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January 25, 2018

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APPLICATION NUMBER: 62/612,424
FILING DATE: *December 30, 2017*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS US62/612,424



Certified by

Nichelle K. Lee

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24400
		Application Number	
Title of Invention	Laminate With Thin Integrated Organic Obscuration		
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.			

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Inventor Information:

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Legal Name					
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24400
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Title of Invention	Laminate With Thin Integrated Organic Obscuration		

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

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

Title of the Invention	Laminate With Thin Integrated Organic Obscuration		
Attorney Docket Number	1511.24400	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	6	Suggested Figure for Publication (if any)	

Filing By Reference:

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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 ⁱ

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24400
		Application Number	
Title of Invention	Laminate With Thin Integrated Organic Obscuration		

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.			
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Customer Number	130961		

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Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24400
		Application Number	
Title of Invention	Laminate With Thin Integrated Organic Obscuration		

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Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ^j (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	1511.24400
		Application Number	
Title of Invention	Laminate With Thin Integrated Organic Obscuration		

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.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24400
		Application Number	
Title of Invention	Laminate With Thin Integrated Organic Obscuration		

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		Remove
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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Assignee Information including Non-Applicant Assignee Information:

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24400
		Application Number	
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Assignee 1				
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See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Joseph L. Morales/		Date (YYYY-MM-DD)	2017-12-30
First Name	Joseph	Last Name	Morales	Registration Number
				58835
Additional Signature may be generated within this form by selecting the Add button. Add				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24400
		Application Number	
Title of Invention	Laminate With Thin Integrated Organic Obscuration		

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LAMINATE WITH THIN INTEGRATED ORGANIC OBSCURATION

Abstract

Black enamel frit obscurations are commonly printed on laminated and tempered automotive safety glazing where they serve to hide the adhesive used to bind the glazing to the automotive body and to protect the adhesive from ultraviolet radiation. However, frit has a number of drawbacks. Frit weakens the surface of the glass. It can create distortion in the glass due to thermal gradients. Printed frit obscurations are incompatible and cannot be used with many types of coatings. Standard frit blocks ion exchange and cannot be used with the chemical tempering process. In addition, while many types of frits are available for printing on soda-lime glass, there are very few, if any, for non-soda lime glass. As the market moves towards thinner and lighter glazing, non-soda lime glass types are finding increasing application in automotive glazing.

These limitations are overcome by replacing the printed black obscuration with an obscuration formed from a thin sheet of non-plasticized PVB, which is integrated into the laminate.

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Cross-References to Related Applications

None

Background of the invention

Black enamel frit obscurations are commonly printed on laminated and tempered automotive safety glazing. However, black enamel frits are difficult, impractical, uneconomical or impossible to use with non-soda lime glass, glass that will be chemically tempered and glass with certain types of coatings. In addition, black frit obscurations weaken the glass and can
5 produce optical distortion.

The practice of applying black enamel frit obscurations became usual since 1980s when the industry switched from the rubber channel and the butyl adhesive strip windshield mounting systems to polyurethane adhesive (PU). This change was made in response to the poor safety performance of the prior technology. Channel/butyl mounted windshields were often
10 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 channel mount is only seen on commercial and off-road vehicles.

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

In order to enable the use of polyurethane, this had to change. To get the required bond strength between the vehicle and the glass, it was found that the bead of polyurethane had to be
20 substantially wider than the prior butyl strip. 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.

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,
25 having the durability needed and wherein the color can be reliably replicated from batch to batch. The other reason is aesthetics. A black obscuration will go with any color of paint. This obscuration band of black enamel frit is commonly called the “black band”.

Black frit print obscuration serves both functional and aesthetic role. The substantially opaque
30 black print on the glass serves to protect the poly-urethane adhesive used to bond the glass to

the vehicle from ultra-violet light and the degradation that it causes. It also serves to hide the adhesive from view from the exterior of the vehicle.

5 The black obscuration must be durable, lasting the life of the vehicle under all exposure and weather conditions. Part of the aesthetic requirement is that the black have a dark black glossy appearance and a consistent appearance from part to part and over the time. A part produced today must match up with one that was produced and in service 20 years ago. Parts must also match up with other parts in the vehicle which may not have been fabricated by the same manufacturer or with the same frit formulation. Standard automotive black enamel inks (frits)
10 have been developed that can meet these requirements.

Black enamel frit is comprised of pigments, carriers, binders and finely ground glass. Other materials are also sometimes added to enhance certain properties: the firing temperate, anti-stick, chemical resistance, etc. Black frit is applied to the glass using a silk screen or ink jet printing process, prior to the heating and bending of the glass. As flat glass is heated during
15 the bending process, the powdered glass in the frit softens and melts, fusing to the surface of the glass. The black print becomes a permanent part of the glass. The frit is said to be “fired” when this takes place. This is a vitrification process which is very similar to the process used to apply enamel finishes on bathroom fixtures, pottery, china and appliances.

Float glass appears to be near perfect. Any defects that may be present are so small that are
20 not visible to the naked eye. 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 and expand, eventually leading to failure. Therefore, laminated automotive glass almost always fails in tension. Even when not placed in tension, the surface defects will react with moisture and slowly “grow” over time. This phenomenon is known as
25 slow crack growth.

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, like 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
30 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 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. 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
5 degrees centigrade can arise over a short distance. These high abrupt thermal gradients on the surface result in optical distortion and high residual stress 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.

One method used to address the burn line problem is the dot fadeout. Starting at the inner solid
10 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
15 regulatory requirements for driver vision. Dot fadeout patterns are also undesirable in that they increase the production cost of the glazing due to the higher cost and shorter life of the screen and the higher reject rate due to screen printing defects.

Black frit interferes with the annealing process. Laminated glass, as required for windshields, must be annealed to meet safety requirements. Glass is annealed by heating the glass into the
20 glass transition range to soften it, letting it soak for some period to allow any stress to be relieved, and then slowly cooling back down through the glass transition range until the glass freezes. The ideal would be to have an isothermal condition. However, black frit absorbs radiant heat. Black frit gets much hotter than unpainted portions. As a result, black frit areas remain soft and only freeze after the cooling of the clear portion, resulting in residual stress,
25 which can exceed 1000 PSI in the laminate.

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 slight differences in the shape of the surfaces. When the two surfaces are forced together during lamination, the mismatch results in residual stress in the laminate.

30 For these reasons, it would be desirable to minimize or eliminate black frit obscurations. However, areas of windshield with a black frit obscuration have increased in recent years. There are many reasons why this is occurring.

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. Cameras must typically 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, 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 increases, the need for a clear distortion free field of view increases.

While covers and various styling methods can be used to obscure 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 to create an obscuration on the number four **104** surface with openings in the obscuration to provide for the required field of view.

When black enamel frit band is extended downward from the top center black band to create an obscuration **6** on the number four surface **104**, distortion and stress can become a major problem. This is because the black frit is extending further from the edge into the area where more heat must be applied to bend the glass. The large surface area of the obscuration increases the probability of breakage due to 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 occupant an extended vertical field of view.

In the case of a panoramic windshield the problem is even more pronounced as the obscuration **6** extends several centimeters 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.

One possible solution is to print the obscuration on the plastic interlayer rather than on the glass. To date, the primary application for printed interlayers has been for architectural laminates, providing a means to produce vivid colors and patterns at 600DPI that were never

before possible. However, little has been done in the automotive market. One of the reasons is that screen print enamel frits provide 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 than the black enamel frits do.

Another reason is that interlayer printed inks do not provide the deep black glossy appearance of a fired black frit. This is due to the limited number of inks that are available for printing on interlayers.

In addition, the various interlayers in use 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 sheets do not lend themselves well to the automated feed systems of typical printing equipment.

Another area where black printed frits presents challenges is solar control.

In response to the government regulatory requirements for increased automotive fuel economy, as well as the growing public awareness and demand for energy efficient environmentally friendly products, automotive original equipment manufacturers around the world, have been working to improve the energy efficiency of their vehicles.

One of the key elements of this strategy to improve efficiency has been solar control. By reducing the solar load on the vehicle, substantial improvements can be made in energy consumption, especially in warmer climates, by reducing the load on the air-conditioning unit and allowing operation of the vehicle with the windows closed, which improves aerodynamics. This is especially important for electric vehicles, where the improvement directly translates into an increase in the range of the vehicle.

Infrared (IR) absorbing and infrared reflecting glazing are the two primary technologies that are being used to improve solar control.

Infrared absorbing glass has a higher iron content than ordinary transparent glass giving it a greenish tint. Iron compounds in the glass absorb solar energy. By absorbing the energy before it enters the passenger compartment, the solar load on the vehicle is reduced. While infrared absorbing windows can be very effective in reducing the solar load, the glass will heat up and transfer some of the absorbed energy to the passenger compartment through convective transfer and radiation. The glass will get hotter than ordinary transparent glass.

A more efficient method is to reflect the energy back to the atmosphere before it can heat the glass or the interior of the cabin. This is done using various films and coatings that reflect in the infrared.

5 Infrared reflecting coatings include but are not limited to various metal/dielectric layered coatings applied primarily through Magnetron Sputtered Vacuum Deposition (MSVD) as well as others known in the art that are applied via pyrolytic, spray, controlled vapor deposition (CVD), spin, dip, roller and other methods.

The biggest problem, with respect to IR reflecting coating, is that coatings are not compatible with frits. The frit will damage the coating if the frit is printed after the glass has been coated.
10 The frit must first be printed on the glass, fired and then coated. Very few manufacturers have this capability as it requires a large capital investment. Another drawback is that the black frit absorbs solar energy and can get very hot.

Another problem is applying obscurations to non soda-lime glass.

Historically, windows have been made from standard soda-lime glass. This is the most common
15 and economical formulation and accounts for a large percentage of the world's glass productions both for windows and containers. Other types of glass are known but have primarily been reserved for specialty applications. Increasingly, non-standard glass types are finding application in automotive glazing. There they are used to provide for thinner and lighter glazing. While many types of inks are available for printing on soda-lime glass, there are very
20 few if any for non-soda lime glass due to differences in chemistry and processing.

Another key element of the strategy to improve efficiency has been the concept of light weighting. Often, more traditional, less expensive, conventional materials and processes are being replaced by innovative new materials and processes which while sometime being more expensive, still have higher utility than the materials and processes being replaced due to their
25 lower weight and the corresponding increase in fuel efficiency. Sometimes, new materials and processes bring with them added functionality as well in addition to their lighter weight. Vehicle glazing has been no exception.

However, there are limits to get thin the glazing using annealed soda-lime glass. Stress under wind load has always been a factor. With the trend towards increasing the size of windshields,
30 wind load is even more of a concern. Glass is also becoming a structural element in more and more vehicles. The glazing contributes to the stiffness and strength of the car. Fixed glass,

once bonded with a relatively soft curing poly-urethane, is being mounted with higher modulus adhesives. As a result, the glass, once isolated by rubber gaskets and soft butyl adhesives, is now much more subject to loading from the bumps in the road and vehicle torsion.

5 Today, windshields with a 2.1 mm outer ply, a 1.6 mm inner ply and a 0.76 mm plastic interlayer, totaling just under 4.5 mm in total thickness are becoming common. This may be close to the limit of what can be done with conventional annealed soda-lime glass. Increasingly, other non-standard types of glass are finding their way into automotive applications as the quest for thinner, lighter, more durable and stronger glazing continues.

10 There are two processes that can be used to increase the strength of glass. They are thermal strengthening, in which the hot glass is rapidly cooled (quenched) and chemical tempering, which achieves the same effect through an ion exchange chemical treatment.

In the chemical tempering process, ions in and near the outside surface of the glass are exchanged with ions that are larger. This places the outer layer of glass in compression. Compressive strengths of up to 1,000 MPa are possible. Typical methods involved submerging
15 the glass in a tank of molten salt where the ion exchange takes place.

Chemical tempering presents a challenge for glazing where an obscuration is needed. A black frit is typically printed directly onto the surface of the glass prior to the bending of the glass. However, to chemically temper, the glass surface must not have any paint or coatings that will interfere with the ion exchange process. Therefore, organic black inks are applied after bending
20 and chemically tempering. This is a labor intense expensive process. Also, the organic inks are not as durable as their ceramic counterparts.

It would be advantageous to be able to produce an automotive laminate with an obscuration that does not have these drawbacks.

25 **Brief Summary of the Invention**

The laminate of the invention is comprised of at least two glass layers with opposite major faces bonded to each other by means of a plastic bonding interlayer. At least one obscuration is formed integral to the laminate by cutting a sheet of thin non-plasticized PVB (NPPVB) to shape and inserting into the laminate, as the laminate layers are being assembled. The BPPVB
30 is stiff and can be easily formed and handled in thin sheets. Sheets as thin as 50 μm have been

used. Due to the thinness of the obscuration and composition, no compensation is needed to offset the change in thickness at the inboard edge of the obscuration. The PVB and the NPPVB will become viscous and flow under the heat and pressure of the lamination process allowing for even more compliance than with other materials such as PET which do not flow. The BPPVB has excellent adhesion to both the glass and the interlayer, as well as all of the common performance films such as IR reflecting and switchable found in the market. The BPPVB can be cut using the same standard equipment used to cut PVB interlayers. No change is needed to any of the other equipment or processes.

Forming a obscuration integral to the laminate by inserting a sheet of thin non-plasticized PVB (NPPVB) allows for the use of a coatings that are not compatible with frits, allows for the use of a glass compositions that are not compatible with frits, eliminates the need to use organic ink to paint after bending on chemically tempered glass and glass for which no frit is available, improves optical quality (lower reflected and transmitted distortion, an improved modulus transfer function and lower double image separation), provides aesthetics and performance comparable to fired black enamel frit with same glossy deep black appearance as the back frit, provides probability of breakage of 20% lower as measured by ring on ring testing, does not require compensation for thickness and can be fabricated using standard automotive glass processes and equipment.

Description of drawings

1A	Cross section of a typical automotive laminate with black frit obscurations on surfaces 2 and 4.
1B	Cross section of a laminate with an IR reflecting film 24 or a switchable film 44 sandwiched between a set of two transparent plastic interlayers on either side of the film, and two 50 µm thick NPPVB obscurations on surfaces 2 and 3.
2	Exploded view of a windshield comprising a NPPVB obscuration 16. The 201 surface has an IR reflecting coating with a 6 mm edge deletion.
3	Exploded view of a panoramic windshield comprising a NPPVB obscuration around the periphery 16 and an additional separate NPPVB obscuration for the camera area 16. The 201 surface has an IR reflecting coating with a 6 mm edge
4	Exploded view of a panoramic roof comprising a NPPVB obscuration 16. The 201 surface has an IR reflecting coating with a 6 mm edge deletion.

5	Exploded view of a panoramic roof comprising a NPPVB obscuration 16 concealing the edges of and busbars of a sheet of variable light transmittance switchable film from the exterior of the vehicle. The 201 surface has an IR reflecting coating with a 6 mm edge deletion. A printed black frit obscuration is printed on the 202 of the interior glass layer concealing the same from the interior
6	Exploded view of a panoramic roof comprising a NPPVB obscuration 16 concealing the edges of and busbars of a sheet of variable light transmittance switchable film from the exterior of the vehicle and a second NPPVB obscuration concealing the same from the interior of the vehicle. The number two 201 surface has an IR reflecting coating with a 6 mm edge deletion.

Reference numerals

2	Glass
4	Plastic Bonding Interlayer
6	Black Frit Obscuration
16	Non-plasticized polyvinyl butyral
18	IR Reflecting Coating
24	IR Reflecting Film
34	Bus bar
44	Switchable Film
101	Surface one
102	Surface two
103	Surface three
104	Surface four
201	Outer glass layer
202	Inner glass layer

Detailed description of the invention

- 5 The following terminology is used to describe the laminated glazing of the invention.

A typical automotive laminate cross section is illustrated in Figure 1A. The laminate is comprised of two layers of glass, the exterior or outer 201 and interior or inner 202, that are

permanently bonded together by a plastic layer 4 (interlayer). The glass surface that is on the exterior of the vehicle is referred to as surface 101. The opposite face of the exterior glass layer 201 is surface 102. The glass 2 surface that is on the interior of the vehicle is referred to as surface 104. The opposite face of the interior layer of glass 202 is surface 103. Surfaces
5 two 102 and three 103 are bonded together by the plastic layer 4. An obscuration 6 may be also applied to the glass. Obscurations are commonly comprised of black enamel frit printed on either surface 102, surface 104, or both. The laminate may also comprise a coating 18 on one or more of the surfaces.

The types of glass 2 that may be used include but are not limited to: the common soda-lime
10 variety typical of automotive glazing as well as aluminosilicate, lithium aluminosilicate, borosilicate, glass ceramics, and the various other inorganic solid amorphous compositions which undergo a glass transition and are classified as glass included those that are not transparent. The glass layers may be comprised of infrared absorbing glass compositions as well as infrared reflecting and other types of coatings.

15 The glass layers may be annealed or strengthened. There are two processes that can be used to increase the strength of glass. They are thermal strengthening, in which the hot glass is rapidly cooled (quenched) and chemical tempering which achieves the same effect through an ion exchange chemical treatment. In the chemical tempering process, ions in and near the outside surface of the glass are exchanged with ions that are larger. This places the outer layer of glass
20 in compression. Compressive strengths of up to 1, 000 Mpa are possible.

Laminated safety glass is made by bonding two sheets (201 & 202) of annealed glass 2 together using a plastic bonding layer comprised of a thin sheet of transparent thermo plastic 4 (interlayer) as shown in Figure 1. Annealed glass is glass that has been slowly cooled from the bending temperature down through the glass transition range. This process relieves any stress
25 left in the glass from the bending process. Annealed glass breaks into large shards with sharp edges. When laminated glass breaks, the shards of broken glass are held together, much like the pieces of a jigsaw puzzle, by the plastic layer helping to maintain the structural integrity of the glass. A vehicle with a broken windshield can still be operated. The plastic layer 4 also helps to prevent penetration by objects striking the laminate from the exterior and in the event
30 of a crash occupant retention is improved.

Glass layers are formed using gravity bending, press bending, cold bending or any other conventional means known in the art. In the gravity bending process, the glass flat is supported

near the edge of glass and then heated. The hot glass sags to the desired shape under the force of gravity. With press bending, the flat glass is heated and then bent on a full or partial surface mold. Air pressure and vacuum are often used to assist the bending process. Gravity and press bending methods for forming glass are well known in the art and will not be discussed in detail
5 in the present disclosure.

Cold bending is a relatively new technology. As the name suggests, the glass is bent, while cold to its final shape, without the use of heat. On parts with minimal curvature a flat sheet of glass can be bent cold to the contour of the part. This is possible because as the thickness of glass decreases, the sheets become increasingly more flexible and can be bent without inducing stress
10 levels high enough to significantly increase the long-term probability of breakage. Thin sheets of annealed soda-lime glass, in thicknesses of about 1 mm, can be bent to large radii cylindrical shapes (greater than 6 m). When the glass is chemically, or heat strengthened the glass can endure much higher levels of stress and can be bent along both major axis. The process is primarily used to bend chemically tempered thin glass sheets (≤ 1 mm) to shape.

15 Cylindrical shapes can be formed with a radius in one direction of less than 4 meters. Shapes with compound bend, that is curvature in the direction of both principle axis can be formed with a radius of curvature in each direction of as small as approximately 8 meters. Of course, much depends upon the surface area of the parts and the types and thicknesses of the substrates.

The cold bent glass will remain in tension and tend to distort the shape of the bent layer that it
20 is bonded to. Therefore, the bent layer must be compensated to offset the tension. For more complex shapes with a high level of curvature, the flat glass may need to be partially thermally bent prior to cold bending.

The glass to be cold bent is placed with a bent to shape layer and with a bonding layer placed between the glass to be cold bent and the bent glass layer. The assembly is placed in what is
25 known as a vacuum bag. The vacuum bag is an airtight set of plastic sheets, enclosing the assembly and bonded together its edges, which allows for the air to be evacuated from the assembly and which also applies pressure on the assembly forcing the layers into contact. The assembly, in the evacuated vacuum bag, is then heated to seal the assembly. The assembly is then placed into an autoclave which heats the assembly and applies high pressure. This
30 completes the cold bending process as the flat glass at this point has conformed to the shape of the bent layer and is permanently affixed. The cold bending process is very similar to a

standard vacuum bag/autoclave process, well known in the art, except for having an unbent glass layer added to the stack of glass.

The laminate of the invention may include variable light transmittance layers. To control the level of light transmission through the laminate, there are many technologies available:
5 electrochromic, photochromic, thermochromic and electric field sensitive films which are designed to be incorporated into laminated glass. Of interest are suspended particle device (SPD) films and polymer dispensed liquid crystal (PDLC) films which can quickly change their light transmittance in response to an electrical field.

SPD is a variable tint technology which level of tint can be controlled and varied in response
10 to an applied electrical field. SPD goes from dark in the off state to less dark in the on state. In a SPD film, microscopic droplets of liquid containing needle like particles, light vales, are suspended in a matrix. In the off state the particles are in a random state of alignment and block the transmission of light. The degree of alignment and resulting tint can be varied in response to the applied voltage. The light transmittance in the on and off states can also be
15 shifted through changes to the thickness and composition of the active material. In the off state, it is still possible to see clearly through SPD.

SPD glazing is produced by adding a special film to a laminate. The typical construction of the film is comprised of the active material sandwiched between two thin plastic layers having a transparent conductive coating on each one. The film is laminated between two plastic
20 bonding interlayer layers to form a laminated glazing.

PDLC is a light scattering technology which goes from opaque in the off state to clear in the on state. In a PDLC film, microscopic droplets of liquid crystal are suspended in a polymer matrix. In the off state the liquid crystals are in a random state of alignment and scatter the light providing privacy. In the off state, the film is substantially opaque. When an electric filed
25 is applied, the crystals align and allow light to pass. The degree of scattering can be varied by varying the amplitude of the applied voltage. The level of light transmittance in the on and off states can also be shifted by making changes to the thickness and composition of the active material. PDLC is primarily a privacy product, though it can also be used for solar control as it reduces the solar energy transmitted.

30 Laminates that incorporate these variable light transmittance technologies are sometime referred to as “smart” glass or switchable.

Heat strengthened, full temper soda lime float glass, with a compressive strength in the range of at least 70 Mpa, can be used in all vehicle positions other than the windshield. Heat strengthened (tempered) glass has a high compression layer on the outside surfaces of the glass, balanced by tension on the inside of the glass, which is produced by the rapid cooling of the hot softened glass. When tempered glass breaks, tension and compression are no longer in balance and the glass breaks into small beads with dull edges. Tempered glass is much stronger than annealed laminated glass. Thickness limits of the typical automotive heat strengthening process are in the 3.2mm to 3.6 mm range. This is due to the required rapid heat transfer. It is not possible to achieve the high surface compression needed with thinner glass using the typical blower type low pressure air quenching systems.

The plastic bonding layer **4** (interlayer) has the primary function of bonding the major faces of adjacent layers to each other. The material selected is typically a clear thermoset plastic.

For automotive use, the most commonly used bonding layer **4** (interlayer) is polyvinyl butyral (PVB). PVB has excellent adhesion to glass and is optically clear once laminated. It is produced by the reaction between polyvinyl alcohol and n-butyraldehyde. PVB is clear and has high adhesion to glass. However, PVB is too brittle. Plasticizers must be added to make the material flexible and to provide the ability to dissipate energy over a wide range over the temperature range required for an automobile. Only a small number of plasticizers are used. They are typically linear dicarboxylic esters. Two in common use are di-n-hexyl adipate and tetra-ethyleneglycol di-n-heptanoate. A typical automotive PVB interlayer is comprised of 30-40% plasticizer by weight.

In addition to polyvinyl butyl, ionoplast polymers, ethylene vinyl acetate (EVA), cast in place (CIP) liquid resin and thermoplastic polyurethane (TPU) can also be used. Automotive interlayers are made by extrusion process with thickness tolerance and process variation. As a smooth surface tends to stick to the glass, it is difficult to position it on the glass and to trap air. To facilitate the handling of the plastic sheet and the removal of air (deairing) from the laminate, the surface of the plastic is normally embossed, contributing additional variation to the sheet. Standard thicknesses for automotive PVB interlayer is between 0.38 mm and 0.76 mm (15 and 30 mil). Automotive interlayers are made through extrusion process.

Interlayers are available in a wide range of colors ranging in transparency from transparent to substantially opaque.

While plasticized PVB sheets are limp at room temperature, non-plasticized PVB is stiff. Non-plasticized PVB can be produced in sheets as thin as 10 μm .

As a general rule of thumb, a film, busbar, sensor, wire, lead or other objects can be laminated if the thickness is not more than 1/3 of the total thickness of the interlayer. The interlayer is soft at room temperature. During the lamination process, the interlayer is treated at high temperature and will flow to accommodate onto the added object. The maximum thickness will depend upon other factors such as the dimensions of the object, the thickness of the glass, the strength of the glass, the specific interlayer and the time, temperature and pressure of the lamination cycle. If the object is too thick, the glass may break. Objectionable distortion can also occur. With all other factors remaining the same, thinner is always better with respect to the risk of breakage and distortion.

The obscuration of the invention is produced by cutting a thin sheet of black opaque non-plasticized PVB to the desired shape and then inserting the cut sheet into the laminate. The non-plasticized PVB has excellent adhesion to both the glass and the normal PVB interlayer. Some of the plasticizer from the normal PVB migrates to the non-plasticized PVB further enhancing the properties. A laminate made by this process will pass all government and industry homologation tests, the same as a standard laminate. In fact, the laminate of the invention is stronger since no fired black frit is used, although some embodiments may use a non-plasticized PVB obscuration in conjunction with a standard printed black frit, when convenient as illustrated in the examples. Optics in the area adjacent to the obscuration are remarkably improved over those of a printed and fired black frit, due to the absence of the burn line distortion and residual stress.

The non-plasticized PVB sheets can be cut using the same means used for normal PVB. Typically, PVB is either die cut or CNC cut. Several sheets may be cut at the same time. The stiffness of the material facilitates handling. While the scrap rate may be high, all of the scrap can be recycled and eventually used. Given the thinness of non-plasticized PVB, nothing is needed to compensate for the change in thickness of the layer. The thickness of the non-plasticized PVB is no more than one third of the total thickness of the layer separating the glass layers. Generally, a sheet with a thickness of less than 200 μm will be used, preferably less than 100 μm and preferably less than 50 μm . Thinness is always better as far as lamination is concerned. It should be noted that the thickness of the fired black frit is in the range of 10 – 20 μm .

If needed, the NPPVB black band obscuration and the standard interlayer, may be bonded to each other through the use of heat or a solvent. This may be done if the interlayer/obscuration sheet are to be assembled before the assembly of the laminate. Otherwise, they are assembled together in the normal manner during the step in which the standard interlayer is placed
5 between the two bent glass layers during the assembly portion of the lamination process.

The potential embodiments of the invention include, but are not limited, to a NPPVB plastic. Other plastics that can serve the same function may be substituted, including a partially plasticized PVB and others which have comparable durability, transparency, clarity and adhesion to the various automotive laminate substrates as needed, without departing from the
10 concept of the invention. A fully plasticized PVB may be used as well, but would be cumbersome to prepare and handle in the thickness needed and so presents no advantage over a NPPVB. In standard PVB thicknesses, if an opaque PVB is used for the obscuration, a transparent PVB insert must be used to fill the area not occupied by the obscuration.

As the NPPVB has excellent adhesion to glass when laminated in contact with normal PVB,
15 the obscuration may be positioned in the laminate next to any of the internal glass surface (**102 or 103**). Alternately, if more than one bonding interlayer **4** is used, the obscuration may be placed with both major faces in contact with non-glass surfaces, as it also has excellent adhesion to the interlayer plastic itself and various performance films.

Laminates made in this manner have surprisingly good aesthetics and performance. Viewed
20 side by side, the laminates made by both methods, black frit vs. black NPPVB, are virtually indistinguishable with the laminate of the invention having the same glossy deep black appearance as the back frit. The probability of breakage is 20% better, as measured by ring on ring testing. Optical quality is measurably better with surprisingly lower reflected and transmitted distortion, an improved modulus transfer function and lower double image
25 separation.

Examples

Example 1

The laminated windshield illustrated in Figure 2 is comprised of a standard transparent soda-lime glass, 2.5 mm thick, exterior glass layer **201** and a 2.1 mm thick soda-lime solar green
30 interior glass layer **202**. A sheet of 20 μ m black substantially opaque NPPVB **16** is cut to shape

and inserted into the laminate with a sheet of 0.76 mm PVB interlayer **4**. The assembled laminated is processed, using standard automotive laminating equipment.

Example 2

The laminated panoramic windshield illustrated in Figure 3 is comprised of a standard transparent soda-lime glass, 2.5 mm thick, exterior glass layer **201** and a 2.1 mm thick soda-lime solar green interior glass layer **202**. A sheet of 20 μ m black substantially opaque NPPVB is cut to shape to form the black periphery band obscuration **16**. A second sheet of 20 μ m black substantially opaque NPPVB is cut to shape to form the black camera area obscuration **16** located toward the top center of the windshield. Both obscurations are inserted into the laminate with a sheet of 0.76 mm solar absorbing PVB interlayer **4**. The assembled laminated is processed, using standard automotive laminating equipment.

Example 3

The laminated panoramic roof illustrated in Figure 4 is comprised of a standard transparent soda-lime glass, 2.5 mm thick, exterior glass layer **201** and a 2.1 mm thick soda-lime solar green interior glass layer **202**. A sheet of 20 μ m black substantially opaque NPPVB **16** is cut to shape and inserted into the laminate with a sheet of 0.76 mm PVB interlayer **4**. A black frit obscuration **6** is printed on the number four surface **104** of the interior glass layer **202**. The assembled laminated is processed, using standard automotive laminating equipment.

Example 4

The laminated panoramic roof illustrated in Figure 5 is comprised of a standard transparent soda-lime glass, 2.5 mm thick, exterior glass layer **201** and a 2.1 mm thick soda-lime solar green interior glass layer **202**. A sheet of 20 μ m black substantially opaque NPPVB **16** is cut to shape and inserted into the laminate adjacent to the number two 102 surface of glass. A layer of SPD film **44**, with busbars **37** on opposite ends, is sandwiched between two layers of 0.36 mm thick plastic bonding interlayer **4**. The SPD film **44** has a light transmittance of 20% in the ON state and 2% in the OFF, unpowered state. A black frit obscuration is printed on the number four surface **104** of the interior glass layer **202**. The assembled laminated is processed, using standard automotive laminating equipment.

Example 5

The laminated panoramic roof illustrated in Figure 5 is comprised of a standard transparent soda-lime glass, 2.5 mm thick, exterior glass layer **201** and a 0.7 mm thick chemically tempered aluminosilicate interior glass layer **202**. Two sheets of 20 µm black substantially opaque NPPVB **16** are cut to shape and inserted into the laminate adjacent to the number two **102** and
5 number three **103** surface of glass. A layer of SPD film **44**, with busbars **37** on opposite ends, is sandwiched between two layers of 0.36 mm thick plastic bonding interlayer **4**. The SPD film **44** has a light transmittance of 20% in the ON state and 2% in the OFF, unpowered state. A black frit obscuration is printed on the number four surface **104** of the interior glass layer **202**. The assembled laminated is processed, using standard automotive laminating equipment.

10 Example 6

Example 6 is the same as Example 5 but with a cold bent interior glass layer 202.

CLAIMS

What is claimed is:

1. A laminated glazing comprising:
 - a. at least two glass layers;
 - 5 b. at least one plastic interlayer layer;
 - c. at least one obscuration;

wherein the obscuration is comprised of a thin plastic.
2. The laminate of claim 1 wherein the obscuration comprises a non-plasticized PVB.
3. The laminate of claim 1 wherein the obscuration comprises a partially plasticized PVB.
- 10 4. The laminate of claim 1 wherein the obscuration comprises a fully plasticized PVB.
5. The laminate of claim 1 wherein the thickness of the obscuration is no more than one third of the total thickness of the layer separating the glass layers.
6. The laminate of claim 1 wherein the thickness of the obscuration is less than 200 μm .
7. The laminate of claim 1 wherein the thickness of the obscuration is less than 100 μm .
- 15 8. The laminate of claim 1 wherein the thickness of the obscuration is less than 50 μm .
9. The laminate of claim 1 wherein the major face of the obscuration is in contact with a glass layer.
10. The laminate of claim 1 wherein the major faces of the obscuration are not in contact with a glass layer.
- 20 11. The laminate of claim 1 wherein the laminate comprises a cold bent glass layer.
12. The laminate of claim 1 wherein the laminate comprises a chemically tempered glass layer.
13. The laminate of claim 1 wherein the obscuration serves to obscure from view the laminate components from view from the exterior of the vehicle.
- 25 14. The laminate of claim 1 wherein the obscuration serves to obscure from view the laminate components from view from the interior of the vehicle.
15. The laminate of claim 1 wherein the laminate comprises an IR reflecting layer.
16. The laminate of claim 1 wherein the laminate comprises a variable light transmittance layer.
- 30 17. A vehicle comprising the laminate of claim 1.

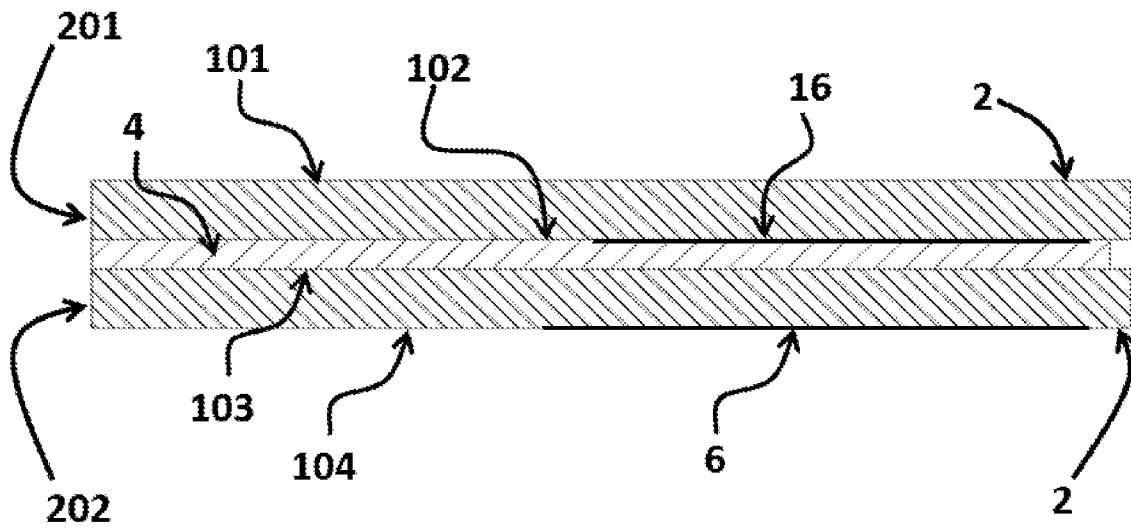


FIG. 1A

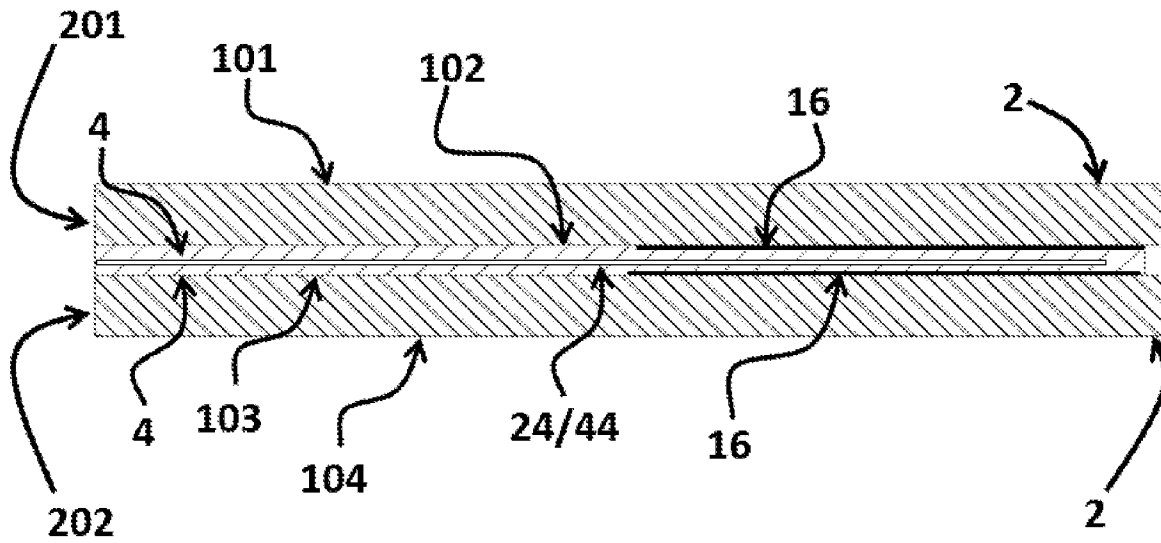


FIG. 1B

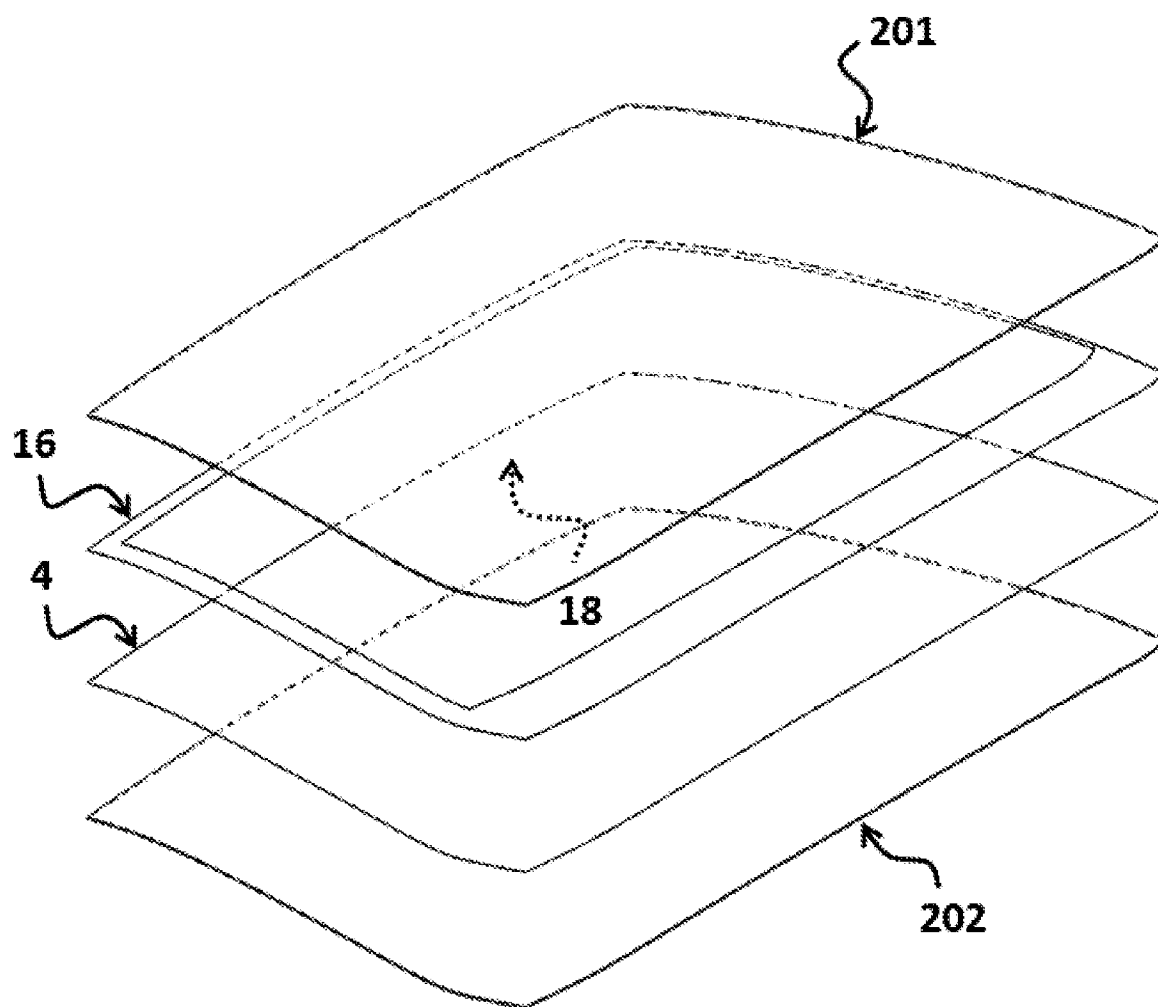


FIG. 2

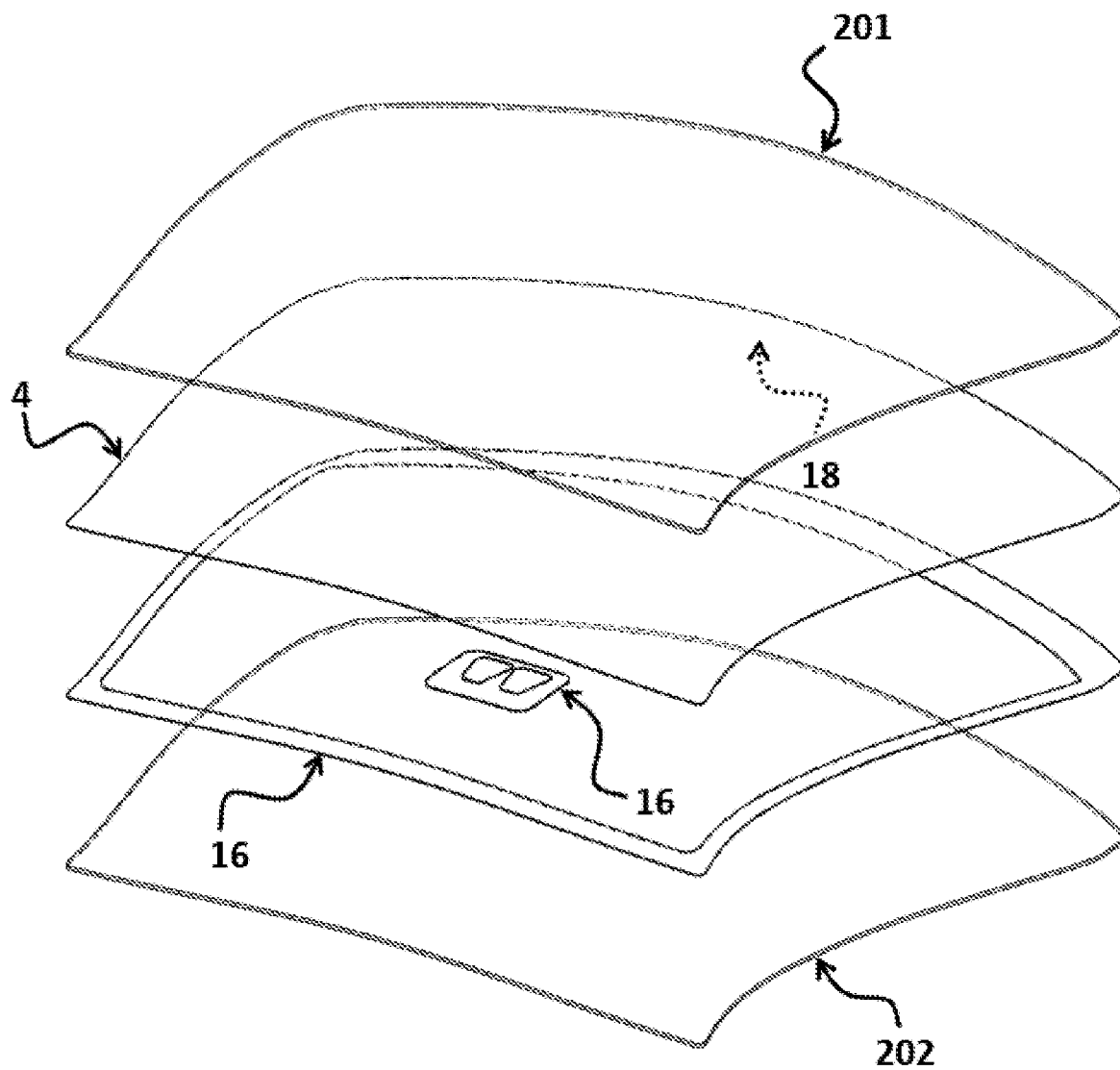


FIG. 3

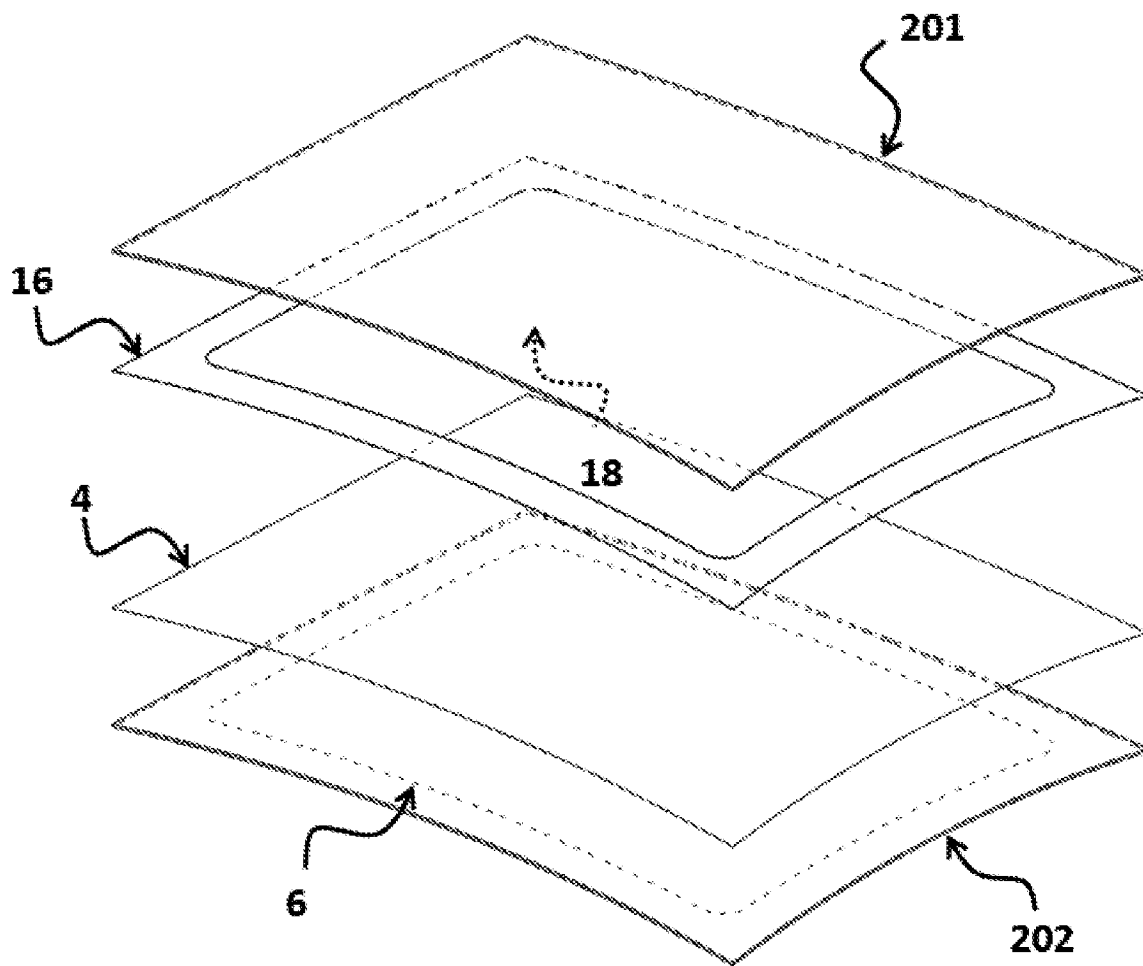


FIG. 4

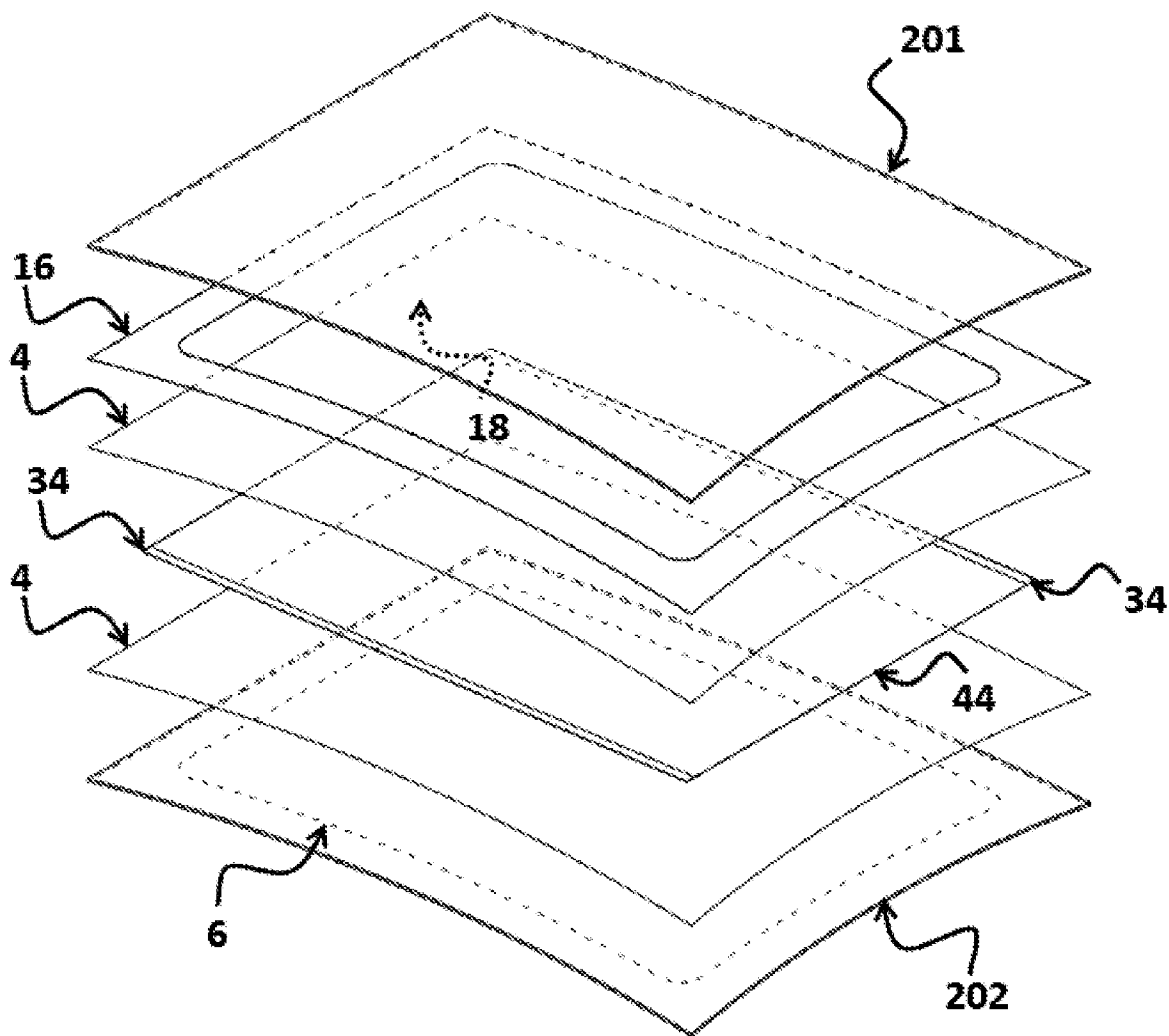


FIG. 5

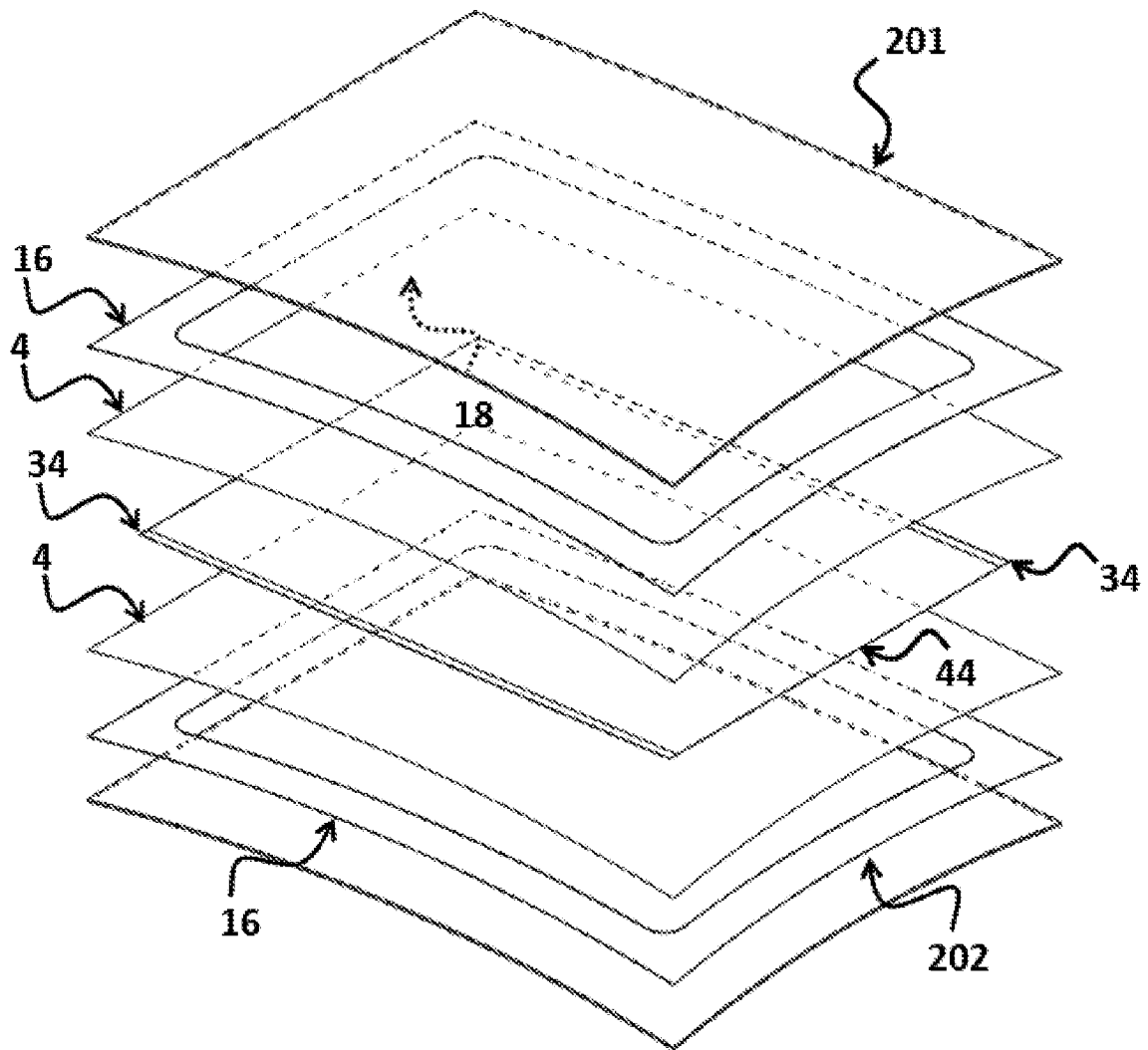


FIG. 6

Provisional Application for Patent Cover Sheet

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

Inventor(s)

Inventor 1

Remove

Given Name

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Family Name

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

Add

Title of Invention

Laminate With Thin Integrated Organic Obscuration

Attorney Docket Number (if applicable)

1511.24400

Correspondence Address

Direct all correspondence to (select one):

☒ The address corresponding to Customer Number

☐ Firm or Individual Name

Customer Number

130961

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

☒ No.

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

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

Entity Status

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

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

Warning

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Signature

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

Signature	Joseph L. Morales/		Date (YYYY-MM-DD)	2017-12-30
First Name	Joseph	Last Name	Morales	Registration Number (If appropriate)
				58835

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Electronic Acknowledgement Receipt

EFS ID:	31373319
Application Number:	62612424
International Application Number:	
Confirmation Number:	7277
Title of Invention:	Laminate With Thin Integrated Organic Obscuration
First Named Inventor/Applicant Name:	Mario Arturo Mannheim Astete
Customer Number:	130961
Filer:	Joseph L. Morales
Filer Authorized By:	
Attorney Docket Number:	1511.24400
Receipt Date:	30-DEC-2017
Filing Date:	
Time Stamp:	21:42:28
Application Type:	Provisional

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	14258.PDF	1823067	no	9
			fa4b46529b464803da6db5682b797138101c8b8a		

Warnings:

Information:					
2	Specification	14256.PDF	482761	no	25
			8c2037cad16ebd5283a39100a6e59143bdb58b87		
Warnings:					
Information:					
3	Provisional Cover Sheet (SB16)	14257.PDF	1477148	no	3
			59059714f13215b05954c1d82ced9b1505a81b0b		
Warnings:					
Information:					
Total Files Size (in bytes):			3782976		
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