

Señores

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIRECCIÓN DE NUEVAS CREACIONES

E. S. D.

Re: Expediente No. NC2017/0008445

**Solicitud de Patente de Invención Titulada: “OSCURECIMIENTO CON
RESISTENCIA Y CALIDAD ÓPTICA SUPERIORES PARA UN
LAMINADO DE AUTOMOTORES”**

Solicitante: AGP AMERICA S.A.

Nuestra Ref.: P2017/000104

MEMORIAL DE ALCANCE

CARLOS R. OLARTE, mayor de edad y vecino de Bogotá, D.C., identificado tal como aparece al pie de mi firma, en mi carácter de apoderado de la sociedad en referencia, me permito aportar los siguientes documentos de prioridad:

- US 15/393.584 de fecha 29 de diciembre de 2016.
- US 15/498.852 de fecha 27 de abril de 2017.

Rogamos tomar atenta nota y proceder de conformidad.

Atentamente,



CARLOS R. OLARTE
CC. No.79.782.747 de Bogotá
T.P. 74.295

7655509



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

November 01, 2017

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 15/393,584
FILING DATE: *December 29, 2016*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US15/393,584*



Certified by

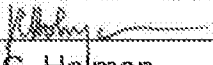
Nichelle K. Lee

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

UTILITY PATENT APPLICATION TRANSMITTAL <i>(Only for new nonprovisional applications under 37 CFR 1.53(b))</i>	Attorney Docket No.	P75029US1
	First Named Inventor	Arturo MANNHEIM ASTETE
	Title	OBSCURATION HAVING SUPERIOR STRENGTH AND...
	Express Mail Label No.	

APPLICATION ELEMENTS <i>See MPEP chapter 600 concerning utility patent application contents.</i>	ADDRESS TO: Commissioner for Patents P.O. Box 1450 Alexandria, VA 22313-1450
ACCOMPANYING APPLICATION PAPERS	
1. ☒ Fee Transmittal Form (PTO/SB/17 or equivalent) 2. ☐ Applicant asserts small entity status. See 37 CFR 1.27 3. ☐ Applicant certifies micro entity status. See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent. 4. ☒ Specification [Total Pages 24] Both the claims and abstract must start on a new page. (See MPEP § 608.01(a) for information on the preferred arrangement) 5. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 9] 6. ☒ Inventor's Oath or Declaration [Total Pages] (including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e)) a. ☐ Newly executed (original or copy) b. ☐ A copy from a prior application (37 CFR 1.63(d)) 7. ☒ Application Data Sheet * See note below. See 37 CFR 1.76 (PTO/AIA/14 or equivalent) 8. ☐ CD-ROM or CD-R in duplicate, large table, or Computer Program (Appendix) ☐ Landscape Table on CD 9. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, items a. - c. are required) a. ☐ Computer Readable Form (CRF) b. ☐ Specification Sequence Listing on: i. ☐ CD-ROM or CD-R (2 copies); or ii. ☐ Paper c. ☐ Statements verifying identity of above copies	10. ☐ Assignment Papers (cover sheet & document(s)) Name of Assignee _____ 11. ☐ 37 CFR 3.73(c) Statement (when there is an assignee) ☐ Power of Attorney 12. ☐ English Translation Document (if applicable) 13. ☒ Information Disclosure Statement (PTO/SB/08 or PTO-1449) ☐ Copies of citations attached 14. ☐ Preliminary Amendment 15. ☐ Return Receipt Postcard (MPEP § 503) (Should be specifically itemized) 16. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed) 17. ☐ Nonpublication Request Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent. 18. ☐ Other: _____

*Note: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 must be included in an Application Data Sheet (ADS).
 (2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.48(b).

19. CORRESPONDENCE ADDRESS				
☒ The address associated with Customer Number: 00136 OR ☐ Correspondence address below				
Name				
Address				
City	State	Zip Code		
Country	Telephone	Email		
Signature			Date	December 29, 2016
Name (Print/Type)	John C. Holman		Registration No. (Attorney/Agent)	22,769

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995 no persons are required to respond to a collection of information unless it displays a valid OMB control number.

FEE TRANSMITTAL**Complete if known**

☐ Applicant asserts small entity status. See 37 CFR 1.27.	Application Number	UNASSIGNED
☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.	Filing Date	December 29, 2016
	First Named Inventor	Arturo MANNHEIM ASTETE
	Examiner Name	UNASSIGNED
	Art Unit	UNASSIGNED
TOTAL AMOUNT OF PAYMENT (\$)	Practitioner Docket No.	P75029US1
1,740		

METHOD OF PAYMENT (check all that apply)
☐ Check ☒ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☐ Deposit Account Deposit Account Number: _____ Deposit Account Name: _____

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, except for the filing fee

☐ Charge any additional fee(s) or underpayment of fee(s) ☐ Credit any overpayment of fee(s) under 37 CFR 1.16 and 1.17

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION**1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)**

Application Type	FILING FEES			SEARCH FEES			EXAMINATION FEES			Fees Paid (\$)
	U (\$)	S (\$)	M (\$)	U (\$)	S (\$)	M (\$)	U (\$)	S (\$)	M (\$)	
Utility	280	140*	70	600	300	150	720	360	180	1,808
Design	180	90	45	120	60	30	460	230	115	
Plant	180	90	45	380	190	95	580	290	145	
Reissue	280	140	70	600	300	150	2,160	1,080	540	
Provisional	260	130	65	0	0	0	0	0	0	

* The \$140 small entity status filing fee for a utility application is further reduced to \$70 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	Undiscounted Fee (\$)	Small Entity Fee (\$)	Micro Entity Fee (\$)
Each claim over 20 (Including Reissues)	80	40	20
Each independent claim over 3 (Including Reissues)	420	210	105
Multiple dependent claims	780	390	195
Total Claims	Extra Claims	Fee (\$)	Fee Paid (\$)
9	-20 or HP =	X	=
HP = highest number of total claims paid for, if greater than 20.			
Indep. Claims	Extra Claims	Fee (\$)	Fee Paid (\$)
1	-3 or HP =	X	=
HP = highest number of independent claims paid for, if greater than 3.			

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$400 (\$200 for small entity) (\$100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
33	- 100 =	/ 50 =	(round up to a whole number) X	=

4. OTHER FEE(S)

	Fees Paid (\$)
Non-English specification, \$130 fee (no small or micro entity discount)	
Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, \$400 fee (\$200 small or micro entity)	
Other (e.g., late filing surcharge): Late filing of the Declaration surcharge	140

SUBMITTED BY

Signature	Registration No. 22,769 (Attorney/Agent)	Telephone (202)638-6666
Name (Print/Type) John C. Holman		Date December 29, 2016

This collection of information is required by 37 CFR 1.135. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US1
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
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Inventor Information:

Inventor 1					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Arturo		MANNHEIM ASTETE		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Lima	Country of Residence ¹	PE		
Mailing Address of Inventor:					
Address 1		Av. Guillermo Dansey 1996,			
Address 2		Cercado de			
City	Lima	State/Province			
Postal Code		Country ¹	PE		
Inventor 2					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Vincenzo		MANNINO		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Lima	Country of Residence ¹	PE		
Mailing Address of Inventor:					
Address 1		Ca. Manuel Tovar 656, Dpt. 301,			
Address 2		Miraflores			
City	Lima	State/Province			
Postal Code		Country ¹	PE		
Inventor 3					Remove
Legal Name					

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		P75029US1	
		Application Number			
Title of Invention		OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE			

Prefix	Given Name	Middle Name	Family Name	Suffix
	Charles	S.	VOETZEL	
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service				
City	New Kensington	State/Province	PA	Country of Residence
				US

Mailing Address of Inventor:

Address 1	Malecon de la Reserva 101, #501,			
Address 2	Miraflores			
City	Lima	State/Province		
Postal Code		Country i	PE	
Inventor 4				Remove
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Laura	Granados	Caro	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Lima	Country of Residence i	PE	

Mailing Address of Inventor:

Address 1	Guillermo Dansey 1846,			
Address 2	Cercado de Lima			
City	Lima	State/Province		
Postal Code		Country i	PE	
Inventor 5				Remove
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Philip	Denton	Gordon	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Lima	Country of Residence i	PE	

Mailing Address of Inventor:

Address 1	Guillermo Dansey 1846,			
Address 2	Cercado de Lima			
City	Lima	State/Province		
Postal Code		Country i	PE	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		P75029US1
		Application Number		
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE			
Inventor 6				Remove
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Elena	K.	Mendoza Carranza	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Lima	Country of Residence ¹	PE	
Mailing Address of Inventor:				
Address 1		Guillermo Dansey 1846,		
Address 2		Cercado de Lima		
City	Lima	State/Province		
Postal Code		Country ¹	PE	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add				

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ An Address is being provided for the correspondence information of this application.

Customer Number	00136		
Email Address	patent@jhip.com	Add Email	Remove Email

Application Information:

Title of the Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		
Attorney Docket Number	P75029US1	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	9	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US1
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	00136		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Remove		
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation in part of	14625952	2015-02-19
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US1
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)¹ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ¹	Filing Date (YYYY-MM-DD)	Access Code ¹ (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

☐ NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US1
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant must opt-out of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby grants the USPTO authority to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US1
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

☒ Assignee
 ☐ Legal Representative under 35 U.S.C. 117
 ☐ Joint Inventor

☐ Person to whom the inventor is obligated to assign.
 ☐ Person who shows sufficient proprietary interest

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name AGP America S.A.

Mailing Address Information For Applicant:

Address 1		Calle 15 #35-59	
Address 2			
City	Bogota	State/Province	
Country	CO	Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US1
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name AGP America S.A.

Mailing Address Information For Assignee Including Non-Applicant Assignee:

Address 1 Calle 15 #35-59

Address 2

City Bogota

State/Province

Country CO

Postal Code

Phone Number

Fax Number

Email Address

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet must be signed by a patent practitioner if one or more of the applicants is a juristic entity (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, all joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of all joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/John C. Holman/ 		Date (YYYY-MM-DD)	2016-12-29	
First Name	John C.	Last Name	Holman	Registration Number	22,769

Additional Signature may be generated within this form by selecting the Add button.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US1
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

TITLE OF THE INVENTION:**OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE
LAMINATE****BRIEF SUMMARY OF THE INVENTION**

The presently disclosed invention is directed to a laminated automotive glazing having an obscuration that has superior optical quality and strength as well as the method used to create said glazing.

BACKGROUND OF THE INVENTION

Black enamel frit obscurations are commonly printed on laminated and tempered automotive safety glazing.

Obscurations have multiple functional and aesthetic requirements.

The obscuration must be substantially opaque. This is needed to prevent the adhesive, used to mount the glazing to the vehicle, from being seen from the outside of the vehicle. It must also protect the adhesive from the harmful effects of ultra-violet. The obscuration also serves this same function for the equipment attached to the inside surface of the glazing. On heated and coated glazing, the obscuration is used to hide the edge of the coating, bus bars, leads and any other items that would detract from the appearance of the vehicle. The obscuration also has the additional aesthetic requirement that it have a dark black color and a reflective glossy appearance.

In addition to hiding the adhesive, equipment mounted to the glazing and other items the obscuration must be durable. It must last for the life of the glazing, without fading, having a

reduction in adhesion or otherwise failing. Another important functional requirement is that the obscuration must protect the adhesives from the ultraviolet rays of the sun.

The obscurations are usually printed on the surface **24** of glass facing the inside of the vehicle.

In addition to the obscurations, markings required for regulatory compliance (date, manufacturer, compliance classification, model, etc.) and images, such as trademarks, barcodes etc., are also printed on the glass.

Obscurations have historically been black. One of the reasons for this comes from the limitations imposed by ceramic frits. It is difficult to produce frits, in colors other than black, that have the durability needed and for which the color can be reliably replicated from run to run. The other reason is that a black obscuration can be used with any color of paint.

The practice of applying black enamel frit obscurations became common place the 1980s when the industry switched from the rubber H channel and the butyl adhesive strip windshield mounting systems to polyurethane adhesive mounting of safety glazing. This change was made in response to the poor safety performance of the prior technology. The channel/butyl mounted windshields were often dislodged on impact allowing the occupants to be ejected from the vehicle. To improve occupant retention in crashes, the industry switched to polyurethane adhesive mounting. Today, on new vehicles, butyl is no longer used and the rubber H channel mount is only seen on commercial and off-road vehicles.

One advantage of the butyl strip system was that the strip was narrow enough to be covered by a molding or trim strip to obscure the butyl and the vehicle mounting flange. The rubber channel also did not require an edge obscuration as the rubber covered both the edge of glass and the flange.

This had to change to enable the use of polyurethane. To obtain the required bond strength, between the vehicle and the glass, it was found that the bead of polyurethane had to be substantially wider than the butyl strip had been. With a minimum width of 19mm, it was no longer practical to obscure the adhesive from view from the outside with a trim strip or molding due to the width that would have been required. In addition, polyurethane needs to be protected from ultra-violet light, UV, to prevent degradation. As a result, the black enamel frit obscuration band was added to the glass, to obscure the view of the polyurethane and to protect the polyurethane by blocking the UV. This obscuration band of black enamel frit that encircles the day light opening is commonly called the “black band”.

While there can be no doubt that the polyurethane system has saved countless lives, it has some disadvantages.

Black enamel frit is comprised of pigments, a carrier, binders and finely ground glass. Other materials are also sometimes added to enhance certain properties: the firing temperate, anti-stick, chemical resistance, etc. The black frit is applied to the glass using a silk screen or ink jet printing process prior to heating and bending. During the bending process, the finely ground glass in the frit soften and fuses with the glass surface. The frit is said to be “fired” when this takes place. This is very similar to the process used to apply enamel finishes on bathroom fixtures, pottery, china and appliances.

Metals and many other types of materials have an ultimate yield strength at which point the material will fail. However, with glass we can only specify a probability of breakage for a given value of stress. Looking at glass at the molecular level, we would expect the strength to be very high. In fact, what we find in practice is that glass has a very high compressive strength, as expected, but very low tensile strength.

For a given set of glass test specimens, with identical loading, the point of failure at first glance might appear to be a random variable. In fact, the yield point follows a Weibull distribution

and the probability of breakage can be calculated as a function of, stress, duration, surface area, surface defects and the modulus of glass.

To the naked eye, float glass appears to be near perfect. Any defects that may be present as so small as to not be visible. But, in fact, at the microscopic level, the surface appears rough and can be seen to be dotted with flaws. When the glass is placed in tension, these surface defects tend to open up and expand, eventually leading to failure. Therefore, laminated automotive glass almost always fails in tension. Even when not in tension, the surface defects react with the moisture in the environment and slowly “grow” over time. This phenomenon is known as slow crack growth. As a result, glass weakens as it ages.

A fired black frit increases surface defects. This can be seen if the black pigment of a fired black obscuration is chemically dissolved. The surface of glass will have a frosted appearance, similar to sand blasted or chemically etched glass. The frosted appearance is due to the myriad surface defects present from the fused glass. This makes the surface weaker increasing the probability of breakage. Testing has shown that glass with black frit fails at a stress level that is substantially lower than glass that does not have black frit.

Another problem arises from the thermal gradients that occur during the bending process. As one would expect, the black frit absorbs more radiant heat than the clear glass. Radiant heat is the predominant heat source used for glass bending. The black frit areas of the glass run hotter than the adjacent clear areas. With glass being a poor conductor of heat, gradients in the tens of degrees centigrade can arise over a short distance. These high abrupt thermal gradient on the surface result in optical distortion and high residual along the inner edge of the black band. This is known as the “burn” line in the industry. This can often be seen along the edges of the black obscuration found along the edges of most windshields.

Obscurations used with glass mounted camera systems are forced to designate a “buffer” zone **15** between the edge of the camera field of view **16** and the edge of the black frit **8** (Figure 9A)

to exclude the burn line. This is an accommodation required due to the limitations of the black frit. The ideal would be to have no buffer zone **15** as the larger obscuration reduces the driver field of view and the natural light entering the vehicle (Figure 9B).

One method used to address the burn line problem is the dot fadeout. Starting at the inner solid edge of the black paint, rows of increasingly smaller dots are painted on the glass. This is the same principle as used in greyscale printing. This reduces the rate of change in the surface temperature, spreading it over a wider area. The dot fadeout also helps to hide the distortion. However, on some parts, even a wide dot fadeout is not sufficient to eliminate all distortion. A wide dot fadeout also may not be possible depending upon the size of the opening and the regulatory requirements for driver vision. Dot fadeout patterns are also undesirable in that they increase the production cost of the glazing.

Another problem is surface mismatch. A laminate is comprised of at least two layers of glass. The frit is typically applied to only one of the glass layers. This can result in a slight difference in the shape of the surfaces. When the two surfaces are forced together during lamination, the mismatch results in residual stress in the laminate and optical distortion.

Even with these drawbacks, the area of the windshield with a black frit obscuration has increased in recent years. There are a number of reasons why this is occurring.

To improve aerodynamics and lower wind noise, the wiper rest position on many vehicles is located out of sight below the hood line. When this is done, the bottom edge of the windshield is extended to form a “wiper rest” **31** so as to provide a resting surface for the wipers when not in use as shown in **Figures 1, 2 and 3**. This area is typically obscured with a black enamel frit **31** extending downward and connecting to the black band. The width of this area can be in excess of 15cm. This area is also normally heated, to prevent snow and ice from building up, using a screen print conductive silver on the number four **24** surface of the glass. The power density required to keep this area free of ice and snow is double that of a rear window defroster due to

the snow and ice that is packed in from the wiper action. The wide wiper rest frit obscuration, with drawbacks intrinsic to frit, coupled with the thermal stress of melting snow and ice, leads to a high breakage rate for these windshields.

As the electronic content of modern vehicles has increased, the area of the windshield, near the top center, has become increasingly crowded on many vehicles. Once the province of just the rear-view mirror, we now find a wide array of equipment mounted in this location.

One of the first devices to compete for this area was the infra-red rain sensor use to provide for a full automatic mode of windshield wiper operation as well as other vehicle functions such as closing the sun roof and pulsing the brakes to keep the rotors dry. The rain sensor must have a lens optically coupled to the number four **24** surface of the windshield. An IR LED shines light onto the number one **21** surface. The amount of light reflected back correlates to the amount of water present on the number one **21** surface. The field of view of the lens must be in the area cleared by the wipers in order to function properly. Therefore, the lens is generally mounted on or near the vertical centerline near the top of the wiped area. Power and signal wiring is required for the sensor to work. In addition to the lens **10**, the sensor comprises a housing **12** and a cover **14** all of which need to be hidden from view from the outside of the vehicle to avoid an unsightly clutter appearance.

The rear view mirror itself has undergone a major transformation. Once a purely mechanical device, electro-chromic automatic dimming rear-view mirrors have become a popular option and are standard equipment on many models. The additional components required to provide this functionality make the mirror heavier and therefore require a larger footprint mounting bracket than a standard non-dimming mirror.

The rear-view mirror has further evolved as telematics driver aid systems, integrated garage door openers and hands free blue-tooth interfaces have been introduced. The rear view mirror

is a convenient place to locate control push-buttons and microphones which require additional wires which also must be protected and covered. Power also needs to be provided to the mirror. A cover is often provided to protect the cable and to hide it from the inside of the vehicle.

The use of cameras, requiring a wide field of view and a high level of optical clarity, is also growing at a rapid rate with the introduction of vehicles capable of various levels of autonomous operation. The resolution of the cameras is also increasing at an equally fast rate. These typically must be mounted on the windshield in the wiper area. Early initial applications were for night-vision. Today, camera based systems are used to provide a wide array of safety functions including adaptive cruise control, obstacle detection, lane departure warning and support for autonomous operation. Many of these applications require the use of multiple cameras. A clear undistorted field of view, with minimal double imaging and excellent MTF (Modulation Transfer Function, a measure of how well a lens maps an image to a sensor), is especially critical for camera based systems to perform as intended. It is essential for these systems to be able to quickly differentiate between objects, capture text, identify signage, and operate with minimal lighting. Further, as the resolution of the cameras used increases the need for a clear distortion free field of view increases.

While covers **14** and various styling methods can be used to obscure the components and cables from the inside, we also need to maintain clean lines and a good aesthetic when the vehicle is viewed from the exterior.

Standard practice has been to extend the black enamel frit band **32** to create an obscuration **8** on the number four **24** surface with openings in the obscuration **30** to provide for the required field of view as shown in **Figures 1, 2 & 3**.

When the black enamel frit band **32** is extended downward from the top center black band to create an obscuration **8** on the number two **22** or number four surface **24**, distortion and stress

can become a major problem **Figure 1**. This is because the black frit is extending further from the edge into the area that where more heat must be applied to bend the glass. The large surface area of the obscuration increases the probability of breakage due to the surface defects and stress introduced by the frit. This is also a critical viewing area.

A panoramic windshield is a windshield in which the top edge of glass has been extended to include at least a portion of the roof giving the driver a vertical field of vision of at least 45 degrees as defined by the applicable regulatory standards.

In the case of a panoramic windshield **Figure 3**, the problem is even more pronounced as the obscuration **8** extends several cm from the top edge and is located near the weakest point of the windshield. This is also where the highest temperatures are required to bend the glass.

The process for printing on laminate interlayers was first commercialized in 2003. Some of the key patents include: US 8002938 B2, US 7232213 B2 and US 7278730. To date, the primary application has been for architectural laminates, providing a means to produce images and marking, in vivid colors at a resolution that was never before possible. However, little has been done in the automotive market. DE201110004500 teaches the use of a printed plastic layer for use in an automotive laminate for reducing weight and providing artistic freedom to the designer. US 20080286542 provides for an acoustic laminate with an image printed on film and adhered to the interlayer through use of an adhesion promoter.

One of the reasons why we have not seen the adaptation of printed interlayers in automotive is that the printed interlayers do not meet the functional requirements of an obscuration. A screen print enamel frit provides a high degree of protection from UV which is needed to protect the polyurethane used to bond the glazing to the vehicle opening. Inks printed on the interlayer do not have the same level of opacity and UV blocking ability that the black enamel frits do. They also do not provide the deep black glossy appearance of a fired black frit. This failure is due to the limited types of ink that are available for printing on interlayers.

One of the primary functions of the interlayer is to serve as the adhesive to hold the sheets of glass together. In the event of an accident, the interlayer holds the shards of glass together and helps to prevent the occupant from being ejected. In the event of an impact from the exterior of the vehicle, the interlayer helps to prevent the projectile from penetrating and entering the cabin. Penetration resistance is a key requirement for regulatory compliance. Any ink applied to the interlayer, must not interfere with this essential safety function. The interlayer must be able to bond to the glass **through** the print. Adhesion promoters are often needed even with the best ink formulations. This requirement severely limits the type of inks that can be used.

Interlayer sheets do not lend themselves well to the automated feed systems of typical printing equipment. The various materials used to produce interlayer sheets are all thermo plastics with glass transition points in the room temperature range or lower. As such, the sheets are limp and difficult to work with. The surface of interlayers for lamination also need to be embossed to facilitate handling and the lamination process. It is difficult to print on an embossed surface.

Summary of the invention

Having examined the drawback of using a black enamel frit to produce an obscuration, it can be appreciated that it would be desirable to produce a windshield that did not have the limitations that result from producing black enamel frit obscurations on glass.

The subject of the immediate invention is a laminated automotive glazing with a least one obscuration produced by printing the obscuration directly onto at least one surface of at least one sheet of a plastic film.

The film with the printed obscuration is then laminated between at least two of sheets of a thermoplastic interlayer 4 such as a PVB, EVA or PU. Alternately, a laminating resin can be

used. Other markings and images can also be printed on the sheet **17**. A wedge interlayer can be used to further improve double image.

The unaltered original surface of the interlayer is able to bond to the glass and retains its original adhesion to the glass. The addition of the film **17** increases the penetration resistance of the laminate. As a result, the printed area of the sheet does not need to have as high of a level of adhesion to the interlayer as the interlayer needs to have to the glass. The interlayer does not have to maintain adhesion through the print and adhesion promoters are not needed for the film. The primary requirement is that the ink have good adhesion to the film and to the interlayer. This opens the possibility to use a wider range of inks than possible than with inks that need to be printed directly onto an interlayer.

Laminates made in this manner are stronger and have superior optical quality, especially in the areas of the laminate used by cameras.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a typical automotive windshield with a black band obscuration **32**, a wiper rest obscuration **31** and an equipment obscuration **34** extending downward from the black band obscuration, having openings **30** to provide a forward field of view for two cameras.

Figure 2 shows an automotive windshield with a black band **32**, a wiper rest obscuration **31** and an obscuration **34** separated from the black band, having openings **30** to provide a forward field of view for two cameras.⁸

Figure 3 shows a panoramic automotive windshield with a black band **32**, , a wiper rest obscuration **31** and an obscuration **34** separated from the black band, having openings **30** to provide a forward field of view for two cameras.

Figure 4 shows the obscuration 8 of the prior art, a black enamel frit applied to the fourth surface 24.

Figure 5 shows the obscuration 8 printed on the film 17 facing the third surface 23.

Figure 6 shows the obscuration 8 printed on both side of the film 17.

Figure 7 shows the obscuration 8 printed on a sheet of performance plastic laminated between two sheets of plastic interlayer 4 having an obscuration 8 printed on at least one side.

Figure 8 consists of:

Figure 8A shows a laminate with interlayers of uniform thickness

Figure 8B shows a laminate with one interlayer sheet of uniform thickness and one with a wedge angle greater than zero.

Figure 8C shows a laminate with two interlayer sheets having a wedge angle greater than zero.

Figure 9 consists of:

Figure 9A shows the path of light through a laminate with interlayers of uniform thickness.

Figure 9B shows the path of light through a laminate with interlayers having a wedge angle greater than zero.

Reference Numerals

3 Wedge Plastic Interlayer

4 Plastic Interlayer

5 Glass
6 Sunshade
8 Obscuration
10 Equipment Mounted To Glass
11 Adhesive
12 Device Housing
14 Cover
15 Buffer
16 Field of view
17 Film
21 First Surface of Glass
22 Second Surface of Glass
23 Third Surface of Glass
24 Fourth Surface of Glass
30 Openings in Equipment Obscuration
31 Wiper Rest Obscuration
32 Black Band Obscuration
34 Equipment Obscuration
40 Double image Angle
41 Observation point
42 Incident ray from image
43 Primary image
44 Secondary image
45 Wedge angle
46 Incident angle
48 Refracted ray
50 Surface normal
52 Angle of deviation
56 Inclination angle

DETAILED DESCRIPTION OF THE INVENTION

The invention eliminates the drawbacks associated with the black frit obscurations of the prior art by printing at least some of the obscurations on a plastic film layer which is then laminated as an integral part of the glazing. This allows for a more uniform heat distribution across the part during bending which reduces residual stresses and the associated surface mismatch, warping and distortion caused by the thermal gradients.

Film, as used in this document shall refer to single ply/layer compositions as well as films comprised of multiple layers. A common plastic used in such films is PET (polyethylene terephthalate) but as can be appreciated can be of any other composition found to be suitable can be used. Some examples include but are not limited to: metal based heat reflecting films, non-metal based heat reflecting films, tint films, and heat absorbing films, Suspended Particle Device (SPD) films, Polymer Dispersed Liquid Crystal (PDLC) films, conductive coated films, and ordinary PET.

There are many PET based automotive film products in production providing a ready base of field proven performance films that can be used as the film of the invention. One of the most common and oldest has a heat reflecting coating for enhancing solar load control. Others include but are not limited to: films used to improve occupant retention, stiffen the laminate and provide for variable control of visible light transmission. To laminate these films **17**, two layers of interlayer **4** are needed to achieve the required adhesion to the glass and to the film. An obscuration **16** can be printed on either or both sides of the film.

The obscurations of the immediate invention are not limited to inkjet printing as is the prior art. The obscurations can be printed using inkjet, screen print, pad print or any other conventional printing means. The obscurations can be printed on either or both sides of the film.

The unaltered original surface of the interlayer is able to bond to the glass and retains its adhesion to the glass. The addition of the film **17** increases the penetration resistance of the laminate. As a result, the printed area of the sheet does not need to have as high of a level of adhesion to the interlayer as the interlayer needs to have to the glass. This opens the possibility of uses a wider range of inks than possible than with inks that need to be printed directly onto an interlayer.

During development, five printing technologies were evaluated and more than sixteen inks were tested. The criteria for the inks was based upon appearance (opacity and color), adhesion of ink to the PET, adhesion of ink to the interlayers and durability. The objective was to find a black color ink with high opacity, having good adhesion to PET and interlayers and durability.

A variety of different inks were tested using screen-printing. Solvent inks and UV inks for screen-printing process were evaluated. Both, UV and solvent inks had good durability results. Both inks also presented good adhesion results on PET penetrating into the substrate and creating a permanent bond. The UV ink was selected for prototype production due to the fast cure time, no need to add a catalyst and low volatile content. The UV ink is also ready to use with no need to add any catalyst and is instantly hardened by intense UV light polymerization (curing). The high reactivity of the ink delivered good curing results. UV ink properties give flexibility to work on large and small format printing.

Some modifications to the ink were required. The ink modifications included tuning the UV frequency response and removing silicon from the formulation. It was found that the silicon lead to delamination in the areas near the glass edge. Broad band UV was found to cause warping or modulus of the substrate due to over saturation of energy. Restricting the overall bandwidth to a specific wavelength enhanced the ability to cure the ink using less overall energy. The obscuration produced has a dark black color and a shiny gloss comparable to black

frit. The printed sheets are then cut to size and assembled into the laminate. For large scale production, roll to roll printing could be used.

Protection of the polyurethane adhesive from UV is achieved thorough the opacity of the ink in combination with the use of a UV blocking interlayer. Such UV blocking interlayers are well known in the art and have been in common use for many years.

To aid in the alignment of the printed sheet **17** when assembling the laminate, registration marks can be printed on the sheet **17**.

Another benefit of the process is the ability to fine tune the optical properties and appearance of the laminate. A near limitless range of colors can be produced. Properties in the non-visible portion of the spectrum can also be enhanced. Some performance films are sensitive and degrade over time, with exposure to the near UV. Additives that absorb or reflect the specific wavelengths of interest can be added to the ink to achieve targeted optical properties.

If a combination of frit and ink are used for the black band **32** and the equipment obscuration **34**, any difference in the appearance between the two may be noticeable. In that case, separating the equipment obscuration **34** from the black band, as shown in Figure 2, will improve the aesthetic. The transition line between the black band **32** and the wiper rest **31** will not generally be visible.

In the obscuration areas where the invention is applied, all of the detrimental effects of the black enamel frit on the glass are eliminated resulting in superior optical quality, lower stress, and a lower probability of breakage.

In addition to the benefits to the finished laminate, the elimination of the non-uniform heating and high thermal gradient present in the black frit areas increases yields through the bending

process and also, due to the higher strength and lower surface mismatch, increases yields through the lamination process.

Distortion in windshields is measured in terms of refractive power. Refractive power is the change in the angular deviation along over distance. At a high enough level, it can result in noticable optical distortion. The refractive power is expressed in diopters.

$$D_{\varepsilon} = \frac{d\alpha_{\varepsilon}}{dx} \frac{1}{\cos \varepsilon} \quad (1)$$

Where:

ε : angle formed between the ray of light **42** and a line perpendicular to the surface of the glazing **50**

α_{ε} : angular deviation

D_{ε} : refractive power

Most large windshield production lines utilize online automated inspection system which scan the glass and produce a contour map showing the optical distortion in diopters.

Laminates produced by this invention have significantly lower distortion in the areas near the obscurations as compared to the same and similar laminates produced with screen print black frit.

Double image, another problem of the prior art, is illustrated in Figures 8A and 8B.

A ray of light **42** enters the surface of the glass at an incident angle **46** and passes through the glazing to the observer **41**. The light bends (refracts) as it passes through the glazing. The angle by which the light bends is known as the angular deviation **52**. This refraction of the light causes a shifting of the apparent position **43** of the object observed

Some of the light from the ray **42** entering the glass is reflected back from the inside surface **24** and exits the glazing. A portion of the reflected light is again reflected back from outside surface **21** resulting in a double image. The separation angle **40** is the angle between the primary **43** and secondary image **44** and the observer **41**. If the primary and secondary images are coincident, then the separation angle is zero. Regulatory requirements limit the separation angle to 15 minutes of arc for vision zone A (as defined by United Nations Regulation 42, revision 3) and 25 minutes of arc for vision zone B. However, it is well known that the maximum amount of double imaging imperceptible for the human eye is 7 minutes of arc.

The double image angle, η **40**, is calculated as shown in equation 2. It increases with decreasing angle of inclination **56**, increasing curvature of the glass surface **24** and with increasing size of the glazing. The double image angle, η **40**, can be reduced by altering the angle between the plies of glass as shown in Figure 8b. Normally, the glass surfaces are substantially parallel to each other. By creating an angle **45** between the surfaces, the primary and secondary images can be shifted towards convergence.

$$\eta = \frac{2t \sin(\varepsilon)}{R \sqrt{n^2 - \sin(\varepsilon)^2}} \quad (2)$$

where:

η : double image angle

t: thickness of the glazing

n: refractive index

R: radius of curvature

The angle between the plies of glass is adjusted through the use of an interlayer that has a non-uniform thickness, typically tapering from a thickness greater than the standard 0.76 mm at or near the top of the glazing a lesser thickness at the bottom. Such interlayers are produced

through extrusion of the plastic. Such interlayers are known as “wedge” interlayers. They can also be formed, to a lesser extent by shaping (stretching) of the interlayer. Shaping is typically done to create a curved sunshade 6. Table 1 shows the wedge angle and reduction in thickness for a standard 0.76 mm thick interlayer over 1 meter as a function of sunshade radius.

Note that wedge interlayer can be shaped to increase the wedge angle. Any combination of wedge and shaped interlayer can be used to obtain the desired results.

Figures 7A, 7B and 7C show: a laminate with two standard interlayers, a laminate with one wedge interlayer and a laminate with two wedge interlayers.

Wedge interlayer can be used with a printed obscuration to further reduce double vision.

Sunshade Radius	Interlayer Thickness	Wedge Angle
m	mm	mrاد
2.0000	0.5067	0.253
2.5000	0.5429	0.217
3.0000	0.5700	0.190
3.5000	0.5911	0.169
4.0000	0.6080	0.152
4.5000	0.6218	0.138
5.0000	0.6333	0.127
5.5000	0.6431	0.117
6.0000	0.6514	0.109
6.5000	0.6587	0.101
7.0000	0.6650	0.095
7.5000	0.6706	0.089
8.0000	0.6756	0.084

8.5000	0.6800	0.080
9.0000	0.6840	0.076
9.5000	0.6876	0.072
10.0000	0.6909	0.069

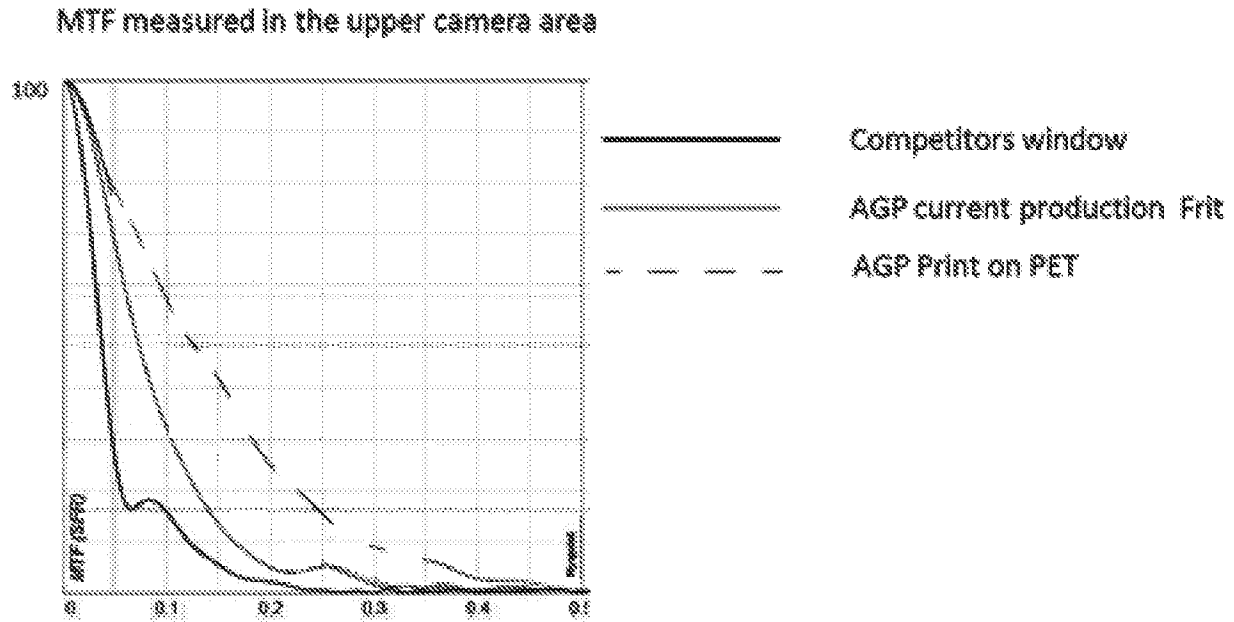
Table 1: Sunshade Radius vs. Wedge Angle

Enamel frit and printed ink can both be used on the same part and in any combination that is convenient. As an example, the obscurations could be printed on the sheet **17**, while the other markings and images can be made with a conventional black screen print. The markings and images do not have the same detrimental effect as the obscuration prints, due to their small size and function.

Experimental results have demonstrated the remarkable and unexpected magnitude of improvement of the invention and are shown in the following table (Table 2) and graphs. Fracture strength is more than doubled, MTF is drastically improved (see Graph 1), distortion is reduced by a factor of six and double image if reduced from 15" to 3". One should also note that all four of these parameters are critical to the operation of a safety camera.

Table 2

	Laminate with Black Frit	Laminate with Obscuration Printed on Film
Fracture Strength (ring-on-ring)	60 Mpa	115 Mpa
Distortion (Camera window - 5mm from the black edge)	150 milli diopters	25 milli diopters
Double image (Camera window - 5mm from the black edge)	15" (arc minute)	3" (arc minute)



Graph 1

As camera system for cars improve and cars now have advanced driving assisted systems the vehicles windshield becomes an important component of the complex lens system that makes up the vehicle vision system. For our interest here our windshield serves as a lens in front of the camera, comprising one component of a complex lens system. The best way to evaluate this system is by measuring the MTF.

Modulation Transfer Function or "MTF" is the most widely used scientific method of describing lens performance. The modulation transfer function is, a measure of the transfer of modulation (or contrast) from the subject to the image. In other words, it measures how faithfully a lens reproduces (or transfers) detail from the object to the image produced by a lens. When we graph MTF we chart against contrast dropping from 100 to 0 and Spatial frequency (Nyquist frequency). Spatial frequency is the ability to resolve over distance and as contrast drops this ability gets weaker. Plotting in this X&Y gives us the total systems contrast and its ability to faithfully reproduce into the distance. This is especially important in semi-autonomous or autonomous driving vehicles as the focus will be the horizon and all images in the focal plane will need to be detectable both in shape and in size.

Printing the obscuration has resulted in a remarkable improvement in system MTF as compared to the same production model with a normal frit obscuration.

Advantages

1. Best in class optics.
2. Frit induced surface defects are eliminated.
3. Residual stress caused by non-uniform heating of the frit is eliminated.
4. Residual stress caused surface mismatch due to the frit is eliminated.
5. Low distortion, comparable to ordinary clear glass.
6. Low double image, comparable to ordinary clear glass.
7. Lower probability of breakage.
8. Higher yield during bending due to elimination of non-uniform heating.
9. Higher yields during lamination due to higher strength, lower residual stress and less surface mismatch.

Embodiment 1

The windshield of Figure 1 comprising a black enamel frit band **32**, a black enamel frit wiper rest area **31** one wedge interlayer, and an equipment obscuration **8, 34** printed on one surface of the plastic sheet **17** (Figure 5).

Embodiment 2

The windshield of Figure 1 comprising a black enamel frit band **32**, a black enamel frit wiper rest area **31** and an equipment obscuration **8, 34** printed on both surfaces of the film **17** (Figure 6).

Embodiment 3

The windshield of Figure 1 comprising a wiper rest **31**, black band **32** and an equipment obscuration **8, 34** printed on one surface of the film **17** (Figure 5).

Embodiment 4

The windshield of Figure 1 comprising a wiper rest **31**, black band **32** and an equipment obscuration **8, 34** printed on both surfaces of the film **17** (Figure 6).

Embodiment 5

The windshield of Figure 1 comprising a film **17**, a wiper rest **31**, black band **32** and an equipment obscuration **8, 34** printed on one surface of the film (Figure 5).

Embodiment 6

The obscuration combinations of the previous embodiments, 1-5, further comprising an equipment obscuration separate from the black band and spaced from said black band by at least 3mm illustrated in Figure 2.

Embodiment 7

A panoramic windshield (Figure 3) with the equipment obscuration printing on one surface of the film **17** and an enamel frit wiper rest/black band.

Embodiment 8

A panoramic windshield (Figure 3) comprising and equipment obscuration printed on both surfaces of the film **17** (Figure 6).

CLAIMS

1. A laminate comprising: at least two glass layers; at least two plastic interlayers; at least one film layer; film layer, printed obscuration, the plastic interlayers positioned between each set of glass and film layers and serving to attached glass layers to film layers; and at least one obscuration produced by printing said obscuration onto a film layer.
2. The laminate of claim 1 further comprising a PET film layer.
3. The laminate of claim 1 further comprising at least one wedge interlayer.
4. The laminate of clam 1 further comprising a performance film plastic layer.
5. The laminate of claim 1 further comprising a color correction filter printed on the film layer.
6. The laminate of clam 1 further comprising an equipment obscuration separate from and spaced from the black band obscuration.
7. The laminate of claim 1 further comprising at least one obscuration screen printed on the film layer.
8. The laminate of claim 1 further comprising at least one obscuration printed with a UV cured ink.
9. A vehicle utilizing the laminate of claim 1.

ABSTRACT OF THE DISCLOSURE

The object of this invention is to provide a laminated automotive glazing having an obscuration area produced by printing the obscuration on a film laminated between at least two layers of plastic interlayers rather than printing and firing an enamel frit onto the glass. This results in a laminate having superior optical quality, higher strength and a lower probability of breakage as compared to a laminate with a black enamel frit obscuration.

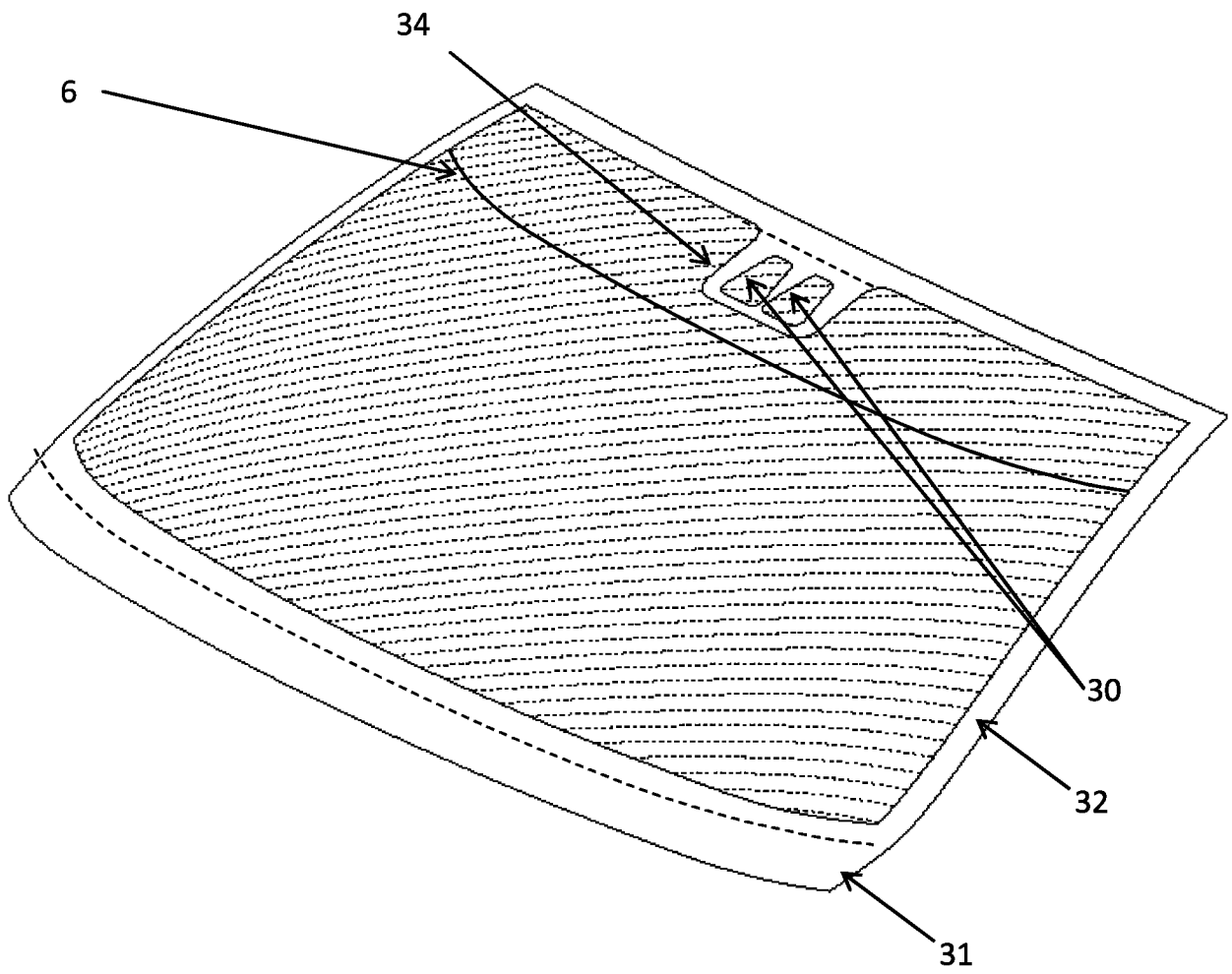


Fig. 1

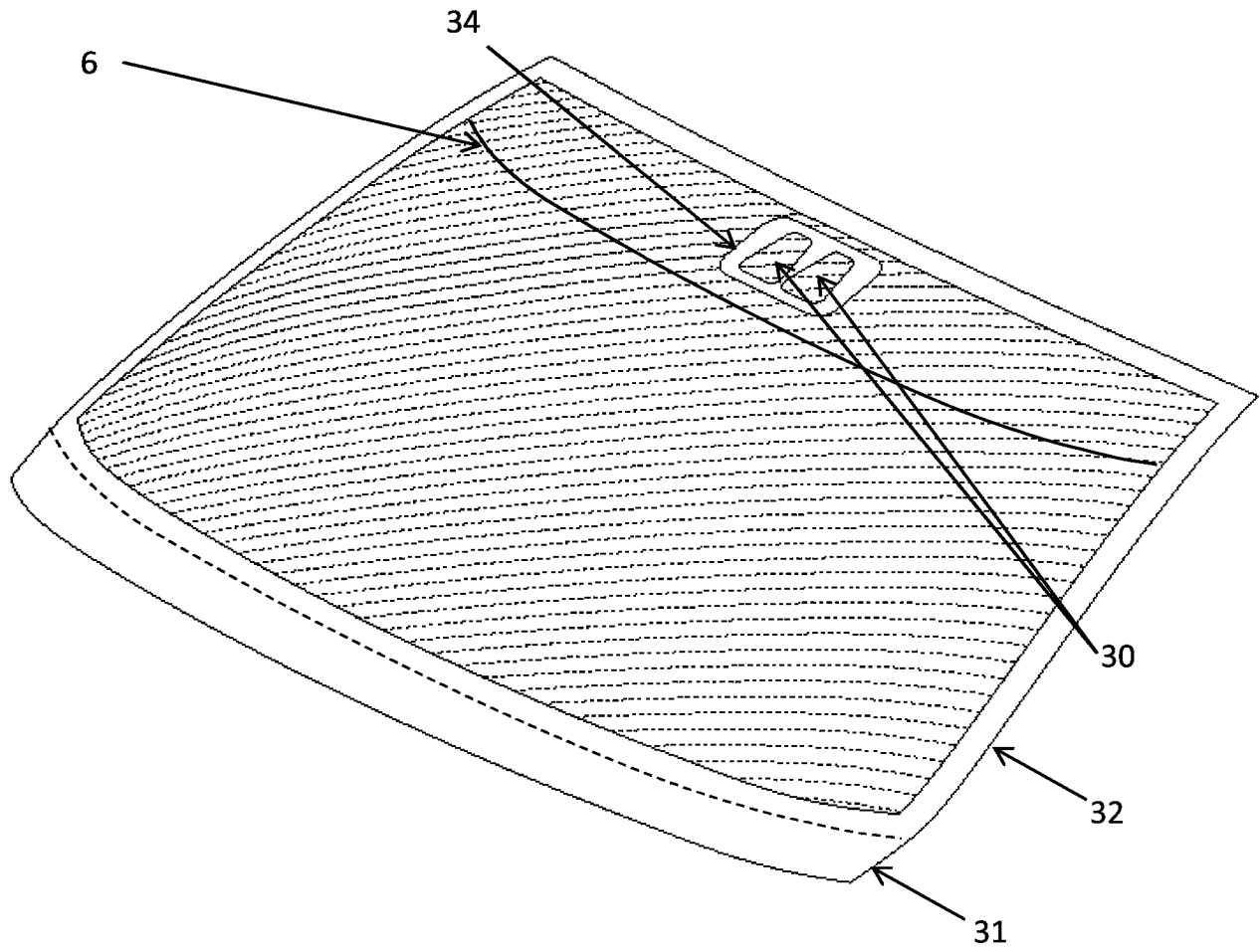


Fig. 2

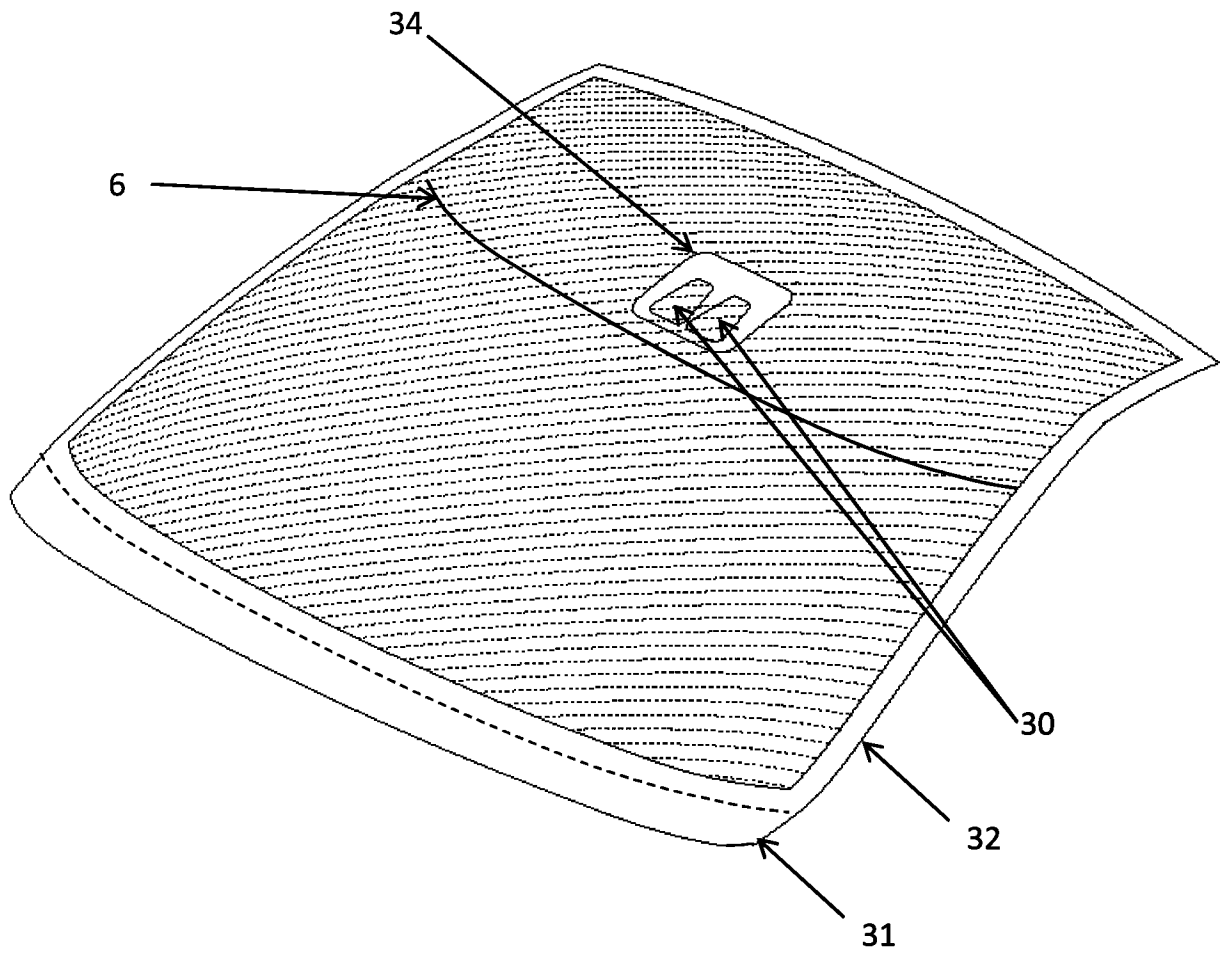


Fig. 3

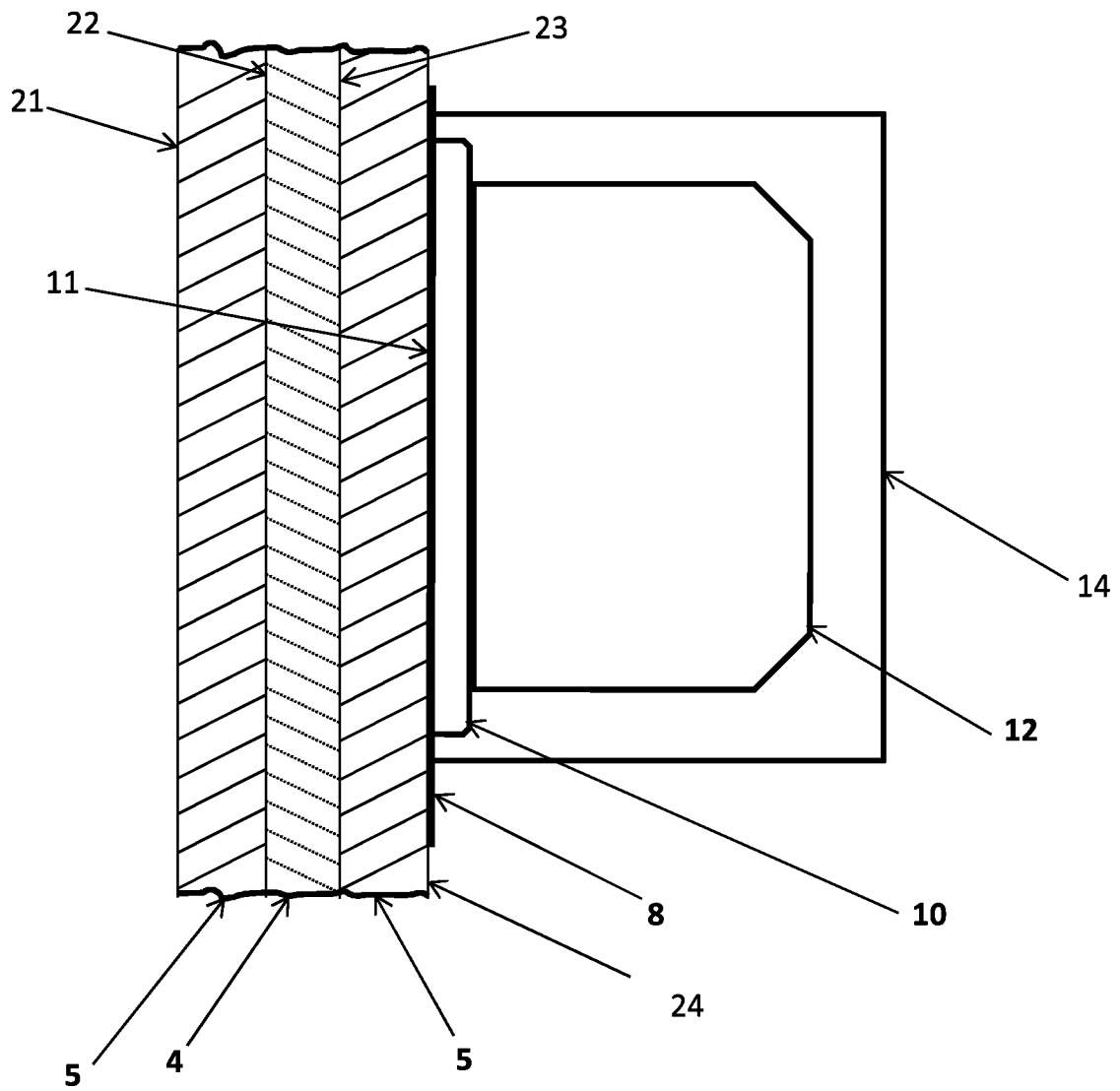


Fig. 4
(Prior Art)

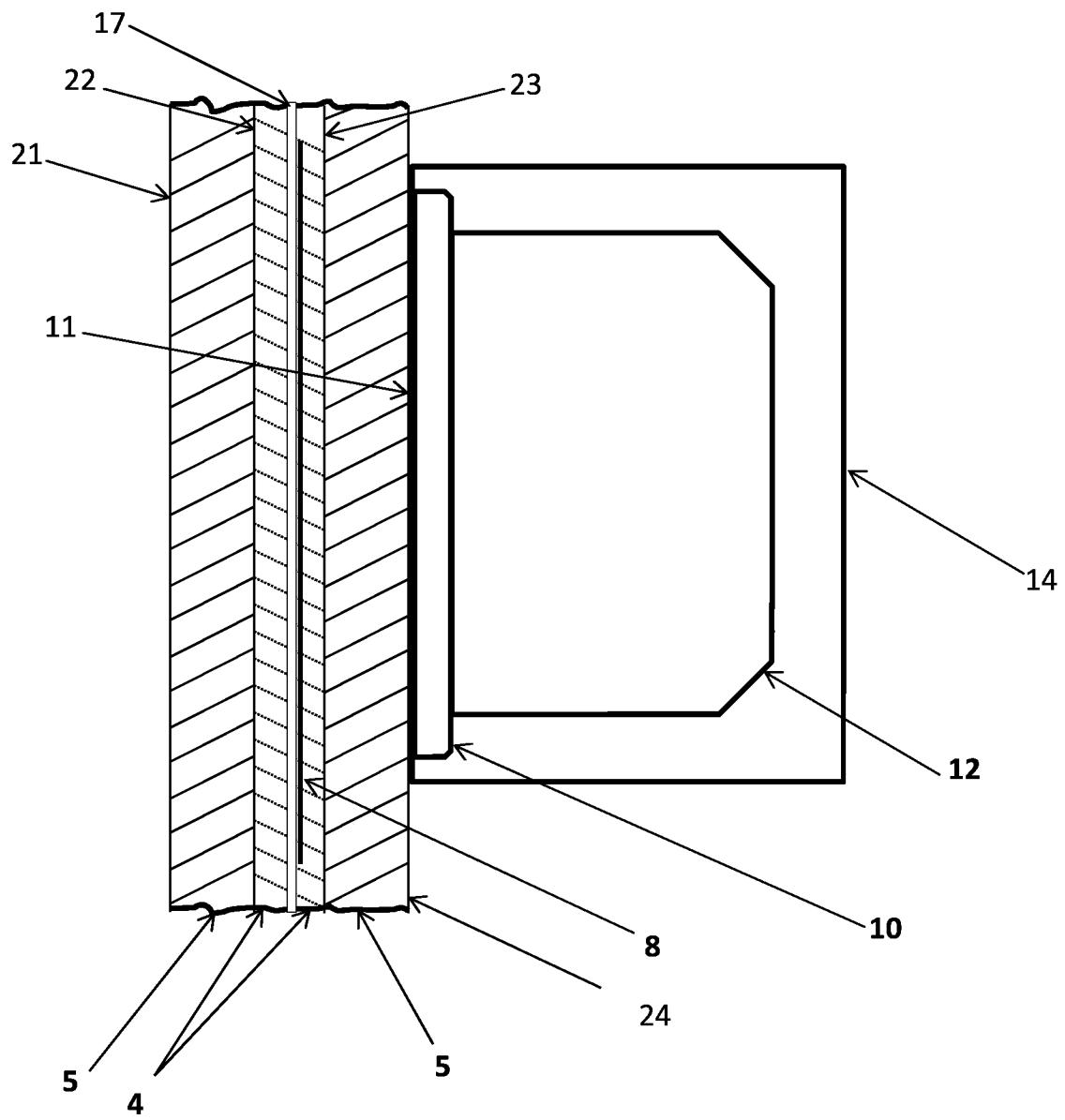


Fig. 5

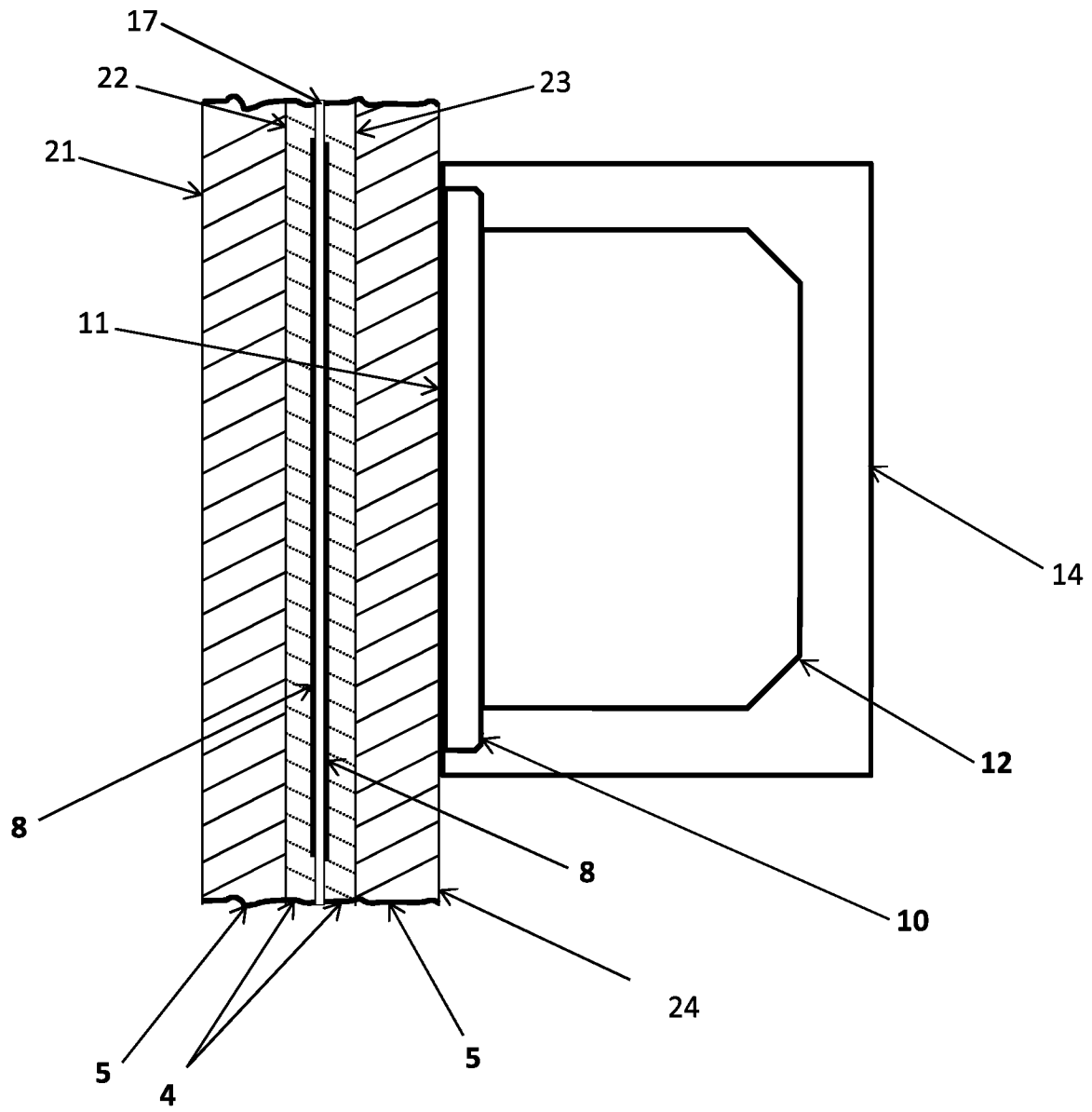
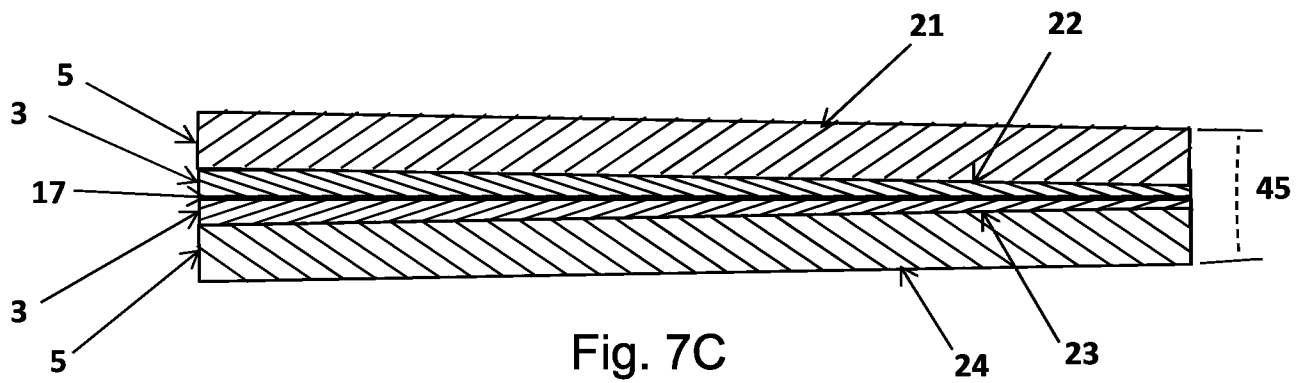
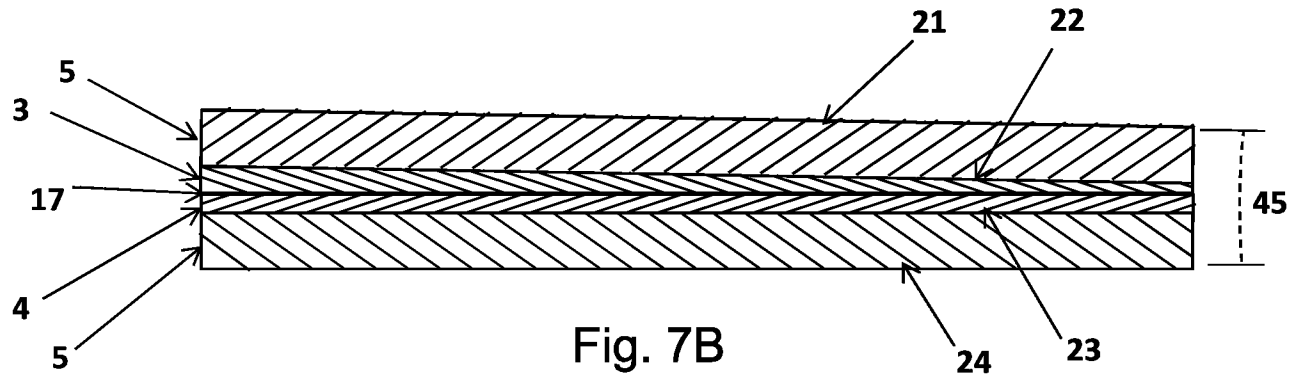
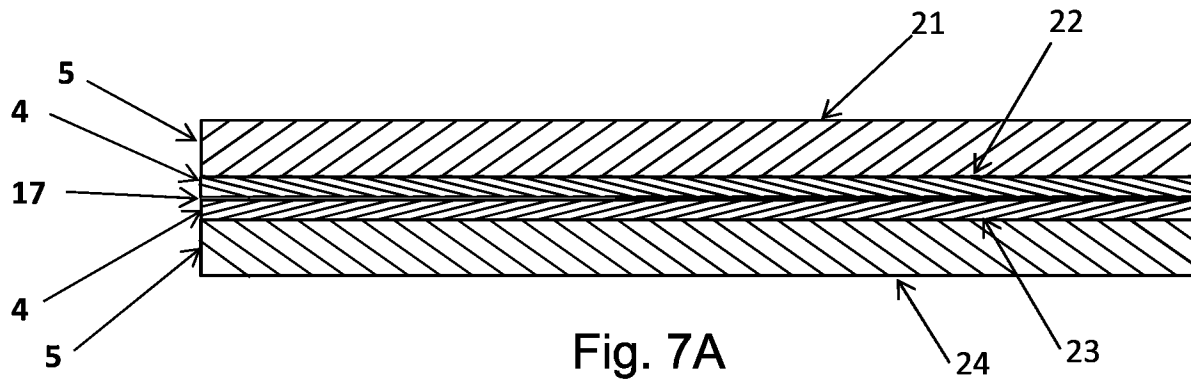
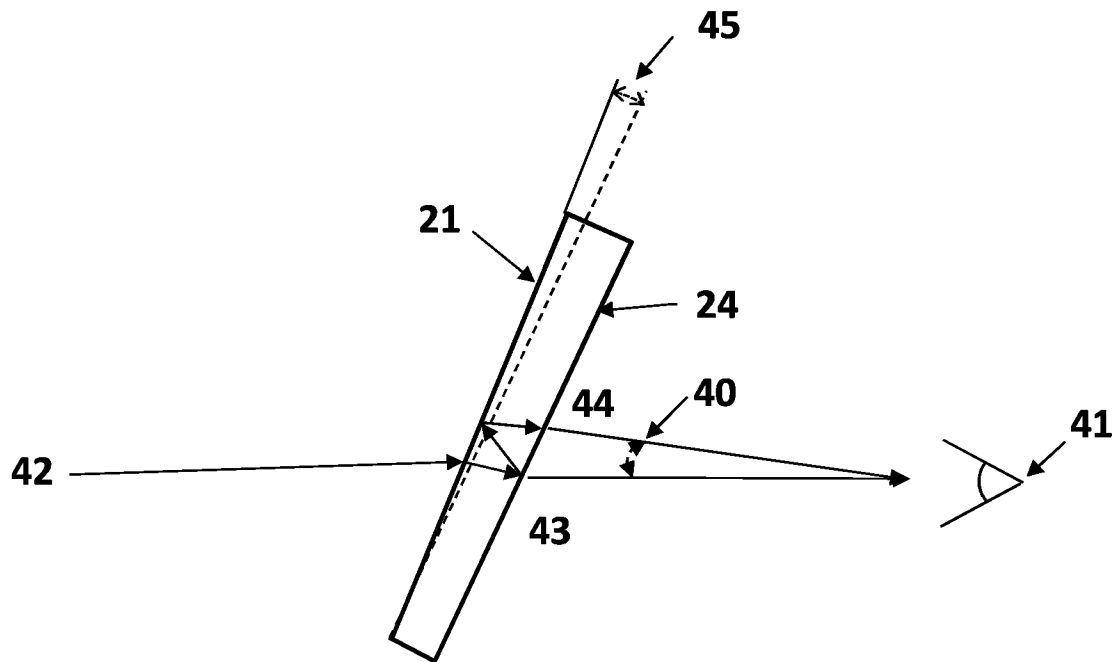
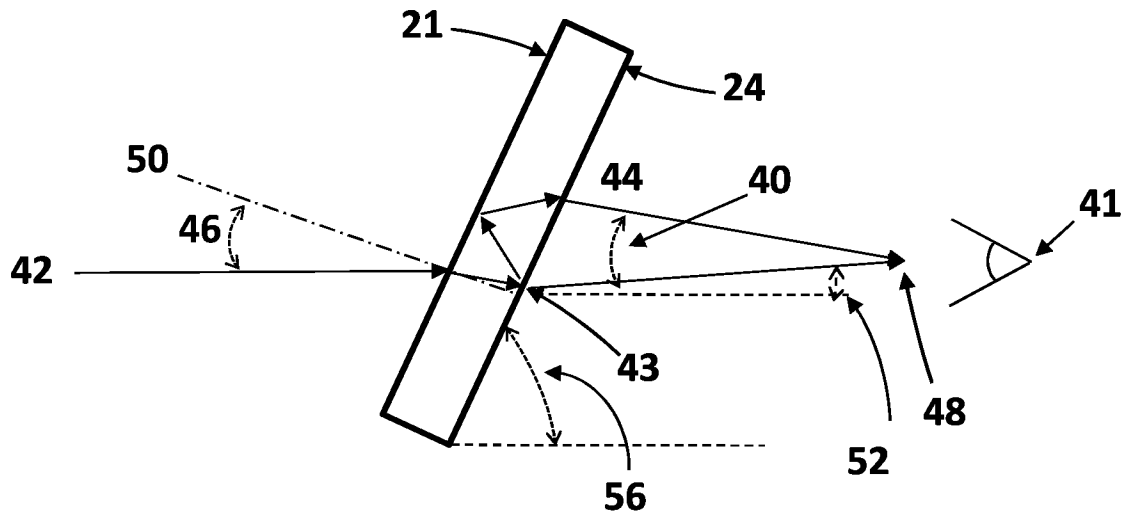


Fig. 6





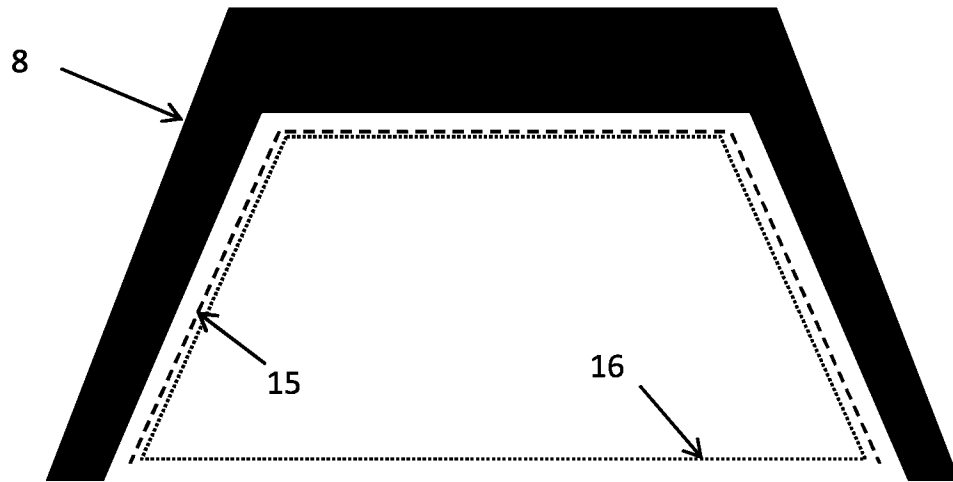


Fig. 9A

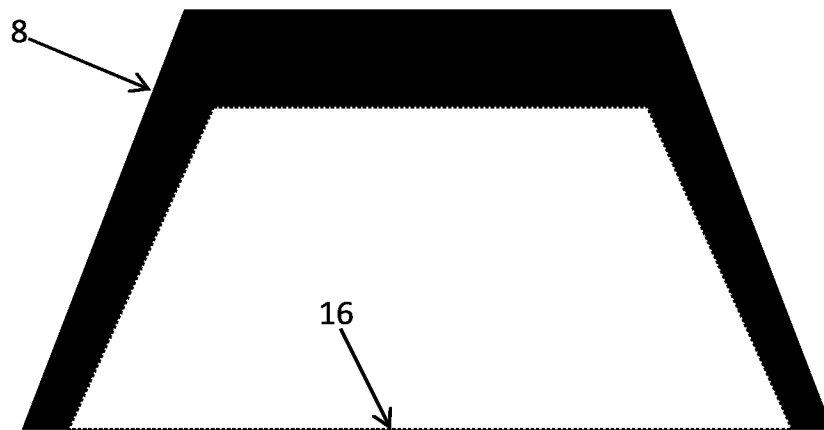


Fig. 9B

Electronic Acknowledgement Receipt

EFS ID:	27927175
Application Number:	15393584
International Application Number:	
Confirmation Number:	2915
Title of Invention:	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE
First Named Inventor/Applicant Name:	Arturo MANNHEIM ASTETE
Customer Number:	136
Filer:	John Clarke Holman/Jenna Brock
Filer Authorized By:	John Clarke Holman
Attorney Docket Number:	P75029US1
Receipt Date:	29-DEC-2016
Filing Date:	
Time Stamp:	12:54:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

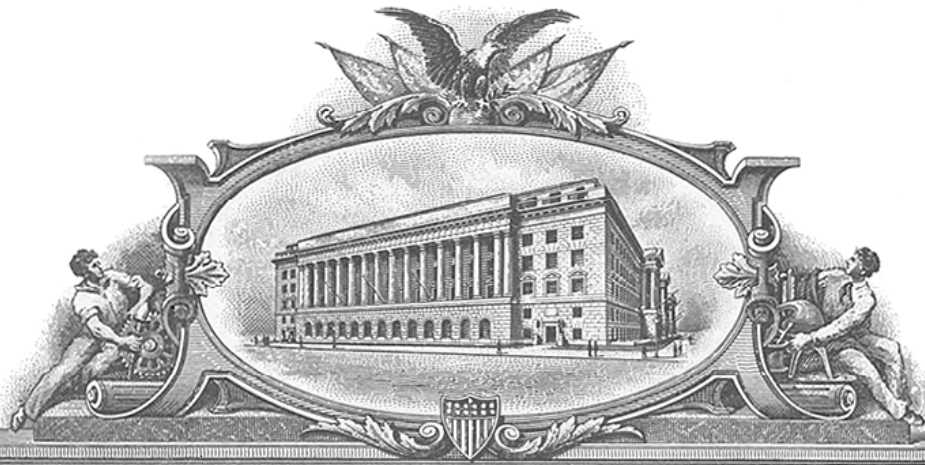
Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 1740
RAM confirmation Number	122916INTEFSW12555000
Deposit Account	
Authorized User	

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File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	P75029US1_CIP-Transmittal.pdf	101986	no	1
			724c3ef06fe89b14a059582054a1fe19f297f35e		
Warnings:					
Information:					
2	Miscellaneous Incoming Letter	P75029US1_Fee-Transmittal.pdf	104197	no	1
			64c678032d2dba3607110b0d3ff410ec3a681c7c		
Warnings:					
Information:					
3	Application Data Sheet	P75029US1_ADS.pdf	708784	no	9
			244186ef955340388bad1610e3bf21deb6760ae5		
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
4		P75029US1_SPEC.pdf	257717	yes	24
			df2e6a71ad65e1dfe392d4b258f17bceec643e81c		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	22	
	Claims		23	23	
	Abstract		24	24	
Warnings:					
Information:					

5	Drawings-only black and white line drawings	P75029US1_Drawings.pdf	2804791	no	9
			a279e06b8e2604c45c615007b51e91613308ac16		
Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	P75029US1_IDS.pdf	136888	no	3
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Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
7	Fee Worksheet (SB06)	fee-info.pdf	37019	no	2
			697ce1a2fdcd3638a8d171bdb57424ca7d3f5b62		
Warnings:					
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Total Files Size (in bytes):			4151382		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> 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. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

7655503



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UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

November 01, 2017

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 15/498,852
FILING DATE: *April 27, 2017*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS US15/498,852



Certified by

Nichelle K. Lee

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. **P75029US2**

First Named Inventor **A. MANNHEIM ASTETE**

Title **OBSCURATION HAVING SUPERIOR STRENGTH AND...**

Express Mail Label No. **UNASSIGNED**

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ Fee Transmittal Form (PTO/SB/17 or equivalent)
2. ☐ Applicant asserts small entity status. See 37 CFR 1.27
3. ☐ Applicant certifies micro entity status. See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. ☒ Specification [Total Pages **25**] Both the claims and abstract must start on a new page. (See MPEP § 608.01(a) for information on the preferred arrangement)
5. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets **9**]
6. Inventor's Oath or Declaration [Total Pages _____] (including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))
 - a. ☐ Newly executed (original or copy)
 - b. ☐ A copy from a prior application (37 CFR 1.63(d))
7. ☒ Application Data Sheet * See note below. See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. ☐ CD-ROM or CD-R in duplicate, large table, or Computer Program (Appendix)
 ☐ Landscape Table on CD
9. Nucleotide and/or Amino Acid Sequence Submission (if applicable, items a. - c. are required)
 - a. ☐ Computer Readable Form (CRF)
 - b. ☐ Specification Sequence Listing on:
 - i. ☐ CD-ROM or CD-R (2 copies); or
 - ii. ☐ Paper
 - c. ☐ Statements verifying identity of above copies

ADDRESS TO:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

ACCOMPANYING APPLICATION PAPERS

10. ☐ Assignment Papers (cover sheet & document(s))
Name of Assignee _____
11. ☐ 37 CFR 3.73(c) Statement (when there is an assignee) ☐ Power of Attorney
12. ☐ English Translation Document (if applicable)
13. ☒ Information Disclosure Statement (PTO/SB/08 or PTO-1449)
☐ Copies of citations attached
14. ☐ Preliminary Amendment
15. ☐ Return Receipt Postcard (MPEP § 503) (Should be specifically itemized)
16. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
17. ☐ Nonpublication Request Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. ☐ Other: _____

*Note: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 must be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

☒ The address associated with Customer Number: **00136** OR ☐ Correspondence address below

Name			
Address			
City	State	Zip Code	
Country	Telephone	Email	
Signature	Date		April 27, 2017
Name (Print/Type)	Registration No. (Attorney/Agent)		22,769

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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FEE TRANSMITTAL

Complete if known

- ☐ Applicant asserts small entity status. See 37 CFR 1.27.
- ☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

TOTAL AMOUNT OF PAYMENT (\$ 1,740

Application Number UNASSIGNED

Filing Date April 27, 2017

First Named Inventor A. MANNHEIM ASTETE

Examiner Name UNASSIGNED

Art Unit UNASSIGNED

Practitioner Docket No. P75029US2

METHOD OF PAYMENT (check all that apply)

☐ Check ☒ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☒ Deposit Account Deposit Account Number: 06-1354 Deposit Account Name: _____

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

- ☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, except for the filing fee
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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

Application Type	FILING FEES			SEARCH FEES			EXAMINATION FEES			Fees Paid (\$)
	U (\$)	S (\$)	M (\$)	U (\$)	S (\$)	M (\$)	U (\$)	S (\$)	M (\$)	
Utility	280	140*	70	600	300	150	720	360	180	1,600
Design	180	90	45	120	60	30	460	230	115	
Plant	180	90	45	380	190	95	580	290	145	
Reissue	280	140	70	600	300	150	2,160	1,080	540	
Provisional	260	130	65	0	0	0	0	0	0	

* The \$140 small entity status filing fee for a utility application is further reduced to \$70 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	Undiscounted Fee (\$)	Small Entity Fee (\$)	Micro Entity Fee (\$)
Each claim over 20 (including Reissues)	80	40	20
Each independent claim over 3 (including Reissues)	420	210	105
Multiple dependent claims	780	390	195
Total Claims	Extra Claims	Fee (\$)	Fee Paid (\$)
10 - 20 or HP = _____ X _____ = _____			
HP = highest number of total claims paid for, if greater than 20.			
Indep. Claims	Extra Claims	Fee (\$)	Fee Paid (\$)
1 - 3 or HP = _____ X _____ = _____			
HP = highest number of independent claims paid for, if greater than 3.			

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$400 (\$200 for small entity) (\$100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
34 - 100 = _____	/ 50 = _____	(round up to a whole number) X _____		

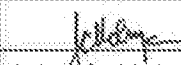
4. OTHER FEE(S)

Non-English specification, \$130 fee (no small or micro entity discount) _____

Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, \$400 fee (\$200 small or micro entity) _____

Other (e.g., late filing surcharge): Late filing of the Declaration surcharge _____ 140

SUBMITTED BY

Signature  Registration No. 22,769 Telephone (202)638-6666

Name (Print/Type) John C. Holman (Attorney/Agent) Date April 27, 2017

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
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Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
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City	Lima	State/Province		
Postal Code		Country ¹	PE	
Inventor 2 Remove				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
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Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
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Mailing Address of Inventor:				
Address 1		Ca. Manuel Tovar 656, Dpt. 301,		
Address 2		Miraflores		
City	Lima	State/Province		
Postal Code		Country ¹	PE	
Inventor 3 Remove				
Legal Name				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Prefix	Given Name	Middle Name	Family Name	Suffix
	Charles	S.	VOETZEL	
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Mailing Address of Inventor:

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Address 2	Miraflores			
City	Lima	State/Province		
Postal Code		Country ⁱ	PE	

Inventor 4

Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Laura		GRANADOS CARO	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Lima	Country of Residence ⁱ	PE	

Mailing Address of Inventor:

Address 1	Guillermo Dansey 1846,			
Address 2	Cercado de Lima			
City	Lima	State/Province		
Postal Code		Country ⁱ	PE	

Inventor 5

Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Philip	Denton	Gordon	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Lima	Country of Residence ⁱ	PE	

Mailing Address of Inventor:

Address 1	Guillermo Dansey 1846,			
Address 2	Cercado de Lima			
City	Lima	State/Province		
Postal Code		Country ⁱ	PE	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Inventor 6 Remove				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Elena	K.	Mendoza Carranza	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Lima	Country of Residence ¹	PE	
Mailing Address of Inventor:				
Address 1		Guillermo Dansey 1846,		
Address 2		Cercado de Lima		
City	Lima	State/Province		
Postal Code		Country ¹	PE	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add				

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence information of this application.			
Customer Number	00136		
Email Address	patent@jhip.com	Add Email	Remove Email

Application Information:

Title of the Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		
Attorney Docket Number	P75029US2	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	9	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation in part of	15393584	2016-12-29

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2		
		Application Number			
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE				
Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15393584	Continuation in part of	14625952	2015-02-19	9623634	2017-04-18
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.					

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)¹ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove			
Application Number	Country ¹	Filing Date (YYYY-MM-DD)	Access Code ¹ (if applicable)
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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

☐ NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant must opt-out of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby grants the USPTO authority to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant DOES NOT authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant DOES NOT authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

[Clear](#)

☒ Assignee
 ☐ Legal Representative under 35 U.S.C. 117
 ☐ Joint Inventor

☐ Person to whom the inventor is obligated to assign.
 ☐ Person who shows sufficient proprietary interest

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

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Phone Number Fax Number

Email Address

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

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Fax Number

Email Address

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Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a juristic entity (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/John C. Holman/ 		Date (YYYY-MM-DD)	2017-04-27	
First Name	John C.	Last Name	Holman	Registration Number	22,769
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	P75029US2
		Application Number	
Title of Invention	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

TITLE OF THE INVENTION:**OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE
LAMINATE****BRIEF SUMMARY OF THE INVENTION**

The presently disclosed invention is directed to a laminated automotive glazing having an obscuration that has superior optical quality and strength as well as the method used to create said glazing.

BACKGROUND OF THE INVENTION

Black enamel frit obscurations are commonly printed on laminated and tempered automotive safety glazing.

Obscurations have multiple functional and aesthetic requirements.

The obscuration must be substantially opaque. This is needed to prevent the adhesive, used to mount the glazing to the vehicle, from being seen from the outside of the vehicle. It must also protect the adhesive from the harmful effects of ultra-violet. The obscuration also serves this same function for the equipment attached to the inside surface of the glazing. On heated and coated glazing, the obscuration is used to hide the edge of the coating, bus bars, leads and any other items that would detract from the appearance of the vehicle. The obscuration also has the additional aesthetic requirement that it have a dark black color and a reflective glossy appearance.

In addition to hiding the adhesive, equipment mounted to the glazing and other items the obscuration must be durable. It must last for the life of the glazing, without fading, having a

reduction in adhesion or otherwise failing. Another important functional requirement is that the obscuration must protect the adhesives from the ultraviolet rays of the sun.

The obscurations are usually printed on the surface **24** of glass facing the inside of the vehicle.

In addition to the obscurations, markings required for regulatory compliance (date, manufacturer, compliance classification, model, etc.) and images, such as trademarks, barcodes etc., are also printed on the glass.

Obscurations have historically been black. One of the reasons for this comes from the limitations imposed by ceramic frits. It is difficult to produce frits, in colors other than black, that have the durability needed and for which the color can be reliably replicated from run to run. The other reason is that a black obscuration can be used with any color of paint.

The practice of applying black enamel frit obscurations became common place the 1980s when the industry switched from the rubber H channel and the butyl adhesive strip windshield mounting systems to polyurethane adhesive mounting of safety glazing. This change was made in response to the poor safety performance of the prior technology. The channel/butyl mounted windshields were often dislodged on impact allowing the occupants to be ejected from the vehicle. To improve occupant retention in crashes, the industry switched to polyurethane adhesive mounting. Today, on new vehicles, butyl is no longer used and the rubber H channel mount is only seen on commercial and off-road vehicles.

One advantage of the butyl strip system was that the strip was narrow enough to be covered by a molding or trim strip to obscure the butyl and the vehicle mounting flange. The rubber channel also did not require an edge obscuration as the rubber covered both the edge of glass and the flange.

This had to change to enable the use of polyurethane. To obtain the required bond strength, between the vehicle and the glass, it was found that the bead of polyurethane had to be substantially wider than the butyl strip had been. With a minimum width of 19mm, it was no longer practical to obscure the adhesive from view from the outside with a trim strip or molding due to the width that would have been required. In addition, polyurethane needs to be protected from ultra-violet light, UV, to prevent degradation. As a result, the black enamel frit obscuration band was added to the glass, to obscure the view of the polyurethane and to protect the polyurethane by blocking the UV. This obscuration band of black enamel frit that encircles the day light opening is commonly called the “black band”.

While there can be no doubt that the polyurethane system has saved countless lives, it has some disadvantages.

Black enamel frit is comprised of pigments, a carrier, binders and finely ground glass. Other materials are also sometimes added to enhance certain properties: the firing temperate, anti-stick, chemical resistance, etc. The black frit is applied to the glass using a silk screen or ink jet printing process prior to heating and bending. During the bending process, the finely ground glass in the frit soften and fuses with the glass surface. The frit is said to be “fired” when this takes place. This is very similar to the process used to apply enamel finishes on bathroom fixtures, pottery, china and appliances.

Metals and many other types of materials have an ultimate yield strength at which point the material will fail. However, with glass we can only specify a probability of breakage for a given value of stress. Looking at glass at the molecular level, we would expect the strength to be very high. In fact, what we find in practice is that glass has a very high compressive strength, as expected, but very low tensile strength.

For a given set of glass test specimens, with identical loading, the point of failure at first glance might appear to be a random variable. In fact, the yield point follows a Weibull distribution

and the probability of breakage can be calculated as a function of, stress, duration, surface area, surface defects and the modulus of glass.

To the naked eye, float glass appears to be near perfect. Any defects that may be present as so small as to not be visible. But, in fact, at the microscopic level, the surface appears rough and can be seen to be dotted with flaws. When the glass is placed in tension, these surface defects tend to open up and expand, eventually leading to failure. Therefore, laminated automotive glass almost always fails in tension. Even when not in tension, the surface defects react with the moisture in the environment and slowly “grow” over time. This phenomenon is known as slow crack growth. As a result, glass weakens as it ages.

A fired black frit increases surface defects. This can be seen if the black pigment of a fired black obscuration is chemically dissolved. The surface of glass will have a frosted appearance, similar to sand blasted or chemically etched glass. The frosted appearance is due to the myriad surface defects present from the fused glass. This makes the surface weaker increasing the probability of breakage. Testing has shown that glass with black frit fails at a stress level that is substantially lower than glass that does not have black frit.

Another problem arises from the thermal gradients that occur during the bending process. As one would expect, the black frit absorbs more radiant heat than the clear glass. Radiant heat is the predominant heat source used for glass bending. The black frit areas of the glass run hotter than the adjacent clear areas. With glass being a poor conductor of heat, gradients in the tens of degrees centigrade can arise over a short distance. These high abrupt thermal gradient on the surface result in optical distortion and high residual along the inner edge of the black band. This is known as the “burn” line in the industry. This can often be seen along the edges of the black obscuration found along the edges of most windshields.

Obscurements used with glass mounted camera systems are forced to designate a “buffer” zone **15** between the edge of the camera field of view **16** and the edge of the black frit **8** (Figure 9A)

to exclude the burn line. This is an accommodation required due to the limitations of the black frit. The ideal would be to have no buffer zone **15** as the larger obscuration reduces the driver field of view and the natural light entering the vehicle (Figure 9B).

One method used to address the burn line problem is the dot fadeout. Starting at the inner solid edge of the black paint, rows of increasingly smaller dots are painted on the glass. This is the same principle as used in greyscale printing. This reduces the rate of change in the surface temperature, spreading it over a wider area. The dot fadeout also helps to hide the distortion. However, on some parts, even a wide dot fadeout is not sufficient to eliminate all distortion. A wide dot fadeout also may not be possible depending upon the size of the opening and the regulatory requirements for driver vision. Dot fadeout patterns are also undesirable in that they increase the production cost of the glazing.

Another problem is surface mismatch. A laminate is comprised of at least two layers of glass. The frit is typically applied to only one of the glass layers. This can result in a slight difference in the shape of the surfaces. When the two surfaces are forced together during lamination, the mismatch results in residual stress in the laminate and optical distortion.

Even with these drawbacks, the area of the windshield with a black frit obscuration has increased in recent years. There are a number of reasons why this is occurring.

To improve aerodynamics and lower wind noise, the wiper rest position on many vehicles is located out of sight below the hood line. When this is done, the bottom edge of the windshield is extended to form a "wiper rest" **31** so as to provide a resting surface for the wipers when not in use as shown in **Figures 1, 2 and 3**. This area is typically obscured with a black enamel frit **31** extending downward and connecting to the black band. The width of this area can be in excess of 15cm. This area is also normally heated, to prevent snow and ice from building up, using a screen print conductive silver on the number four **24** surface of the glass. The power density required to keep this area free of ice and snow is double that of a rear window defroster due to

the snow and ice that is packed in from the wiper action. The wide wiper rest frit obscuration, with drawbacks intrinsic to frit, coupled with the thermal stress of melting snow and ice, leads to a high breakage rate for these windshields.

As the electronic content of modern vehicles has increased, the area of the windshield, near the top center, has become increasingly crowded on many vehicles. Once the province of just the rear-view mirror, we now find a wide array of equipment mounted in this location.

One of the first devices to compete for this area was the infra-red rain sensor use to provide for a full automatic mode of windshield wiper operation as well as other vehicle functions such as closing the sun roof and pulsing the brakes to keep the rotors dry. The rain sensor must have a lens optically coupled to the number four **24** surface of the windshield. An IR LED shines light onto the number one **21** surface. The amount of light reflected back correlates to the amount of water present on the number one **21** surface. The field of view of the lens must be in the area cleared by the wipers in order to function properly. Therefore, the lens is generally mounted on or near the vertical centerline near the top of the wiped area. Power and signal wiring is required for the sensor to work. In addition to the lens **10**, the sensor comprises a housing **12** and a cover **14** all of which need to be hidden from view from the outside of the vehicle to avoid an unsightly clutter appearance.

The rear view mirror itself has undergone a major transformation. Once a purely mechanical device, electro-chromic automatic dimming rear-view mirrors have become a popular option and are standard equipment on many models. The additional components required to provide this functionality make the mirror heavier and therefore require a larger footprint mounting bracket than a standard non-dimming mirror.

The rear-view mirror has further evolved as telematics driver aid systems, integrated garage door openers and hands free blue-tooth interfaces have been introduced. The rear view mirror

is a convenient place to locate control push-buttons and microphones which require additional wires which also must be protected and covered. Power also needs to be provided to the mirror. A cover is often provided to protect the cable and to hide it from the inside of the vehicle.

The use of cameras, requiring a wide field of view and a high level of optical clarity, is also growing at a rapid rate with the introduction of vehicles capable of various levels of autonomous operation. The resolution of the cameras is also increasing at an equally fast rate. These typically must be mounted on the windshield in the wiper area. Early initial applications were for night-vision. Today, camera based systems are used to provide a wide array of safety functions including adaptive cruise control, obstacle detection, lane departure warning and support for autonomous operation. Many of these applications require the use of multiple cameras. A clear undistorted field of view, with minimal double imaging and excellent MTF (Modulation Transfer Function, a measure of how well a lens maps an image to a sensor), is especially critical for camera based systems to perform as intended. It is essential for these systems to be able to quickly differentiate between objects, capture text, identify signage, and operate with minimal lighting. Further, as the resolution of the cameras used increases the need for a clear distortion free field of view increases.

While covers **14** and various styling methods can be used to obscure the components and cables from the inside, we also need to maintain clean lines and a good aesthetic when the vehicle is viewed from the exterior.

Standard practice has been to extend the black enamel frit band **32** to create an obscuration **8** on the number four **24** surface with openings in the obscuration **30** to provide for the required field of view as shown in **Figures 1, 2 & 3**.

When the black enamel frit band **32** is extended downward from the top center black band to create an obscuration **8** on the number two **22** or number four surface **24**, distortion and stress

can become a major problem **Figure 1**. This is because the black frit is extending further from the edge into the area that where more heat must be applied to bend the glass. The large surface area of the obscuration increases the probability of breakage due to the surface defects and stress introduced by the frit. This is also a critical viewing area.

A panoramic windshield is a windshield in which the top edge of glass has been extended to include at least a portion of the roof giving the driver a vertical field of vision of at least 45 degrees as defined by the applicable regulatory standards.

In the case of a panoramic windshield **Figure 3**, the problem is even more pronounced as the obscuration **8** extends several cm from the top edge and is located near the weakest point of the windshield. This is also where the highest temperatures are required to bend the glass.

The process for printing on laminate interlayers was first commercialized in 2003. Some of the key patents include: US 8002938 B2, US 7232213 B2 and US 7278730. To date, the primary application has been for architectural laminates, providing a means to produce images and marking, in vivid colors at a resolution that was never before possible. However, little has been done in the automotive market. DE201110004500 teaches the use of a printed plastic layer for use in an automotive laminate for reducing weight and providing artistic freedom to the designer. US 20080286542 provides for an acoustic laminate with an image printed on film and adhered to the interlayer through use of an adhesion promoter.

One of the reasons why we have not seen the adaptation of printed interlayers in automotive is that the printed interlayers do not meet the functional requirements of an obscuration. A screen print enamel frit provides a high degree of protection from UV which is needed to protect the polyurethane used to bond the glazing to the vehicle opening. Inks printed on the interlayer do not have the same level of opacity and UV blocking ability that the black enamel frits do. They also do not provide the deep black glossy appearance of a fired black frit. This failure is due to the limited types of ink that are available for printing on interlayers.

One of the primary functions of the interlayer is to serve as the adhesive to hold the sheets of glass together. In the event of an accident, the interlayer holds the shards of glass together and helps to prevent the occupant from being ejected. In the event of an impact from the exterior of the vehicle, the interlayer helps to prevent the projectile from penetrating and entering the cabin. Penetration resistance is a key requirement for regulatory compliance. Any ink applied to the interlayer, must not interfere with this essential safety function. The interlayer must be able to bond to the glass **through** the print. Adhesion promoters are often needed even with the best ink formulations. This requirement severely limits the type of inks that can be used.

Interlayer sheets do not lend themselves well to the automated feed systems of typical printing equipment. The various materials used to produce interlayer sheets are all thermo plastics with glass transition points in the room temperature range or lower. As such, the sheets are limp and difficult to work with. The surface of interlayers for lamination also need to be embossed to facilitate handling and the lamination process. It is difficult to print on an embossed surface.

Summary of the invention

Having examined the drawback of using a black enamel frit to produce an obscuration, it can be appreciated that it would be desirable to produce a windshield that did not have the limitations that result from producing black enamel frit obscurations on glass.

The subject of the immediate invention is a laminated automotive glazing with a least one obscuration produced by printing the obscuration directly onto at least one surface of at least one sheet of a plastic film or on the interlayer itself.

The film with the printed obscuration is then laminated between at least two of sheets of a thermoplastic interlayer 4 such as a PVB, EVA or PU. Alternately, a laminating resin can be

used. Other markings and images can also be printed on the sheet **17**. A wedge interlayer can be used to further improve double image.

The unaltered original surface of the interlayer is able to bond to the glass and retains its original adhesion to the glass. The addition of the film **17** increases the penetration resistance of the laminate. As a result, the printed area of the sheet does not need to have as high of a level of adhesion to the interlayer as the interlayer needs to have to the glass. The interlayer does not have to maintain adhesion through the print and adhesion promoters are not needed for the film. The primary requirement is that the ink have good adhesion to the film and to the interlayer. This opens the possibility to use a wider range of inks than possible than with inks that need to be printed directly onto an interlayer.

Laminates made in this manner are stronger and have superior optical quality, especially in the areas of the laminate used by cameras.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a typical automotive windshield with a black band obscuration **32**, a wiper rest obscuration **31** and an equipment obscuration **34** extending downward from the black band obscuration, having openings **30** to provide a forward field of view for two cameras.

Figure 2 shows an automotive windshield with a black band **32**, a wiper rest obscuration **31** and an obscuration 34 separated from the black band, having openings 30 to provide a forward field of view for two cameras.⁸

Figure 3 shows a panoramic automotive windshield with a black band **32**, a wiper rest obscuration 31 and an obscuration 34 separated from the black band, having openings **30** to provide a forward field of view for two cameras.

Figure 4 shows the obscuration **8** of the prior art, a black enamel frit applied to the fourth surface **24**.

Figure 5 shows the obscuration **8** printed on the film **17** facing the third surface **23**.

Figure 6 shows the obscuration **8** printed on both side of the film **17**.

Figure 7 consists of:

Figure 7A shows a laminate with interlayers of uniform thickness

Figure 7B shows a laminate with one interlayer sheet of uniform thickness and one with a wedge angle greater than zero.

Figure 7C shows a laminate with two interlayer sheets having a wedge angle greater than zero.

Figure 8 consists of:

Figure 8A shows the path of light through a laminate with interlayers of uniform thickness.

Figure 8B shows the path of light through a laminate with interlayers having a wedge angle greater than zero.

Figure 9 consists of:

Figure 9A shows a black frit obscuration **8** and the buffer zone **15** between the black frit and camera field of view **16**.

Figure 9B shows an obscuration **8** printed on film with no buffer zone **15** between the black frit and camera field of view **16**.

Reference Numerals

- 3 Wedge Plastic Interlayer
- 4 Plastic Interlayer
- 5 Glass
- 6 Sunshade
- 8 Obscuration
- 10 Equipment Mounted To Glass
- 11 Adhesive
- 12 Device Housing
- 14 Cover
- 15 Buffer
- 16 Field of view
- 17 Film
- 21 First Surface of Glass
- 22 Second Surface of Glass
- 23 Third Surface of Glass
- 24 Fourth Surface of Glass
- 30 Openings in Equipment Obscuration
- 31 Wiper Rest Obscuration
- 32 Black Band Obscuration
- 34 Equipment Obscuration
- 40 Double image Angle
- 41 Observation point
- 42 Incident ray from image
- 43 Primary image
- 44 Secondary image
- 45 Wedge angle
- 46 Incident angle

48 Refracted ray

50 Surface normal

52 Angle of deviation

56 Inclination angle

DETAILED DESCRIPTION OF THE INVENTION

The invention eliminates the drawbacks associated with the black frit obscurations of the prior art by printing at least some of the obscurations on a plastic film layer which is then laminated as an integral part of the glazing. This allows for a more uniform heat distribution across the part during bending which reduces residual stresses and the associated surface mismatch, warping and distortion caused by the thermal gradients.

Film, as used in this document shall refer to single ply/layer compositions as well as films comprised of multiple layers. A common plastic used in such films is PET (polyethylene terephthalate) but as can be appreciated can be of any other composition found to be suitable can be used. Some examples include but are not limited to: metal based heat reflecting films, non-metal based heat reflecting films, tint films, and heat absorbing films, Suspended Particle Device (SPD) films, Polymer Dispersed Liquid Chrystal (PDLC) films, conductive coated films, and ordinary PET.

There are many PET based automotive film products in production providing a ready base of field proven performance films that can be used as the film of the invention. One of the most common and oldest has a heat reflecting coating for enhancing solar load control. Others include but are not limited to: films used to improve occupant retention, stiffen the laminate and provide for variable control of visible light transmission. To laminate these films **17**, two layers of interlayer **4** are needed to achieve the required adhesion to the glass and to the film. An obscuration **16** can be printed on either or both sides of the film.

The obscurations of the immediate invention are not limited to inkjet printing as is the prior art. The obscurations can be printed using inkjet, screen print, pad print or any other conventional printing means. The obscurations can be printed on either or both sides of the film.

The unaltered original surface of the interlayer is able to bond to the glass and retains its adhesion to the glass. The addition of the film **17** increases the penetration resistance of the laminate. As a result, the printed area of the sheet does not need to have as high of a level of adhesion to the interlayer as the interlayer needs to have to the glass. This opens the possibility of uses a wider range of inks than possible than with inks that need to be printed directly onto an interlayer.

During development, five printing technologies were evaluated and more than sixteen inks were tested. The criteria for the inks was based upon appearance (opacity and color), adhesion of ink to the PET, adhesion of ink to the interlayers and durability. The objective was to find a black color ink with high opacity, having good adhesion to PET and interlayers and durability.

A variety of different inks were tested using screen-printing. Solvent inks and UV inks for screen-printing process were evaluated. Both, UV and solvent inks had good durability results. Both inks also presented good adhesion results on PET penetrating into the substrate and creating a permanent bond. The UV ink was selected for prototype production due to the fast cure time, no need to add a catalyst and low volatile content. The UV ink is also ready to use with no need to add any catalyst and is instantly hardened by intense UV light polymerization (curing). The high reactivity of the ink delivered good curing results. UV ink properties give flexibility to work on large and small format printing. Surprisingly, it was found that obscurations printed in this manner also could be printed directly onto the interlayer.

Some modifications to the ink were required. The ink modifications included tuning the UV frequency response and removing silicon from the formulation. It was found that the silicon

lead to delamination in the areas near the glass edge. Broad band UV was found to cause warping or modulus of the substrate due to over saturation of energy. Restricting the overall bandwidth to a specific wavelength enhanced the ability to cure the ink using less overall energy. The obscuration produced has a dark black color and a shiny gloss comparable to black frit. The printed sheets are then cut to size and assembled into the laminate. For large scale production, roll to roll printing could be used.

Protection of the polyurethane adhesive from UV is achieved thorough the opacity of the ink in combination with the use of a UV blocking interlayer. Such UV blocking interlayers are well known in the art and have been in common use for many years.

To aid in the alignment of the printed sheet **17** when assembling the laminate, registration marks can be printed on the sheet **17**.

Another benefit of the process is the ability to fine tune the optical properties and appearance of the laminate. A near limitless range of colors can be produced. Properties in the non-visible portion of the spectrum can also be enhanced. Some performance films are sensitive and degrade over time, with exposure to the near UV. Additives that absorb or reflect the specific wavelengths of interest can be added to the ink to achieve targeted optical properties.

If a combination of frit and ink are used for the black band **32** and the equipment obscuration **34**, any difference in the appearance between the two may be noticeable. In that case, separating the equipment obscuration **34** from the black band, as shown in Figure 2, will improve the aesthetic. The transition line between the black band **32** and the wiper rest **31** will not generally be visible.

In the obscuration areas where the invention is applied, all of the detrimental effects of the black enamel frit on the glass are eliminated resulting in superior optical quality, lower stress, and a lower probability of breakage.

In addition to the benefits to the finished laminate, the elimination of the non-uniform heating and high thermal gradient present in the black frit areas increases yields through the bending process and also, due to the higher strength and lower surface mismatch, increases yields through the lamination process.

Distortion in windshields is measured in terms of refractive power. Refractive power is the change in the angular deviation along over distance. At a high enough level, it can result in noticable optical distortion. The refractive power is expressed in diopters.

$$D_{\varepsilon} = \frac{d\alpha_{\varepsilon}}{dx} \frac{1}{\cos \varepsilon} \quad (1)$$

Where:

ε : angle formed between the ray of light **42** and a line perpendicular to the surface of the glazing **50**

α_{ε} : angular deviation

D_{ε} : refractive power

Most large windshield production lines utilize online automated inspection system which scan the glass and produce a contour map showing the optical distortion in diopters.

Laminates produced by this invention have significantly lower distortion in the areas near the obscurations as compared to the same and similar laminates produced with screen print black frit.

Double image, another problem of the prior art, is illustrated in Figures 8A and 8B.

A ray of light **42** enters the surface of the glass at an incident angle **46** and passes through the glazing to the observer **41**. The light bends (refracts) as it passes through the glazing. The angle

by which the light bends is known as the angular deviation **52**. This refraction of the light causes a shifting of the apparent position **43** of the object observed

Some of the light from the ray **42** entering the glass is reflected back from the inside surface **24** and exits the glazing. A portion of the reflected light is again reflected back from outside surface **21** resulting in a double image. The separation angle **40** is the angle between the primary **43** and secondary image **44** and the observer **41**. If the primary and secondary images are coincident, then the separation angle is zero. Regulatory requirements limit the separation angle to 15 minutes of arc for vision zone A (as defined by United Nations Regulation 42, revision 3) and 25 minutes of arc for vision zone B. However, it is well known that the maximum amount of double imaging imperceptible for the human eye is 7 minutes of arc.

The double image angle, η **40**, is calculated as shown in equation 2. It increases with decreasing angle of inclination **56**, increasing curvature of the glass surface **24** and with increasing size of the glazing. The double image angle, η **40**, can be reduced by altering the angle between the plies of glass as shown in Figure 8B. Normally, the glass surfaces are substantially parallel to each other. By creating an angle **45** between the surfaces, the primary and secondary images can be shifted towards convergence.

$$\eta = \frac{2t \sin(\varepsilon)}{R\sqrt{n^2 - \sin(\varepsilon)^2}} \quad (2)$$

where:

η : double image angle

t: thickness of the glazing

n: refractive index

R: radius of curvature

The angle between the plies of glass is adjusted through the use of an interlayer that has a non-uniform thickness, typically tapering from a thickness greater than the standard 0.76 mm at or near the top of the glazing a lesser thickness at the bottom. Such interlayers are produced through extrusion of the plastic. Such interlayers are known as “wedge” interlayers. They can also be formed, to a lesser extent by shaping (stretching) of the interlayer. Shaping is typically done to create a curved sunshade 6. Table 1 shows the wedge angle and reduction in thickness for a standard 0.76 mm thick interlayer over 1 meter as a function of sunshade radius.

Note that wedge interlayer can be shaped to increase the wedge angle. Any combination of wedge and shaped interlayer can be used to obtain the desired results.

Figures 7A, 7B and 7C show: a laminate with two standard interlayers, a laminate with one wedge interlayer and a laminate with two wedge interlayers.

Wedge interlayer can be used with a printed obscuration to further reduce double vision.

Sunshade Radius	Interlayer Thickness	Wedge Angle
m	mm	mrاد
2.0000	0.5067	0.253
2.5000	0.5429	0.217
3.0000	0.5700	0.190
3.5000	0.5911	0.169
4.0000	0.6080	0.152
4.5000	0.6218	0.138
5.0000	0.6333	0.127
5.5000	0.6431	0.117
6.0000	0.6514	0.109

6.5000	0.6587	0.101
7.0000	0.6650	0.095
7.5000	0.6706	0.089
8.0000	0.6756	0.084
8.5000	0.6800	0.080
9.0000	0.6840	0.076
9.5000	0.6876	0.072
10.0000	0.6909	0.069

Table 1: Sunshade Radius vs. Wedge Angle

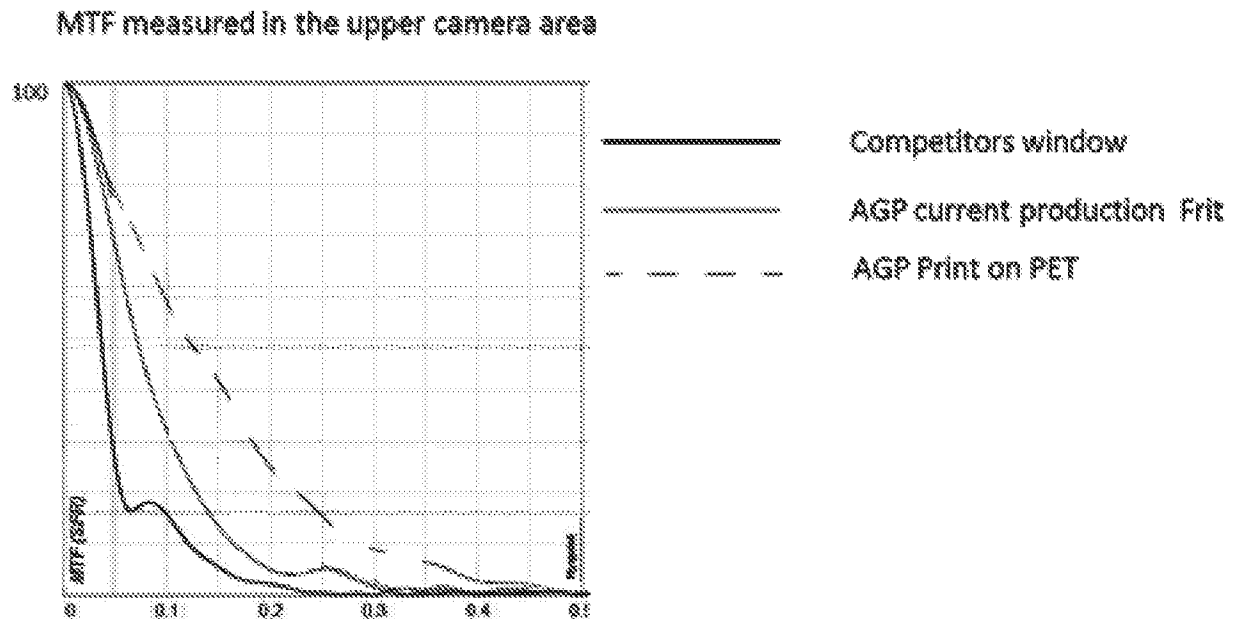
Enamel frit and printed ink can both be used on the same part and in any combination that is convenient. As an example, the obscurations could be printed on the sheet **17**, while the other markings and images can be made with a conventional black screen print. The markings and images do not have the same detrimental effect as the obscuration prints, due to their small size and function.

Experimental results have demonstrated the remarkable and unexpected magnitude of improvement of the invention and are shown in the following table (Table 2) and graphs. Fracture strength is more than doubled, MTF is drastically improved (see Graph 1), distortion is reduced by a factor of six and double image if reduced from 15" to 3". One should also note that all four of these parameters are critical to the operation of a safety camera.

Table 2

	Laminate with Black Frit	Laminate with Obscuration Printed on Film
Fracture Strength (ring-on-ring)	60 Mpa	115 Mpa
Distortion (Camera window - 5mm from the black edge)	150 milli diopters	25 milli diopters
Double image (Camera	15" (arc minute)	3" (arc minute)

window - 5mm from the black edge)		
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Graph 1

As camera system for cars improve and cars now have advanced driving assisted systems the vehicles windshield becomes an important component of the complex lens system that makes up the vehicle vision system. For our interest here our windshield serves as a lens in front of the camera, comprising one component of a complex lens system. The best way to evaluate this system is by measuring the MTF.

Modulation Transfer Function or "MTF" is the most widely used scientific method of describing lens performance. The modulation transfer function is, a measure of the transfer of modulation (or contrast) from the subject to the image. In other words, it measures how faithfully a lens reproduces (or transfers) detail from the object to the image produced by a lens. When we graph MTF we chart against contrast dropping from 100 to 0 and Spatial frequency (Nyquist frequency). Spatial frequency is the ability to resolve over distance and as contrast drops this ability gets weaker. Plotting in this X&Y gives us the total systems contrast and its ability to

faithfully reproduce into the distance. This is especially important in semi-autonomous or autonomous driving vehicles as the focus will be the horizon and all images in the focal plane will need to be detectable both in shape and in size.

Printing the obscuration has resulted in a remarkable improvement in system MTF as compared to the same production model with a normal frit obscuration.

Advantages

1. Best in class optics.
2. Frit induced surface defects are eliminated.
3. Residual stress caused by non-uniform heating of the frit is eliminated.
4. Residual stress caused surface mismatch due to the frit is eliminated.
5. Low distortion, comparable to ordinary clear glass.
6. Low double image, comparable to ordinary clear glass.
7. Lower probability of breakage.
8. Higher yield during bending due to elimination of non-uniform heating.
9. Higher yields during lamination due to higher strength, lower residual stress and less surface mismatch.

Embodiment 1

The windshield of Figure 1 comprising a black enamel frit band **32**, a black enamel frit wiper rest area **31** one wedge interlayer, and an equipment obscuration **8, 34** printed on one surface of the plastic sheet **17** (Figure 5).

Embodiment 2

The windshield of Figure 1 comprising a black enamel frit band **32**, a black enamel frit wiper rest area **31** and an equipment obscuration **8, 34** printed on both surfaces of the film **17** (Figure 6).

Embodiment 3

The windshield of Figure 1 comprising a wiper rest **31**, black band **32** and an equipment obscuration **8, 34** printed on one surface of the film **17** (Figure 5).

Embodiment 4

The windshield of Figure 1 comprising a wiper rest **31**, black band **32** and an equipment obscuration **8, 34** printed on both surfaces of the film **17** (Figure 6).

Embodiment 5

The windshield of Figure 1 comprising a film **17**, a wiper rest **31**, black band **32** and an equipment obscuration **8, 34** printed on one surface of the film (Figure 5).

Embodiment 6

The obscuration combinations of the previous embodiments, 1-5, further comprising an equipment obscuration separate from the black band and spaced from said black band by at least 3mm illustrated in Figure 2.

Embodiment 7

A panoramic windshield (Figure 3) with the equipment obscuration printing on one surface of the film **17** and an enamel frit wiper rest/black band.

Embodiment 8

A panoramic windshield (Figure 3) comprising and equipment obscuration printed on both surfaces of the film **17** (Figure 6).

CLAIMS

1. A laminate comprising: at least two glass layers; at least two plastic interlayers; at least one film layer; film layer, printed obscuration, the plastic interlayers positioned between each set of glass and film layers and serving to attached glass layers to film layers; and at least one obscuration produced by printing said obscuration onto a film layer.
2. The laminate of claim 1 further comprising a PET film layer.
3. The laminate of claim 1 further comprising at least one wedge interlayer.
4. The laminate of clam 1 further comprising a performance film plastic layer.
5. The laminate of claim 1 further comprising a color correction filter printed on the film layer.
6. The laminate of clam 1 further comprising an equipment obscuration separate from and spaced from the black band obscuration.
7. The laminate of claim 1 further comprising at least one obscuration screen printed on the film layer.
8. The laminate of claim 1 further comprising at least one obscuration printed with a UV cured ink.
9. A vehicle utilizing the laminate of claim 1.
10. A laminate comprising:
 - a. at least two glass layers;
 - b. at least one plastic interlayer,
 - c. at least one obscuration,
 - d. said at one plastic interlayer is positioned between each set of said glass layers and serving to bond said glass layers to each other,
 - e. said least one obscuration produced by printing said obscuration onto said plastic interlayer.
11. The laminate of claim 10 further comprising a PET film layer.
12. The laminate of claim 10 further comprising at least one wedge interlayer.

13. The laminate of claim 10 further comprising a performance film plastic layer.
14. The laminate of claim 10 further comprising a color correction filter printed on a film layer.
15. The laminate of claim 10 further comprising an equipment obscuration separate from and spaced from a black band obscuration.
16. The laminate of claim 10 further comprising at least one obscuration screen printed on the film layer.
17. The laminate of claim 10 further comprising at least one obscuration printed with a UV cured ink.
18. A vehicle comprising the laminate of claim 10.

ABSTRACT OF THE DISCLOSURE

The object of this invention is to provide a laminated automotive glazing having an obscuration area produced by printing the obscuration on a film laminated between at least two layers of plastic interlayers or directly on the interlayer rather than printing and firing an enamel frit onto the glass. This results in a laminate having superior optical quality, higher strength and a lower probability of breakage as compared to a laminate with a black enamel frit obscuration.

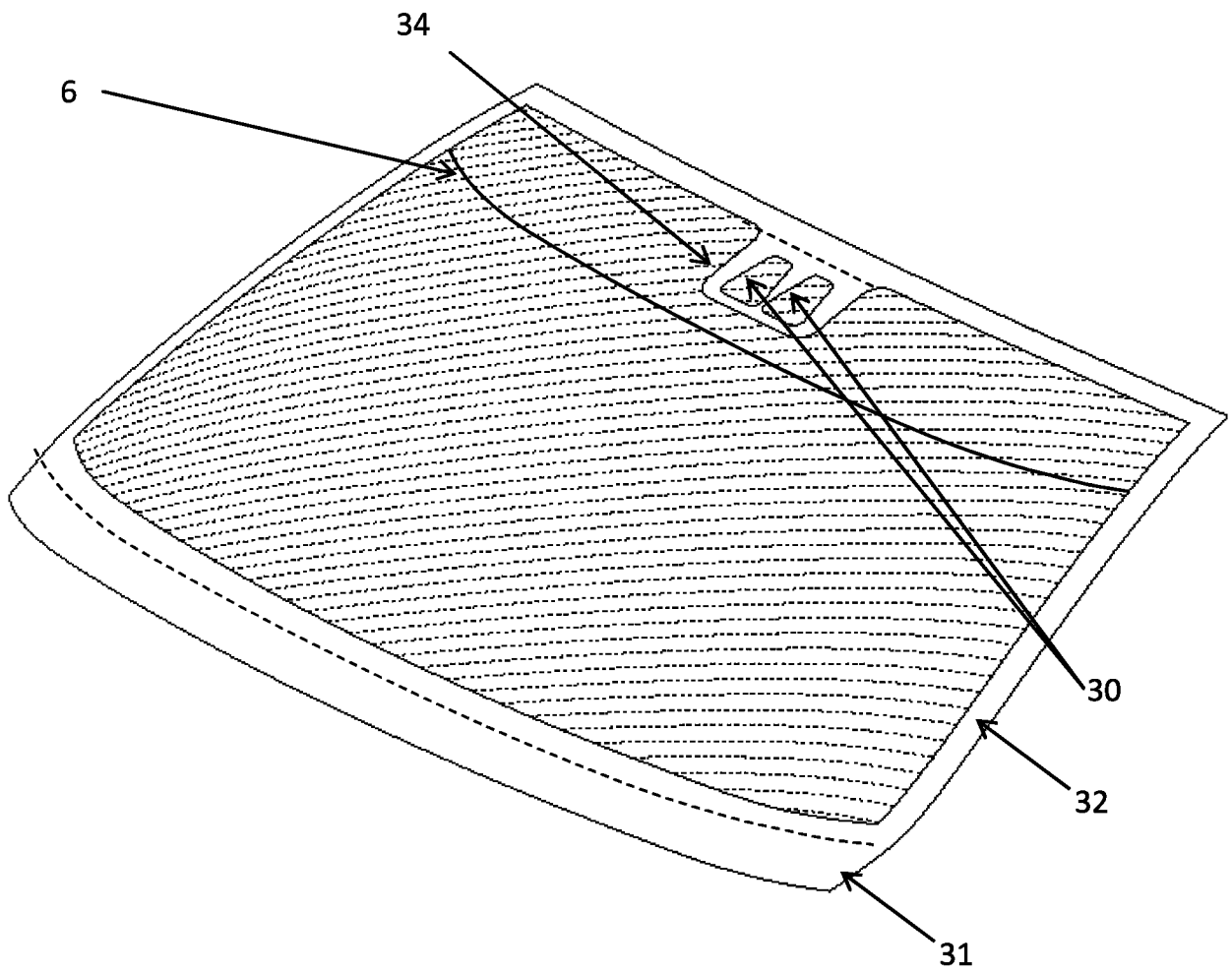


Fig. 1

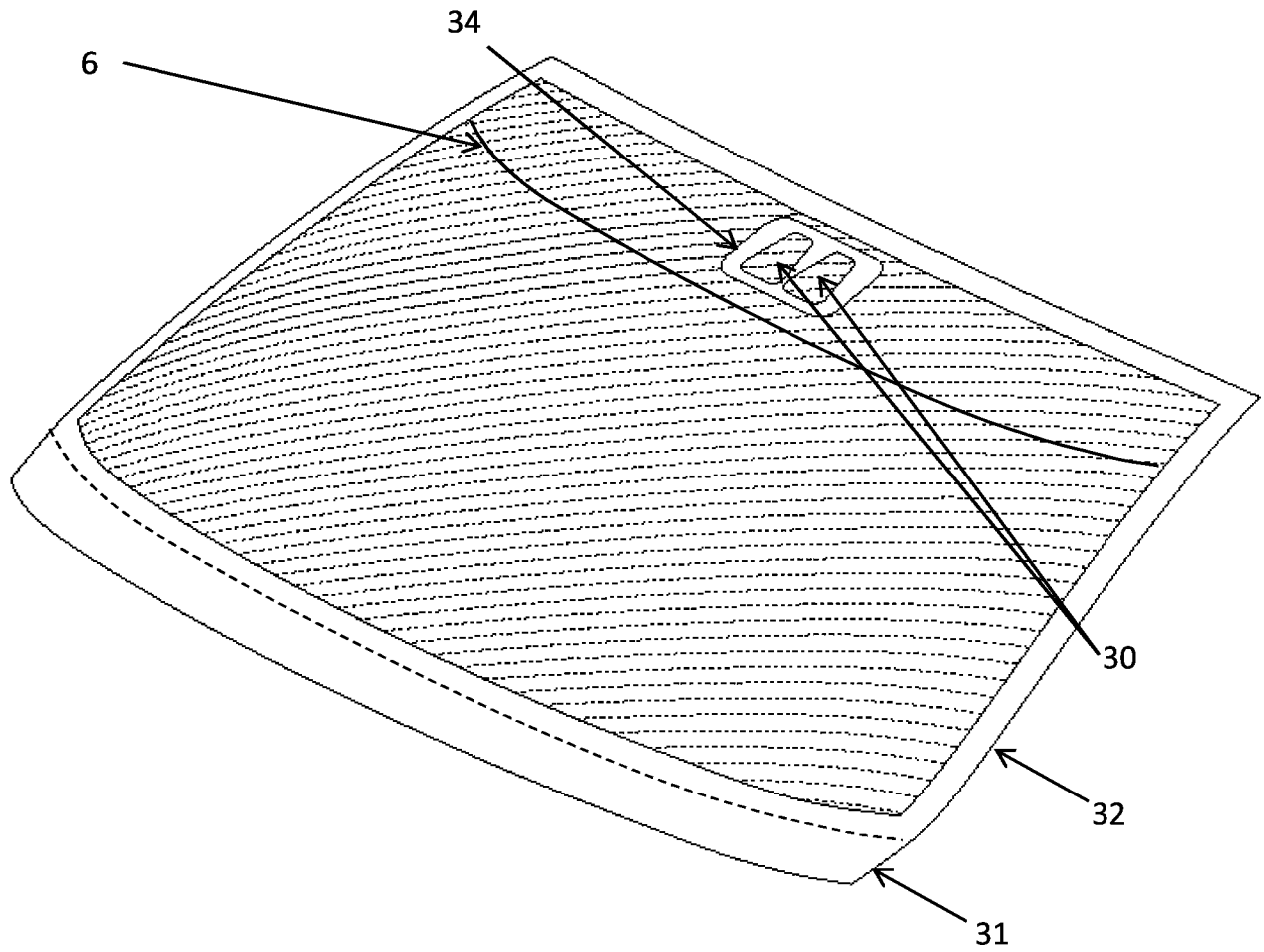


Fig. 2

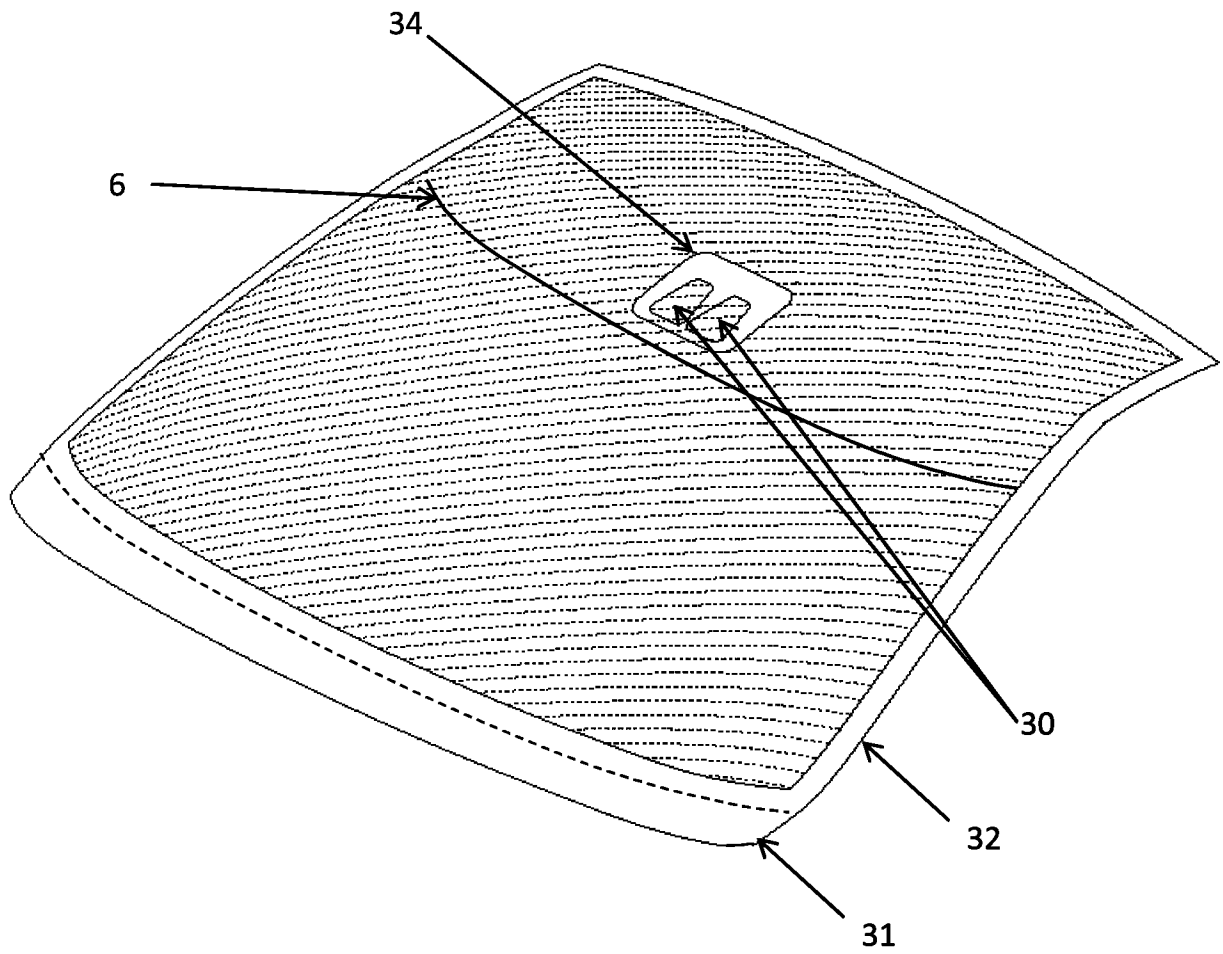


Fig. 3

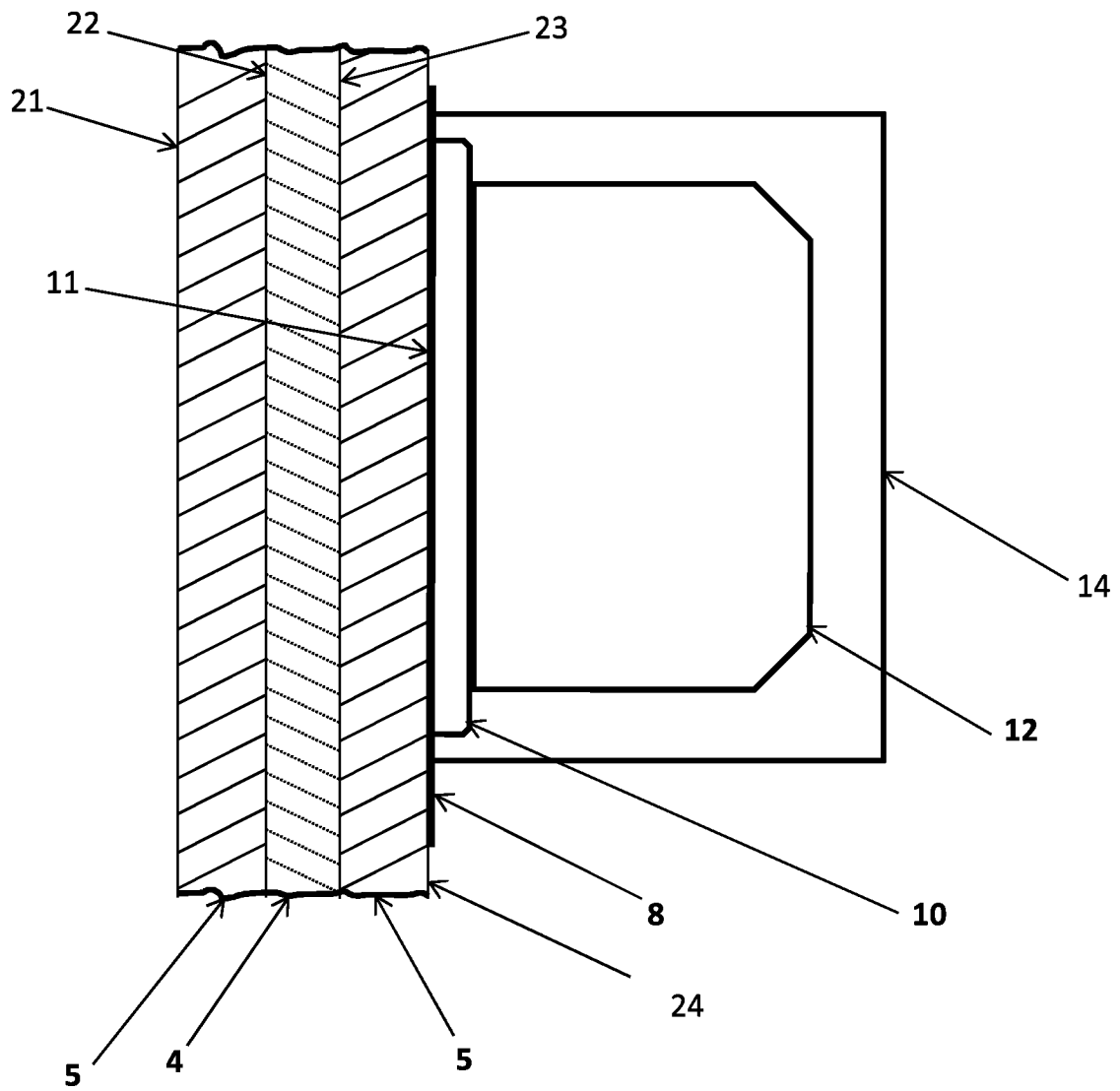


Fig. 4
(Prior Art)

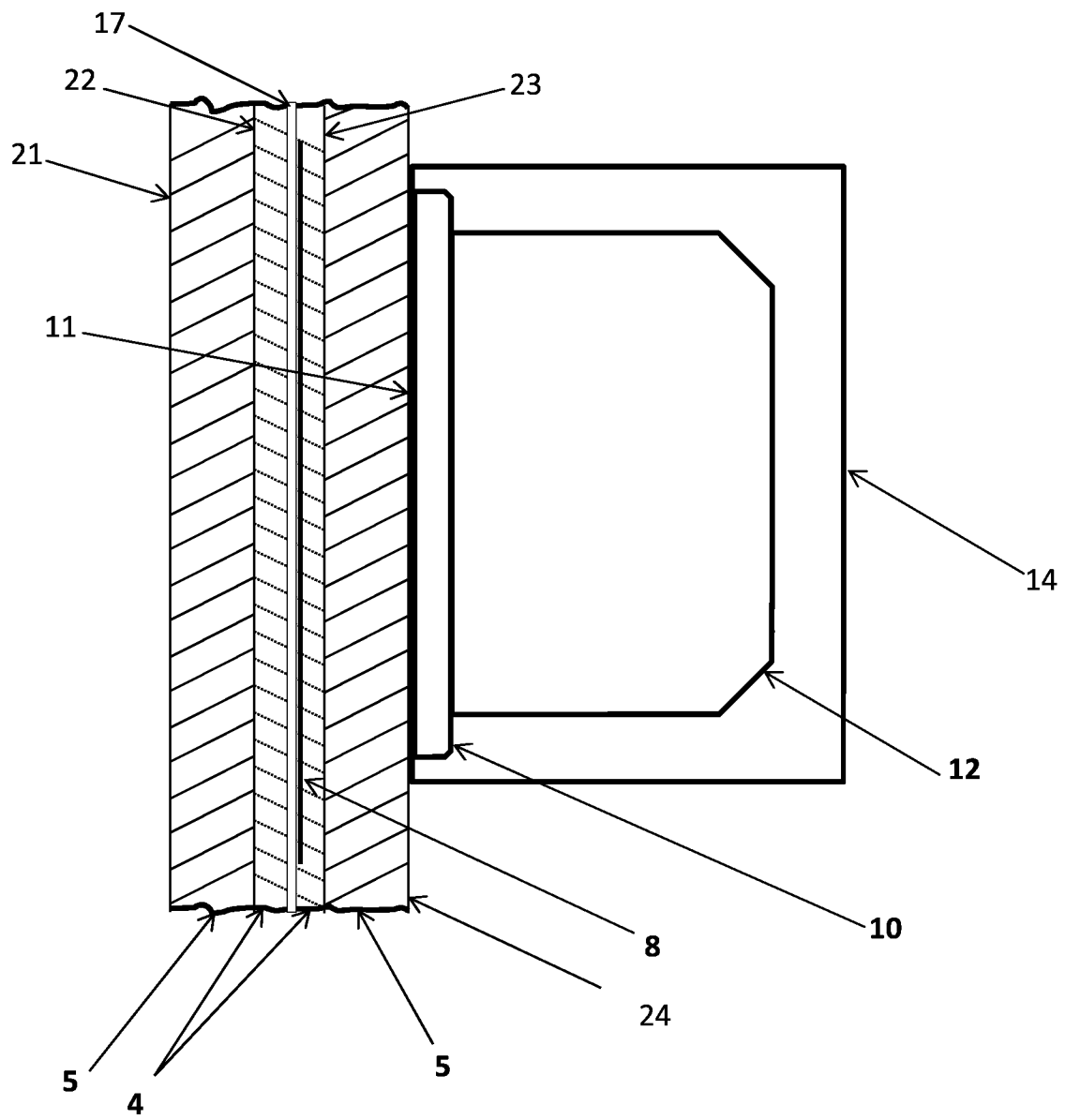
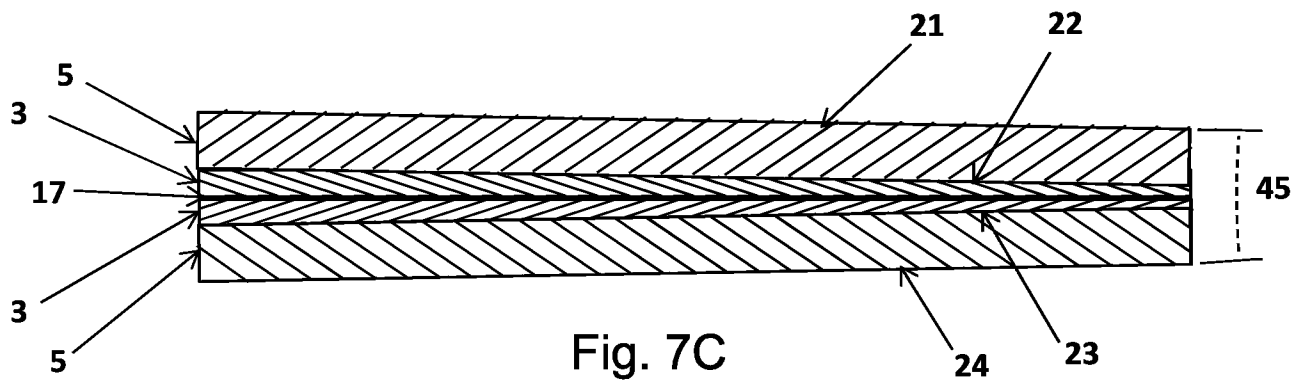
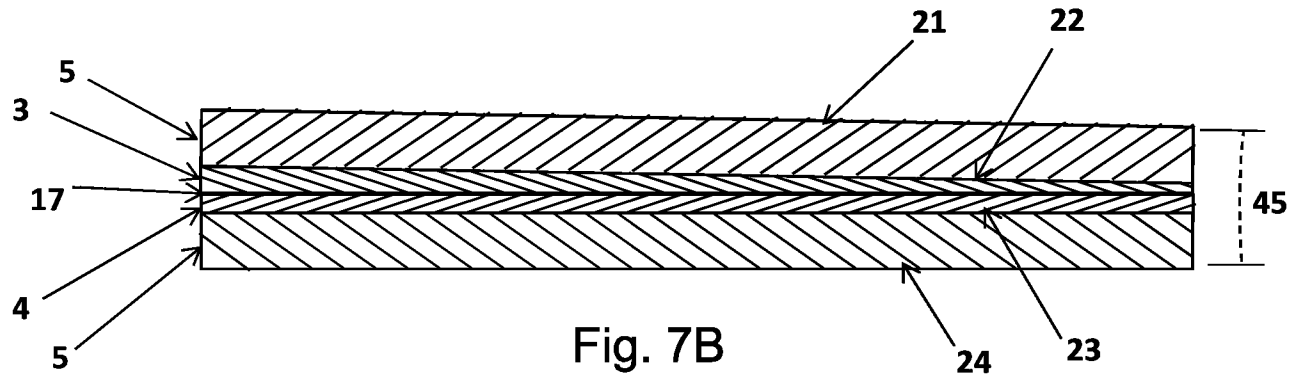
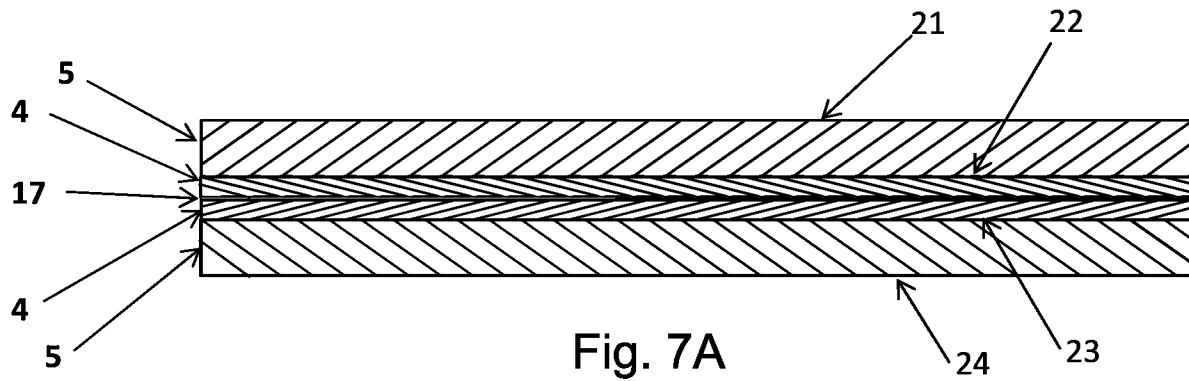


Fig. 5



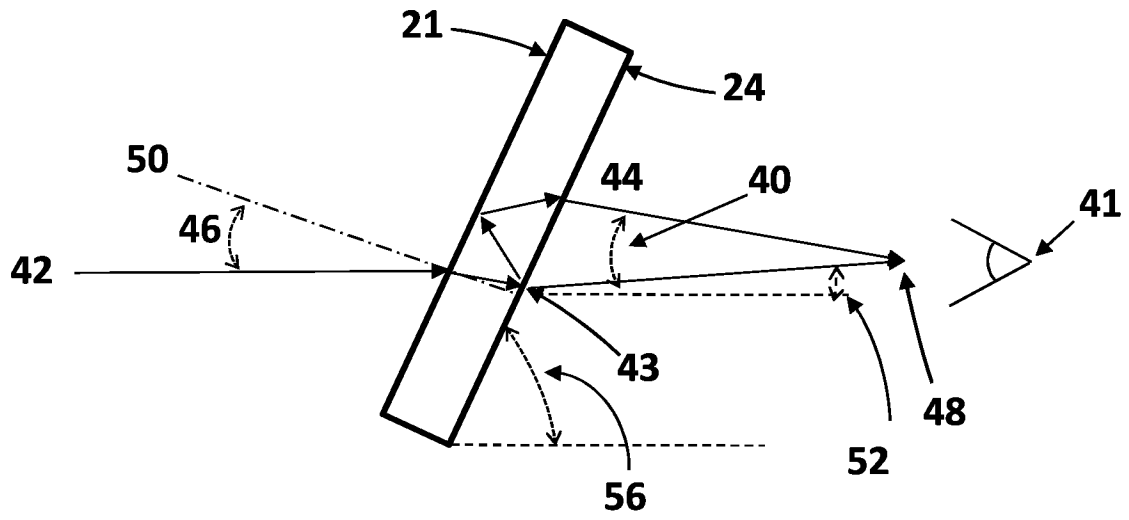


Fig. 8A

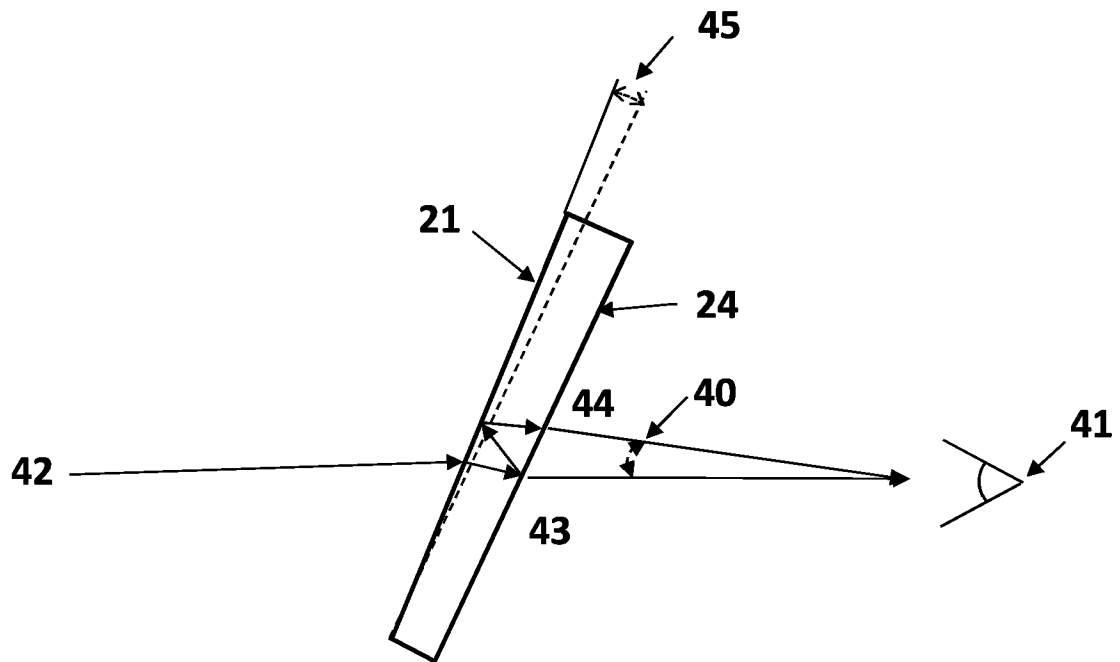


Fig. 8B

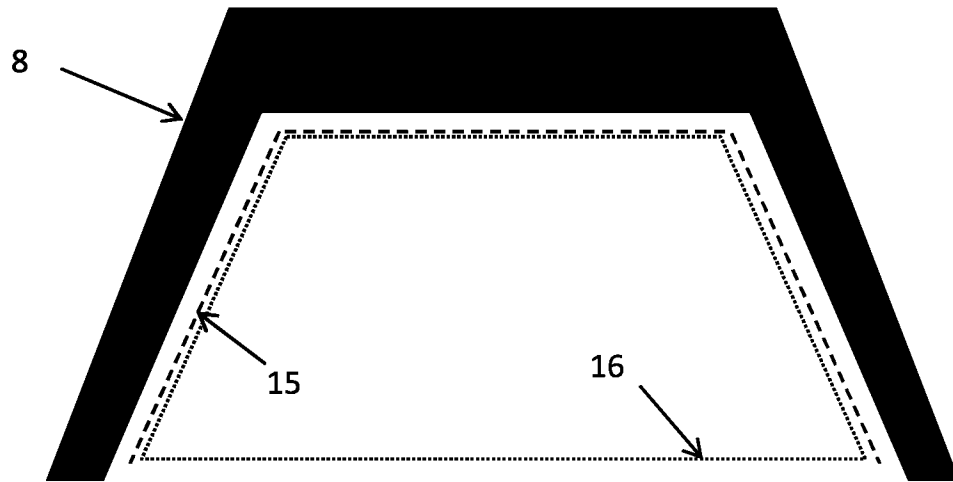


Fig. 9A

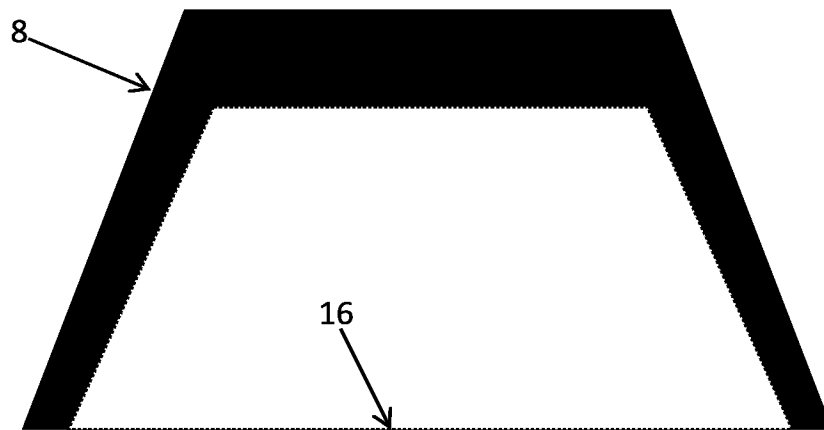


Fig. 9B

Electronic Acknowledgement Receipt

EFS ID:	29047345
Application Number:	15498852
International Application Number:	
Confirmation Number:	3110
Title of Invention:	OBSCURATION HAVING SUPERIOR STRENGTH AND OPTICAL QUALITY FOR AN AUTOMOTIVE LAMINATE
First Named Inventor/Applicant Name:	Arturo MANNHEIM ASTETE
Customer Number:	136
Filer:	John Clarke Holman
Filer Authorized By:	
Attorney Docket Number:	P75029US2
Receipt Date:	27-APR-2017
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Time Stamp:	13:34:47
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 1740
RAM confirmation Number	042717INTEFSW13354000
Deposit Account	061358
Authorized User	Jenna Brock

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File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	P75029US2_Transmittal.pdf	103069	no	1
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Warnings:					
Information:					
2	Miscellaneous Incoming Letter	P75029US2_FeeTransmittal.pdf	101000	no	1
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Warnings:					
Information:					
3	Application Data Sheet	P75029US2_ADS.pdf	680425	no	9
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4	Information Disclosure Statement (IDS) Form (SB08)	P75029US2_IDS.pdf	134593	no	3
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	Specification		1	22	
	Claims		23	24	

	Abstract		25	25	
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6	Drawings-only black and white line drawings	P75029US2_Drawings.pdf	2804791	no	9
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