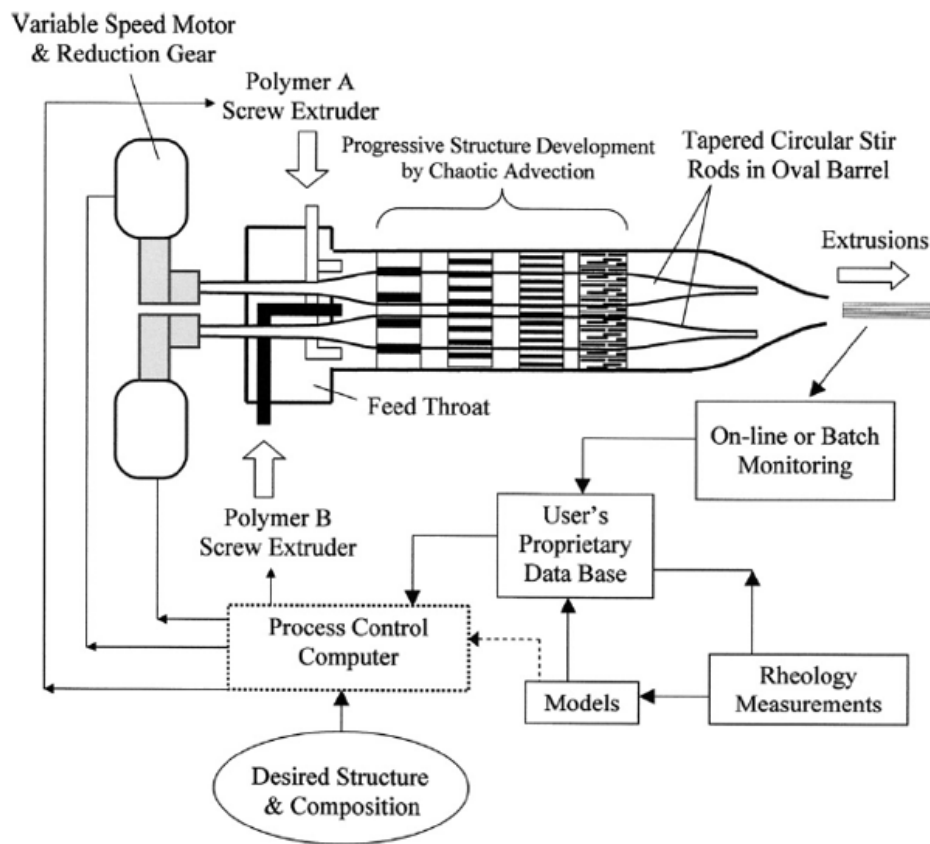
Number of elements	1	2	3	4	5
Partition figure					
Number of partitions	2	4	8	16	32

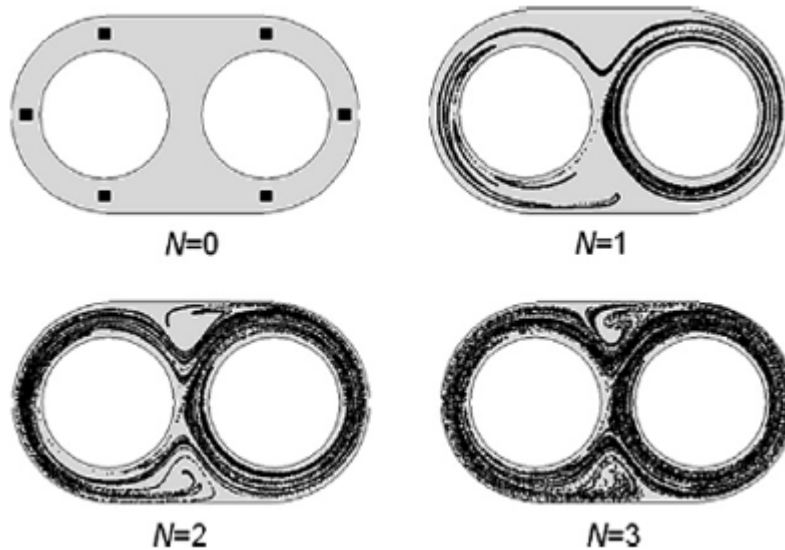
Id., Fig. 2; [0018]. The melted material is then molded using a “die or mold” into a board that has the striped grain on the surface and interior, like real wood. *Id.*, [0015], [0020], [0026-0027]; RPI1005, ¶¶93-95.

Nam is a Korean patent issued in 2013 and is prior art. 35 U.S.C. §102(a)(1)(post-AIA).

3. *Zumbrunnen* (RPI1012)

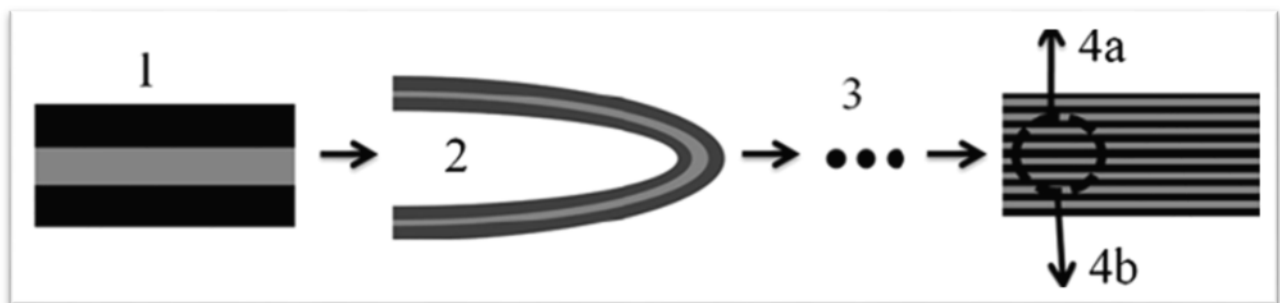
Zumbrunnen discloses extruding various “plastic products,” including ones “with the appearance of realistic wood grains both inside and on [their] surfaces.” RPI1012, 401. Zumbrunnen teaches that “[p]olymer melts are supplied to a feed throat of [its] smart blender by screw extruders in prescribed proportions to give a desired composition in the extrusion.” *Id.*, 403; Fig. 22.2. Zumbrunnen’s teachings “can be used with existing polymer resins,” including HDPE. *Id.*, 401, 408. As the “melt advances along the stir rods, melt domains are stretched and folded recursively by chaotic advection so that a layered arrangement first arises.” *Id.*, 403.





Id., 404, Fig. 22.2; RPI1005, ¶¶98-99.

Through “chaotic advection, initially large melt domains (e.g., resin pellet size or larger) or melt streams are stretched and folded (steps 1-3) into alternating multilayers,” with “[t]hick multilayers reduc[ing] in thickness as stretching and folding progress and the melt moves toward an extrusion point.” *Id.*, 402, 403.



Id., Fig. 22.1; *id.*, 402. “At the extrusion point, the melt is formed by an attached die into a desired extrusion form such as a film, plate, or filament.” *Id.*, 403. “By extruding th[e] structured melt through a die,” an infinite variety of appearances is possible, including “simulated wood grains”:

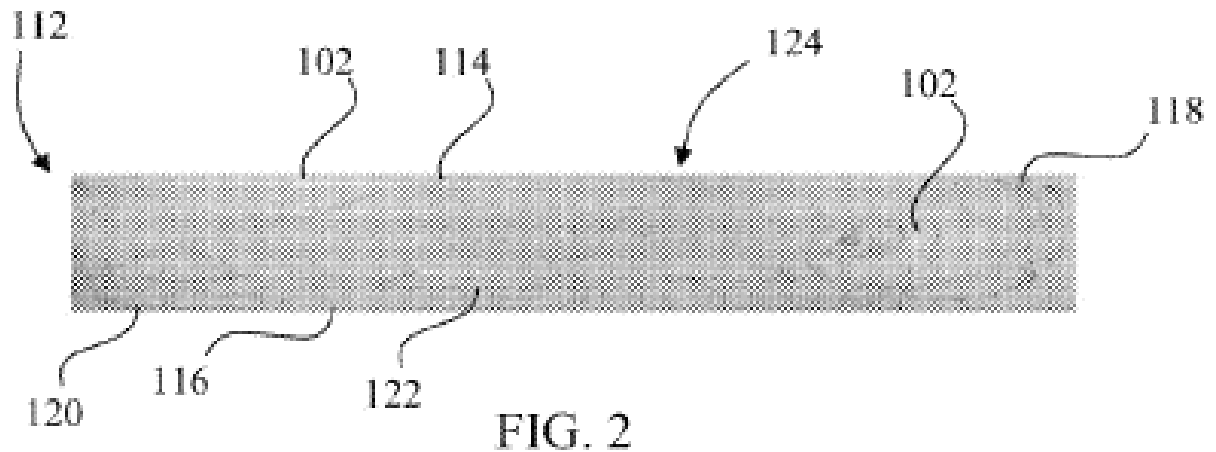
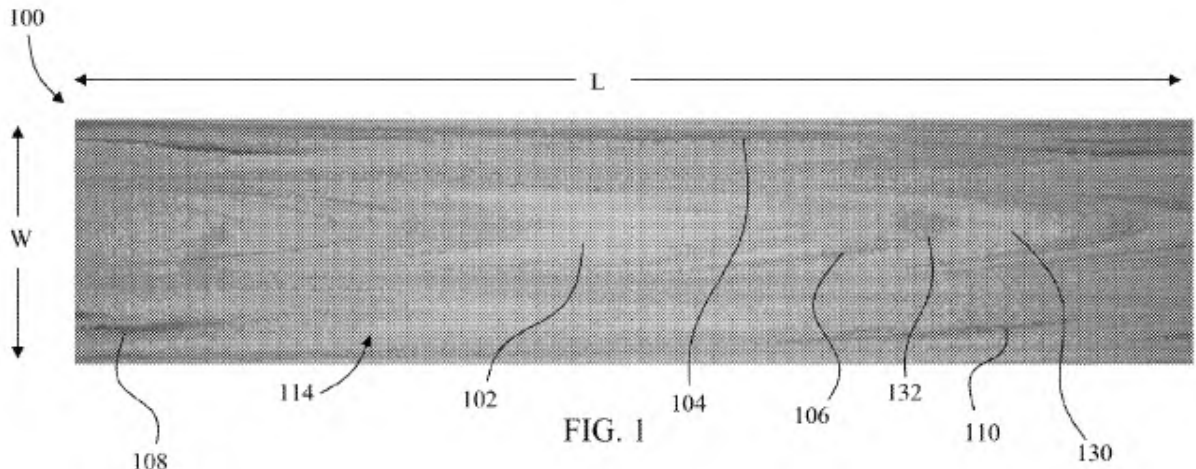


RPI1012, Fig. 22.12; 412-13. “Desired colors are obtained by using pigmented polymer resins such as those from colorant manufacturers intended specifically to impart wood appearance.” *Id.*, 413. “Like cut wood, the simulated grain appears both on the surface and interior of extrusions.” *Id.*, 413; RPI1005, ¶¶100-03.

Zumbrunnen was published in December 2011 and is prior art. 35 U.S.C. §102(a)(1)(post-AIA).

4. *Rassi* (RPI1013)

Rassi discloses “an extruded board” having “a realistic look similar to...natural wood.” RPI1013, Title, Abstract, 1:57-58. The board is made by extruding a base resin with colored streak portions to give the appearance of natural wood. RPI1013, 1:66-2:20, 5:63-65, 6:13-14. Figures 1 and 2 show a top view and a cross-section of the board, respectively:



Rassi teaches using additives like foaming agents and UV stabilizers in its extrusion. *Id.*, 6:36-42. Rassi discloses that different patterns can be realized on the board, including a burlled appearance, and that grain-like patterns can be embossed on the outer surface. *Id.*, 5:12-14, 6:6-10. Once extruded, the board can be cut and fastened like real wood. *Id.*, 10:30-31; RPI1005, ¶¶104-05.

Rassi is prior art because the application that led to its issuance was filed on December 17, 2014. 35 U.S.C. §102(a)(2)(post-AIA).

V. Detailed Explanation of the Challenge

A. Ground 1: Claims 1-4, 6, 9-12, 15, 17, 19-22, and 24 Are Obvious Over Nam in View of StaMixCo

1. Independent Claims 1, 10, 20, and 24

i. Elements [1pre], [10pre], [20pre], and [24pre-24a]⁵

Nam discloses producing “synthetic wood having striped grain” that can be “introduced to a mold” to create three-dimensional synthetic wood with “striped grain on both the surface and interior.” RPI1011, [0001]. Nam’s “synthetic wood” is made from “plastic,” “resin,” or “petrochemical” materials, which a POSITA would have understood to be referring to “polymers.” RPI1011, [0004-0005], [0007], [0018]; RPI1005, ¶107. Nam additionally discloses that extruded synthetic wood products “are similar to wood materials, slabs, and lumber” and “are mainly used in building materials.” RPI1011, [0006].

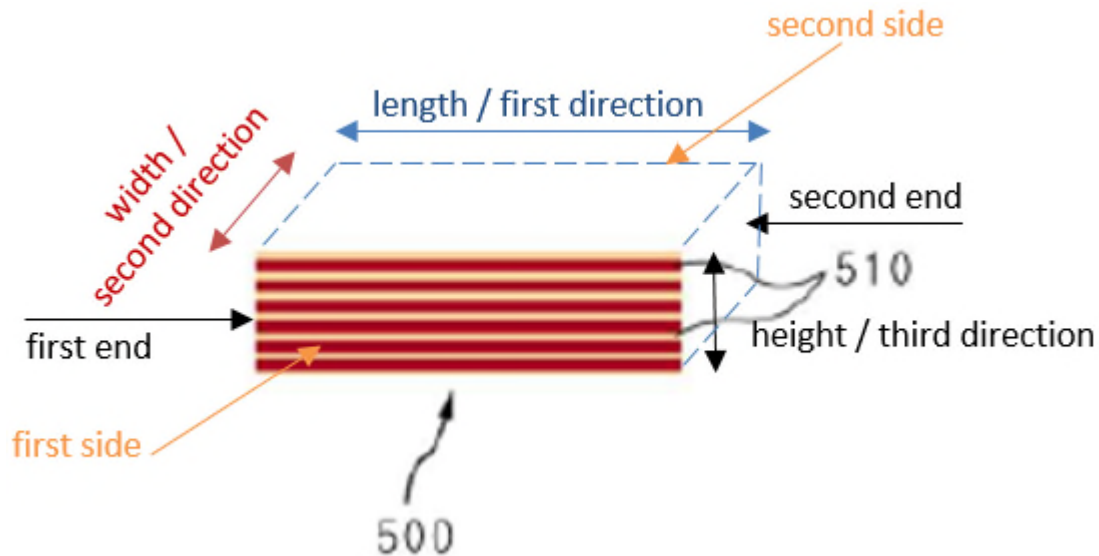
Because Nam’s polymer wood has “striped grain on both the surface and *interior*,” and is similar to “lumber” and other “building materials,” it is clear that the wood is three-dimensional. RPI1005, ¶108; RPI1011, [0017] (“Fig. 3 is a *frontal* schematic diagram...”). Indeed, it is intended to be an improvement on the three-

⁵ Similar claim elements are grouped together, with any differences addressed. Each element is reproduced in full in the Claim Appendix. Petitioner assumes the preambles are limiting for purposes of this Petition.

dimensional synthetic wood shown in Figure 1. RPI1011, Fig. 1, [0004], [0010]. Nam therefore discloses “[a] simulated natural wood-grained polymer board” ([1pre], [24pre]) or “substrate” ([10pre], [20pre]). RPI1005, ¶108. A POSITA would have further understood that the extruded three-dimensional synthetic wood of Nam has a non-hollow “core” ([10pre]) and, because Nam discloses that its wood is made from polymers, that the core is a “polymer core” ([24a]). *Id.*

To the extent there is any difference between the claimed “boards” and “substrates” it would at most be one of dimension. RPI1005, ¶109. This is consistent with how Mr. Morales, a named inventor, understood the terms. RPI1007, 75:22-77:17. A POSITA would have known how to alter the dimensions of the synthetic wood of Nam through choosing different dies and/or through post-processing, as suggested by Nam, such as by cutting the extrudate into variously shaped and dimensioned “substrates” or “boards,” as desired for a given application. RPI1005, ¶109.

Nam also discloses each of the dimensional requirements claimed in [1pre], [10pre], [20pre], and [24a], as can be seen with reference to Figure 3:



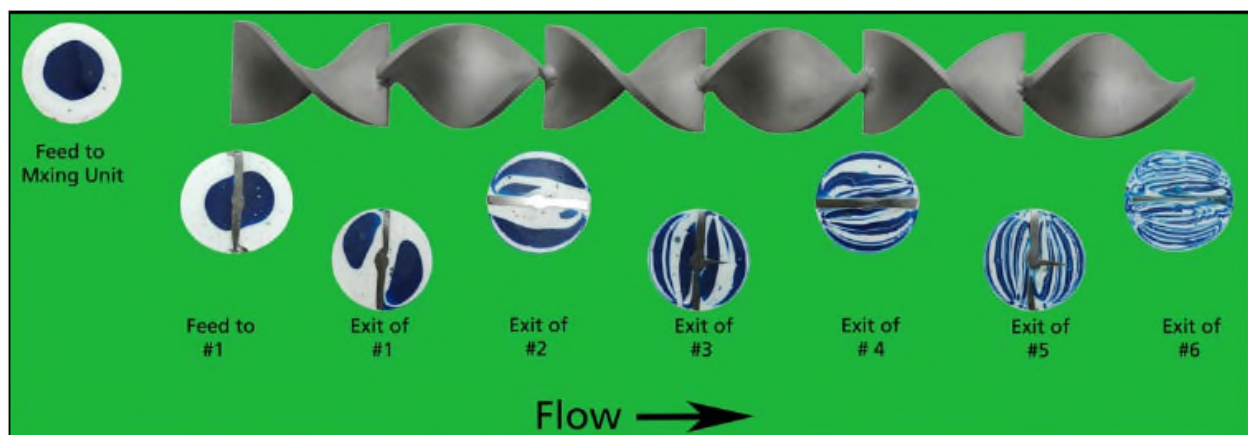
RPI1011, FIG. 3 (annotated); RPI1005, ¶110.

As can be seen above, Nam’s three-dimensional synthetic wood, including its polymer core, “extend[s] along a first direction,” has a “first side and a second side spaced apart from the first side along a second direction different than the first direction,” with the “first and second sides” or the “spacing between” them “defining...a width...of the” board/substrate or its core, “the first and second sides extending along a length/the first direction” of the board/substrate or its core “between a first end and a second end, the first and second ends defining a length of the” board/substrate or its core. RPI1005, ¶111. The “core of the substrate extend[s] between the first and second sides and along the first direction” and has “a length defined along a first direction, a width defined along a second direction perpendicular to the first direction, and a height defined along a third direction perpendicular to both the first and second directions.” *Id.* These dimensions and

spatial relationships are merely reflective of a three-dimensional rectangular board or substrate. *Id.*

If PO were to argue that Nam does not disclose a simulated “*natural wood-grained*” look, notwithstanding Nam’s express disclosure of “synthetic wood having striped grain” and stated goal of “realiz[ing] the naturalness of real wood” (RPI1011, [0010]), this element would have been obvious in view of StaMixCo. RPI1005, ¶112.

StaMixCo discloses “static mixer designs” used in the extrusion of “molten polymer[s],” including a helical static mixer in which two differently-colored “viscous resin[s]” are pumped through six static mixing elements, with “cross-sectional cuts...made at the outlet of each mixing element” to show the resulting mix following each element (RPI1010, 2, 10):



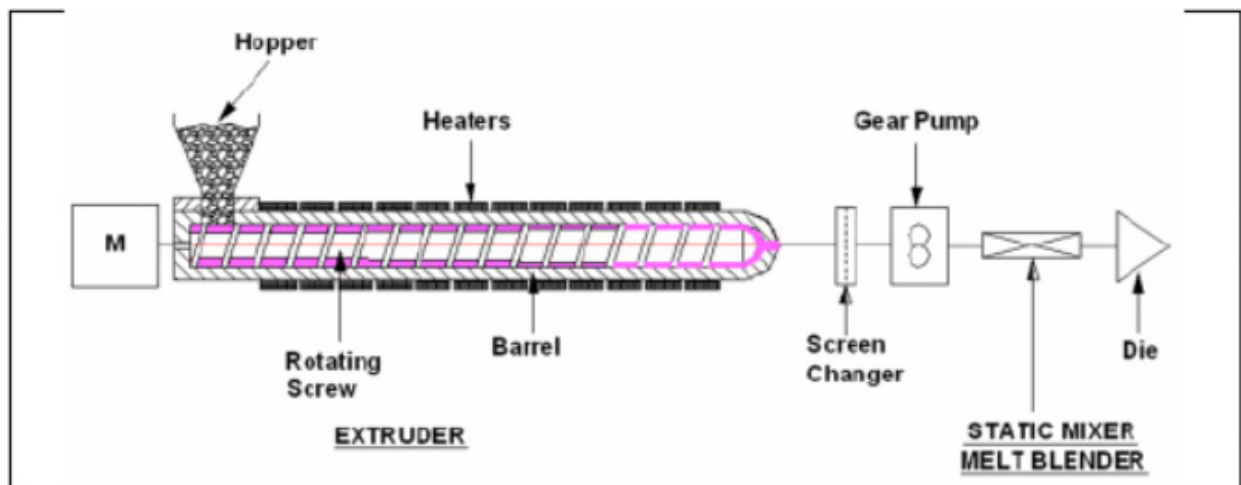
RPI1010, Fig. 20. Just like in Nam, the mixer is “installed just in front of the extruder die.” RPI1010, 2. A POSITA would have understood that once the polymer melt exits the mixer, no further mixing occurs, and the pattern shown in the cross-section

exiting a given mixing element will be the cross-section pattern in the extruded product after it passes through a die. RPI1005, ¶113; RPI1007, 149:2-153:22.

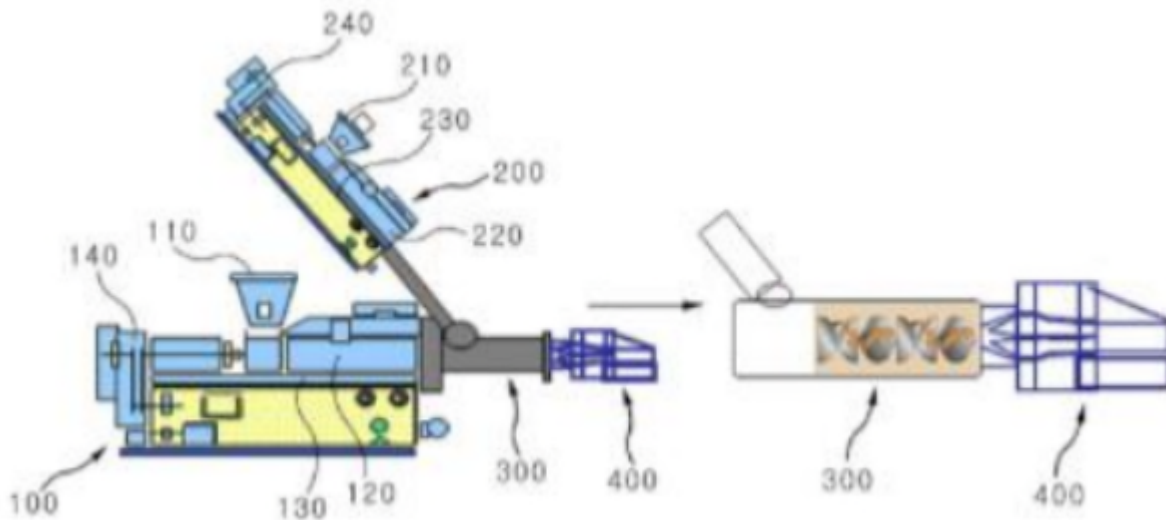
By the '350 patent's own admission, the cross-section patterns illustrated at "Exit of #5" and "#6"—reproduced as Figs. 5F and 5G in the '350 patent—will result in plastic lumber having a "*natural wood-grained*" appearance, as shown in Figs. 10 and 6 of the '350 patent, respectively, once they are put through a die. RPI1001, 3:52-54, 5:61-6:3, 6:24-61, 7:21-33; RPI1007, 149:2-151:3; 153:2-22; 154:6-10; RPI1005, ¶114.

Nam teaches that the striped pattern can be attained by limiting the number of mixing elements to reduce "the mixture level of the mixture." RPI1011, [0020]. StaMixCo similarly teaches that its Figure 20 mixer is a "low performance mixing device" that results in a "low degree of mixing." RPI1010, 10. Nam and StaMixCo show the cross-section of the pattern created following each successive mixing element, with the graining pattern at each step in StaMixCo appearing less rigid, more curved, and with more graining than the pattern disclosed at each step in Nam. RPI1011, Fig. 2; RPI1010, Fig. 20; RPI1005, ¶115. A POSITA would have therefore been motivated to use StaMixCo's static mixer in Nam's extrusion apparatus to create "synthetic wood having striped grain" that can even better "realize the naturalness of real wood," as is Nam's goal. RPI1011, [0010]; RPI1005, ¶115.

A POSITA would have also had a reasonable expectation of success due to the compatibility of the disclosures, which both teach pushing differently colored polymer melts through a static helical mixer to impart a pattern, and then using a die or mold to shape the melt into synthetic wood. RPI1011, [0011-14], [0022], [0024], [0026-28]; RPI1010, 2, 10, Fig. 20; RPI1005, ¶116. Their similar extruder-static mixer-die architectures can be seen below:



(RPI1010, Fig. 1)

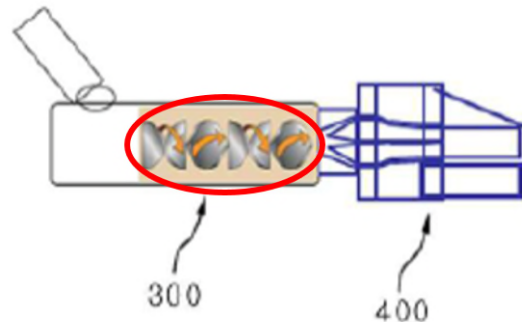


(RPI1011, Fig. 3)

Even the helical mixing elements are similar:



RPI1010, Fig. 20

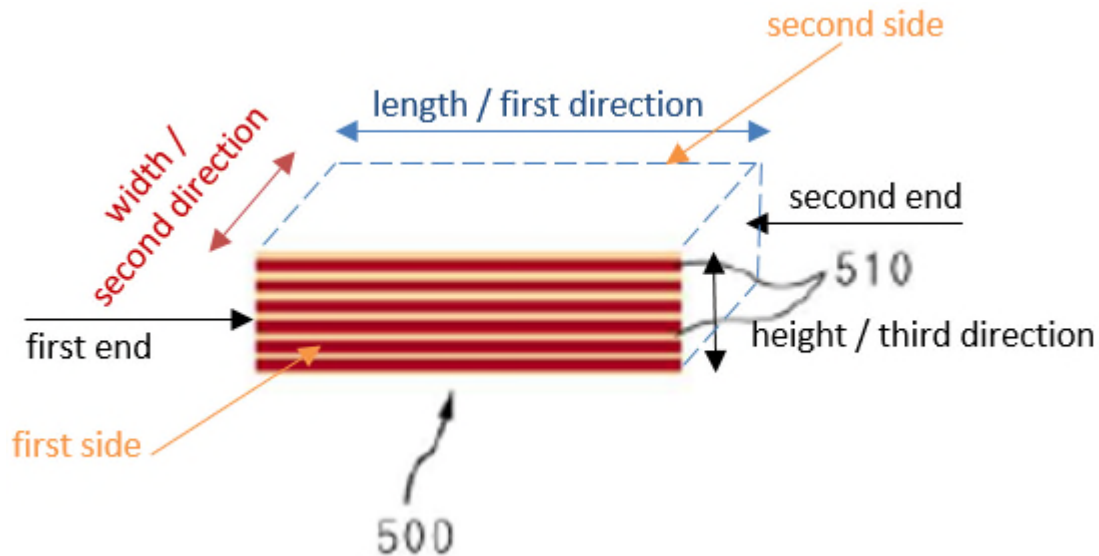


RPI1011, FIG. 3 (annotated)

A POSITA would have therefore readily been able to implement StaMixCo's static mixer into Nam's extrusion apparatus, to arrive at polymer boards and substrates having a more "*natural wood-grained*" look. RPI1005, ¶¶116-18. The selection of colors to arrive at such a look would have been a mere design choice. RPI1005, ¶118; RPI1007, 122:10-123:5.

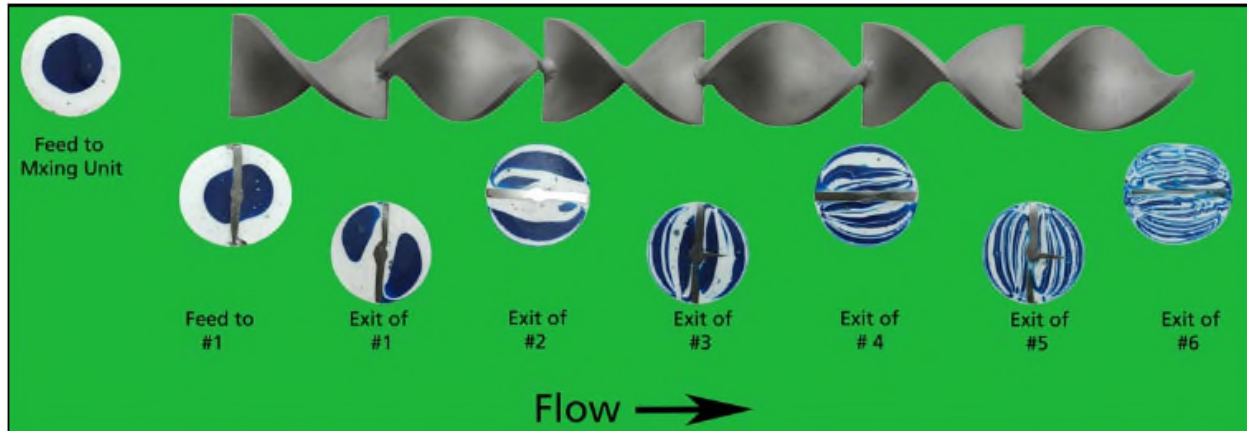
ii. Elements [1a-1b], [10a-10b], [20a-20b], and [24b-24c]

Nam's synthetic wood "has striped grain on both the surface and interior." RPI1011, [0001], [0020], [0027]. Nam creates this appearance by adding two polymers of different colors through a "main extruder" and a "sub extruder" into a static mixer. *Id.*, Abstract, [0011-12], [0014-15], [0021-24]. The resulting grain pattern extends along the entire length of the wood:



Id., FIG. 3 (annotated). The synthetic wood is produced after the polymers exit the static mixer and thus their pattern is no longer changing, such that this alternating-colored polymer structure will remain consistent along the entire “length” or “first direction” in the extrusion direction of whatever shape is defined by the die or mold. *See id.*, [0027]; RPI1005, ¶119.

This would remain the case if Nam were combined with StaMixCo in the manner discussed. RPI1005, ¶120. StaMixCo likewise teaches pushing two-differently colored polymers through a static mixer. RPI1010, 5, 6, 8, 10. The pattern exiting the static mixer of StaMixCo, whether at “Exit of #5” or “#6” (depending on the number of elements used), would likewise remain fixed at that point and remain consistent along the length in the extrusion direction of the wood formed after passing through the die or mold, as the ’350 patent admits. RPI1005, ¶120; RPI1001, 3:52-54, 5:61-6:3, 6:24-61, 7:21-33.



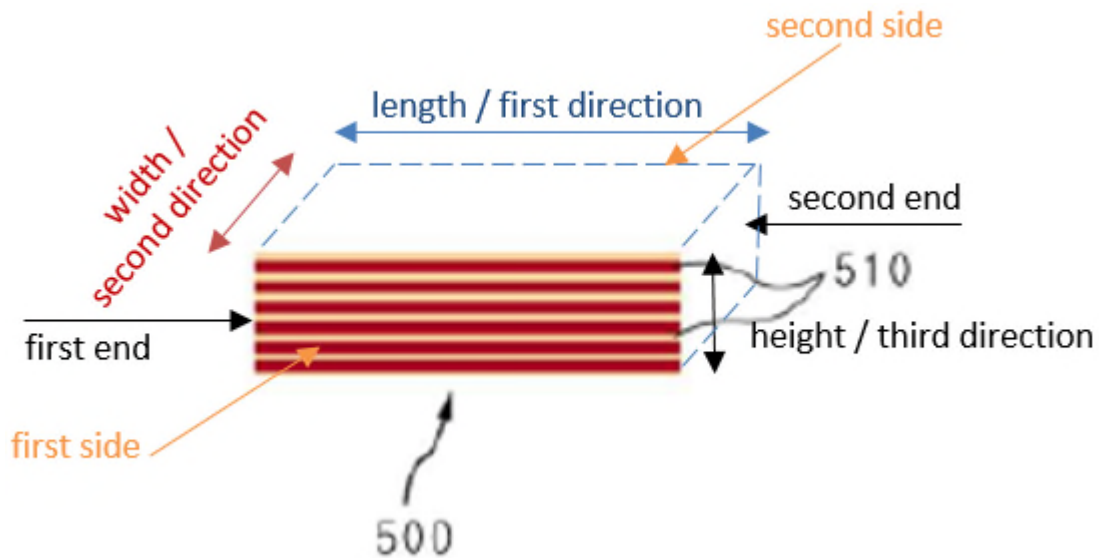
RPI1010, Fig. 20.

Thus, with reference to Figure 3 above, the synthetic wood of Nam (and its obvious combination with StaMixCo) comprises “a first set of polymer layers extending along the length/first direction and containing a first colorant, a majority of the first set of polymer layers extending along the entire length of the” board/substrate or its core (e.g., the lighter, orange color in Nam; the blue color in StaMixCo) and “a second set of polymer layers extending along the length direction and containing a second colorant different than the first colorant, a majority of the second set of polymer layers extending along the entire length/first direction of the” board/substrate or its core (e.g., the darker, red color in Nam; white color in StaMixCo), with a “majority of” each of “the first” and “second set of polymer layers” being “substantially continuous along the first direction.” RPI1005, ¶121.

iii. Elements [1c], [10c-10d], [20c-20d], and [24d]

The “striped grain” pattern of Nam’s wood exists in “both the surface and interior.” RPI1011, [0001]; [0020], [0027]. Because this pattern is consistent along

the length of the wood in the extrusion direction, as discussed, a POSITA would have understood that the same pattern shown in Fig. 3 would exist throughout the core. RPI1005, ¶122. That is, each of the lighter and darker polymer layers extend along the entire width/second direction (from the first side to the second side), and alternate with one another along the height/third direction:



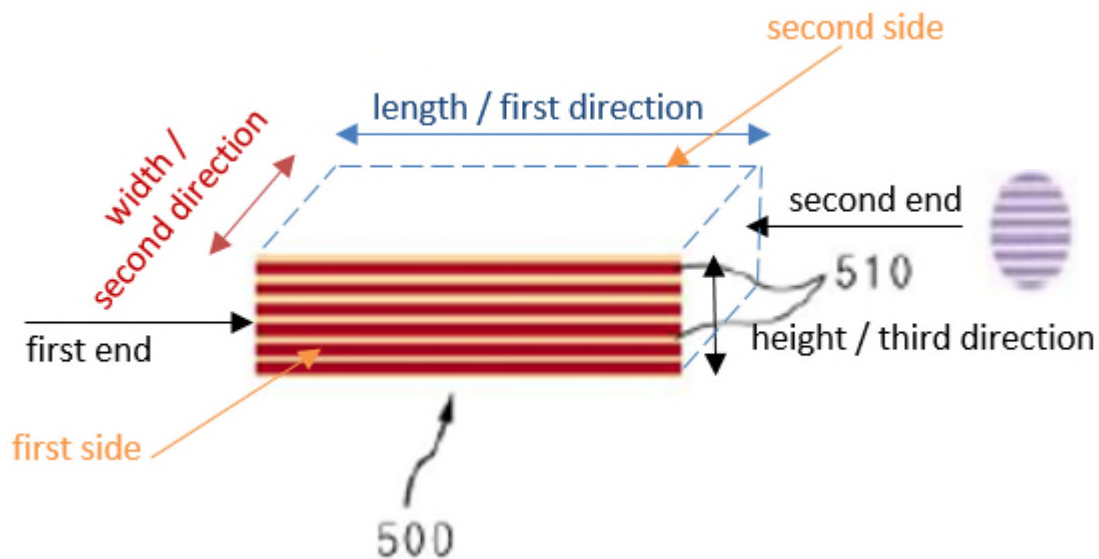
RPI1011, FIG. 3 (annotated); RPI1005, ¶122.

This is confirmed in Figure 2, which shows a cross-section of the grain pattern based on the number of static mixing elements used:

Number of elements	1	2	3	4	5
Partition figure					
Number of partitions	2	4	8	16	32

RPI1011, FIG. 2. A POSITA would have understood that Fig. 2 depicts a vertically-oriented grain pattern inside the synthetic wood when the final mixing element is

oriented vertically. RPI1005, ¶¶123-124. Each of the polymer layers extends along the entire cross-section, with no interruptions of any kind. RPI1005, ¶124. A POSITA would have understood that the synthetic wood in Nam's Figure 3 would have a horizontally-oriented grain pattern throughout its core, consistent with the outside pattern in which the first and second sets of polymer layers alternate with one another, as illustrated below using four of Nam's mixing elements. *Id.*



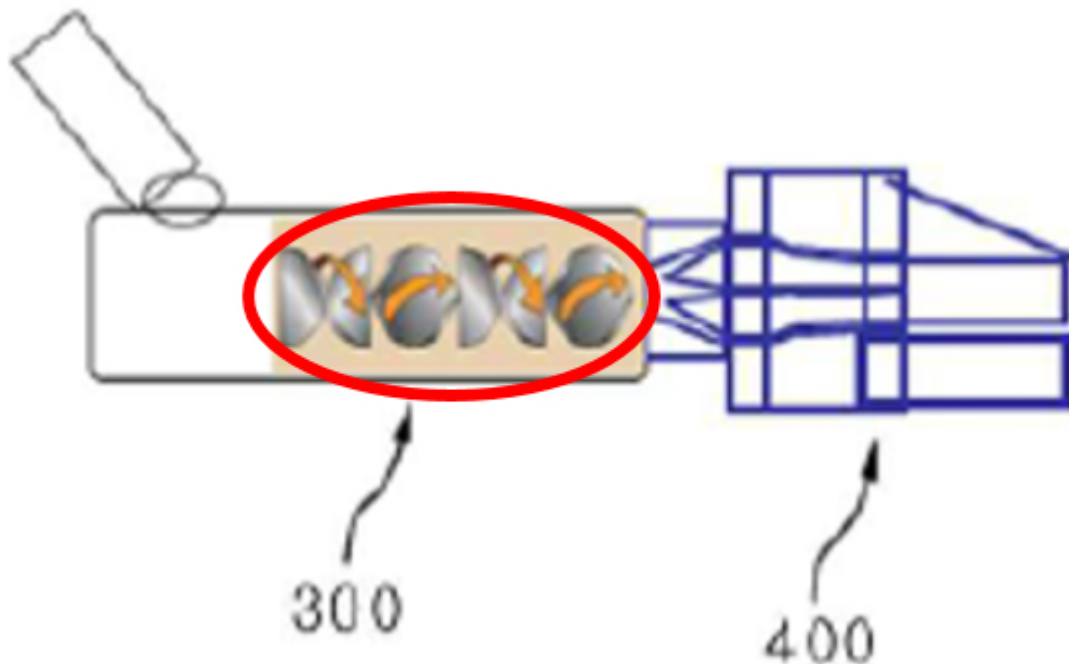
RPI1011, FIG. 3 (annotated); Fig. 2 (rotated).

Thus, as can be seen in Figures 2 and 3, Nam discloses that “a plurality of individual layers of the first and second sets of polymer layers alternate within the” board/substrate or its core “along the third direction...and extend along a substantially uninterrupted...path originating proximate the first side...and terminating proximate the second side of the” board/substrate or its core or “originating proximate an outer surface of a first portion of the substrate and

terminating proximate an outer surface of a second portion of the substrate.”

RPI1005, ¶125. These alternating individual sets of polymer layers are what give the wood of Nam its “striped grain” appearance “on both the surface and interior” (RPI1011, [0001]), and thus “*form a natural wood-grained appearance throughout the*” substrate or its core, as discussed above. RPI1005, ¶125.

While Nam’s grain patterns are depicted using seemingly straight lines, a POSITA would have recognized these illustrations are approximations. RPI1005, ¶126. Nam teaches creating its patterns using a “static mixer [that] repeats the arrangement of elements alternating in the form of a rectangular plate being twisted 180-degrees on the flow path of resin” (RPI1011, [0018])—i.e., a helical static mixer, as depicted in Figure 3 (RPI1005, ¶126):



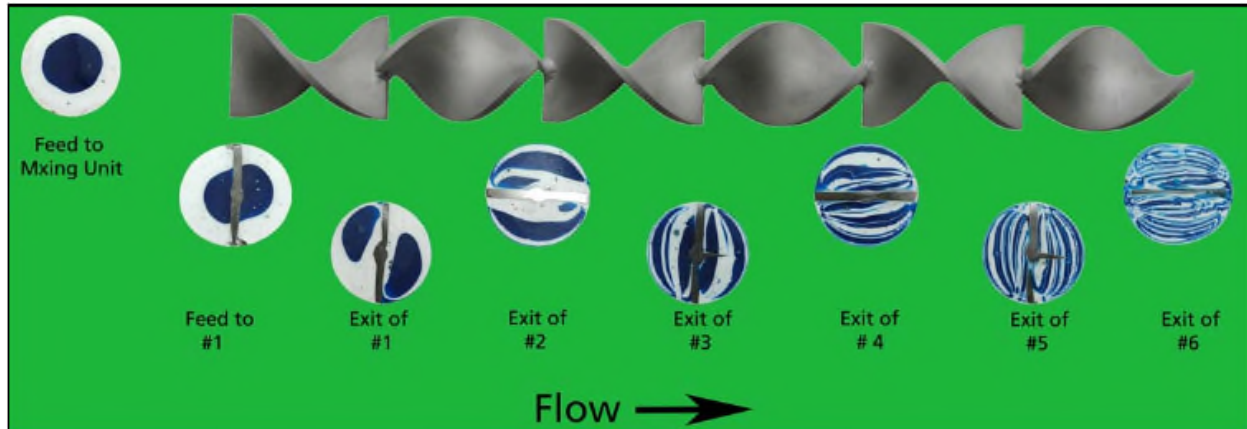
RPI1011, FIG. 3 (annotated). A POSITA would have expected a helical static mixer to create curved, not straight patterns. RPI1005, ¶126. A POSITA would have therefore understood the polymer layers of Nam to “extend along a substantially uninterrupted *curvilinear* path.” *Id.*

If PO were to argue that Nam does not disclose the alternating polymer layers forming a “*natural wood-grained appearance*” or not extending along a “*curvilinear*” path, these elements would have been obvious in view of StaMixCo. A POSITA would have been motivated and able to combine the static mixer disclosed in StaMixCo with Nam’s extrusion apparatus as previously discussed. RPI1005, ¶127.

A POSITA would have understood that once the polymer melt exits the static mixer, no further mixing occurs and the pattern shown in the cross-section exiting a given mixing element will be the cross-section pattern of the extruded product, as discussed. RPI1005, ¶128; RPI1007, 149:2-153:22. By the ’350 patent’s own admission, the patterns illustrated at “Exit of #5” and “#6” (reproduced as ’350 patent Figs. 5F, 5G), once they are put through a die, would result in plastic lumber in which the “*alternating*” polymer layers form a “*natural wood-grained appearance throughout [the core of] the substrate*” and a plurality of them extend along the claimed “*substantially uninterrupted curvilinear path,*” “*terminat[ing]*” and “*originat[ing]*” “*proximate*” the sides of the board/substrate/or its core, or the

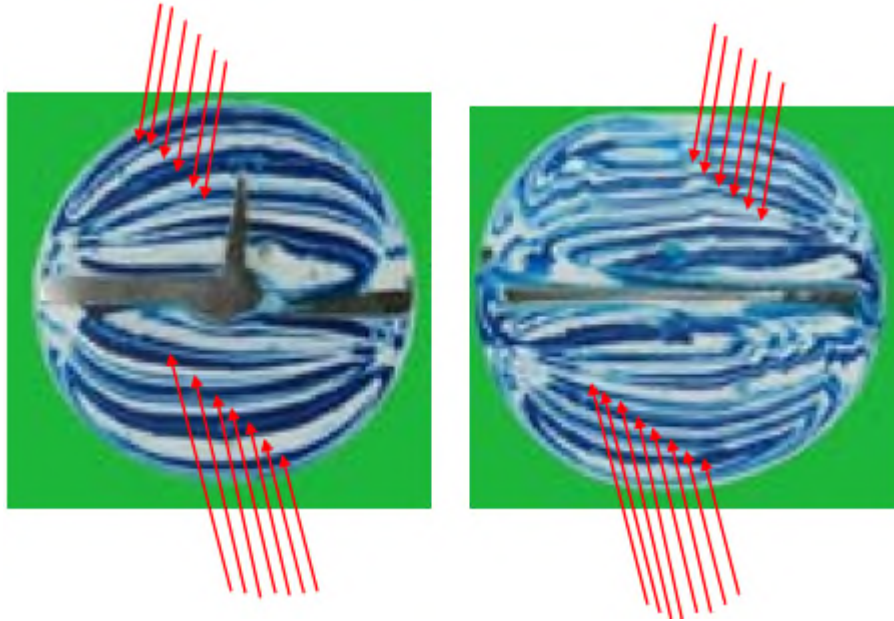
substrate's outer surfaces, as shown in Figs. 10 and 6 of the '350 patent, respectively.

RPI1001, 3:52-54, 5:61-6:3, 6:24-61, 7:21-33; RPI1007, 149:2-151:3; 153:2-22;
154:6-10; RPI1005, ¶¶128-29.



RPI1010, Fig. 20.

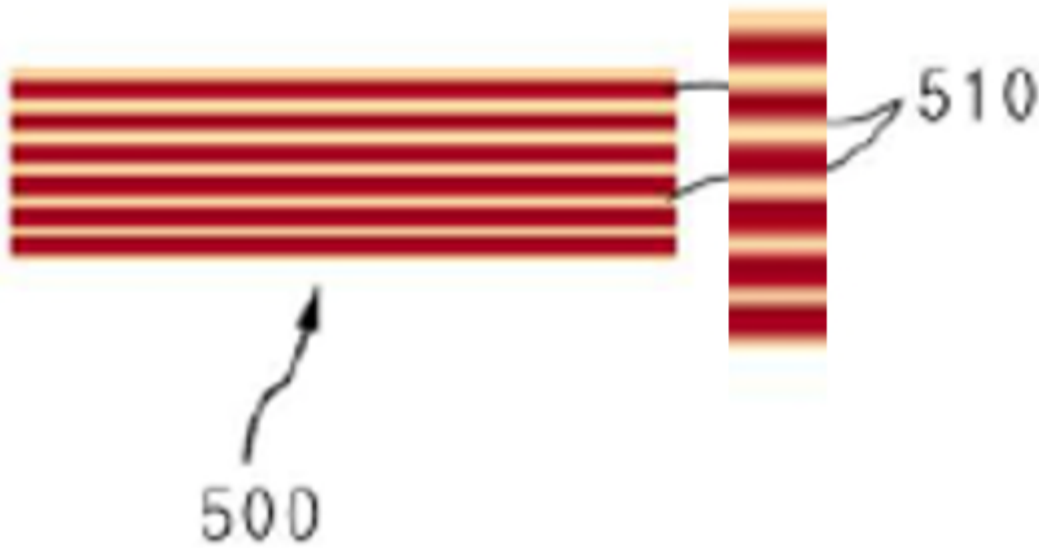
Just looking at the cross-section of the polymer melt shown exiting at either “#5” or “#6,” a POSITA would have recognized that a plurality of the differently colored polymer layers alternate with one another, and continue in curved paths having no interruptions, “*terminat[ing]*” and “*originat[ing]*” “*proximate*” the sides of the board/substrate/or its core, or the substrate's outer surfaces:



RPI1010, Fig. 20, Exits of #5 and #6 (exemplary layers annotated); RPI1005, ¶130. To the extent PO were to argue—notwithstanding the '350 patent's admission to the contrary—that there is not a plurality of these layers that “*terminate*” and “*originate*” “*proximate*” the sides of the board/substrate/or its core, or the substrate's outer surfaces, this could be readily accomplished by post-processing the substrates/boards, by cutting them such that the grain patterns extend along the entire width, as in Nam. RPI1005, ¶130.

2. *Claims 2, 11, and 21*

As can be seen in Nam's Figure 3, its “*first set of polymer layers*” (e.g., lighter, orange-color) “*are thinner than...the second set*” (e.g., darker, red-color):

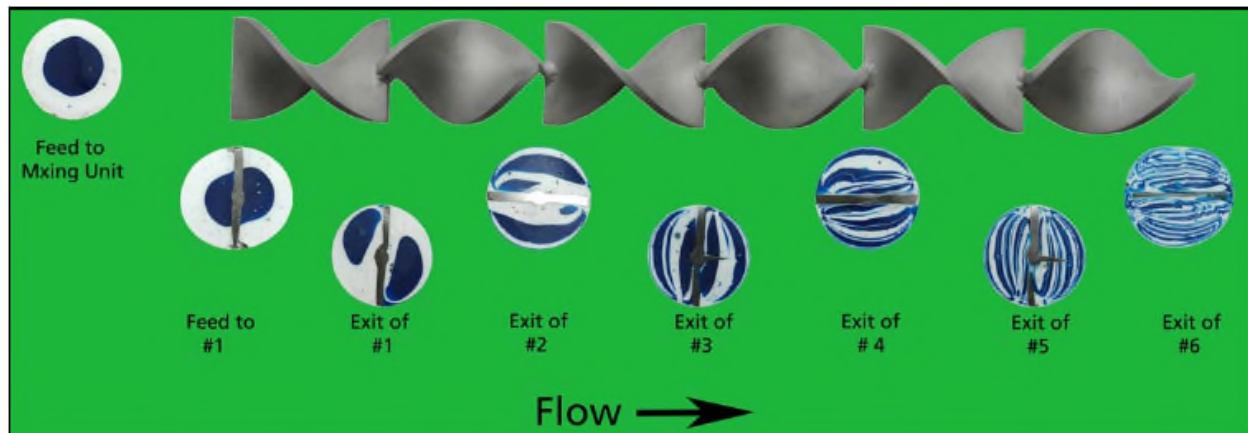


RPI1011, FIG. 3. Nam discloses that separate polymers are introduced via a “main” and a “sub extruder,” which a POSITA would have understood to mean that more polymeric material would be introduced through the “main extruder,” resulting in thinner layers for the polymer introduced through the “sub extruder.” *See id.*, [0011], [0014], [0022-24]; RPI1005, ¶¶131-32.

If PO were to argue that Nam does not disclose the first set of polymer layers being “*thinner*” than the second, such an arrangement would have been obvious in view of StaMixCo. RPI1005, ¶133. A POSITA would have been motivated and able to combine StaMixCo’s static mixer with Nam’s extrusion apparatus for the reasons previously discussed. *Id.*

A POSITA would have understood that once the polymer melt exits the static mixer, no further mixing occurs, and the cross-section pattern of the extruded product is set. RPI1005, ¶¶134-35; RPI1007, 149:2-153:22. The ’350 patent admits

that the cross-section patterns illustrated at “Exit of #5” and “#6” (reproduced as ’350 patent Figs. 5F, 5G) would result in plastic lumber in which the first set of polymer layers is “*thinner*” than the second set as shown in Figs. 10 and 6 of the ’350 patent, respectively, after passing through a die. RPI1001, 3:52-54, 5:61-6:3, 6:24-61, 7:21-33; RPI1007, 149:2-151:3; 153:2-22; 154:6-10.



Furthermore, making one set of polymer layers “*thinner*” than the other would have been an obvious design choice. The goal of Nam was to create synthetic wood “having striped grain” that could better “realize the naturalness of real wood.” RPI1011, [0010]. A POSITA would have therefore been motivated to experiment with the graining’s thickness to better achieve this goal, especially depending on the type of wood being simulated. RPI1005, ¶136.

A POSITA would have also had a reasonable expectation of success. Nam teaches that “when one of the[] elements [of its static mixer] is passed through, it doubles the number of layers.” RPI1011, [0018]. StaMixCo discloses a similar effect resulting from its static mixer. RPI1010, Fig. 20. A POSITA would have therefore

been able to control the relative thickness of the two polymer layers by introducing the polymers in different amounts into the static mixer. RPI1005, ¶137. This would result in the polymer being introduced in a lesser amount being divided into layers that are “thinner” than those of the polymer introduced in a greater amount. *Id.*

3. Claim 3

Nam’s striped grain synthetic wood can go through “follow-up processes such as...cutting” and has “striped grain on not only the surface, but also on the inside.” RPI1011, [0020], [0027]. As discussed, this graining extends from one side of the board to the other, and along its entire length direction (and would continue to do so if Nam were combined with StaMixCo, as discussed above). RPI1005, ¶138. The polymer layers also alternate with one another and follow a curved pattern, as discussed. *Id.*

Thus, a POSITA would have understood that planing the wood of Nam (or of its combination with StaMixCo) or cutting it along and parallel to its length direction, would remove a portion of at least one of the first or second sides and expose portions of the first and second sets of polymer layers along the length direction. RPI1005, ¶139. Indeed, Nam distinguishes its synthetic wood over others on which “only the surface has a striped grain.” RPI1001, [0009], [0027]. Both cutting and planing of plastic lumber was well-known and done prior to the ’350 patent. RPI1001, 1:31-37, 1:62-65; RPI1007, 98:2-12. These were ordinary and

expected post-processing steps intended to get the correct dimensions of the lumber and to smoothen it, respectively, for a given application. RPI1005, ¶139. Nam and its obvious combination with StaMixCo therefore disclose a board “*wherein a portion of at least one of the first side and second side of the board is removed to expose portions of the first and second sets of polymer layers along the length direction.*” RPI1005, ¶¶139-40.

4. Claim 4

A “burled grain” pattern, within the meaning of the ’350 patent, is what necessarily results from planing the surface of a board having internal graining formed from the claimed polymer layers, so long as those layers do not terminate at a perpendicular angle to the surface. RPI1007, 163:21-165:17; RPI1005, ¶141. A POSITA would have therefore understood that planing the board of Nam (or of its obvious combination with StaMixCo), which has curved grain patterns that do not run perpendicular to the surface, would expose a burled grain pattern. RPI1005, ¶141.

Indeed, the ’350 patent admits that the cross-section patterns illustrated at “Exit of #5” and “#6” of StaMixCo (reproduced as ’350 patent Figs. 5F, 5G), once they pass through a die, would result in plastic lumber having the curved graining as shown in Figs. 10 and 6 of the ’350 patent, respectively. RPI1001, 3:52-54, 5:61-6:3, 6:24-61, 7:21-33; RPI1007, 149:2-151:3; 153:2-22; 154:6-10. The patent further

teaches that by removing “a thin layer” from the outer surface of such plastic lumber to expose the wood grain pattern within “as suggested in FIG. 9,...a burling effect is created.” RPI1001, 6:38-43.

Nam and its obvious combination with StaMixCo therefore disclose a board “*wherein the exposed portions of the first and second sets of polymer layers form a burlled grain pattern resulting from planing the surface.*” RPI1005, ¶¶142-43.

5. Claims 6, 12, and 22

Both Nam and StaMixCo are concerned with extruding polymers, as discussed above. A POSITA would have found it obvious to use HDPE as the polymer to be extruded in Nam and its obvious combination with StaMixCo. RPI1005, ¶144. HDPE was one of the most commonly used polymers in simulated wood production long before the ’350 patent. RPI1005, ¶145; RPI1007, 19:23-20:2 (U.S. Plastic), 20:4-11 (Eaglebrook), 60:6-15 (Tangent in 2003); 121:18-122:8. Even Mr. Morales conceded that there was nothing inventive about the ’350 patent’s use of extruded HDPE to create plastic lumber. RPI1007, 33:24-34:5, 106:6-11, 118:23-120:3, 130:12-24.

Indeed, there were several known benefits for using HDPE in simulated wood production. RPI1005, ¶¶146-47. HDPE was known to be cost effective and to be easy to work with due to its heat history. RPI1005, ¶146; RPI1007, 20:20-21:20. It was also known to have good moisture barrier and chemical resistance properties,

making it particularly useful in plastic lumber. RPI1007, 119:6-21, 120:5-23; RPI1005, ¶146. A POSITA would have further known that HDPE boards have suitable strength for most applications replacing natural lumber. RPI1005, ¶146.

Additionally, HDPE has significant environmental benefits, because it does not require natural wood and can be made from recycled materials. RPI1005, ¶147. It is also easier to recycle end-of-life HDPE boards than composite boards that contain materials such as other plastics, fiberglass, and/or wood fiber or wood flour. *Id.* Compared to other plastics, HDPE boards also contain fewer chemical hazards and associated environmental impacts. *Id.*

A POSITA would have therefore considered HDPE to be a common and preferable polymer to use in extruding simulated wood. RPI1005, ¶148. A POSITA would have also had a reasonable expectation of success in using HDPE in creating plastic lumber, as evidenced by the fact that several companies had previously done so, the '350 patent does not suggest any inventiveness or specialized knowledge required in using it, and the patent's inventor admitted that extruding HDPE to create plastic lumber was known. RPI1005, ¶148; *see* RPI1001, 3:30-33; RPI1007, 19:23-20:11, 20:20-21:20, 33:24-34:25, 60:6-15, 105:10-106:11, 118:23-120:23, 121:18-122:8, 125:8-12, 130:12-24.

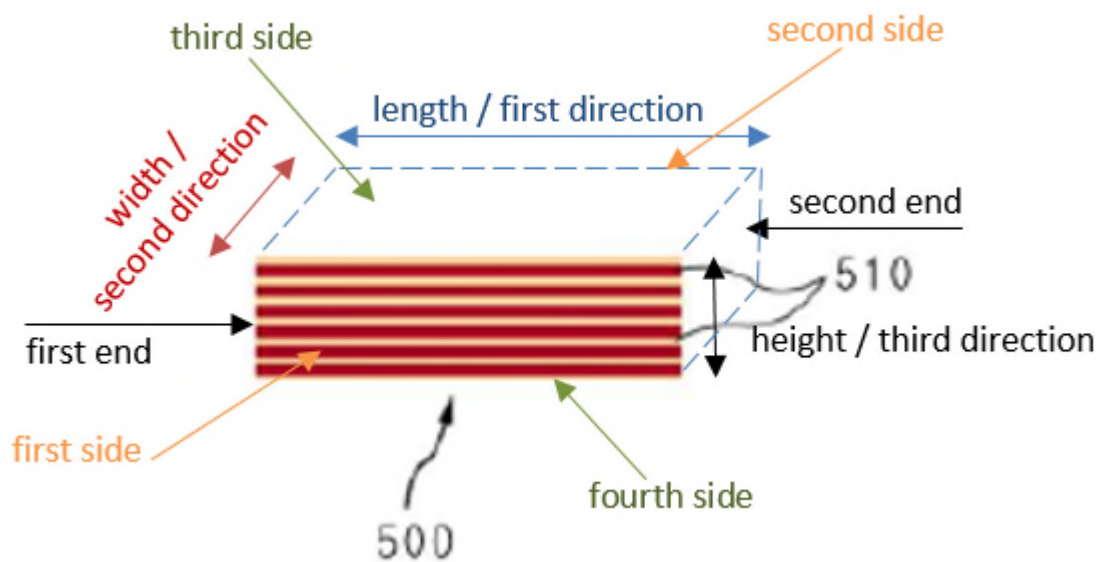
It would have therefore been obvious to “*form[]...the first and second sets of polymer layers*” of the wood disclosed by Nam and by its obvious combination with StaMixCo “*from high density polyethylene.*” RPI1005, ¶149.

6. Claims 9 and 15

As discussed with respect to the independent claims, Nam discloses three-dimensional synthetic wood. RPI1005, ¶150. It further discloses that extruded synthetic wood products are “mainly employed in building materials” and are “similar to wood materials, slabs, and lumber.” RPI1011, [0004], [0006]. In Fig. 3, Nam provides a “frontal” view of what a POSITA would have understood to be a three-dimensional, rectangular synthetic wood product having a rectangular cross-section along its length. RPI1011, Fig. 3. StaMixCo likewise discloses extrusions having rectangular cross-sections along their length (RPI1010, Figs. 3, 4), and both references teach that a die can be used to create the desired shape. RPI1010, 2; RPI1011, Abstract, [0001], [0027]; RPI1005, ¶150. A POSITA would have therefore understood that Nam (and its obvious combination with StaMixCo) disclose a board or substrate that “*is formed to define a polygonal cross-section along [its] length.*” RPI1005, ¶150. Post-processing the product or using a die to give it such a shape (to better simulate a natural wood board) would have also been an obvious modification, as discussed above. RPI1005, ¶151.

7. **Claims 17 and 19**

Claims 17 and 19, which depend from **Claims 1 and 10**, respectively, merely recite a third dimension to the claimed board and substrate. For largely the same reasons discussed with respect to elements **[1pre]**, **[10pre]**, **[20pre]**, and **[24pre-24a]** above, and with reference to annotated Figure 3 below, Nam and its obvious combination with StaMixCo discloses each of these additional limitations:



RPI1011, FIG. 3 (annotated); RPI1005, ¶152.

Because the wood of Nam is three-dimensional, as discussed, it will include a “height” or “third direction.” RPI1005, ¶153. Thus, as can be seen above, the wood of Nam comprises “a third side and a fourth side spaced apart from the third side along a height/third direction different than the length/first direction and width/second direction, wherein the third and fourth sides define a height of the”

board or substrate, “*wherein the third and fourth sides extend along the length/first direction between the first and second ends.*” *Id.*

As also discussed, the three-dimensional synthetic wood of Nam includes a “*core,*” and the wood-grain pattern extends throughout the entire core. RPI1005, ¶154. Thus, with reference to Figure 3 above, Nam discloses that “*the core of the*” board or substrate “*extends between the first, second, third, and fourth sides and between the first and second ends*” and “*along the first direction,*” and “*the individual layers of the first and second sets of polymer layers alternate within the core of the*” board or substrate “*along the height/third direction.*” *Id.*

The obvious combination of Nam and StaMixCo would likewise disclose this limitation. RPI1005, ¶155. The final mixing element of StaMixCo would simply need to be oriented in a horizontal manner, as discussed above, in order to match the orientation of Nam and for the individual layers to “*alternate within the core...along the height/third direction.*” *Id.*

B. Ground 2: Dependent Claims 5, 7-8, 13-14, 16, 18, and 23 Are Obvious Over Nam in View of StaMixCo, and Further in View of Rassi

1. Claim 5

Rassi, like Nam, teaches plastic lumber created through an extrusion process. RPI1013, Abstract, 1:10-62, 1:66-2:20. Rassi, like Nam, is also concerned with creating plastic lumber “*exhibiting a ‘natural’ look like the look of grains in wood*

boards.” RPI1013, 5:63-65; 1:57-58. Rassi is also similarly concerned with creating plastic lumber where “the graining pattern extends into the core,” and is not limited to its surface. RPI1013, 1:25-62, 10:31-33. Rassi further teaches that the look and feel of any outer surface of simulated wood can be “augmented by **embossed grain-like patterns**” that provide a “grain-like texture.” RPI1013, 1:32-33, 1:48-50, 3:20-22, 6:6-10, 12:13-15; RPI1005, ¶¶156-57.

A POSITA would have therefore been motivated to emboss the surfaces of Nam’s wood (or its obvious combination with StaMixCo), as taught by Rassi, to further Nam’s goal of simulating “the naturalness of real wood.” RPI1011, Abstract, [0009-10]; RPI1005, ¶¶158. A POSITA would have also been motivated to emboss the surfaces for anti-slip reasons (i.e., to provide better traction on the walking surfaces). RPI1005, ¶158. These were both well-known reasons for embossing plastic lumber. *Id.*; RPI1007, 24:13-24.

Because embossing was a known technique applied to extruded plastic lumber, a POSITA would have had a reasonable expectation of success in applying it to Nam’s synthetic wood (or its obvious combination with StaMixCo). RPI1005, ¶159. This is confirmed by the ’350 patent’s generic statements that its plastic lumber products “can be post-processed” and “further enhanced by embossing techniques,” without providing any further information as to those techniques. *E.g.*, RPI1001, 3:40-43, 6:34-38. Mr. Morales likewise admitted that embossing plastic

lumber was a well-known step employed in the plastic lumber industry, and not an inventive aspect of the '350 patent. RPI1007, 24:3-24, 35:2-10, 61:11-21, 126:8-14.

A POSITA would have therefore found it obvious to “*emboss[] with a wood grain pattern...at least one of the first and second sides of the board*” of Nam or of its obvious combination with StaMixCo, in view of Rassi. RPI1005, ¶160.

2. ***Claims 7 and 13***

As discussed above, Rassi, like Nam, discloses extruded plastic lumber intended to resemble real wood inside and out. RPI1005, ¶161. Rassi further teaches that its extruded polymers include additives, such as “chemical ***foaming agents...and UV stabilizers.***” RPI1013, 6:40-42; 2:47-59; 7:1-4.

Rassi teaches that foaming agents can “provide texture to the outer surface” of the plastic lumber “closer to the feel of real wood,” and that “permit[s] the board...to retain stains.” RPI1013, 5:67-6:12. A POSITA would have also understood that foaming agents affect an object’s density. RPI1005, ¶162. To that end, Rassi teaches that the “[d]ensity” of its plastic lumber “is varied to achieve a desired mechanical performance.” RPI1013, 6:40-46.

A POSITA would have therefore been motivated to add foaming agents, as taught by Rassi, into the polymer layers of Nam (or its obvious combination with StaMixCo). Doing so would have furthered Nam’s goal of simulating “the naturalness of real wood,” by providing “texture to the outer surface” that is “closer

to the feel of real wood” and by allowing the wood to be stained. RPI1011, Abstract, [0009-10]; RPI1013, 5:67-6:12; RPI1005, ¶163. A POSITA would have also understood that foaming agents can reduce the weight of polymer boards, thus reducing material and transportation costs, and the weight of any end products, providing additional motivation to implement them. RPI1005, ¶163; RPI1007, 23:17-24:1, 24:25-25:22.

With regard to UV inhibitors, a POSITA would have known they could prevent color and structural degradation from exposure to sunlight, thus increasing synthetic wood’s aesthetic longevity and its durability. RPI1005, ¶164. A POSITA would have therefore been motivated to add UV inhibitors, as taught by Rassi, into Nam’s polymer layers (or its obvious combination with StaMixCo) for these purposes. *Id.*; RPI1007, 25:23-26:5. This would further Nam’s stated goal of having a natural wood-grain appearance, which the UV inhibitors would help prevent from deteriorating, and Nam’s goal for its plastic wood to be used as “lumber” and in “building materials,” which could be expected to be used outdoors. *See* RPI1011, Abstract, [0002-10] (discussing use in building materials and lumber); RPI1005, ¶164.

Because adding UV inhibitors and foaming agents into extruded polymeric layers was a known process, a POSITA would have had a reasonable expectation of success including these additives in the polymer layers of Nam (or its obvious

combination with StaMixCo). RPI1005, ¶165. This is further confirmed by the '350 patent's generic statements that the polymer layers "can include" or be "mixed with other additives, such as UV inhibitors, foaming agents," without providing any information as to how that is done. *E.g.*, RPI1001, 3:35-39, 4:8-18. Rassi similarly refers to "using a foaming agent" in plastic lumber "*as is generally known in the art.*" RPI1013, 5:66-6:1. And Mr. Morales likewise admitted that UV stabilizers and foaming agents were known and used in the plastic lumber industry, and not an inventive aspect of the '350 patent. RPI1007, 22:2-23, 23:17-24:1, 24:25-25:22, 34:20-25, 35:12-16, 35:23-36:2, 60:6-61:4, 64:19-65:14, 124:23-125:12; *see also* RPI1010, 2, 4, 11 (contemplating use of additives).

A POSITA would have therefore found it obvious to "*include at least one of a UV inhibitor and a foaming agent*" in "*the first and second sets of polymer layers*" of the wood of Nam (or its obvious combination with StaMixCo), in view of Rassi. RPI1005, ¶166.

3. *Claims 8 and 14*

For the reasons discussed with respect to Claims 7 and 13, a POSITA would have found it obvious to "*include[]a foaming agent*" in "*one of the first and second sets of polymer layers*" of the board of Nam (or of its obvious combination with StaMixCo), in view of Rassi. RPI1005, ¶167.

4. Claims 16, 18, and 23

Nam faults prior art “conventional synthetic wood panel[s]” which use plastic “mixed with wood shavings” for having shortcomings as compared to plastic wood, which is “less absorbent...and does not rot.” RPI1011, [0004], [0006]. Nam further references the “issue of environmental conservation ha[ving] become prominent worldwide.” RPI1011, [0002]. Nam also distinguishes the prior art as having only “an *external* appearance...similar to that of natural wood,” which resulted from wood fragments being “inserted during molding.” RPI1011, [0004-0005], [0009].

Nam’s “invention was devised by considering the[se] problems with the...prior art.” RPI1011, [0010]. Nam teaches synthetic wood having graining both on the surface and in the, without requiring any natural wood materials and therefore overcomes the shortcomings of products that utilize such materials. RPI1005, ¶¶168-69. A POSITA would have therefore understood that Nam’s synthetic wood has a “*core [that] is substantially free of natural wood materials.*” RPI1005, 169. Combining Nam with StaMixCo’s static mixer would not change this determination, as StaMixCo does not suggest using natural wood materials and similarly teaches static mixers for use with extruded “viscous polymers,” “molten polymers,” and “resins.” RPI1010, 1, 2, 10; RPI1005, ¶169.

If PO were to argue that Nam or its obvious combination with StaMixCo does not disclose having “*the core [be] substantially free of natural wood materials,*” this

limitation would have nevertheless been obvious in view of Rassi. RPI1005, ¶170. Rassi, like Nam, recounts various shortcomings with natural wood: its “susceptib[ility] to various pests and decay” and to “deteriorate over time”; the depletion of natural wood resources; and the failure of prior art wood-plastic composite boards to resemble natural wood. RPI1013, 1:10-18, 1:25-31. Rassi teaches that its simulated wood can be created without any natural wood materials. RPI1013, 6:36-46. Thus, to the extent Nam’s synthetic wood is argued to contain any natural wood materials, a POSITA would have been motivated to remove substantially all of them due to their shortcomings. RPI1005, ¶171. A POSITA would have had a reasonable expectation of success in creating such a natural-wood free board, which was well-known in the industry, and because Nam says nothing about natural wood materials being required. RPI1005, ¶172. This is further confirmed by the ’350 patent’s generic statement that the polymer substrate claimed “can be free of natural wood or other organic fibers,” without further explanation. *E.g.*, RPI1001, 3:33-35. Mr. Morales likewise admitted wood-free plastic lumber was known and sold prior to the patent. RPI1007, 47:3-48:16.

C. Ground 3: Claims 1-4, 6, 9-12, and 15-24 Are Obvious Over Zumbrunnen

1. Independent Claims 1, 10, 20, and 24

i. Elements [1pre], [10pre], [20pre], and [24pre-24a]

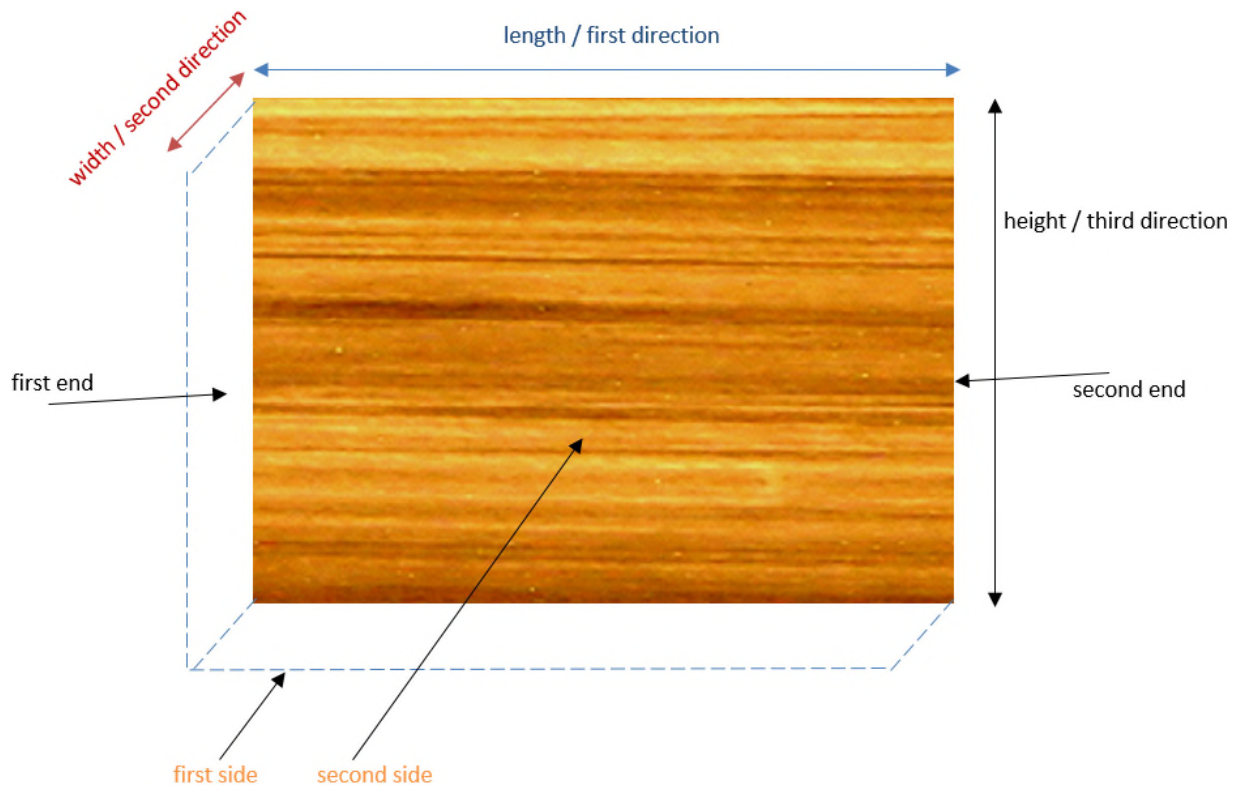
Zumbrunnen teaches a blending system that can be used with “polymer melts for extruding” shapes such as “cast and blown film, sheet, rod, tubing, fibers, and other plastic products.” RPI1012, 401. Dies are used to “form an extrusion into a desired shape and dimension.” RPI1012, 403, 405. One of these extruded products is simulated “[p]lastic” wood having “the appearance of realistic wood grains *both inside and on surfaces of the extrusions.*” RPI1012, 401.

Zumbrunnen teaches that by “extruding [its] structured melt through a die, the various wood grain patterns in Figure 22.12 form” and that, “[l]ike cut wood, the simulated grain appears both on the surface and interior of [the] extrusions.” RPI1012, 413 (describing an “infinite variety” of “[r]ealistic simulated wood grain patterns”). Pigmented polymer resins can be obtained that are “intended specifically to impart wood appearance.” *Id.* Because Zumbrunnen expressly teaches the creation of three-dimensional plastic products, *e.g.*, “sheet[s], rod[s], tubing,” and “plate[s]” (RPI1012, 401, 403), and of simulated wood products that have “realistic wood grains both *inside* and on surfaces of the extrusion” “[l]ike cut wood” (RPI1012, 401, 413), a POSITA would have understood that Zumbrunnen’s simulated wood products are three-dimensional. RPI1005, ¶¶173-75. Zumbrunnen therefore

discloses “[a] *simulated natural wood-grained polymer board*” ([1pre], [24pre]) or “*substrate*” ([10pre], [20pre]). RPI1005, ¶175. A POSITA would have also understood that these three-dimensional wood products have a non-hollow “*core*” ([10pre]) and, because Zumbrunnen discloses that its wood is a “plastic product[]” made from “polymer resins,” that the core is a “*polymer core*” ([24a]). RPI1005, ¶175.

As explained above, to the extent there is any substantive difference between the claimed “boards” and “substrates” it would at most be one of dimension. RPI1005, ¶176; RPI1007, 75:22-77:17. A POSITA would have known how to alter the dimensions through choosing different dies, as specifically suggested by Zumbrunnen, and/or through post-processing, such as by cutting the extrudate into variously shaped and dimensioned “substrates” or “boards,” as desired for a given application. RPI1005, ¶176.

Zumbrunnen also discloses each of the dimensional requirements claimed in [1pre], [10pre], [20pre], and [24a], as can be seen in Figure 22.12:



RPI1012, Figure 22.12 (annotated); RPI1005, ¶¶177-78.

As Figure 22.12 shows, Zumbrunnen’s three-dimensional synthetic wood, including its polymer core, “extend[s] along a first direction,” has a “first side and a second side spaced apart from the first side along a second direction different than the first direction,” the “first and second sides” or the “spacing between” them defining...a width...of the” board/substrate or its core, “the first and second sides extending along a length/the first direction” of the board/substrate or its core “between a first end and a second end, the first and second ends defining a length of the” board/substrate or its core. RPI1005, ¶178. The “core of the substrate extend[s] between the first and second sides and along the first direction” and has “a length defined along a first direction, a width defined along a second direction

perpendicular to the first direction, and a height defined along a third direction perpendicular to both the first and second directions.” Id. Each of these dimensions and spatial relationships is reflective of nothing more than those of a three-dimensional rectangular board or substrate. *Id.*

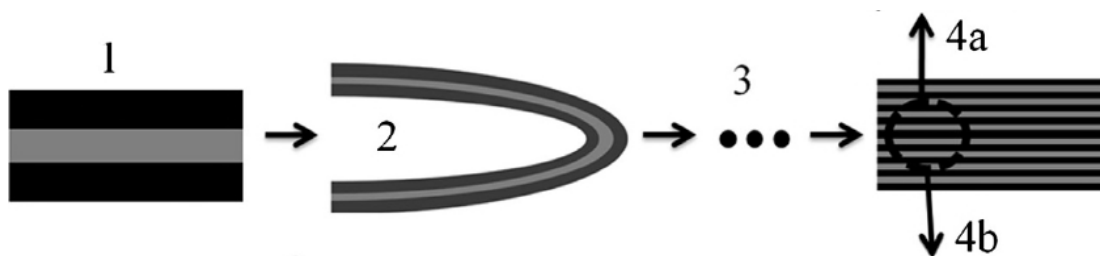
If PO were to argue that Zumbrunnen does not disclose a three-dimensional board or substrate with the dimensional and spatial relationships shown above, it would have been an obvious modification. RPI1005, ¶179. As discussed, Zumbrunnen discloses extruding three-dimensional shapes such as rods, tubing, and plates. RPI1012, 401, 403. A POSITA would have recognized that the shape of an extrusion can be controlled by the die at the end of the process, as Zumbrunnen teaches. RPI1005, ¶179; RPI1012, 403, 405.

Thus, to produce Zumbrunnen’s plastic wood in which, “[l]ike cut wood, the simulated grain appears both on the surface and interior of [the] extrusions,” a POSITA would have been motivated to extrude a three-dimensional plastic wood product having the claimed spatial relationships or to cut it into such a shape. RPI1012, 401, 413; RPI1005, ¶180. Because passing plastic products through a die or cutting them to impart a desired shape was known, a POSITA would have reasonably expected to succeed. RPI1005, ¶180. This is further confirmed by the ’350 patent’s generic statements that its plastic lumber can have various “profiles” that can be “created using a die,” and can be post-processed, such as by cutting,

without providing any further information. *E.g.*, RPI1001, 3:40-51, 6:16-23, 6:63-7:7. Mr. Morales likewise admitted that shaping a polymer melt or cutting polymer lumber into a specific shape was well-known and not an inventive aspect of the '350 patent. RPI1007, 98:2-7, 105:3-8, 153:17-22, 154:6-10, 201:4-202:10.

ii. Elements [1a-1b], [10a-10b], [20a-20b], and [24b-24c]

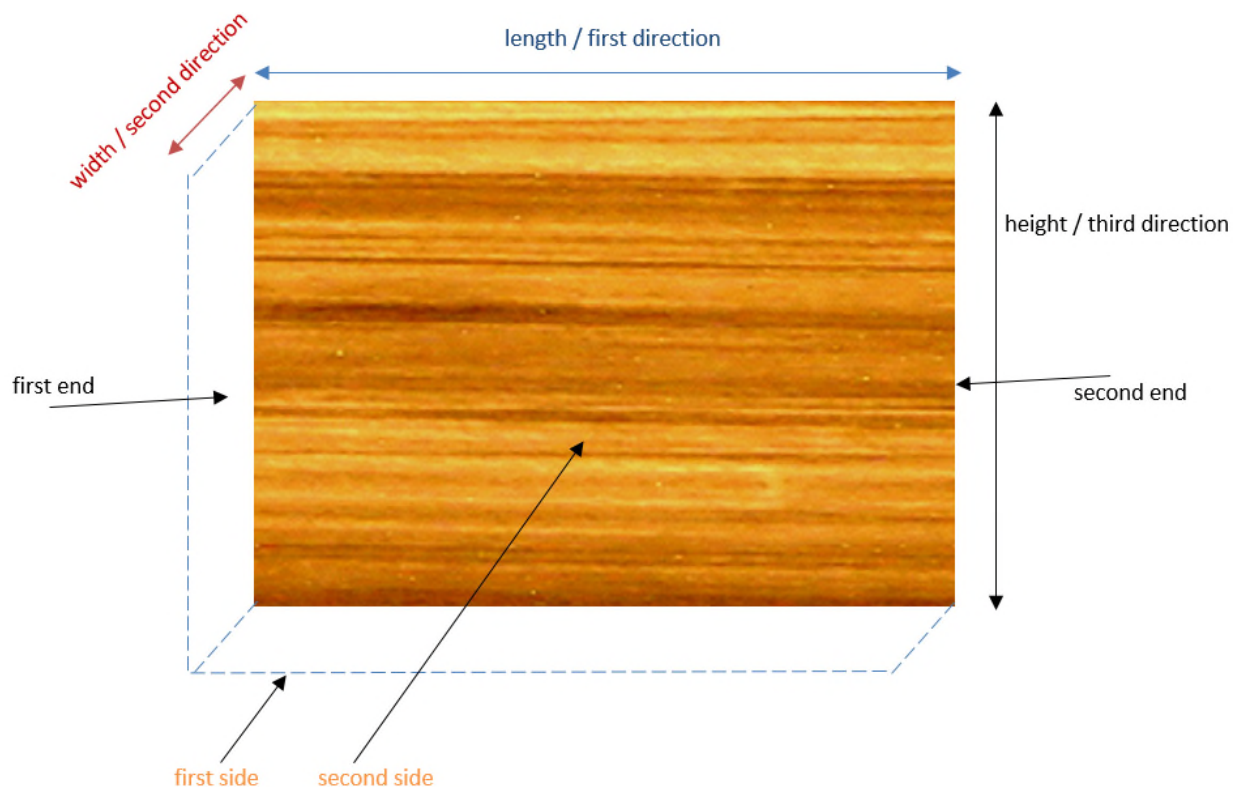
Zumbrunnen teaches that its blender causes chaotic advection and results in mixing two “initially large melt domains (e.g., resin pellet size or larger) or melt streams,” which are then “stretched and folded...into alternating multilayers,” as illustrated in Steps 1-3 of Figure 22.1:



RPI1012, 402, Fig. 22.1. The folding depicted is of a “two component polymer melt,” and “polymer A and polymer B melts are stretched and folded by chaotic advection...to give the multi-layer morphology at *state 2*,” such that “[f]ew layers [ultimately] lead to a larger number of layers (*state 3*).” RPI1012, 402, 406. This results in a “*first set*” (e.g., the darker colored layers) and a “*second set of polymer layers*” (e.g., lighter colored layers). RPI1005, ¶181.

“Desired colors” can be “obtained by using pigmented polymer resins such as those from colorant manufacturers intended specifically to impart wood

appearance.” RPI1012, 413. The “various wood grain patterns” are formed by extruding the “structured melt through a die,” and “can be repeated at intervals along an extrusion.” RPI1012, 413. Figure 22.12 illustrates a resulting polymer board or substrate having alternating polymer layers, of different colors, extending along its length:



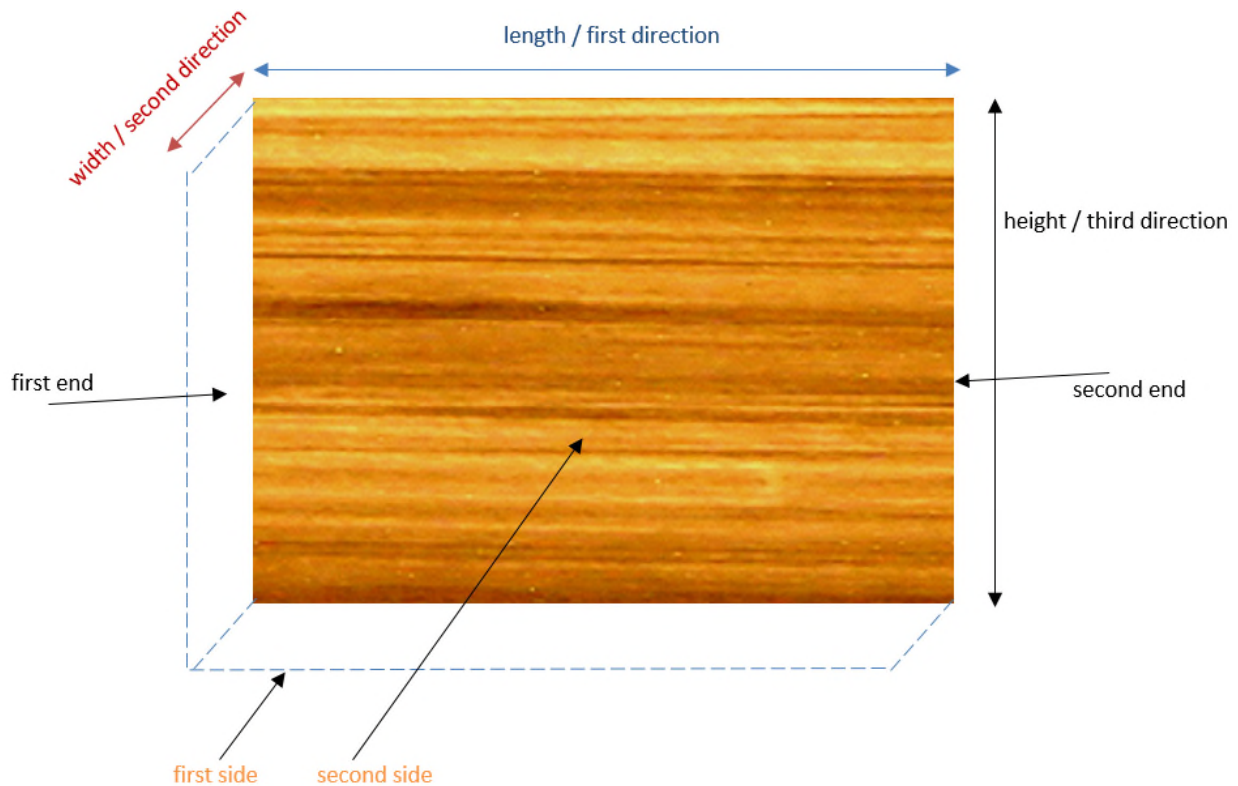
RPI1012, Fig. 22.12 (annotated); RPI1005, ¶182.

As can be seen in Figures 22.1 and 22.12 above, the synthetic wood of Zumbrunnen comprises “a first set of polymer layers extending along the length/first direction and containing a first colorant, a majority of the first set of polymer layers extending along the entire length of the” board/substrate or its core (e.g., the darker brown color (darker gray, in Fig. 22.1) and “a second set of polymer layers extending

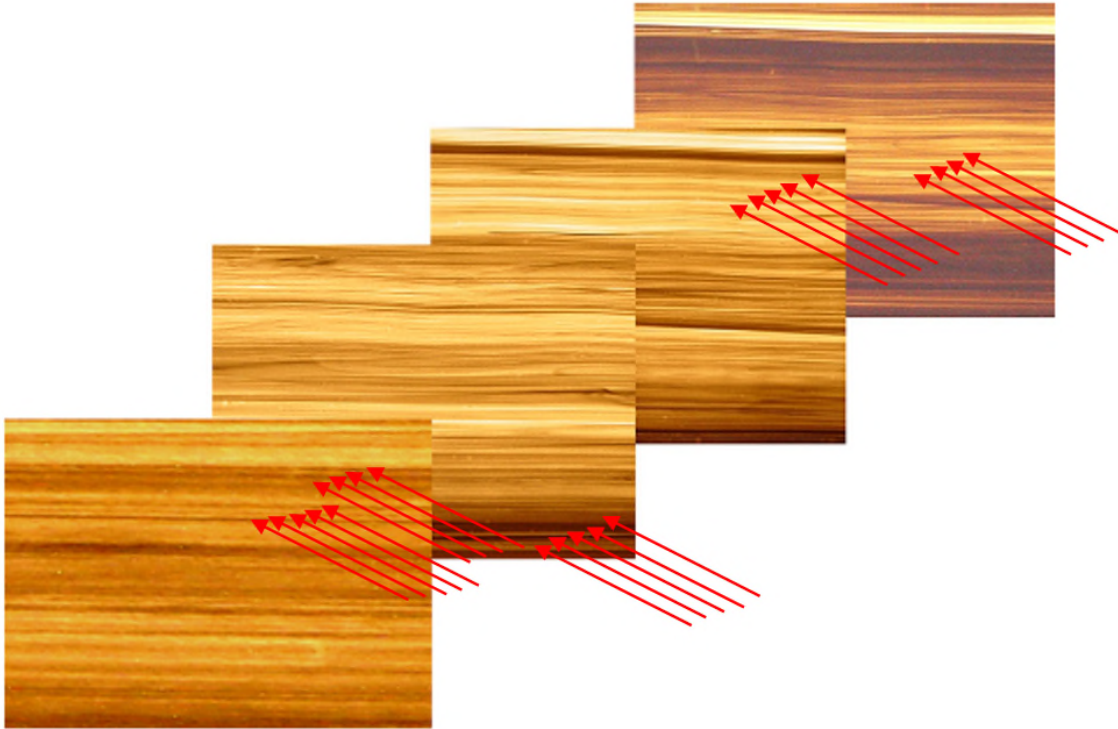
along the length direction and containing a second colorant different than the first colorant, a majority of the second set of polymer layers extending along the entire length/first direction of the board/substrate or its core (e.g., the lighter brown color (lighter gray, in Fig. 22.1). RPI1005, ¶183. Most, if not all, of the lighter and darker polymer layers extend continuously along the entire length direction without any breaks, intersections, or the like. *Id.* A “majority of” each of “the first” and “second set of polymer layers” is therefore “substantially continuous along the first direction.” *Id.*

iii. Elements [1c], [10c-10d], [20c-20d], and [24d]

“Like cut wood,” Zumbrunnen’s “realistic wood grains” appear “*both inside and on surfaces*” of its plastic wood. RPI1012, 401, 413. Because this pattern is consistent along the length of the wood that results from the extrusion process, a POSITA would have understood that the same pattern of alternating two-color layers on the “second side” of the wood shown in annotated Fig. 22.12 would also exist throughout its core. RPI1005, ¶184. That is, each of the lighter and darker polymer layers would extend along the entire width or second direction, as illustrated in annotated Fig. 22.12 below, with the lighter and darker colored layers alternating with one another along the height/third direction:

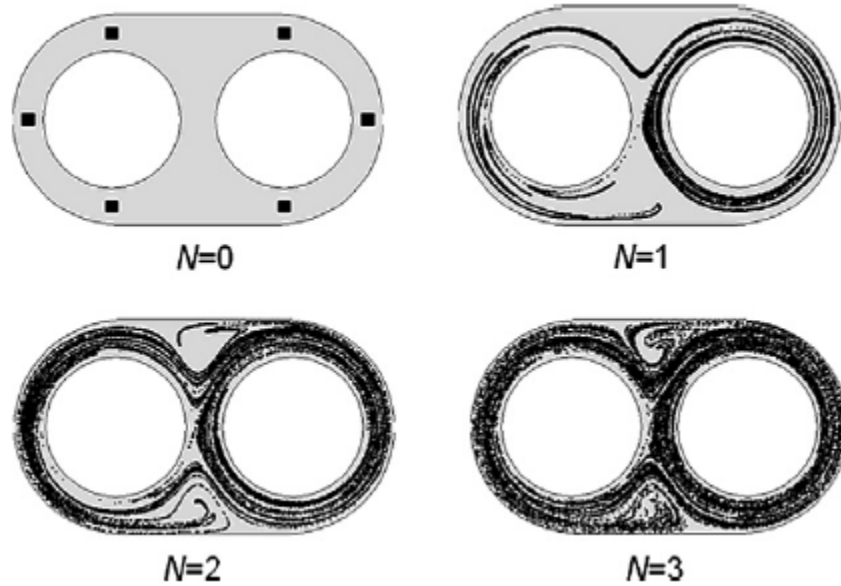


RPI1012, Fig. 22.12 (annotated); RPI1005, ¶184. Because of the nature of the extrusion process, and of Zumbrunnen’s disclosure that its simulated “wood grain patterns can be repeated” (i.e., remain unchanged) “at intervals along an extrusion” (RPI1012, 413), a POSITA would have also understood that the continuous, curved polymeric layers that can be seen on the “second side” in annotated Fig. 22.12 would extend in a curved pattern along the width/second direction. RPI1005, ¶185. The continuous, curvilinear nature of Zumbrunnen’s alternating polymer layers can be more clearly seen in its examples of “infinite variety of simulated wood patterns.” RPI1012, 413. While such exemplary alternating layers are annotated below, additional ones are apparent throughout the “wood patterns”:

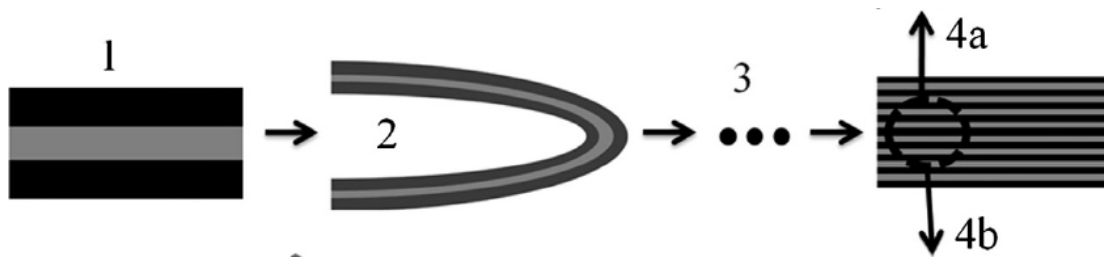


RPI1012, Fig. 22.12 (exemplary layers annotated); RPI1005, ¶187.

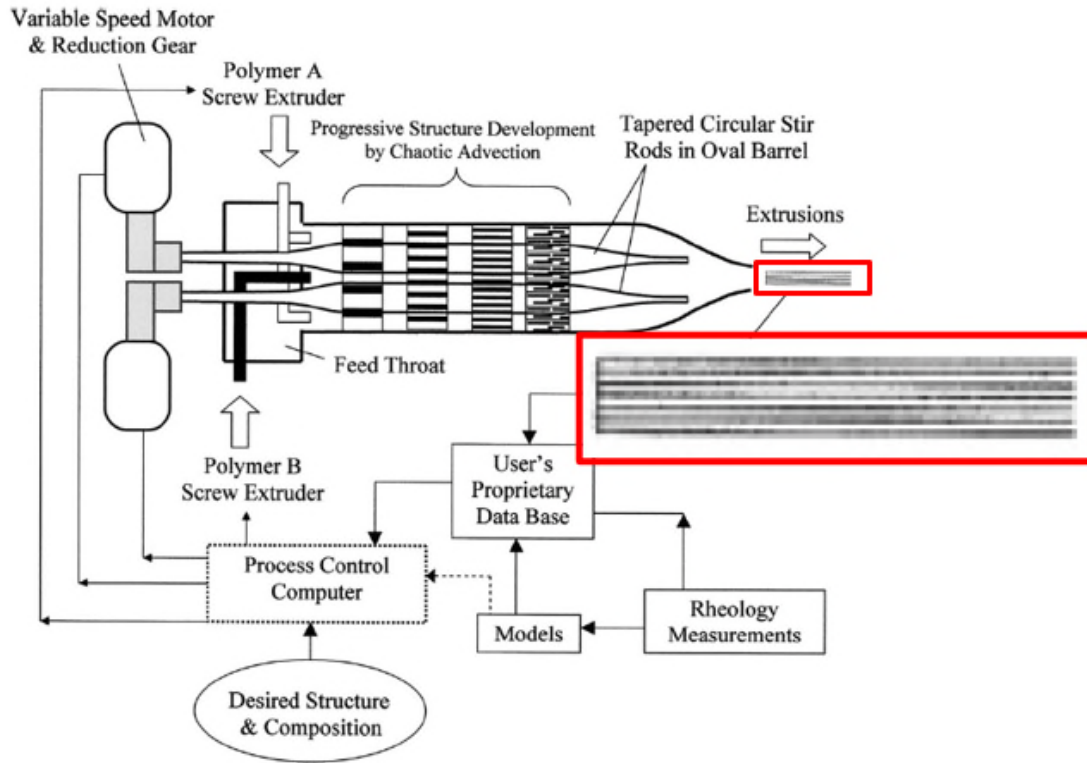
This understanding is further confirmed by Fig. 22.2, which shows a cross-section of the wood grain pattern inside the resulting product based on the number of “rod rotational speed changes” of the pairs of mixing rods in the blender while the “melt is resident in the smart blender”:



RPI1012, 404, Fig. 22.2; RPI1005, ¶186. As can be seen, the alternating polymer layers extend throughout the inside of the entire melt. RPI1005, ¶186. When the rods are arranged vertically to one another, Zumbrunnen teaches that the resulting extrusion has the horizontally-oriented, alternating polymeric layer arrangement shown in Figs. 22.1 and 22.2, which would continue throughout the inside of the wood:



RPI1012, Fig. 22.1.



RPI1012, Fig. 22.2 (annotated); RPI1005, ¶187. A POSITA would have understood that by arranging the stir rods horizontally with one another, a vertically-oriented alternating polymer layer arrangement could be achieved within the core, consistent with the surfaces shown in Figure 22.12. RPI1005, ¶187.

Thus, Zumbrunnen discloses that “a plurality of individual layers of the first and second sets of polymer layers alternate within the” board/substrate or its core “along the third direction...and extend along a substantially uninterrupted curvilinear path originating proximate the first side...and terminating proximate the second side of the” board/substrate or its core or “originating proximate an outer surface of a first portion of the substrate and terminating proximate an outer surface of a second portion of the substrate.” RPI1005, ¶188. These alternating individual

sets of polymer layers are what give the wood of Zumbrunnen its “simulated grain” appearance “both on the surface and interior” discussed above (RPI1012, 401, 413) and thus “*form a natural wood-grained appearance throughout the*” substrate or its core. *Id.* To the extent PO were to argue there is not a plurality of these layers that “*terminate*” and “*originate*” “*proximate*” the sides of the board/substrate/or its core, or the substrate’s outer surfaces, notwithstanding the above and notwithstanding the ’350 patent’s embodiments showing graining terminating and originating further away from those sides or surfaces, this could be readily accomplished by post-processing the substrates/boards, by cutting them so that the grain patterns extend along the entire width. RPI1005, ¶188.

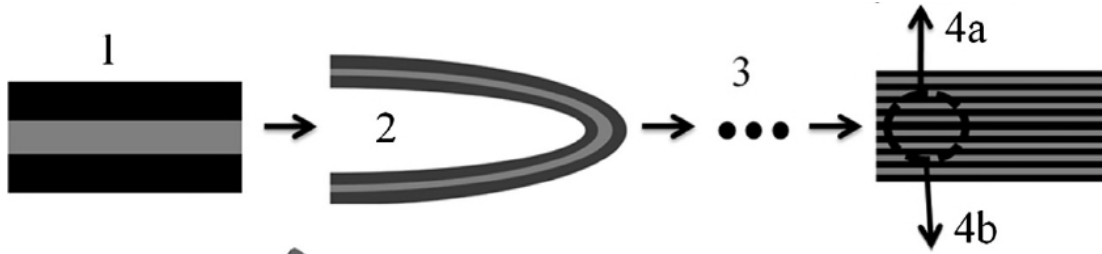
2. *Claims 2, 11, and 21*

As can be seen in Figure 22.12 of Zumbrunnen, its “*first set of polymer layers*” (e.g., darker brown color) “*are thinner than*” the “*second set*” (e.g., lighter brown color):



RPI1012, Fig. 22.12 (annotated); RPI1005, ¶189.

If PO were to argue that Zumbrunnen does not disclose the first set of polymer layers being “*thinner*,” such an arrangement would have been an obvious design choice. RPI1005, ¶190. Zumbrunnen teaches “[t]he ability to produce an infinite variety of simulated wood patterns.” RPI1012, 413. It also teaches that its “stretching and processing can be continued to give a desired layer thickness.” RPI1012, 402. A POSITA would have understood that by introducing more of a first polymer than the second, the stretching and folding will result in thicker layers of the first polymer as compared to the second:



RPI1012, Fig. 22.1; RPI1005, ¶190.

At a minimum, Zumbrunnen illustrates numerous simulated wood grain patterns with varying polymer layer thickness depending on the desired design:



RPI1012, Figure 22.12; RPI1005, ¶191. And because Zumbrunnen expressly discloses creating “realistic wood *grains*” (RPI1012, 401), a POSITA would have been motivated and easily able to make the darker layers thinner than the others to achieve such a graining effect. RPI1005, ¶192.

3. Claim 3

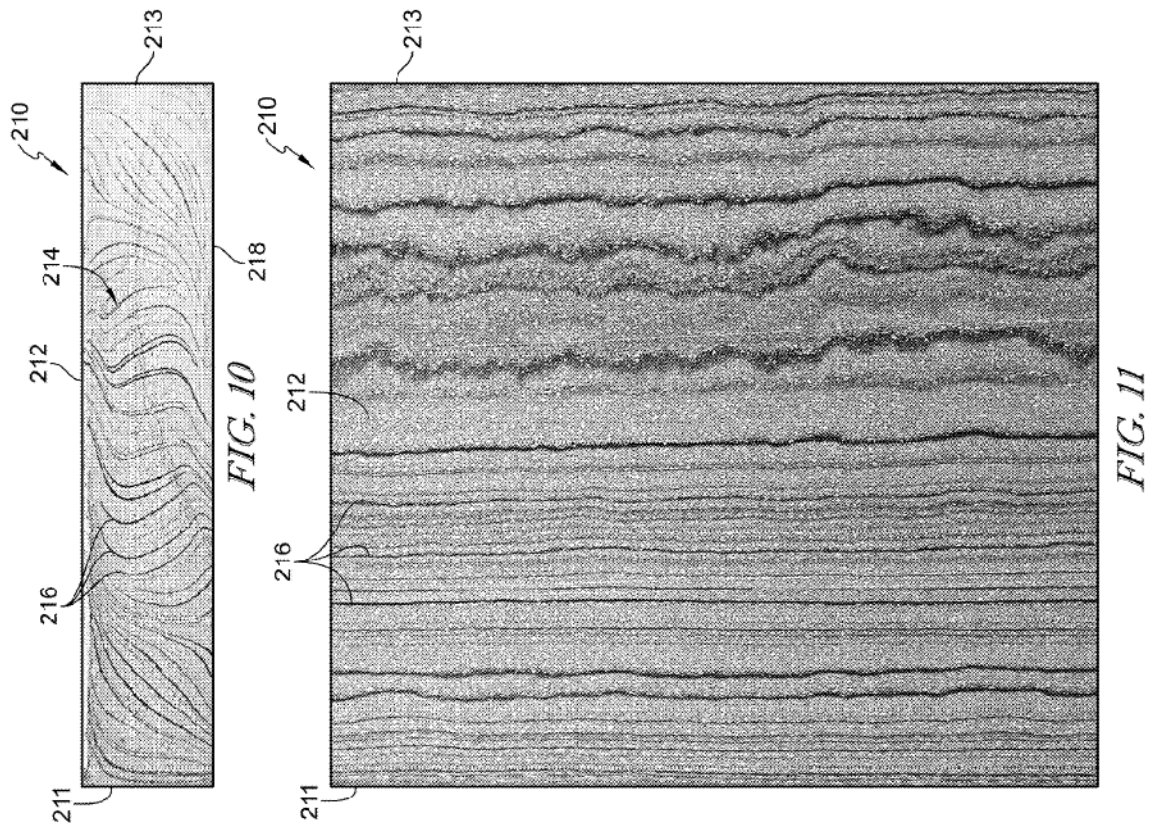
Zumbrunnen's simulated wood has "the appearance of realistic wood grains both *inside* and on surfaces," "[l]ike cut wood." RPI1012, 401, 413. This graining extends from one side of the board to the other, and along its entire length direction. RPI1005, ¶192. Thus, a POSITA would have understood that planing Zumbrunnen's synthetic wood, or cutting it along and parallel to its length direction, would remove a portion of at least one of the first or second sides, and expose portions of the first and second sets of polymer layers along the length direction. RPI1005, ¶192; RPI1012, 401, 413. Both cutting and planing of plastic lumber was well-known and done prior to the '350 patent's priority date. RPI1001, 1:31-37, 1:62-65; RPI1007, 98:2-12. These were ordinary and expected post-processing steps intended to get the correct dimensions of the lumber and to smoothen it, respectively, for a given application. RPI1005, ¶192.

Zumbrunnen therefore discloses a board "*wherein a portion of at least one of the first side and second side of the board is removed to expose portions of the first and second sets of polymer layers along the length direction.*" RPI1005, ¶¶192-93.

4. Claim 4

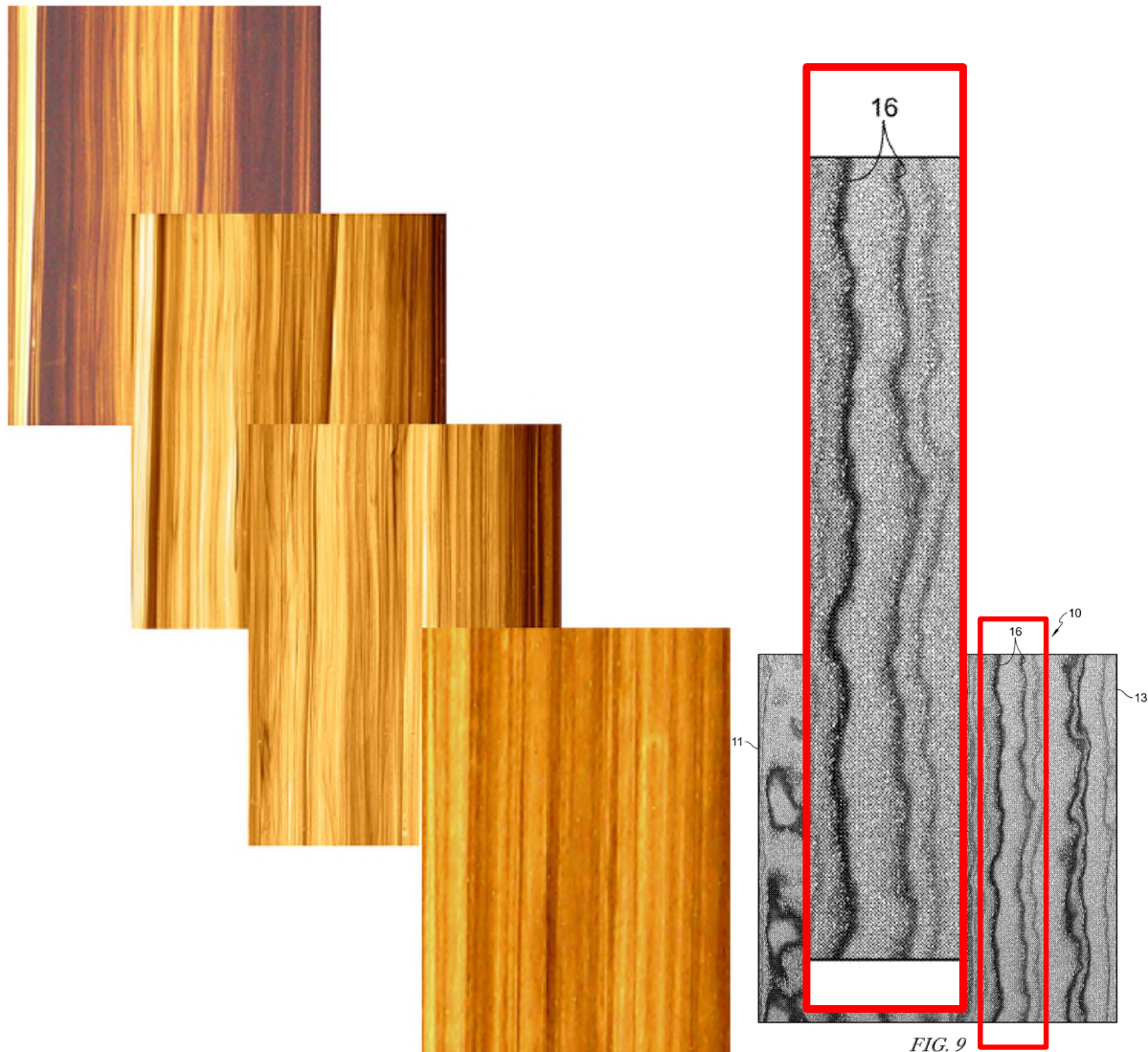
A "burled grain" pattern, within the meaning of the '350 patent, is what necessarily results from planing the surface of a board having internal graining formed from the claimed polymer layers, so long as those layers do not terminate at

a perpendicular angle to the surface. RPI1003, 10; RPI1007, 163:21-165:17. As discussed, Zumbrunnen's graining extends through the inside, and would therefore result in internal graining similar to the internal graining in Fig. 10 of the '350 patent:



RPI1001, Figs. 10, 11; RPI1005, ¶194. Thus, planing the board of Zumbrunnen, which has curved grain patterns that would not run perpendicular to the surface, would result in a burled grain pattern being exposed. RPI1005, ¶194.

Indeed, the grains 16 to which the '350 patent points as an example of “a burled grain pattern” are virtually indistinguishable from Zumbrunnen's grains:



RPI1012, Fig. 22.12; RPI1001, Fig. 9, 6:38-43; RPI1005, ¶195. Zumbrunnen therefore discloses a board “*wherein the exposed portions of the first and second sets of polymer layers form a burled grain pattern resulting from planing the surface.*” RPI1005, ¶¶195-96.

5. Claims 6, 12, and 22

Zumbrunnen teaches that its invention is directed to forming “plastic products” from “polymers,” and expressly discloses HDPE as a polymer that can be

used in its polymer layers. RPI1012, 401, 408 (describing “a blend consisting of 15% by volume [low density polyethylene] LPDE and...**HDPE**”). Zumbrunnen therefore teaches “*form[ing]...the first and second sets of polymer layers*” of its synthetic wood “*from high density polyethylene.*” RPI1005, ¶195.

Furthermore, a POSITA would have found it obvious to use HDPE as the polymeric material. RPI1005, ¶198. As discussed in Ground 1, HDPE was one of the most commonly used types of polymers in simulated wood production prior to the '350 patent, including in extruded simulated wood products, and there were several known benefits to its use. *Id.*; *supra*, §V.A.5. Indeed, the '350 patent's inventor admitted that there was nothing inventive about HDPE's selection. *See supra*, §V.A.5. (citing RPI1007). Thus, for the same reasons described in Ground 1, a POSITA would have been motivated and readily able to use HDPE to form the first and second sets of polymer layers in Zumbrunnen. RPI1005, ¶198; *supra*, §V.A.5.

6. Claims 9 and 15

As discussed above, Zumbrunnen discloses a three-dimensional, rectangular simulated wood board or substrate having a natural wood grain appearing throughout its inside, “[l]ike cut wood.” RPI1005, ¶199. A POSITA would have understood that such three-dimensional, rectangular wood boards and substrates would have a polygonal cross-section along their length. *Id.* Zumbrunnen also discloses using a die to create the desired shape of the product, which a POSITA would have

understood to include such a three-dimensional rectangular shape. *Id.* Accordingly, Zumbrunnen discloses a board or substrate that “*is formed to define a polygonal cross-section along [its] length.*” *Id.* Post-processing the product or using a die to give it such a shape (to better simulate a natural wood board) would have also been an obvious modification, as discussed above. *Id.*

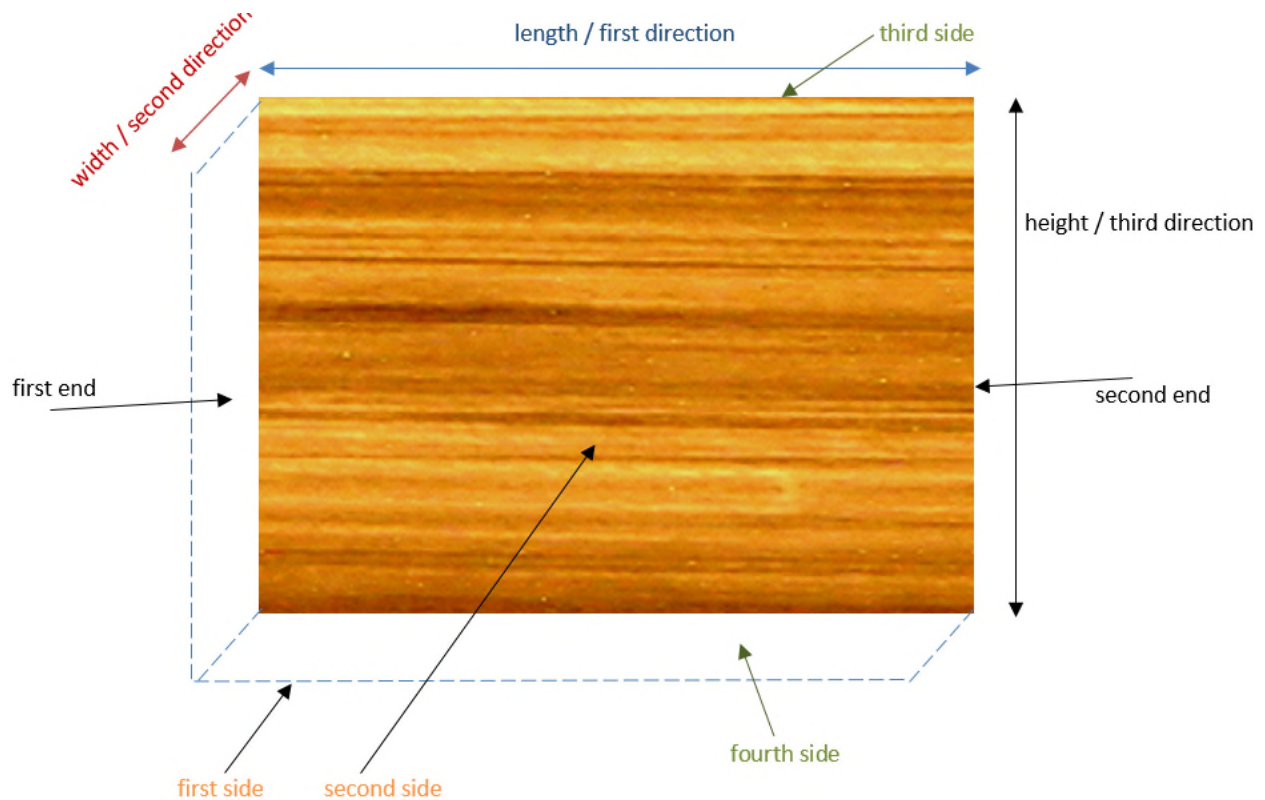
7. Claims 16, 18, and 23

Zumbrunnen is directed to the extrusion of “plastic materials.” RPI1012, 401. Although Zumbrunnen discusses “Polymer-Solid Composites and Nanocomposites,” it never mentions adding any natural wood materials, and instead identifies only some options of using “[i]norganic solids such as carbon black, nanoclays, graphene, nanotubes, and nanofibers” as additives. RPI1012, 408-11. Furthermore, none of those additives are required; rather, they “can” be added and “can” improve certain features. *Id.* Zumbrunnen thus teaches that its plastic wood can be created from polymers, without the need for natural wood materials. RPI1005, ¶200. Zumbrunnen therefore discloses the claimed board and substrates of Claims 6, 12, and 22, “*wherein the core is substantially free of natural wood materials.*” *Id.*

8. Claims 17 and 19

Claims 17 and 19, which depend from **Claims 1 and 10**, respectively, merely recite a third dimension to the claimed board and substrate. For largely the same

reasons discussed with respect to elements [1pre], [10pre], [20pre], and [24pre-24a] above, and with reference to annotated Figure 22.12 below, Zumbrunnen discloses each of these additional dimensional limitations:



RPI1012, Figure 22.12 (annotated); RPI1005, ¶201.

Because the wood of Zumbrunnen is three-dimensional, as discussed, it will include a “height” or “third direction.” RPI1005, ¶201. Thus, as can be seen above, the wood of Zumbrunnen comprises “a third side and a fourth side spaced apart from the third side along a height/third direction different than the length/first direction and width/second direction, wherein the third and fourth sides define a

height of the” board or substrate, “*wherein the third and fourth sides extend along the length/first direction between the first and second ends.*” *Id.*

As also discussed, the three-dimensional synthetic wood of Zumbrunnen includes a “*core*” throughout which the wood-grain pattern extends. RPI1005, ¶203. Thus, with reference to Figure 22.12 above, Zumbrunnen discloses that “*the core of the*” board or substrate “*extends between the first, second, third, and fourth sides and between the first and second ends*” and “*along the first direction.*” *Id.*

If PO were to argue that Zumbrunnen does not disclose a three-dimensional board or substrate with the dimensional and spatial relationships shown above, it would have been an obvious modification, for the same reasons described with respect to elements [1pre], [10pre], [20pre], and [24pre-24a]. *Supra*, §V.C.1.i.; RPI1005, ¶204.

And for the reasons set forth regarding elements [1c], [10c-10d], [20c-20d], and [24d], Zumbrunnen discloses that “*the individual layers of the first and second sets of polymer layers alternate within the core of the*” board or substrate “*along the height/third direction.*” *Supra*, §V.C.1.iii; RPI1005, ¶205.

D. Ground 4: Dependent Claims 5, 7-8, and 13-14 Are Obvious Over Zumbrunnen in View of Rassi

1. Claim 5

As discussed in Ground 2, Rassi discloses extruded plastic lumber having embossed surfaces. *Supra*, §V.B.1. Rassi, like Zumbrunnen, is also concerned with

creating plastic lumber that simulates the look of natural wood and has a graining pattern that extends into its core. RPI1005, ¶206. Rassi further teaches augmenting the look and feel of simulated wood boards by “embossing” their surfaces with grain-like patterns to further “mimick[] the look of real wood” and provide a “grain-like texture.” *Id.*

A POSITA would have been motivated to emboss the surfaces of Zumbrunnen’s wood, as taught by Rassi, to further Zumbrunnen’s goal of producing plastics “with the appearance of realistic wood,” and to impart them with anti-slip properties, and had reasonably expected to succeed, for the reasons stated with respect to Ground 2. RPI1012, 401; RPI1005, ¶207.

A POSITA would therefore have found it obvious to “*emboss[] with a wood grain pattern...at least one of the first and second sides of the board*” of Zumbrunnen, in view of Rassi. RPI1005, ¶208.

2. Claims 7 and 13

Zumbrunnen expressly contemplates “additives” being used in its polymer melts. RPI1012, 403, 408, 411. As discussed in Ground 2, Rassi, like Zumbrunnen, discloses extruded plastic lumber intended to resemble real wood both on its surface and inside. *Supra*, §V.B.2; RPI1005, ¶209. Rassi further teaches including various additives in its extruded polymers, such as “*foaming agents...and UV stabilizers*,” and provides several reasons for doing so in addition to other well-known reasons.

Supra, §V.B.2; RPI1005, ¶209. A POSITA would have therefore been motivated to add foaming agents, as taught by Rassi, into the polymer layers of Zumbrunnen’s wood, for the reasons set forth in Ground 2. *Supra*, §V.B.2; RPI1005, ¶¶209-11. Doing so would have furthered Zumbrunnen’s goal of producing plastics “with the appearance of realistic wood,” by providing “texture to the outer surface” that is “closer to the feel of real wood” and permits it to be stained. RPI1005, ¶211. It would also be desirable to reduce costs and weight. *Id.*

A POSITA would have known that UV inhibitors protect the aesthetic longevity and the durability of simulated wood boards from the effects of sunlight. RPI1005, ¶212 A POSITA would have therefore been motivated to add UV inhibitors, as taught by Rassi, into Zumbrunnen’s polymer layers. *Id.* This is especially true in view of Zumbrunnen’s stated goal of having plastic wood “with the appearance of realistic wood,” which the UV inhibitors would help prevent from deteriorating, especially where the plastic lumber is intended for use outdoors. *See* RPI1012, 401; RPI1005, ¶212.

A POSITA would have had a reasonable expectation of success in adding UV inhibitors and foaming agents into the extruded polymeric layers of Zumbrunnen’s plastic lumber, for the same reasons stated in Ground 2. *Supra*, §V.B.2; RPI1005, ¶213.

A POSITA would have therefore found it obvious to “*include at least one of a UV inhibitor and a foaming agent*” in “*the first and second sets of polymer layers*” of Zumbrunnen’s synthetic wood, in view of Rassi. RPI1005, ¶214.

3. Claims 8 and 14

For the reasons discussed with respect to Claims 7 and 13, A POSITA would have found it obvious to “*include[]a foaming agent*” in “*one of the first and second sets of polymer layers*” of Zumbrunnen’s synthetic wood, in view of Rassi. RPI1005, ¶215.

VI. Discretionary Denial Is Inappropriate

A. Denial Is Inappropriate Under 35 U.S.C. §325(d)

The prior art cited here was not considered during prosecution. *See* IV.B., *supra*. To the contrary, the art cited here discloses the sole allegedly inventive feature whose alleged absence from the prior art resulted in the PTO allowing the ’350 patent to issue—i.e., synthetic wood *having an internal wood-grain pattern throughout*.

None of Nam, Zumbrunnen, or Rassi was ever identified during prosecution.

Zumbrunnen (the primary reference in Grounds 3-4) is not cumulative of any other art that was identified, none of which disclosed a blending system like Zumbrunnen’s that causes chaotic advection to arrive at synthetic wood having wood-grain patterns throughout.

While Piedboeuf involved a static mixer with an extruder, it was found to lack disclosure of wood having a wood-grain pattern throughout. Nam (the primary reference in Grounds 1-2), which also uses a static mixer with an extruder, is therefore not cumulative because it expressly discloses synthetic wood having wood-grain patterns throughout.

While a website related to StaMixCo was disclosed in an IDS nearly three years into prosecution (despite Applicants' knowledge of it long before filing their application), it was never discussed by the Examiner or the Applicants. To the contrary, even after the IDS Applicants continued to argue that their disclosure in the specification was the "*only*" teaching of the claimed synthetic wood having wood-grains throughout. Applicants never revealed to the Examiner that the "key" disclosure (in Figure 5) that teaches making those wood-grains actually was copied wholesale from the StaMixCo prior art cited here (or even addressed StaMixCo or the related website disclosed in the IDS or their relevance). *See* §II.C.

Furthermore, the StaMixCo website Applicants cited in the IDS, consisting of a handful of paragraphs, contained barely a fraction of the disclosure of the detailed 12-page StaMixCo prior art relied on here, and lacks key disclosures providing critical context for how the static mixer could be used and the patterns it could create. For example, the terse webpage lacked the labeling appearing on the image that Applicants copied from the StaMixCo prior art that explained that what was being

shown under each element of the static mixer was the cross-sectional pattern that would result if the melt exited the mixer at that element. The webpage also omitted disclosures explaining that the static mixer could be used with extruded multi-colored viscous polymers, that those polymers can contain additives, and that the mixer can be installed in an extrusion system with an extruder die, among others. The Patent Office thus never had before it the full disclosure of StaMixCo, nor did the Patent Office truly have before it even the more cursory webpage, which was never evaluated and therefore never formed the basis for any rejection. Nor was the combination of Nam and StaMixCo (nor any combination asserted here) before the Office.

In short, during prosecution the Board found that the main art evaluated (Piedboeuf) did not mention synthetic wood or disclose wood-grain patterns throughout. The art and combinations cited here pertain to synthetic wood and expressly recite having wood-grain patterns throughout—i.e., the sole allegedly inventive feature allegedly missing from Piedboeuf. In fact, StaMixCo discloses the *exact* patterns appearing in the '350 patent, which the Applicants copied and represented as their own invention. This Petition is therefore not redundant to the original examination.

B. *Fintiv* Denial Is Not Permitted

Petitioner hereby stipulates that, in the event of institution, Petitioner will not pursue in the parallel litigation any grounds that were raised or reasonably could have been raised in this Petition. This “stipulation is dispositive,” and discretionary denial is not permitted. *BMW of North America, LLC v. Northstar Sys. LLC*, No. IPR2023-01191, Paper 11, 10-11 (P.T.A.B. Mar. 6, 2024); Director’s Mandatory Interim Guidance (June 21, 2022).

VII. Mandatory Notices

A. Real Parties-in-Interest

The real parties-in-interest are Petitioner, Recycled Plastics Industries, LLC, and Premier Outdoor Living, LLC.

B. Related Matters

The ’350 patent is involved in the following pending lawsuit filed by PO against Petitioner: *Tangent Technologies LLC v. Recycled Plastics Industries, LLC*, No. 1:23-cv-00261-WCG (E.D. Wis.).

C. Identification of Counsel and Service Information

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Please direct all correspondence to lead and backup counsel at the address identified above. Petitioner consents to electronic service by e-mail. Concurrently filed herewith is a Power of Attorney pursuant to 37 C.F.R § 42.10(b).

VIII. Grounds for Standing

Petitioner certifies that the '350 patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review of the patent on the grounds identified herein.

IX. Payment of Fees (37 C.F.R. §§ 42.103 and 42.15(a)(1))

The *inter partes* review fee accompanies this Petition. Petitioner authorizes the PTO to charge any additional fees to Deposit Account No. 134365 (Reference No. 049195.000001).

X. Conclusion

Petitioner respectfully requests cancellation of the Challenged Claims.

Respectfully submitted,

Dated: May 8, 2024

/ Bruce J. Rose /

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Recycled Plastic Industries, LLC

Claim Appendix of Challenged Claims

Independent Claim 1

- [1pre]** 1. A simulated natural wood-grained polymer board having a first side and a second side spaced apart from the first side, the spacing between the first and second sides defining one of a width or a height of the board, the first and second sides extending along a length direction between a first end and a second end, the first and second ends defining a length of the board, the board comprising:
- [1a]** a first set of polymer layers extending along the length direction and containing a first colorant, a majority of the first set of polymer layers extending along the length of the entire board;
- [1b]** a second set of polymer layers extending along the length direction and containing a second colorant different than the first colorant, a majority of the second set of polymer layers extending along the length of the entire board; and
- [1c]** wherein a plurality of individual layers of the first and second sets of polymer layers alternate within the board and extend along a substantially uninterrupted curvilinear path originating proximate the first side of the board and terminating proximate the second side of the board.

Dependent Claims 2-9

- [2]** 2. The board of claim 1, wherein the layers of the first set of polymer layers are thinner than the layers of the second set of polymer layers.

- [3] 3. The board of claim 1, wherein a portion of at least one of the first side and second side of the board is removed to expose portions of the first and second sets of polymer layers along the length direction.
- [4] 4. The board of claim 3, wherein the exposed portions of the first and second sets of polymer layers form a burled grain pattern.
- [5] 5. The board of claim 1, wherein at least one of the first and second sides of the board is embossed with a wood grain pattern.
- [6] 6. The board of claim 1, wherein the first and second sets of polymer layers are formed from high density polyethylene.
- [7] 7. The board of claim 6, wherein the first and second sets of polymer layers further include at least one of a UV inhibitor and a foaming agent.
- [8] 8. The board of claim 6, wherein one of the first and second sets of polymer layers further includes a foaming agent.
- [9] 9. The board of claim 1, wherein the board is formed to define a polygonal cross-section along a length of the board.

Independent Claim 10

- [10pre] 10. A simulated natural wood-grained polymer substrate extending along a first direction, the substrate having a first side and a second side spaced apart from the first side along a second direction different than the first direction, the first and second sides defining a width of the substrate, the first and second sides extending along the first direction, a core of the substrate extending between the first and second sides and along the first direction, the substrate comprising:

- [10a]** a first set of polymer layers extending along the first direction and containing a first colorant, a majority of the first set of polymer layers being substantially continuous along the first direction; and
- [10b]** a second set of polymer layers extending along the first direction and containing a second colorant different than the first colorant, a majority of the second set of polymer layers being substantially continuous along the first direction;
- [10c]** wherein individual layers of the first and second sets of polymer layers alternate within the core of the substrate to form a natural wood-grained appearance throughout the core of the substrate; and
- [10d]** wherein a plurality of the individual layers of one of the first and second sets of polymer layers extend along a substantially uninterrupted curvilinear path in the second direction originating proximate the first side and terminating proximate the second side.

Dependent Claims 11-19

- [11]** 11. The substrate of claim 10, wherein the layers of the first set of polymer layers are thinner than the layers of the second set of polymer layers.
- [12]** 12. The substrate of claim 10, wherein the first and second sets of polymer layers are formed from high density polyethylene.
- [13]** 13. The substrate of claim 12, wherein the first and second sets of polymer layers further include at least one of a UV inhibitor and a foaming agent.

- [14]** 14. The substrate of claim 12, wherein one of the first and second sets of polymer layers further includes a foaming agent.
- [15]** 15. The substrate of claim 10, wherein the substrate is formed to define a polygonal cross-section along a length of the substrate.
- [16]** 16. The board of claim 6, wherein the core is substantially free of natural wood materials.
- [17]** 17. The board of claim 1, further comprising a third side and a fourth side spaced apart from the third side along a height direction different than the length direction and width direction, wherein the third and fourth sides define a height of the board, wherein the third and fourth sides extend along the length direction between the first and second ends, wherein the core of the board extends between the first, second, third, and fourth sides and between the first and second ends, and wherein the individual layers of the first and second sets of polymer layers alternate within the core of the board along the height direction.
- [18]** 18. The substrate of claim 12, wherein the core is substantially free of natural wood materials.
- [19]** 19. The substrate of claim 10, further comprising a third side and a fourth side spaced apart from the third side along a third direction different than the first and second directions, wherein the third and fourth sides define a height of the substrate, wherein the third and fourth sides extend along the first direction, wherein the core of the substrate extends between the first, second, third, and fourth sides and along the first direction, and wherein individual layers of the first and second sets

of polymer layers alternate within the core of the substrate along the third direction.

Independent Claim 20

[20pre] 20. A simulated natural wood-grained polymer substrate having a length defined along a first direction, a width defined along a second direction perpendicular to the first direction, and a height defined along a third direction perpendicular to both the first and second directions, the substrate comprising:

[20a] a first set of polymer layers extending along the first direction and containing a first colorant, a majority of the first set of polymer layers being substantially continuous along the first direction; and

[20b] a second set of polymer layers extending along the first direction and containing a second colorant different than the first colorant, a majority of the second set of polymer layers being substantially continuous along the first direction;

[20c] wherein individual layers of the first and second sets of polymer layers alternate within the substrate along the third direction to form a natural wood-grained appearance throughout the substrate; and

[20d] wherein a plurality of the individual layers of one of the plurality of the first and second sets of polymer layers extend along a substantially uninterrupted curvilinear path in the second direction originating proximate an outer surface of a first portion of the substrate and terminating proximate an outer surface of a second portion of the substrate.

Dependent Claims 21-23

- [21] 21. The substrate of claim 20, wherein the layers of the first set of polymer layers are thinner than layers of the second set of polymer layers.
- [22] 22. The substrate of claim 20, wherein the first and second sets of polymer layers are formed from high density polyethylene.
- [23] 23. The substrate of claim 22, wherein the core is substantially free of natural wood materials.

Independent Claim 24

- [24pre] 24. A simulated natural wood-grained polymer board comprising:
- [24a] a polymer core having a first side and a second side spaced apart from the first side, spacing between the first and second sides defining one of a width or a height of the core, the first and second sides extending along a length direction of the core between a first end and a second end, the first and second ends defining a length of the core;
- [24b] a first set of polymer layers extending along the length direction and containing a first colorant, a majority of the first set of polymer layers extending along the entire length of the core;
- [24c] a second set of polymer layers extending along the length direction and containing a second colorant different than the first colorant, a majority of the second set of polymer layers extending along the entire length of the core; and
- [24d] wherein a plurality of individual layers of the first and second sets of polymer layers alternate within the core and extend along a substantially

uninterrupted curvilinear path originating from proximate the first side of the core and terminating proximate the second side of the core.

Certification of Word Count

Under the provisions of 37 C.F.R. § 42.24, I certify that the foregoing Petition contains 13,999 words, not including the table of contents, table of authorities, exhibit list, mandatory notices, claim appendix, certificate of service and certification of word count.

Date: May 8, 2024

By: / Bruce J. Rose /
Bruce J. Rose

Certificate of Service

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105, I certify that the foregoing Petition, along with the accompanying exhibits and power of attorney, was served on the following correspondence address of record for the subject patent via Federal Express:

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