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Application Number: 62208928

Document Date: 08/24/2015

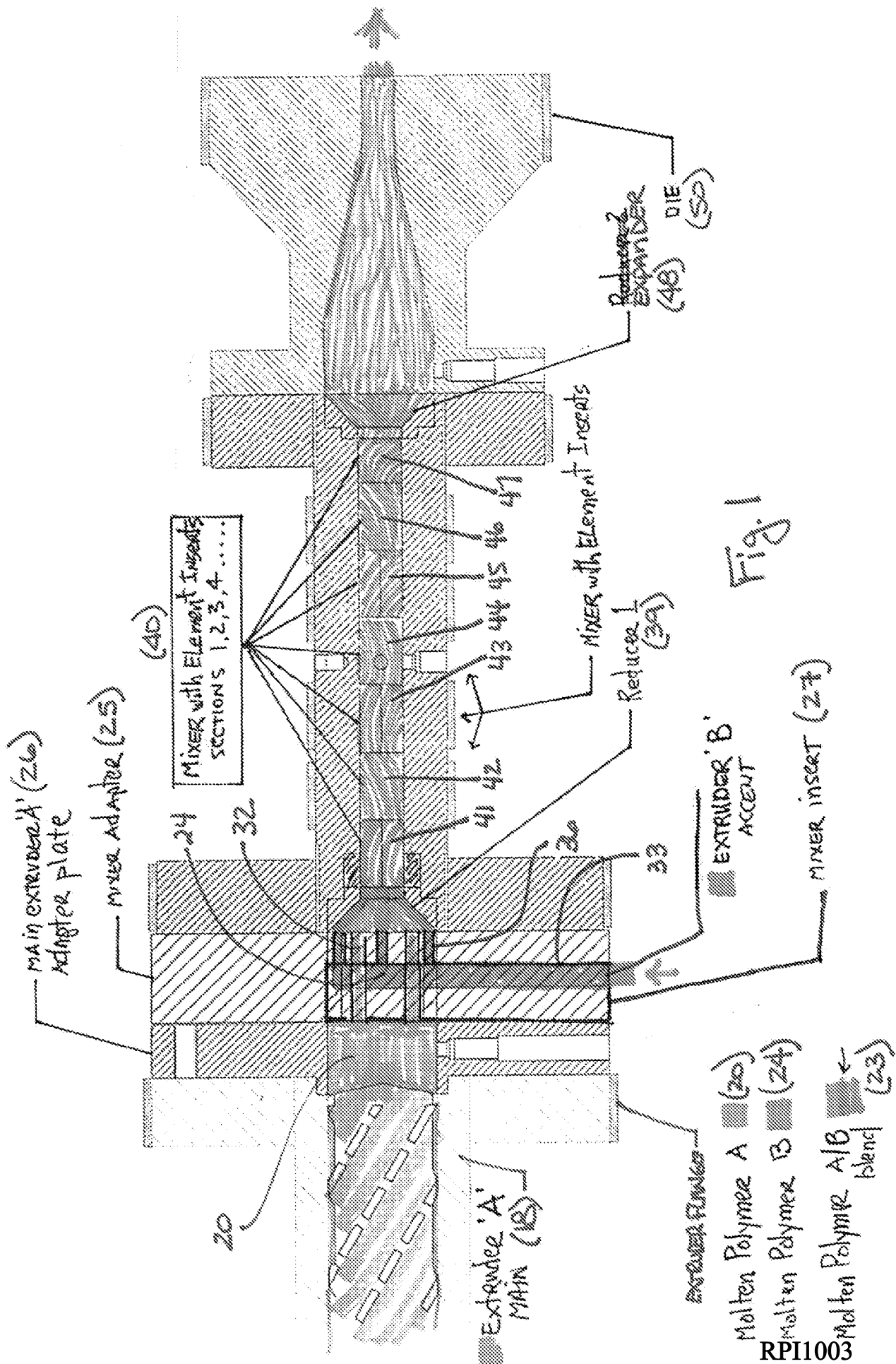
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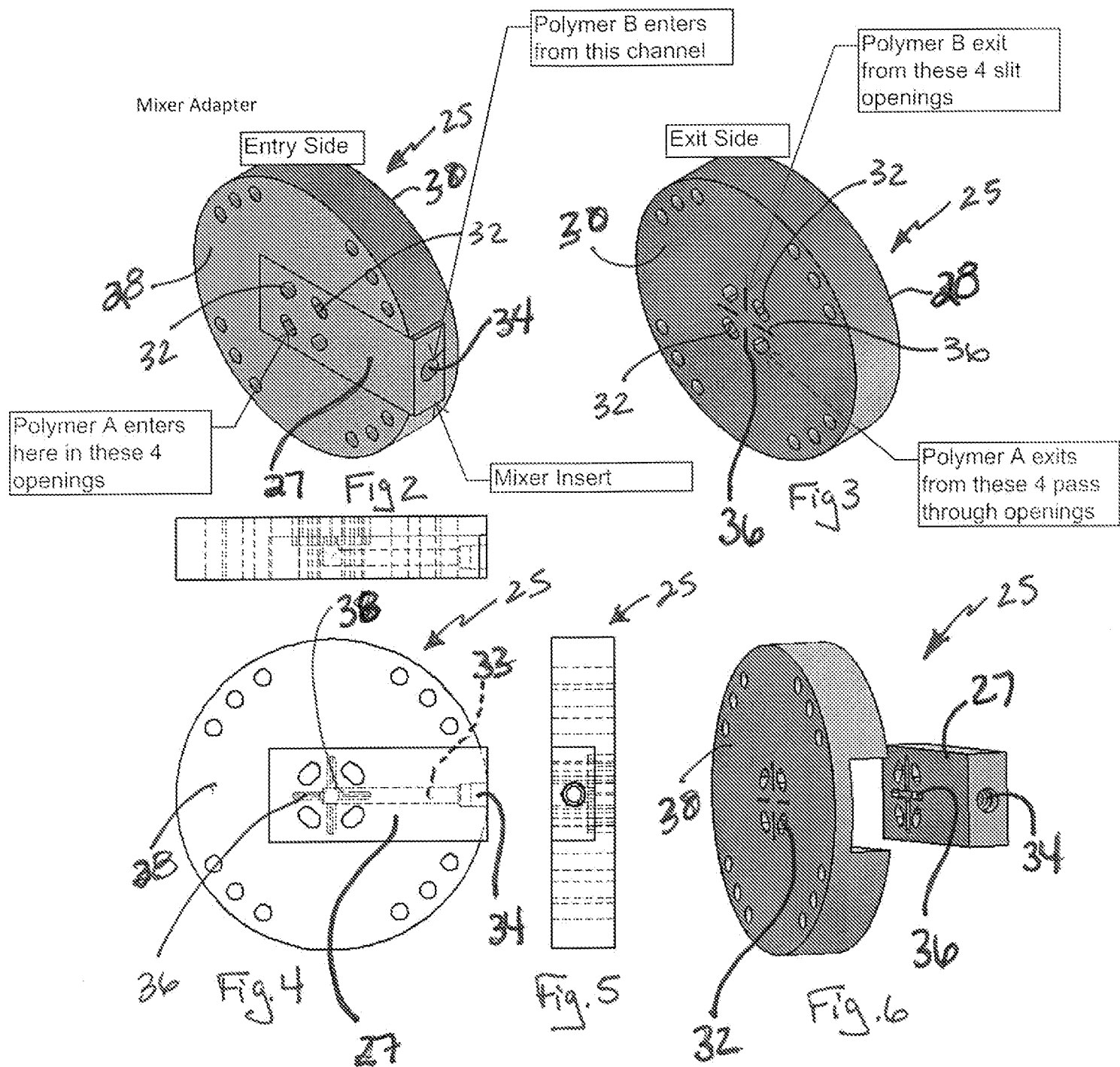
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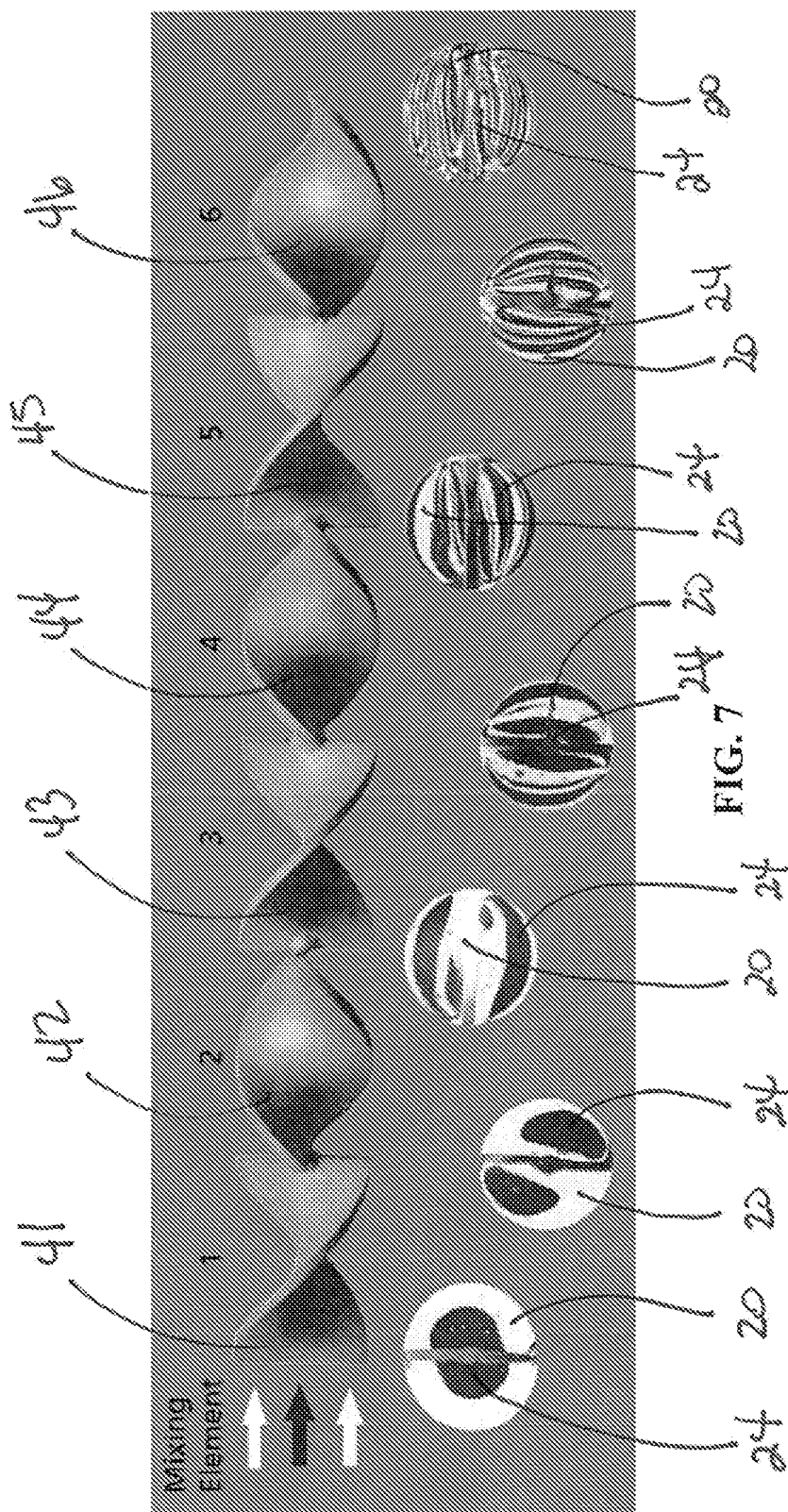
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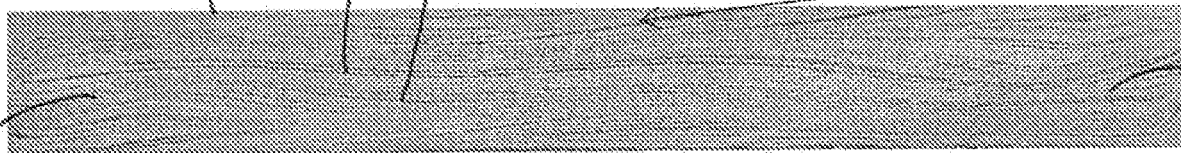






Horizontal graining caused by the last element structure aligning horizontally which on end cuts show graining tight together and horizontal

Horizontal Grain No Emboss, End View



10

Horizontal Grain No Emboss, Top View



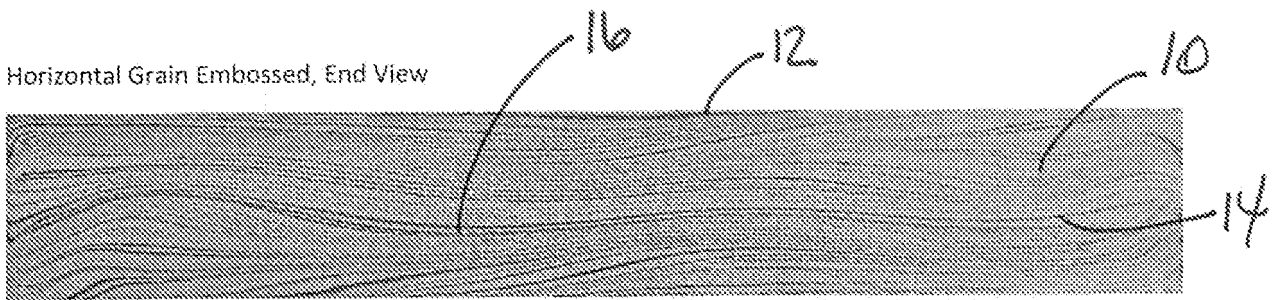
10

12

Fig. 8.

Fig. 9

Horizontal Grain Embossed, End View



Horizontal Grain Embossed, Top View

Fig 10

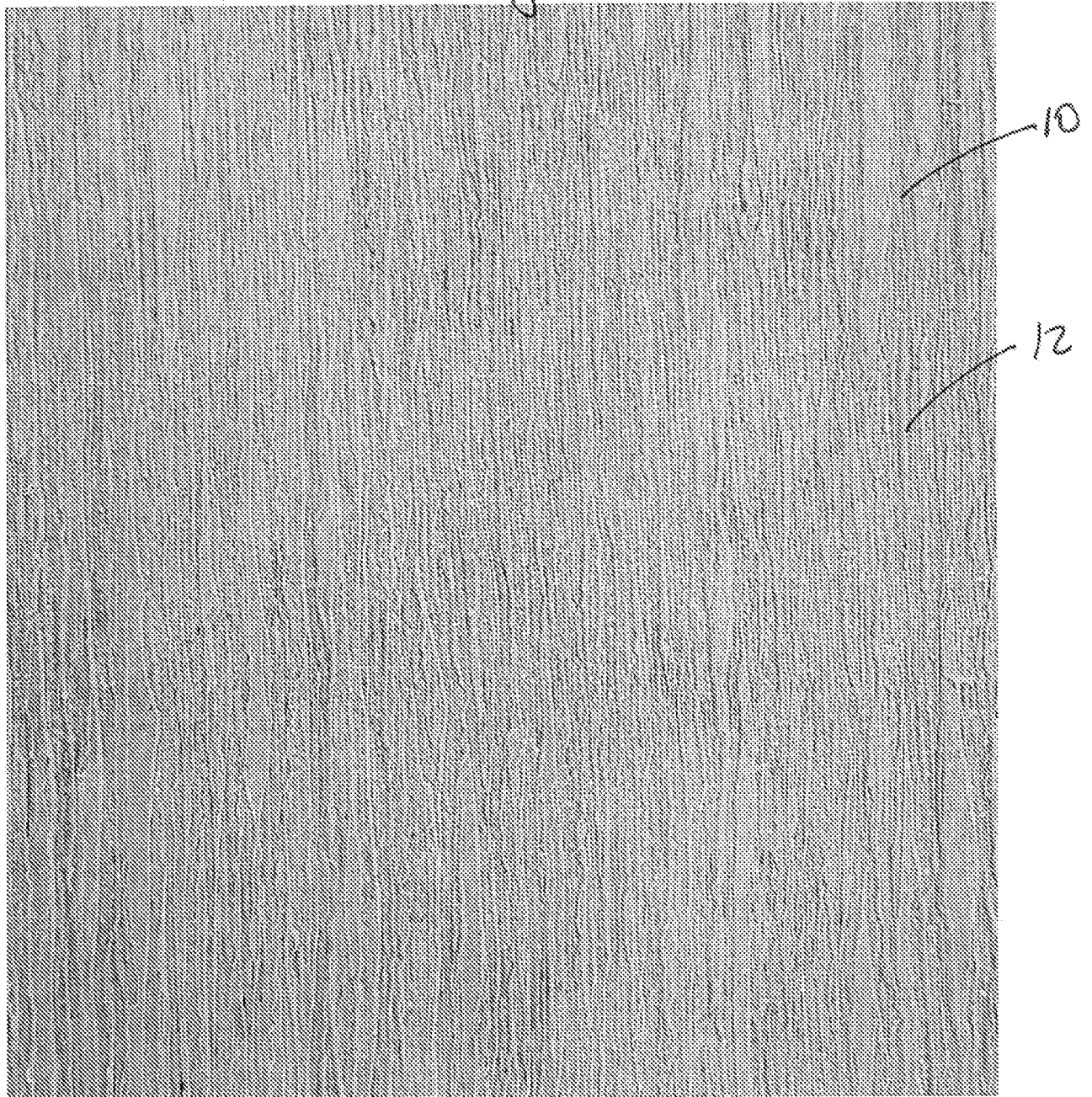
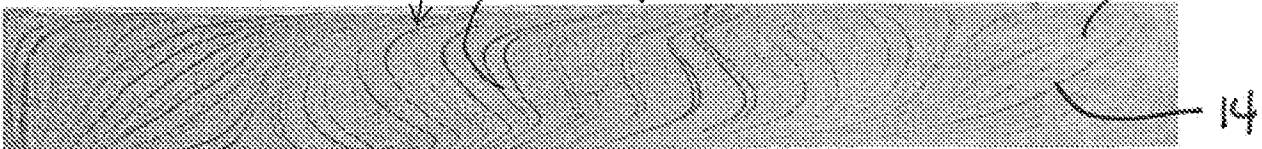


Fig 11

Vertical graining caused by the last element structure aligning vertically which on end cuts show graining in a vertical orientation, spread out (not as tight as horizontal) and organically wavy in nature mimicking tree rings.

Vertical Grain No Emboss, End View



Vertical Grain No Emboss, Top View

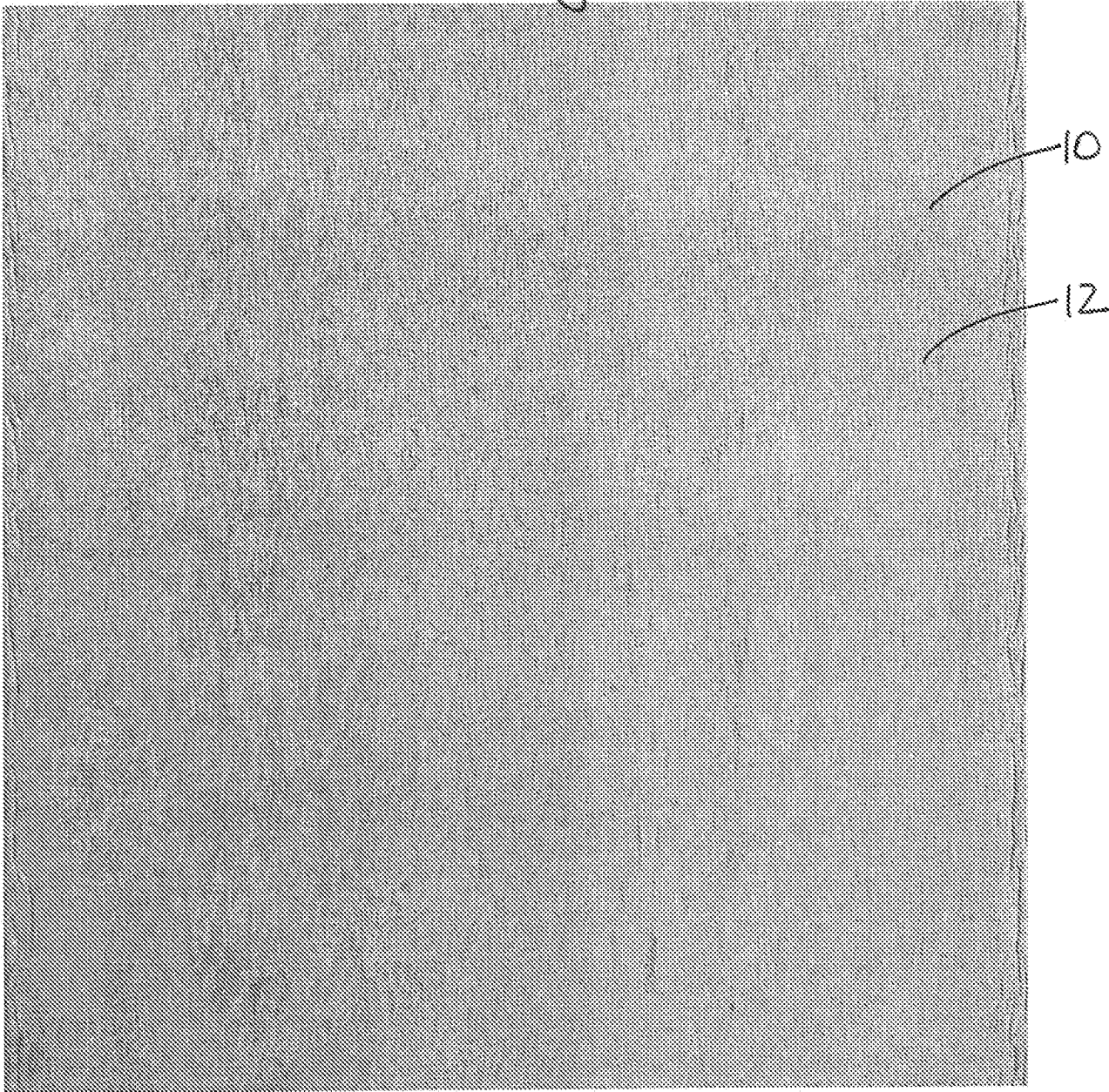
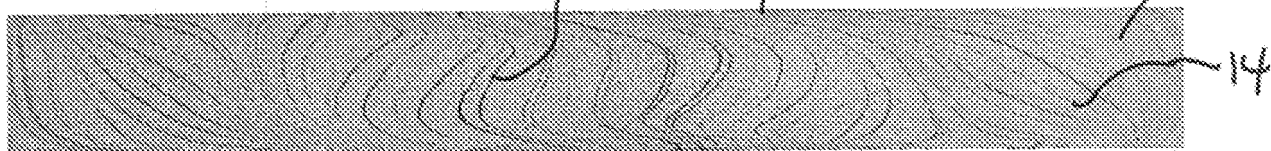


Fig 13

4

Vertical Grain Embossed, End View



Vertical Grain Embossed, Top View

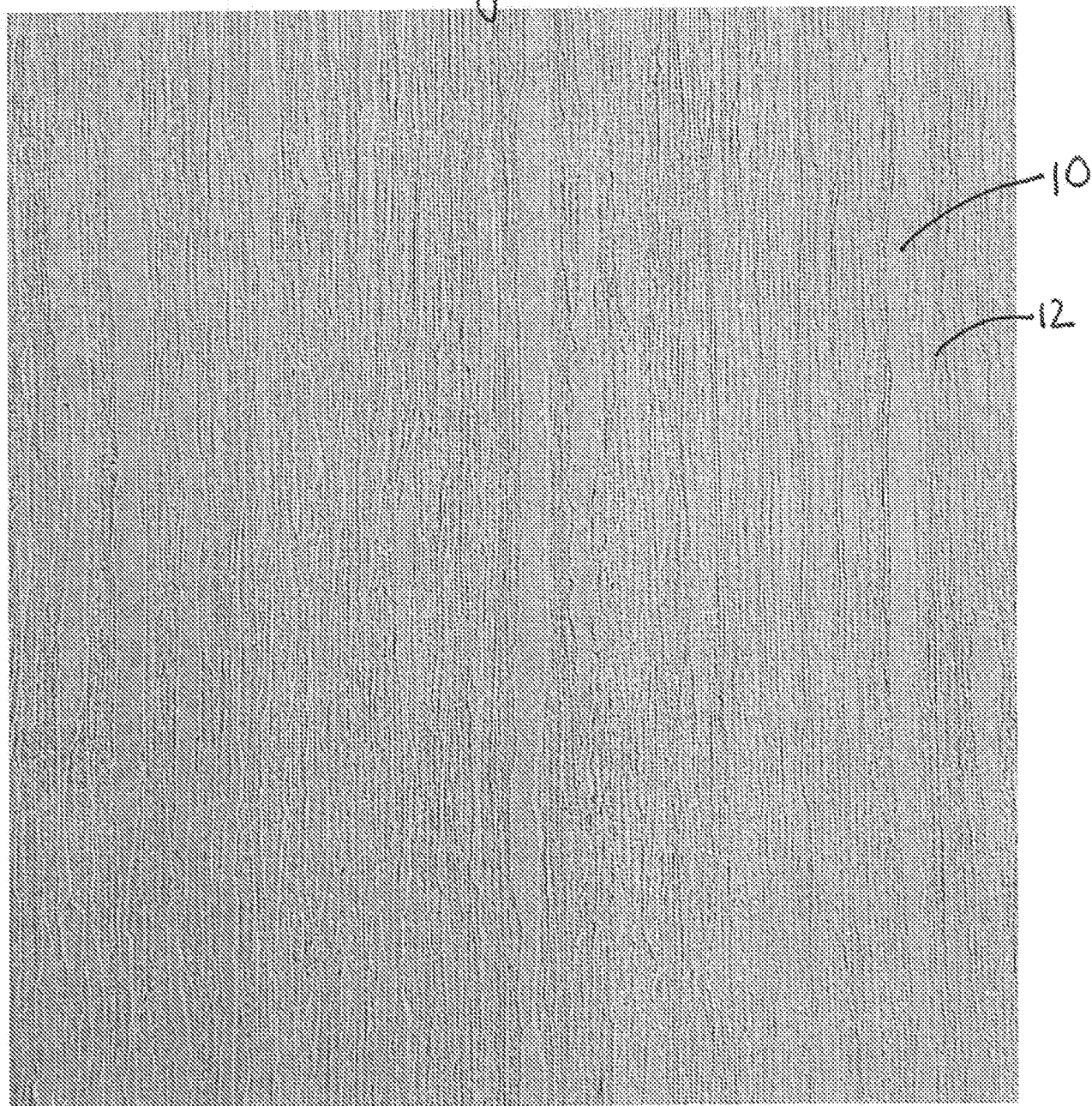
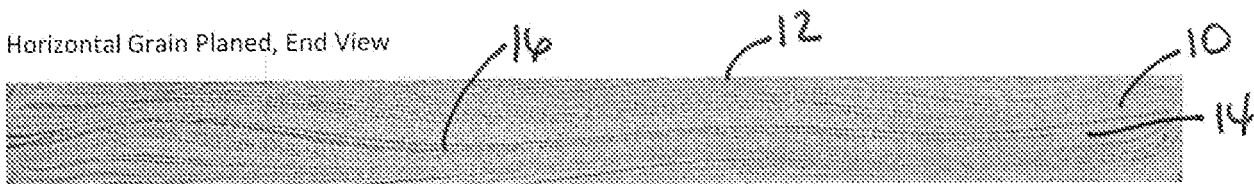


Fig 14

Fig 15

Horizontal Grain Planed, End View



Horizontal Grain Planed, Top View

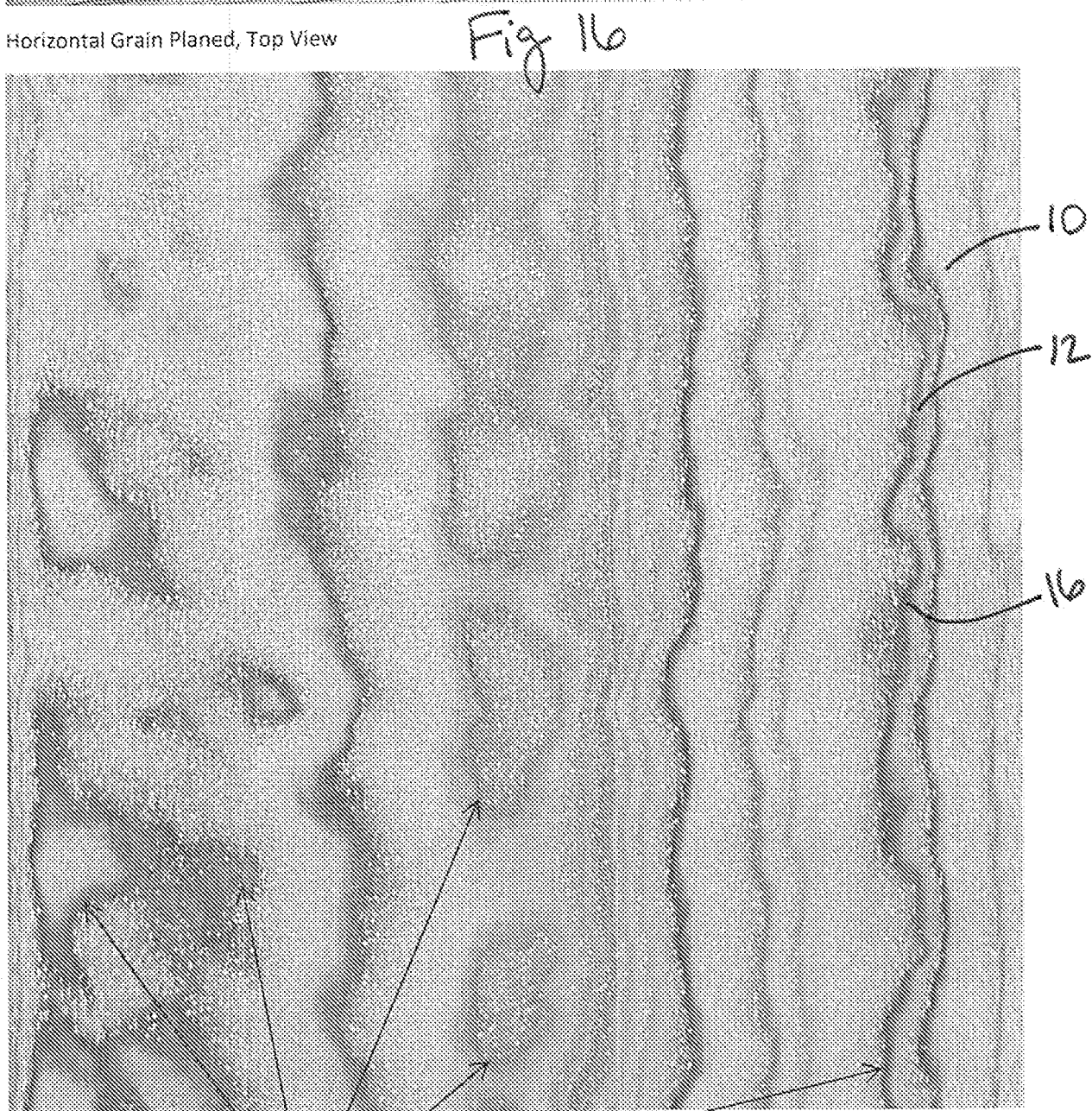


Fig 17

Burling effects from horizontal graining moving parallel to the cut surface

Note when the graining turns and runs parallel to the surface when planed the effect is a more "burled" look versus straight linear lines when the graining terminates more at a 90 deg angle to surface. You see both of these types of effects in sawn lumber based upon grain orientation and surface cut.

Vertical Grain Planed, End View



Vertical Grain Planed, Top View

Linear graining

Fig 18

Burled graining

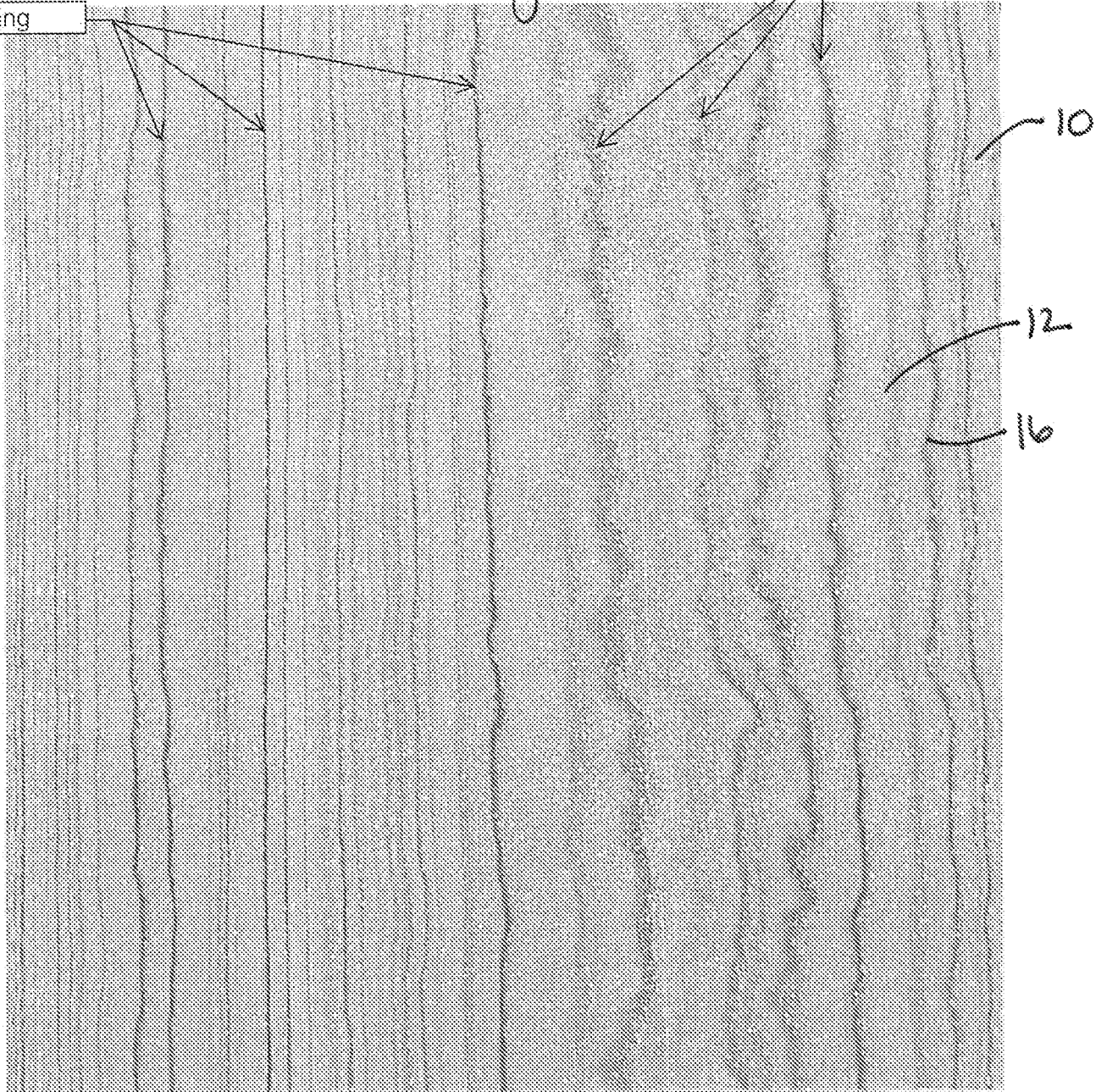


Fig. 19

Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Inventor(s)

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All Inventors Must Be Listed – Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

Add

Title of Invention

WOOD-GRAINED POLYMER SUBSTRATE

Attorney Docket Number (if applicable)

64844-241641

Correspondence Address

Direct all correspondence to (select one):

☒ The address corresponding to Customer Number

☐ Firm or Individual Name

Customer Number

23644

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:

☐ Yes, the invention was under a contract with an agency of the United States Government. The name of the U.S. Government agency and Government contract number are:

Entity Status**Applicant asserts small entity status under 37 CFR 1.27 or applicant certifies micro entity status under 37 CFR 1.29**

- ☒ Applicant asserts small entity status under 37 CFR 1.27
- ☐ Applicant certifies micro entity status under 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
- ☐ No

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Signature

Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Mark J. Nahnsen/			Date (YYYY-MM-DD)	2015-08-24
First Name	Mark J.	Last Name	Nahnsen	Registration Number (If appropriate)	51093

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WOOD-GRAINED POLYMER SUBSTRATE

This paper is a provisional patent application.

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates to polymer composites and more particularly polymer composites that are used as a wood substitute or replacement.

BACKGROUND

[0002] The decking industry has seen numerous product introductions classified as composite and alternative plastic lumber decking products introduced over the past decade. Composite decking typically comprises 50% wood fiber or particles and 50% polyethylene plastic to act as a binder to hold the wood particles together. This entire matrix is extruded into linear deck boards. (Trex® brand is one example). Due to undesirable qualities of this product many companies added a coextruded polymer cap layer around the exterior of the board, which has little or no wood fiber to protect the wood fiber/plastic matrix in the core from exposure and deterioration from environmental exposure.

[0003] In recent years, as composite products have evolved, manufacturers have introduced several colors to the exterior coextruded layer to produce a surface which has varied color tones to emulate natural wood. This wood grain appearance is only skin deep and cutting or planing of the wood composite removes this coextruded cap layer to expose the standard homogenous core.

[0004] The standard plastic extrusion process is designed to evenly mix all ingredients to produce consistent quality of product. Introducing multiple colors at the beginning of the extrusion process results in a homogeneous mixture of a single color. In order to create a wood grain appearance, the industry produced multiple color tones by utilizing color concentrates (streaker colors) that have carrier resins that melt at relatively high temperatures. By keeping the

temperature zones on the extrusion process at or near the temperatures of the melting point of the streaker colors, the streaker color concentrates would soften but not melt immediately whereby the streaker color concentrates would release color randomly and produce a streak effect on the surface of the co-extruded outer cap layer. The core of the board would still be a single homogenous color.

[0005] The streak effect by using streaker color in the cap stock outer layer shows color variation that starts and stops within three to five inches due to the individual color pellet softening, streaking and then being consumed in a discrete area of the co-extruded outer layer. The final co-extruded decking products have varied color tones on the surface but the core of the product remains a single color as evident when the board is cut or planed. The typical use of color concentrate streakers that melt at higher temperatures work for co-extrusion layers but are non-existent within the core, which are not acceptable to customers.

SUMMARY

[0006] The present disclosure may comprise one or more of the following features and combinations thereof.

In illustrative embodiments, a high density polyethylene wood grained substrate includes a plurality of layers of different colors. The substrate is formed in to elongated boards and include a first set of polymer layers formed from a first high density polyethylene. The first set of polymer layers includes a first colorant. The substrate includes a second set of layers formed from a second high density polyethylene. The second set of polymer layers includes a second colorant that is darker than the first colorant. The first and second layers alternate within the substrate to form a wood grained appearance throughout the entire substrate.

[0007] These and other features of the present disclosure will become more apparent from the following description of the illustrative embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Fig. 1 illustrates a sectional view through the extrusion process to manufacture the wood grain polymer board of the present disclosure;

[0009] Fig. 2 is a perspective view of a first side of a mixer adapter to be used in the extrusion process having a mixer insert;

[0010] Fig. 3 is a perspective view of a second side of the mixer adapter;

[0011] Fig. 4 is a side elevational view of the mixer adapter;

[0012] Fig. 5 is an end view of the mixer adapter;

[0013] Fig. 6 is a perspective view of the mixer adapter with the mixer insert removed;

[0014] Fig. 7 is a perspective view of the mixing element inserts used in connection with the static mixer;

[0015] Fig. 8 is an end view of a wood plank showing horizontal graining wherein the grain lines are close together;

[0016] Fig. 9 is a top view of the wood plank of Fig. 8 without embossing or planing of the surface;

[0017] Fig. 10 is an end view of another example of a wood plank showing horizontal grain lines wherein the grain lines are close together;

[0018] Fig. 11 is a top view of the wood plank of Fig. 10 with embossing of the surface without planing;

[0019] Fig. 12 is an end view of a wood plank showing vertical graining wherein the grain lines are spaced apart;

[0020] Fig. 13 is a top view of the wood plank of Fig. 12 without embossing or planing of the surface;

[0021] Fig. 14 is an end view of a wood plank showing vertical graining wherein the grain lines are spaced apart;

[0022] Fig. 15 is a top view of the wood plank of Fig. 14 with embossing of the surface without planing;

[0023] Fig. 16 is an end view of a wood plank showing horizontal graining wherein the grain lines are close together;

[0024] Fig. 17 is a top view of a wood plank showing burling effects from horizontal graining moving parallel to the cut surface as a result of planing the surface;

[0025] Fig. 18 is an end view of a wood plank showing vertical graining wherein the grain lines are spaced apart; and

[0026] Fig. 19 is a top view showing linear graining and burling effects from planing the surface of the board.

DETAILED DESCRIPTION OF THE DRAWINGS

[0027] For the purposes of promoting an understanding of the principles of the disclosure, reference will now be made to a number of illustrative embodiments illustrated in the drawings and specific language will be used to describe the same.

[0028] An illustrative wood grained polymer substrate 10 is preferably made from a polyethylene based recycled materials, as shown in Figs. 8-19, using the process shown in Fig. 1. The wood grained polymer substrate 10 can be used to make polymer lumber products. Most of these products are shipped to customers that design and build a multitude of end products, such as furniture, and they can fabricate the products using polymer substrate 10 as they typically would use actual wood.

[0029] Fabrication using polymer substrate 10 could include drilling, routing, and cutting to build multi-component products such as outdoor furniture, such as adirondack chairs and park benches, for example. The polymer substrate 10 is preferably void of wood or other organic fibers. Polymer substrate 10 is preferably made from a high density polyethylene (HDPE) and includes additives such as UV inhibitors, foaming agents, and color concentrates to produce the desired polymer substrate 10.

[0030] The present disclosure is directed to a polymer substrate 10 that includes a multi-tone wood grain effect that runs throughout the entire substrate (cross section) as well as on the surface 12 so that when removal of material occurs, through planing or cutting, the multi-tone wood grain effect remains both on the surface 12 as well as with the exposed core 14, as shown in Figs. 8-11, for example. The exposed core 14 as well as the remaining surface 12 reveals a multi-tone color effect as well as long linear continuous lines of graining 16.

[0031] The polymer substrate 10 of the present disclosure includes continuous linear lines of color wood grain patterns 16 particularly within the core 14 and exposed core surfaces 12 to emulate wood rings or graining, as shown in Figs. 8-19. Polymer substrate 10 is made using the process illustrated in Fig. 1. First extruder 18 is adapted to extrude first polymer 20 which is blended with the main base color. The first polymer 20 forms the lighter portions of polymer substrate 10. First polymer 20 is the base color resin and includes associated additives such as foam, UV stabilizers, and color concentrate for high density polyethylene extrusions.

[0032] Second extruder 22 extrudes second polymer 24, which is blended with the accent color used to form wood grain patterns 16, as shown in Fig. 1. Colorant for second polymer 24 is chosen to complement the blended color of first polymer 20 which will remain distinctive in the final extrusion but first and second polymers 20, 24 have the potential to partially intermix to produce shade and combinations of color which are identified as polymer A/B blend(s) 23.

[0033] In illustrative embodiments and by way of example, first polymer 20 could be white in color and second polymer 24 could be black in color. When blended according to the present disclosure, areas that intermix showing shades of gray are defined as polymer A/B blend 23. One or more accent color extruders can be used to add additional accent colored resins into the first polymer 20. The process described herein can also be applied to a co-extruded cap layer independent of the core profile.

[0034] Mixer Adapter 25 is coupled to first extruder 18 by securing mixer adapter 25 to adapter plate 26 by use of fasteners, such as bolts, as shown in Figs. 1-6. Mixer adapter 25 is configured to initiate the intermixing of first and second polymers 20, 24. Mixer adapter 25 is positioned downstream from extruders 18, 22 and includes a first face 28 and a second face 30. First face 28 includes a series of first apertures 32 that pass through mixer adapter 25 to second face 30 and permit first polymer 20 to flow through from first face 28 to second face 30.

[0035] Mixer adapter 25 includes a mixer adapter insert 27 a passageway 33 that is coupled to second extruder 22 at a first end 34 and is in fluid communication with a set of second apertures 36 near a second end 38, as shown in Figs. 2-6. Second face 30 includes first and second apertures 32, 36 that are arranged so that first and second polymers 20, 24 are extruded together. Mixer adapter 25 is coupled to a reducer 39, which reduces the cross section of the combined extrusions, as shown in Fig. 1. A slot is machined out of the mixer adapter 25 to allow a mixer adapter 25 with to slide into place and be located on the centerline of extrusion process.

[0036] Openings 32 in mixer adapter 25 are machined over the entire depth to restrict and channel first polymer 20 to exit the mixer adapter 25 and enter the reducer 39 as depicted in Fig. 1. Mixer adapter 25 has a bored passageway 32 to connect to second extruder 22 allowing second polymer 24 to flow into mixer adapter 25, as shown in Figs 4-6.

[0037] Mixer adapter 25 has a second set of machined openings 36 which start at the mid depth distance, exit the mixer adapter 25 and enters reducer 39, as shown in Figs. 1-6. This arrangement allows second polymer 24, which is the accent color to exit the mixer adapter simultaneously with first Polymer 20 in a defined geometric relationship and proportional flow rate.

[0038] Mixer adapter 25 permits the ability to design a variety of patterns and flow rates of first and second polymers 20, 24 to associate with different

profile sizes and well as different linear graining and streaking aesthetics by changing the number and size of the openings 32, 36. Reducer 39 is a cavity which accepts 100% of the combination of first and second polymer 20, 24 and reduces the cross sectional area in order to build pressure, and further initiates the intermixing of the first and second polymers 20, 24 and to prepare the flow channel to enter the static mixer 40 and element insert 41 of element inserts 41-47 at the entry point, as shown in Fig. 1 and Fig. 7.

[0039] Static mixer 40 with element inserts 41-47 is a barrel with a cylindrical bored cavity which allows multiple element inserts 41-47 to be aligned against each other longitudinally to cut, redirect and split the total combination of polymer flow emanating from reducer 39, as shown in Figs. 1 and 7. Element inserts 41-47 can be of different designs and fit together in a variety of orientations to vary the wood grain patterns 16 of polymer substrate 10. Different style static mixers can be used to create different grain patterns. Preferably helical static mixers are used as shown in Fig. 7. For illustrative purposes, six static element inserts are shown 41-46. While seven element inserts are preferred, it is contemplated that any number of element inserts can be used to vary the grain pattern formed in the polymer. The design, orientation and number of element inserts 41-47 play a key role in determining the linear graining and streaking aesthetics for a particular profile size and shape.

[0040] With each successive element insert the intermixing of first polymer 20 and second polymer 24 increases the amount of linear graining between the two polymers as well as promote the polymer A/B blending 23 which produces multiple color combinations between the two colors as depicted in Fig. 7. The combined polymer exiting element insert 47 enters expander 48, as shown in Fig. 1. Expander 48 is a cavity that accepts 100% of the combination of first and second polymers 20, 24 and A/B blend(s) 23 from the exit of the static mixer 40 with element Inserts 41-47 and direct the total combination of polymer flow into the entry of a die 50.

[0041] The Die is designed to spread and shape the molten polymer combination exiting from the Mixer with Element Inserts into the final profile shape, as shown in Fig. 1. The total aggregate of molten polymer combinations of "A", "B" and A/B blending exits the die and enters tooling with the similar dimension of the die exit to begin cooling and forming the final product. Finished product surface can be further enhanced by embossing techniques applied to the surface of the polymer substrate 10. Further, the surface 12 can be planed away to expose the wood grain pattern 16 below the surface 12 of the polymer substrate 10.

[0042] Variations in wood grain patterns are shown in Figs. 9-19. Depending upon the arrangement of the element structures of the static mixer, various patterns can be produced. Figs. 8 and 10 illustrate a horizontal wavy long grain in cross section of the board caused by the last element of the static mixer aligning horizontally. The horizontal cross sections are shown having a tight grain pattern. Figs. 12 and 14 on the other hand illustrate vertical graining caused by the last element of the static mixer aligning vertically, which on end cuts shows graining in a vertical orientation and spread out, with graining that is not as tight as the horizontal graining of Figs. 8 and 10. Graining can also be seen on the top surface of the board if the top layer of the board is planed by a few thousands of an inch to expose the graining beneath the surface as shown in Figs. 17 and 19. Fig. 17 illustrates burling effects from horizontal graining moving parallel to the cut surface. Fig. 19 illustrates linear graining effects from vertical moving parallel to the cut surface.

[0043] While the disclosure has been illustrated and described in detail in the foregoing drawings and description, the same is to be considered as exemplary and not restrictive in character, it being understood that only illustrative embodiments thereof have been shown and described and that all changes and modifications that come within the spirit of the disclosure are desired to be protected.

What is claimed is:

1. A high density polyethylene wood grained substrate having a plurality of layers of different colors comprising:

a first set of polymer layers formed from a first high density polyethylene including a first colorant;

a second set of layers formed from a second high density polyethylene having a second colorant that is darker than the first colorant;

wherein the first and second layers alternate within the substrate to form a wood grained appearance throughout the entire substrate.

2. The high density polyethylene wood grained substrate of claim 1, wherein the outer surface is planed to expose the alternating first and second layers that form the wood grain appearance.

3. The high density polyethylene wood grained substrate of claim 2, wherein the first high density polyethylene includes UV inhibitors, and foaming agents.

4. The high density polyethylene wood grained substrate of claim 3, wherein the second high density polyethylene includes UV inhibitors, and foaming agents.

5. The high density polyethylene wood grained substrate of claim 1, wherein the substrate is in the form of a board having a polygonal cross section.

6. The high density polyethylene wood grained substrate of claim 5, wherein the grain is in the form a plurality of closely oriented horizontal wavy lines across a width of an end of the board when viewed from an end of the board.

7. The high density polyethylene wood grained substrate of claim 5, wherein the grain is in the form of a plurality of spaced apart vertical wavy lines across a width of an end of the board when viewed from an end of the board.

8. The high density polyethylene wood grained substrate of claim 5, wherein the polygon is selected from the group consisting of rectangular and square.

9. The high density polyethylene wood grained substrate of claim 8, wherein the grain has a burling effect when the top surface of the board is planed to remove a portion of the surface of the board.

ABSTRACT OF THE DISCLOSURE

A high density polyethylene wood grained substrate includes a plurality of layers of different colors. The substrate is formed in to elongated boards and include a first set of polymer layers formed from a first high density polyethylene. The first set of polymer layers includes a first colorant. The substrate includes a second set of layers formed from a second high density polyethylene. The second set of polymer layers includes a second colorant that is darker than the first colorant. The first and second layers alternate within the substrate to form a wood grained appearance throughout the entire substrate.

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	WOOD-GRAINED POLYMER SUBSTRATE			
First Named Inventor/Applicant Name:	Andrew Stephens			
Filer:	Mark J. Nahnsen/Mark Sweetin			
Attorney Docket Number:	64844-241641			
Filed as Small Entity				
Filing Fees for Provisional				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Provisional Application Filing Fee	2005	1	130	130
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				130

Electronic Acknowledgement Receipt

EFS ID:	23288884
Application Number:	62208928
International Application Number:	
Confirmation Number:	2681
Title of Invention:	WOOD-GRAINED POLYMER SUBSTRATE
First Named Inventor/Applicant Name:	Andrew Stephens
Customer Number:	23644
Filer:	Mark J. Nahnsen/Mark Sweetin
Filer Authorized By:	Mark J. Nahnsen
Attorney Docket Number:	64844-241641
Receipt Date:	24-AUG-2015
Filing Date:	
Time Stamp:	13:19:15
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 130
RAM confirmation Number	10176
Deposit Account	120913
Authorized User	NAHNSEN, MARK J

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RPI1003

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Drawings-other than black and white line drawings	241641_Drawings.pdf	3848754	no	9
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Warnings:					
Information:					
2	Provisional Cover Sheet (SB16)	241641_PRO_Coversheet.pdf	1477407	no	3
			26463b12237d0188f74b07321351c979029c1a4a		
Warnings:					
Information:					
3		241641_PRO_Application.pdf	39354	yes	11
			5a65c9eb69d244017a3e7cbadded24fb2419dece		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	8	
	Claims		9	10	
	Abstract		11	11	
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30200	no	2
			14d3ad2a0aff2fd2c76eaa5a35d91fb114da6227		
Warnings:					
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Total Files Size (in bytes):			5395715		

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

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
62/208,928	08/24/2015		130	64844-241641		

23644
Barnes & Thornburg LLP (CH)
P.O. Box 2786
Chicago, IL 60690-2786

CONFIRMATION NO. 2681
FILING RECEIPT



Date Mailed: 09/10/2015

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

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If Required, Foreign Filing License Granted: 09/09/2015

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 62/208,928**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

WOOD-GRAINED POLYMER SUBSTRATE

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

page 1 of 3

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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