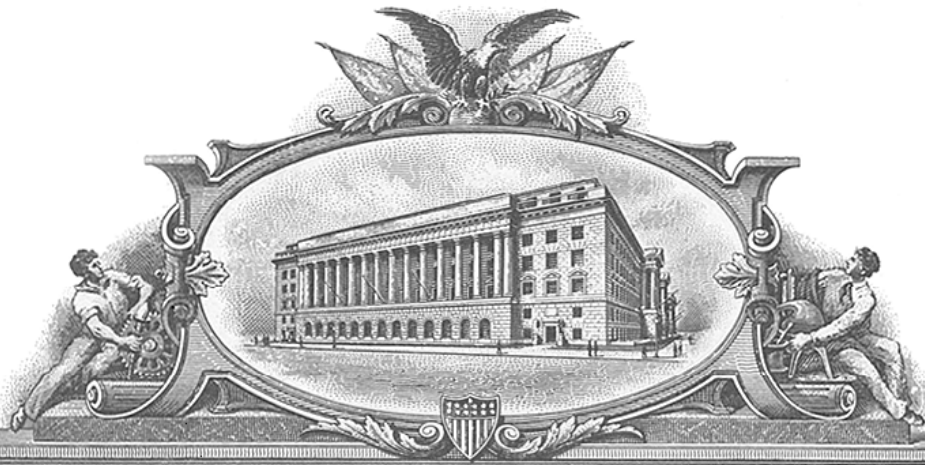


7665781



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

January 25, 2018

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: 62/612,522
FILING DATE: *December 31, 2017*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS US62/612,522



Certified by

Nichelle K. Lee

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

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	1511.24800
		Application Number	
Title of Invention	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending		
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		
	Mario	Arturo	Mannheim Astete			
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		Av. Guillermo Dansey 1846				
Address 2						
City	Cercado de Lima		State/Province			
Postal Code		Country ⁱ	PE			
Inventor	2				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Jean-Marie		Le Ny			
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		Av. Guillermo Dansey 1846				
Address 2						
City	Cercado de Lima		State/Province			
Postal Code		Country ⁱ	PE			
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.						
Add						

Correspondence Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24800
		Application Number	
Title of Invention	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending		

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	130961		
Email Address	morales@moralesq.com	Add Email	Remove Email

Application Information:

Title of the Invention	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending		
Attorney Docket Number	1511.24800	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	7	Suggested Figure for Publication (if any)	

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	130961		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24800
		Application Number	
Title of Invention	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending		

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)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

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)ⁱ 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 ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)	Remove
Additional Foreign Priority Data may be generated within this form by selecting the Add button.				Add

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	1511.24800
		Application Number	
Title of Invention	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending		

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	1511.24800
		Application Number	
Title of Invention	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending		

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. ☒		
Organization Name	AGP America S.A.	
Mailing Address Information For Applicant:		
Address 1	Edificio Arango Orillac, Calle 54 Este	
Address 2	Tercer Piso	
City	Panama City	State/Province
Country	PA	Postal Code
Phone Number		Fax Number
Email Address		
Additional Applicant Data may be generated within this form by selecting the Add button. Add		

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	1511.24800
		Application Number	
Title of Invention	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending		

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.				
				Remove
If the Assignee or Non-Applicant Assignee is an Organization check here.				☐
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country ⁱ		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.				Add

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	/Joseph L. Morales/		Date (YYYY-MM-DD)	2017-12-31
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	1511.24800
		Application Number	
Title of Invention	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending		

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.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

- 1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
- 2 A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
- 3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
- 4 A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
- 5 A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
- 6 A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
- 7 A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
- 8 A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
- 9 A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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

Middle Name

Family Name

City

State

Country j

Mario

Arturo

Mannheim Astete

Lima

PE

Inventor 2

Remove

Given Name

Middle Name

Family Name

City

State

Country j

Jean-Marie

Le Ny

Lima

PE

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

Add

Title of Invention

A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending

Attorney Docket Number (if applicable)

1511.24800

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

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

Signature

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

Signature	Joseph L. Morales/		Date (YYYY-MM-DD)	2017-12-31
First Name	Joseph	Last Name	Morales	Registration Number (If appropriate)
				58835

This collection of information is required by 37 CFR 1.51. 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 8 hours 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. **This form can only be used when in conjunction with EFS-Web. If this form is mailed to the USPTO, it may cause delays in handling the provisional application.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that : (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

A VEHICLE GLAZING HAVING A SHARPLY CURVED PORTION AND THE METHOD FOR BENDING

Field of the invention

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The present invention relates generally to methods for bending vehicle glass layers having complex shapes. Specifically, the present invention relates to methods for forming glass articles having sharply curved complex shapes on the surface of the glass extending from one edge of the glass article and progressively disappearing along its surface.

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Abstract of the invention

The present invention discloses a vehicle glazing having a sharply curved portion and the method for bending such glazing. The sharply curved portion of the glass may extend from one edge and progressively disappears along the surface of the glass. The sharply curved portion is obtained by locally heating by means of laser processing, heating the portion of the glass to a temperature sufficiently high enough to allow said portion of glass to bend. In preferred embodiments, the sharply curved portion comprises a first bent portion described by a first radius and a second bent portion described by a second radius, wherein the point where the radiuses of the first and second bent portions change their orientation generate an inflection point. The radius of curvature of the first and second bent portions is of less than 100 mm.

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Inventors

Name	Nationality	Address
Jean Marie Le Ny	French	Av. Guillermo Dansey 1846, Cercado de Lima, Perú
Arturo Mannheim	Peruvian	Av. Guillermo Dansey 1846, Cercado de Lima, Perú

25

Background of the Invention

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

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One of the key elements of the strategy to improve efficiency has been the concept of light weighting. Often times, 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 lower weight and the corresponding increase in fuel efficiency. Vehicle glazing has been no exception.

Another of the key elements of the strategy to improve efficiency is the concept of aerodynamic. When automobile companies design a new vehicle they take into consideration the automobile drag coefficient in addition to the other performance characteristics. Aerodynamic drag increases with the square of speed; therefore it becomes critically important at higher speeds. Reducing the drag coefficient in an automobile improves the performance of the vehicle as it pertains to speed and fuel efficiency. There are many different ways to reduce the drag of a vehicle.

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For many years, the standard automotive windshield or laminated roof, backlites had a thickness of 5.4mm. In more recent years, we have seen the typical thickness decrease to 4.75 mm. 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 is at or very near the limits of how thin an annealed soda-lime glass windshield can be while still retaining safety and durability characteristics.

It has been a challenge to create new designs of vehicle glazing, where current designs are far from simple flat shapes. The challenge is to get a complex shape of thin flat glass sheets. Optical clarity of the glass sheet is extremely important. Standard molding techniques used for bending and reshaping sheet glass tend to imprint any irregularities to the mold tooling may have onto the glass surface. Additionally, the demand for tighter controlled deformations (e.g., bends) and thinner glass windshields, typically in

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automotive 5 mm thickness or less, means that the traditional processes for bending glass sheets are not suitable as they are unable to cleanly create the necessary structures.

For example in the patent US3865680 describe a window comprising on or more glass
5 sheets having a sharply bent portion extending from edge to edge across a dimension of
the sheet, a pattern of electroconductive material comprising an elongated
electroconductive portion bonded to one or both of said sheets in said sharply bent portion
and approximately coextensive with the sharply bent portion, and further comprising an
additional edge portion of electroconductive material bonded to the glass sheet extending
10 from each end of
said elongated electroconductive portion from a narrow edge portion contacting said
elongated portion to a wider edge portion remote from said elongated portion. The
contacting portion of the edge portion preferably has an electrical resistance per unit
length that approximates that of the elongated portion while the remote, wider edge
15 portion has a lower electrical resistance.

The patent US3865680 refers to a window having a sharply bent portion extending from
edge to edge like is shown in Figure 1. In the present invention a sharply bent portion on
a glazing progressively disappearing along the surface of the glazing and doesn't describe
20 a sharply bent from edge to edge of the glazing like it says in the patent US3865680.

In the prior art the sharp bent portion is composed by at least one radius, said radius in
the prior art are greater than 100mm, like in patent US3865680 where a sharp V-bend
disposed centrally across the window from top edge to bottom edge such that the angle
25 between main portion 12 and main portion 14 is 163 degrees at the top edge gradually
decreasing to 154 degrees at the bottom edge.

Thus, there is a need for processes which allow retention of a high level of flatness in
certain areas of the glazing, and creation of sharply curved portions extending from one
30 edge of the glazing and progressively disappearing along the surface of the glazing.
Embodiments address these needs by allowing for bending and shaping sheet glass using
targeted heating.

Additionally, in the prior art there are vehicle roofs such as the Peugeot RCZ which has two pronounced radius greater than 100 mm. This vehicle uses a panoramic roof with two pronounced radius, which give it, according to its specifications, a greater aerodynamic performance.. These radios are so pronounced that are known as double
5 bubble roof and occupy the entire width and length of the roof vehicle.

It is to be understood that the following detailed description is merely exemplary, and is intended to provide an overview or framework to understanding the nature and character of the claims. The accompanying drawings are included to provide a further
10 understanding, and are incorporated in and constitute a part of this specification. The drawings illustrate one or more embodiment(s), and together with the description serve to explain principles and operation of the various embodiments.

Brief summary of the invention

15

The present invention relates to a vehicle glazing, comprising a glass layer, a sharply curved portion on the glass layer extending from one edge of the glazing and progressively disappearing along the surface of the glazing. The sharply curved portion comprises a first bent portion described by a first radius and a second bent portion
20 described by a second radius, wherein the point where the radiuses of the first and second bent portions change their orientation generate an inflection point. The radiuses of curvature of the first and second bent portions are described by a radius of less than 100mm.

25 The present invention also discloses a method for bending a vehicle glazing having a sharply curved portion, the method comprises: providing a glass sheet, pre-bending the glass sheet by gravity or press bending, locally heating the surface of the glass close to its softening by means of a laser processing, from one edge and progressively disappearing along the surface of the glass, bending the glass in the zone heated.

30

The present invention also discloses a method of bending a flat glass pane having a sharply curved portion, comprising a laser processing the surface of the glass close to its softening point, from one edge and progressively disappearing along the surface of the

outer and inner glass, bending the flat glass with sharp curved portions by gravity or press bending.

Advantages of the present invention:

- 5 • Prevents glass wrinkles during bending.
- Prevents glass wrinkles during lamination.
- Provides an efficient means of bending glass.
- Allows for bending of different glass compositions for use in the same laminate.
- Allows for sharp curved portions on single glass with small radius.
- 10 • Allows to reduce drag coefficient of the vehicle.

Brief description of the drawings

15 FIG. 1 shows a roof from the prior art having two sharply curved portions from edge to edge.

FIG. 2 shows an embodiment of a roof of the present invention having sharply curved portions extending from one edge of the glazing and progressively disappearing along the surface of the glazing.

FIG. 3A shows the cross section of the embodiment of the roof of FIG. 2.

20 FIG. 3B shows the cross section of a laminated roof of the present invention, with a similar shape of the embodiment of FIG. 2.

FIG. 4A, 4B and 4C show different embodiments of roofs of the present invention having different sharply curved portions with different radiuses.

FIG. 5 shows the detail of a sharply curved portion of the roof of the present invention.

25 FIG. 6 shows an embodiment of the process of the present invention, wherein a flat glass is bended by either gravity or press bended, then the glass is processed with laser processing with local heating and finally bended with gravity or press bended in other portions of the glass resulting in a windshield with sharply curved portions.

30 FIG. 7 shows an embodiment of the process of the present invention, wherein a flat glass is located over a mold with a local laser processing to shape two sharply curved portions, after the laser processing the glass rotate 180 degrees and finally the flat parts of the glass are gravity or press bended.

Reference numbers:

1	Inflection point
2	First radius
3	Second radius
4	Glass
5	Press
6	Laser
7	Press-bending
8	Outer glass layer
9	Inner glass layer
10	Windshield/roof
11	Point in the center of the glass
12	Beginning of the path laser
13	End of the path laser
14	Point on the edge of the glass
17	Interlayer
18	Mold
19	Gravity bending
21	Pre- bent glass

Detailed description of the invention

5

The present disclosure can be understood more readily by reference to the following detailed description, drawings, examples, and claims, and their previous and following description. However, before the present compositions, articles, devices, and methods are disclosed and described, it is to be understood that this disclosure is not limited to the specific compositions, articles, devices, and methods disclosed unless otherwise specified, as such can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular aspects only and is not intended to be limiting.

10

Annealed glass is glass that has been slowly cooled from the bending temperature through the glass transition range to relieve any stress in the glass. In a laminate, two sheets of annealed glass are bonded together using a sheet of thermo plastic. If the laminated glass should break, the plastic layer holds the shards of glass together, helping to maintain the structural integrity of the glass. The shards of broken glass are held together much like the pieces of a jigsaw puzzle. A vehicle with a broken windshield can still be operated. On impact, the plastic layer also helps to prevent penetration by the occupant or by objects striking the laminate from the exterior.

Heat strengthened glass, with a compressive strength in the range of 70 Mpa, can be used in all vehicle positions other than the windshield. Heat strengthened, tempered, glass has a layer of high compression on the outside surfaces of the glass, balanced by tension on the inside of the glass. When tempered glass breaks, the 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. The minimum thickness limits of the typical automotive heat strengthening process are in the 3.2mm to 3.6 mm range. This is due to the rapid heat transfer that is required. It is not possible to achieve the high surface compression needed for a full temper with thinner glass using the typical low pressure air quenching systems.

Glass can also be chemically tempered. In this 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. The maximum strength of chemically tempered soda lime glass is limited. However, with some other glass compositions, compressive strengths in excess of 700 Mpa are possible. The practice of chemically tempering glass is well known to those of ordinary skill in the art and shall not be detailed here.

Unlike heat tempered glass, chemically tempered glass breaks into shards rather than beads. This property allows for its use in windshields. However, in standard windshield thicknesses chemically strengthened glass would actually be too strong. In the event of a crash and a head impact, the windshield must break, absorbing the energy of the impact rather than the head of the occupant. Therefore, depending upon the tempered strength, thicknesses of 1.6 mm or less must typically be used.

The majority of the vehicles on the road today have windshields, roofs that were made using the gravity bending process. In this process, the glass layers that form the laminate are placed onto a ring type mold which supports the glass near the edges, or a full surface mold and heated. The glass softens and sags to shape under the forces of gravity.

- 5 Sometimes, for more complex shapes, gravity process is assisted by pneumatic pressure on the partial or full surface pressing. As the glass layers to be laminated are bent in sets, the surfaces, while they may have substantial variation from windshield to windshield, are a near perfect match.
- 10 Glass sheet press bending is performed by pressing a heated glass sheet between complementary curved molds so that the heated glass sheet is bent to conform to the curved shape of the molds. One type of press bending system includes a horizontal conveyor on which glass sheets are conveyed in a generally horizontally extending orientation for the heating and also includes an upper mold that is located above the
- 15 conveyor at a bending station. A lower mold is moved upwardly from below the conveyor to lift each heated glass sheet upwardly toward the upper mold for the press bending operation whereupon a vacuum is drawn at the upper mold to secure the glass sheet as the lower mold is moved downwardly. Thereafter, a transfer mold is moved horizontally under the upper mold and receives the press bent glass sheet for subsequent transfer
- 20 therefrom. Normally, the transfer mold is formed as an open center ring and transfers the press bent glass sheet to a quench station where tempering is performed. This type of press bending system can be utilized with either a gas hearth or roller type conveyor. However, with a gas hearth conveyor where the glass sheets are conveyed on a thin film of pressurized gas, a groove has to be provided in the hearth to permit the lower mold to
- 25 move downwardly below the conveyor so that the heated glass sheet can be conveyed over the lower mold in preparation for the upward movement of the lower mold for the press bending operation. Likewise, a roller conveyor utilizing this type of press bending system requires that the lower mold be of the segmented type so as to be movable upwardly between the spacing between the rolls and full engagement with the periphery
- 30 of the glass sheet being pressed is thus not possible.

In carrying out the above object, the glass sheet press bending system of the invention includes a furnace having a heating chamber for providing a heated ambient for heating

glass sheets and also having a conveyor for conveying the heated glass sheets in a generally horizontally extending orientation. An upper mold of the system is located above the conveyor and has a downwardly facing curved shape. A vacuum drawn at the upper mold and upward gas flow from below the conveyor provide a preferred means for supplying a differential gas pressure to a heated glass sheet on the conveyor below the upper mold to support the glass sheet against the downwardly facing curved shape of the upper mold at a location above the conveyor. A lower mold of the system has an upwardly facing curved shape and is mounted for horizontal movement at an elevation above the conveyor from a first position adjacent the upper mold to a second position below the upper mold and the heated glass sheet supported by the upper mold. An actuator that moves the upper mold vertically provides a preferred means for providing relative vertical movement between the upper and lower molds to press bend the heated glass sheet between the upper and lower molds. A transfer mold of the system receives the bent glass sheet from the upper mold for horizontal movement there from for cooling in the bent shape.

When gravity bending (19) is used, due to the low weight of the thin glass sheets, the edges of the thin glass have a tendency to lift and form wrinkles. If the glass layers are of different compositions, with softening points that are too far apart, it may not be possible to gravity bend the different compositions simultaneously on the same mold as the glass with the lower softening point will become too soft leading to marking and distortion. In this case, the different glass types must be bent separately. Also, due to the low weight of the glass sheets, they do not sag under their own weight in the same predictable and repeatable way that thicker glass does. Another problem is that the glass may begin to sag too soon, before the entire sheet of glass has become soft enough.

Singlet pressing also has problems. The primary one is that as the glass is conveyed through the heating section on rolls it tends to bend under its own weight as it softens resulting in the leading edge hitting the rollers and even falling through.

Lamination also can presents problems for complex geometry. Due to bending deviation and small mismatch between the surface, it can be difficult to get the glass to conform

and to bond to the other glass layers in the laminate. This can lead to delamination, trapped air, distortion and wrinkles.

5 The present invention can provide sharply curved portions along different portions of the glass, specifically from one edge and progressively disappearing along the surface of the glazing. In preferred embodiments, the sharply curved portions can have a radius between 5 mm to 100 mm.

10 The instant invention provides a product and method for a vehicle glazing having a sharply curved portion with a minimum radius. This bent portion starts from one edge and progressively disappears. Additionally, the present invention resolves the problem of making a small sharply bent with a radius less than 20 mm.

15 The vehicle glazing of the present invention, comprises a glass layer; a sharply curved portion on the glass layer extending from one edge of the glazing and progressively disappearing along the surface of the glazing; wherein the sharply curved portion comprises: a first bent portion described by a first radius (2) and a second bent portion described by a second radius (3), wherein the point where the radii of the first and second bent portions change their orientation generate an inflection point (1); wherein the
20 radius of curvature of the first and second bent portions are described by a radius of less than 20 mm.

As can be seen in FIG. 2, there is shown an embodiment of a windshield (10) with at least one sharply curved portion that starts from one edge and progressively disappearing
25 across the surface of the glass. The highlighted area shows that the curved portion disappears in any part of the glass. It is also shown two radii (2) and (3) that provide in one embodiment an S-shaped portion that disappears along the surface of the windshield (10).

30 In the present invention the sharply curved portion on a vehicle glazing like a roof, a windshield or a backlite enables to reduce the drag coefficient of the vehicle.

The sharply curved portion on the vehicle glazing is created with laser (6) processing, wherein the process consists of applying heat locally in the area where the curvature of the glass should be performed. The embodiment of FIG. 2 shows a glass pane that can be made by one single glass layer or can be laminated with at least another one glass layer. It should be noted that the present invention can be laminated with a plurality of glass layers, all of them being curved with the laser process of the present invention in order to get at least two sharply curved portions along the surface of the laminated.

FIG. 3A shows the cross section of the roof of FIG. 2, wherein it is comprised by a single glass layer with two bent curved portions. It should be understood that the glass or glasses can have a plurality of curvature bent portions along the surface of the glass. It should be noted that the present invention allow the creation of curved portions by performing a laser (6) process over the surface of the glass. FIG. 3B shows the cross section of a laminated windshield having plastic interlayers.

FIGs. 4A, 4B, 4C show different embodiments of the present invention, wherein it can be seen the cross section of windshields having a plurality of curved portion with small radiuses. FIG. 4A shows a curved windshield having two curved portions with a first radius (2) and a second radius (3) of less than 20 mm. FIG 4A shows also a big radius (R) which is a typical radius commercially available. It can be of 2000 mm. FIG. 4B shows the cross section of another embodiment of the present invention, where there are two curved portions with small radius (2) connected through flat portions. FIG. 4C shows the cross section of another embodiment, wherein there are at least three curved portions with two small radiuses each one.

FIG. 5 shows the detail of a sharply curved portion of the windshield, the windshield includes a first bent portion described by a first radius (2) and a second bent portion described by a second radius (3), wherein the point where the radiuses of the first and second bent portions change their orientation generate an inflection point (1). The inflection point (1) is the point wherein the first bent curvature changes its course and/or orientation generating a second bent curvature. It should be noted that both curvatures can have similar or different radiuses.

The point of inflection (1) is the point at which the sharply curved portion becomes convex to concave or from concave to convex, as is shown in FIG. 5. The present invention provides windshields allowing to have complex shapes such as curvatures having small radiuses (2) and (3). These curvatures are produced by the application of local heating by means of laser processing over the surface of the glass (4). The laser (6) processing should be understood as the application of precisely power and heat over the surface of the glass (4), in such a way that the bending temperature is reached. The laser (6) is able to control the heat over specific areas and also the depth of penetration of heat power can also be controlled. This would allow the glass windshield to modify the shape by increasing or reducing the curve radiuses.

It has been found that the limit to provide small radiuses is the thickness of the glass. For instance, if the glass has a thickness of 2 mm, the method of the present invention allows the curvature of portions of the glass extending from one of the edges of the glazing having a radius of the same value as the thickness of the glass. In preferred embodiments, the present invention can reach sharply curved portions with a radius having a minimum thickness between 0.5 mm to 5 mm.

In other embodiments, local heating with laser (6) can be combined with other bending methods, such as press or gravity bending. As will be explained in one of the embodiments of the present invention, a press bending (7) process can be carried out after or at the same time the press bending (18) process is performed in one part of the glass (4).

In preferred embodiments, the radius of curvature of the first and second bent portions are described by a radius of less than 100 mm but for the present invention, the radius of curvature of the first and second bent portions are described by a radius, preferably, less than 20 mm.

Conventional bending processes like, press bending (7) or gravity bending (19) allows curvatures with big radiuses, higher than 100 mm. It is almost impossible to reach radiuses below 50 mm using such bending processes. As described in the background, there is no teaching in on how to reach sharp curvatures with a radius of less than 10 mm,

and much less having complex shapes in a windshield wherein the complex shape begins from one edge of the glass and progressively disappear along the surface of the glass like is shown in FIG. 2. The present invention uses the technique of applying local heating in the glass (4) with a laser (6). Such technique allows the parameterization of the power and length of the line of heat appliance on the surface of the glass (4).

FIG. 3B, shows an exemplary embodiment where the glazing comprises a laminated glass.

Laminated safety glass is made by bonding two sheets of glass, the outer glass layer (8) and the inner glass layer (9) of annealed glass together using a plastic bonding layer comprised of a thin sheet of transparent plastic or thermo plastic interlayer (17) as shown in Figure 3B. Annealed glass is glass that has been slowly cooled from the bending temperature down through the glass transition range. This process relieves any stress 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 interlayer (17) also helps to prevent penetration by objects striking the laminate from the exterior and in the event of a crash occupant retention is improved.

Annealed glass is glass that has been slowly cooled from the bending temperature down through the glass transition range. This process relieves any stress 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 interlayer (17) also helps to prevent penetration by objects striking the laminate from the exterior and in the event of a crash occupant retention is improved.

The plastic bonding interlayer (17) has the primary function of bonding the major faces of adjacent layers to each other. The material selected is typically a clear plastic. For automotive use, the most commonly used bonding interlayer (17) is polyvinyl butyl (PVB). 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.

Interlayers (17) are available with enhanced capabilities beyond bonding the glass layers together. The invention may include interlayers (17) designed to dampen sound. Such interlayers (17) are comprised whole or in part of a layer of plastic that is softer and more flexible than that normally used. The interlayer (17) may also be of a type which has solar attenuating properties.

Automotive interlayers (17) are made by an extrusion process. A smooth surface tends to stick to the glass, making it difficult to position 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. Standard thicknesses for automotive PVB interlayer at 0.38 mm and 0.76 mm.

To make a sharply curved portion in a laminated glass each glass in the laminated has thickness from 0.5 mm to 5 mm. This allows to have thinnest laminated glazing with sharply curved portion having radius of less than 20 mm.

On the other hand for tempered glass layers, the glass layers may be annealed or strengthened. There are two processes that can be used to increase the strength of glass. The first one is the thermal strengthening, in which the hot glass is rapidly cooled (quenched) and the second one is chemical tempering, in 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. Compressive strengths of up to 1,000 MPa are possible.

To make a sharply curved portion in a tempered glass, the glass has a minimum thickness from 2.8 mm to 5 mm.

There are many materials that are classified as glass and used like glass layers in a vehicle glazing. Glass (4), as used in this document, includes but are not limited to: the common soda-lime variety typical of automotive glazing, as well as aluminosilicate, alkali aluminosilicate, lithium aluminosilicate, borosilicate, glass ceramics, and other inorganic solid amorphous compositions which undergo glass transition and are classified as glass,

included those that are not transparent. The term glass also includes glass like ceramic materials.

5 There are a wide variety of differences in the glass transition temperature range between the various types of glass. The starting point is to pick a glass that has a glass transition range that is sufficiently higher than the glass type that will be bent in the final product. At the forming temperature of the lower temperature glass, the higher temperature glass must retain its shape and strength. In the case of ordinary soda-lime glass, an example, certain formulations of lithium aluminosilicate glass meet these criteria.

10

In preferred embodiments, the glass of the present invention may be any glass material, for instance a thin sodalime, borofloat or aluminum silicate. Due to the local heating process of the present invention, it is possible to reach small radiuses and complex shapes like sharply curves on different portions of the glass.

15

The types of glass that may be used include but are not limited to: the common soda-lime 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
20 that are not transparent.

Making reference to FIG. 6 that represents a method for bending a vehicle glazing having a sharply curved portion, comprises:

- a. providing a flat glass sheet (4);
- 25 b. pre-bending the glass sheet by gravity (19) or press bending (5);
- c. locally heating the surface of the glass (4) by means of a laser (6). It should be noted that the forming of complex shapes can be programmed depending on the design, wherein the limit of the curvature is the vale equivalent to the thickness of the glass. Due to the process used by the
30 present invention, it is possible to form complex shapes from one edge and progressively disappearing along the surface of the glass (4);
- d. bending the glass in the zone locally heated in step (c).

The method of the present invention begins by providing a flat glass (4) sheet, as shown in FIG. 6 that then is bended by any means available in the art. For instance, it can be a press-bending (7) process or a gravity bending (19) process. The glass layers having big radiuses can be formed using gravity bending, press bending, cold bending or any other
5 conventional means known in the art. The glass can be pre-bended prior to step (a).

Generally, in step b) pre-bending the glass sheet by gravity or press bending, this pre-bending was produced by collapse by gravity to a pre-bending support. The optional step of pre-bending sheets gives a preform shape, intermediate between the planar glass (4)
10 and the desired final shape. This pre-bending may also give to the periphery of the glazing its final shape, while the central part is only outlined. The existence of a preferred pre-bending when the final shape has relatively sharp bends, especially when the final shape has curvatures in orthogonal directions (double curvature).

15 Automotive makers are turning more and more to this type of complex shapes with a dual major bending. This pre-bent glazing (21) is generally carried out by gravity, the superimposed sheets being placed on a suitable support, which moves through an oven furnace in the direction of the main bending zone comprising the upper mold and the lower bending mold (18). The oven is used both to the bending temperature the sheets
20 and perform the pre-bending.

Furthermore, in gravity bending (19) process for the step b), the glass layers that form the laminate are placed onto a ring type mold (18) which supports the glass (4) near the edges, or a mold (18) and heated and allowed to sag to shape under the force of gravity acting
25 on the mass of the glass (4). The glass softens and sags to shape under the forces of gravity. Sometimes, gravity bending (19) is assisted by pneumatic pressure and/or a partial or full surface pressing.

An optional bending process that can be performed in the glass sheets of the present
30 invention, specifically on the step b) of the method is the press bending (7). The press bending (7) process requires that the glass (4) is located over a bending mold (18). Then the mold (18) is heated to the softening point of the glass (4), that its around 650°C,

depending of the viscosity of the glass, and finally is applied a specific pressure over the glass with a press-bending (7), until the glass acquire the shape of the bending mold (18).

5 Afterwards, the bending requires the elevation of temperature to reach the softening point temperature of the glass that is going to be bent. Then, pressure is applied with a press (5) and a mold (18) in order to acquire the desired curvature, and then cooling the glass in a controlled way reaching a temperature below the annealing temperature of the glass.

10 In step d), the step of locally heating the surface of the glass close to its softening, can be made by means of a laser (6) processing. The glass is placed on a graphite mold or a metal mold. Then, a laser (6) is applied to the area where the glass is going to be locally heated. The local heat is applied in order to shape sharply curved portions on the inner glass layer (9) and outer glass layer (8) forming radiuses less than 10 mm. The temperature of the laser can reach the softening point of the glass, allowing the curvature of the windshield.
15 The present invention allow the application of heat to a laminated glazing, with at least two glass layers, as shown in FIG. 6. The laser allow the glass to become viscous and therefore malleable allowing the glass to shape sharply curved portions.

20 The laser (6) beam moves along the surface of the glass with absolute precision, following a defined trajectory. When necessary, the laser (6) beam stops, changes position and continues heating the inner glass layers (9) and/or outer glass layers (8).

25 As long as the laser heats the glass layers, they begin to soften at the points that the laser (6) has heated and, begin to bend by gravity, the heated portions sink as if they were made of thick viscous material. Once the desired shape has been achieved, the laser stops and the glass cools. The result is a sharp curved portion with radius less than 20 mm.

30 The laser used in the present invention is a modified high power laser system with an output power of ~2.0 kW and allows a flexible forming of flat glass (4) products. Due to the high absorption of most glasses in the mid infrared wave length range the CO2 laser can be used very efficiently. This laser has the potential of laser radiation for the partial

forming of flat glass (4) and the deformation of glass materials depending on material thickness and the thermal expansion coefficient. Smaller and smaller glass components with more complex geometries can be processed because of the high focusability of the laser beam. With this intensity, it is possible to achieve forming depths of up to 6 mm.

5

When the glasses are formed with laser radiation, the base material is partially heated beyond the softening point. In this process the materials are only brought to a viscoplastic state, where at the heated volume is neither completely molten nor sublimated. An essential process advantage of the laser treatment compared to conventional glass treatment procedures is the locally highly limited and controllable heat input into the component. The change in shape is very often carried out without additional tools or molds, as it is typical for conventional glass forming procedures, pressing or blowing. Centrifugal forces, created through rotational movements or capillary forces which partially break the surface tension of the glass are also utilized.

15

The good focussability of the laser radiation to very small focus diameters allows very small bending radiuses compared to classical forming procedures. The necessary process time for the forming of an edge length of 150 mm is ~3 seconds.

20 With the laser process, relatively low intensities are applied in order to keep the material removal through vaporisation as low as possible. That is why a galvanometrically driven mirror is used which enable scanning speeds of up to 8 m·s⁻¹. Furthermore, multiple scans along the geometries to be formed allow a quasi-simultaneous heating of the interaction zone. The integration of a fast-moving telescope mirror enables a dynamic
25 focussing in order to form different areas of the glass component. Temperature is an essential process parameter for the forming process. Temperature ranges can be analyzed during the treatment through the integration of temperature measuring systems, thermographic camera or pyrometer. For geometries where a homogeneous heating is not possible, a control circuit can be made from the received temperature signal and the
30 laser power can be adjusted according to the effective temperature value. The high process speed requires fast PID-control algorithms.

The laser can bring high temperatures into the glass (~900°C) and curved different types of glass like for instance sodalime, Borosilicate and Aluminosilicate.

5 Additionally, the laser can act on inner (9) and outer (8) glass in a zone less than 50 mm width to shape the sharp bent portion of the glass and wherein a sharp curved portion is of 100 mm can be made by a sagging process, wherein is needed a sharp bent portion of 50 mm it can be made by a press-bending (7) process. The step d) bending the glass in the zone heated in step (c) by press bending (7), gravity bending (19), or sagging process.

10 To make a sharply curved portion in a laminated glass said laminated glass has a minimum thickness from 0.5 mm to 5 mm.

A wide variety of films are available that can be incorporated into a laminate. The uses for these films include but are not limited to: solar control, variable light transmission,
15 increased stiffness, increased structural integrity, improved penetration resistance, improved occupant retention, providing a barrier, tint, providing a sunshade, color correction, and as a substrate for functional and aesthetic graphics. The term “film” shall include all of these as well as other products that may be developed or which are currently available which enhance the performance, function, aesthetics or cost of a laminated
20 glazing. Most films comprise at least one plastic substrate. Most films do not have adhesive properties. To incorporate into a laminate, sheets of plastic interlayer are needed on each side of the film so as to bond the film to the other layers of the laminate.

25 After the method described above the hot laminated glass can be cooled at ambient temperature.

For tempered glass, the glass layers may be annealed or strengthened. There are two processes that can be used to increase the strength of glass. The first one is the thermal strengthening, in which the hot glass is rapidly cooled (quenched) and the second one is
30 chemical tempering, in 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. Compressive strengths of up to 1,000 MPa are possible.

To make a sharply curved portion in a tempered glass said tempered glass has a minimum thickness from 2.5 mm to 5 mm.

- 5 FIG. 7 describes a second method for bending a flat glass (4) pane having a sharply curved portion, comprising:
- a. laser (6) processing the surface of the glass, from one edge and progressively disappearing along the surface of the outer glass layer (8) and inner glass layer (9);
 - 10 b. bending the flat glass (4) with sharp curved portions by gravity or press bending; and

The differences with the first method described in FIG. 6, lie partly in the order of the step a) laser (6) processing the surface of the glass, from one edge and progressively
15 disappearing along the surface of the outer and inner glass before the step b) bending the flat glass (4) with sharp curved portions by gravity or press bending. The method allow the bending of curved portions for glasses that have a flat section and then need a sharp curved portion. It is possible to provide sharp curved portions made of glass or glass-ceramics having at least one sharply curved portion starting from one edge and
20 progressively disappearing.

The method disclosed in FIG. 7, requires the shape on a glazing a sharply curved portion having a flat glass (4). The process starts bending a portion of the flat glass (4) with the laser (6) described above, forming at least one sharp bent portion on the inner glass layer
25 (9) and outer glass layer (8).

The flat glass is located over a mold (18), which optionally can have vacuum holes on its surface in order to suck the glass and attract the glass to the mold. After located the flat glass (4) on the mold (18) the laser (6) locally heats the portions where the glass needs to
30 be sharply curved. Then, the glass should be rotated 180 degrees over a different mold, for final bending, either by a press-bending (7) or gravity bending (19) process.

In FIG 7, after placing the flat glass on the mold (18) the laser processing shape the sharp curved portion on the glass, there is a flat section of the glass from the point on the edge of the glass (14) to the point of the end of the path laser (13). Adjacent to the flat section there is a section from point of the end of the path laser (13) to point of the beginning of the path laser (12) that describes the width of the laser.

Finally the section from the point of the beginning of the path laser (12) to the point in the center of the glass (11) is wherein the glass is bending by gravity bending or press bending process. The section from the point on the edge of the glass (14) to the point in the center of the glass (11) represents the middle of the glass.

In the method to shape sharply curved portion with good enough geometric tolerance to laminate the glass. This method enable to process of single glass and reach geometrical tolerance that enable good match between glasses for the assembly process, laminated glass with plastic interlayer.

Additionally, the glass curve by means of gravity, press or vacuum and temperature the glass or glass-ceramic intermediate layers, the bending of the glass and glass-ceramic layers is performed simultaneously (bending-annealing) in order to assure parallelism. The process may take anywhere between 100 and 1000 minutes because it requires a slow cooling system in order to allow for the glass/glass, glass/glass-ceramic or glass-ceramic/glass-ceramic interfaces, which cool slower than the glass/air or glass-ceramic/air interfaces, to have lesser cooling rates than the maximum temperature gradient allowed by the material in order to avoid failures due to thermal shock.

After the method described above the hot laminated glass is cooled an ambient temperature.

To make a sharply curved portion in a tempered glass said tempered glass has a minimum thickness from 2.5 mm to 5 mm.

Example 1

In the process of present invention, the vehicles glass pane, preferably composed of thin soda-lime glass, with a thickness of 2.1 mm is pre-bending by press-bending process or a gravity bending process for a laminated glass required in automotive applications and other variety of applications wherein is needed to have bent glass for geometric or functional requirements, like for example in vehicles, wherein is needed to precisely adjust the glass over the desired shape. At the same time, it is important that the glass laminates meets the optical requirements as needed for example in windshield vehicular glasses, giving a glass with the minimum of optical defects.

For pre-bending process sheets may be flat or curved pre already prior to said step and a temperature allowing their bending. They are preferably pre-curved. Before the pre-bending process the glass is heating up at a temperature of $\sim 600^{\circ}\text{C}$. The glass is placed on a full mold and heat it close to its softening point, then a local laser processing reaches a temperature of 900°C to shape sharp curved portions on the inner and outer glass surfaces, around 40mm width, to generate a sharply curved portion of the glass.

A sharply curved portion is formed on the inner and outer surface of the glass by the laser, said sharply curved portion that start from one edge and progressively disappear across the glass having a first bent, describing a radius between 2 mm, or less, to 50 mm in the inner surface, and adjacent to the first bent there is a second bent on the outer surface with a radius between 2 mm, or less, to 100 mm. There is an inflection point between the first bent and the second bent; the inflection point is the point wherein the first bent change its course and/or orientation generating a second bent with a different radius. The exemplified embodiment was constructed with the following dimensions:

Outer surface = 2mm to 5mm
Inner surface = 2mm to 5mm
Radius in the inner surface = 2mm to 50mm
Radius in the outer surface = 2mm to 100mm

It is to be understood that both the foregoing general description and detailed description are merely exemplary, and are intended to provide an overview or framework to understanding the nature and character of the claims. The accompanying drawings are

included to provide a further understanding, and are incorporated in and constitute a part of this specification. The drawings illustrate one or more embodiment(s), and together with the description serve to explain principles and operation of the various embodiments.

CLAIMS

5 What is claimed is:

1. A vehicle glazing, comprising:

- a glass layer;
- a sharply curved portion on the glass layer extending from one edge of the
10 glazing and progressively disappearing along the surface of the glazing;

wherein the sharply curved portion comprises:

a first bent portion described by a first radius and a second bent portion
described by a second radius, wherein the point where the radiuses of
the first and second bent portions change their orientation generate an
15 inflection point;

wherein the radius of curvature of the first and second bent portions are
described by a radius of less than 20 mm.

3 The vehicle glazing of claim 1, wherein the radius of the curvature of the first and
20 second bent portions are described by a radius of less than 100 mm.

4 The vehicle glazing of claim 1, wherein the sharply curved portion is made by
locally heating with a laser.

25 5 The vehicle glazing of claim 1, wherein the glazing is a laminated with a plurality
of glasses and plastic interlayer.

6 The vehicle glazing of claim 1, wherein the glass layer is sodalime, borofloat or
aluminium silicate.

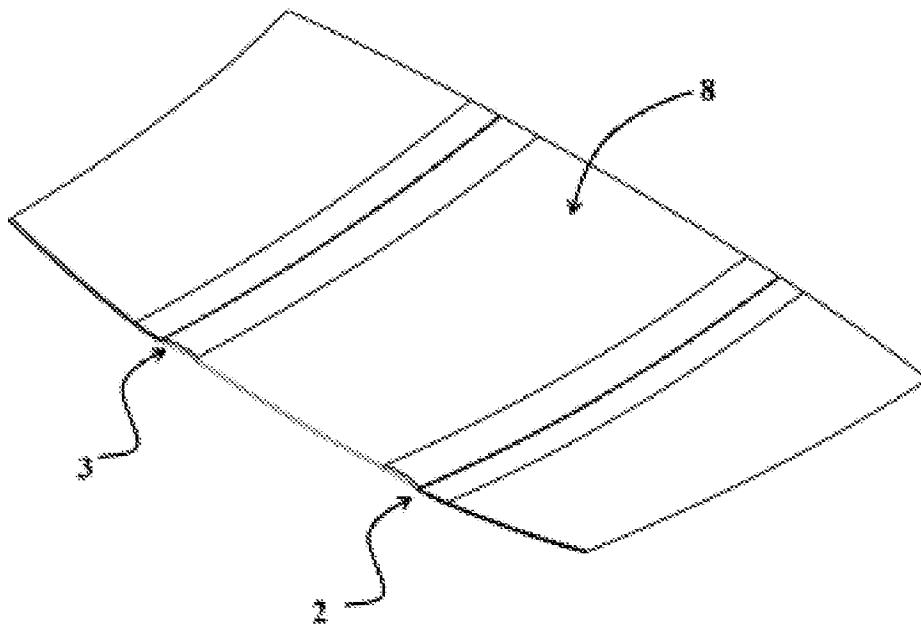
30 7 The vehicle glazing of claim 1, wherein the glass layer is tempered.

8 The vehicle glazing of claim 1, wherein each glass in the laminated has thickness
from 0.5 mm to 5 mm.

- 9 The vehicle glazing of claim 6, wherein the tempered glass has a minimum thickness of 2.5 mm to 5 mm.
- 5 10 The vehicle glazing of claim 1, wherein the vehicle glazing is a roof, backlite or a windshield.
- 11 A method for bending a vehicle glazing having a sharply curved portion, comprising:
- 10 a. providing a glass sheet;
- b. pre-bending the glass sheet by gravity or press bending;
- c. locally heating the surface of the glass by means of a laser processing, from one edge and progressively disappearing along the surface of the glass;
- 15 d. bending the glass in the zone locally heated in step (c).
- 12 The method of claim 11, wherein after step (b), there is a step (c) of laminating.
- 13 The method of claim 11, wherein after step (b), there is a step (d) of thermal strengthening.
- 20 14 The method of claim 12, wherein the bending method is performed to the laminated glass layers either at the same time or individually one after the other.
- 25 15 A method of bending a flat glass pane having a sharply curved portion, comprising:
- a. laser processing the surface of the glass, from one edge and progressively disappearing along the surface of the outer and inner glass;
- b. bending the flat glass with sharp curved portions by gravity or press bending; and
- 30 16 The method of claim 15, wherein after step (b), there is a step (c) of laminating.

- 17 The method of claim 15, wherein after step (b), there is a step (d) of thermal strengthening.
- 18 The vehicle glazing of claim 1, wherein the vehicle glazing is a roof or a backlite
5 that enables to reduce the drag coefficient of the vehicle.

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PRIOR ART

FIG. 1

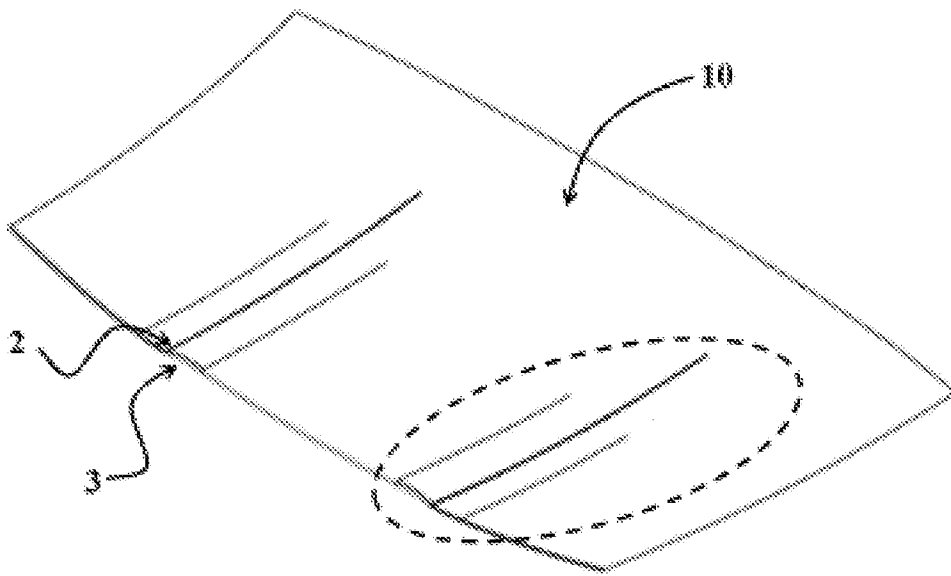
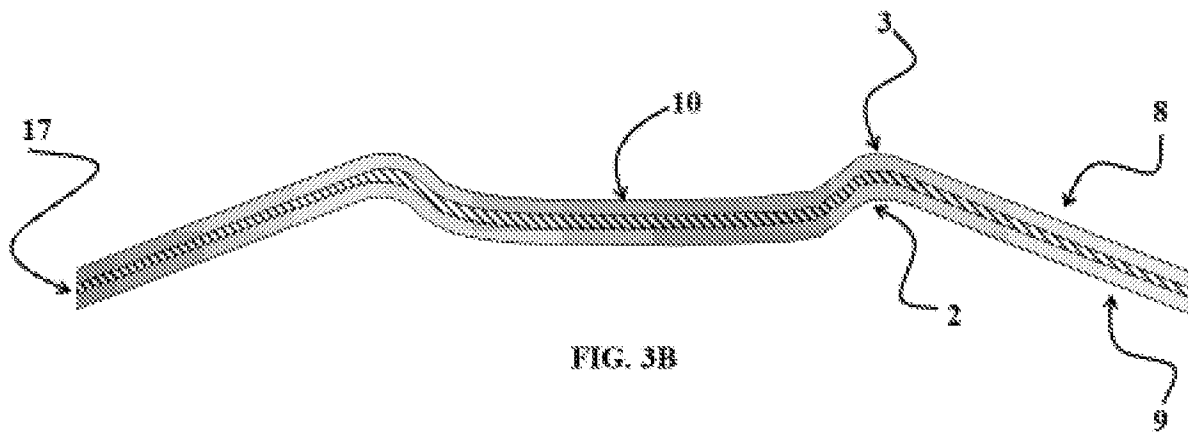
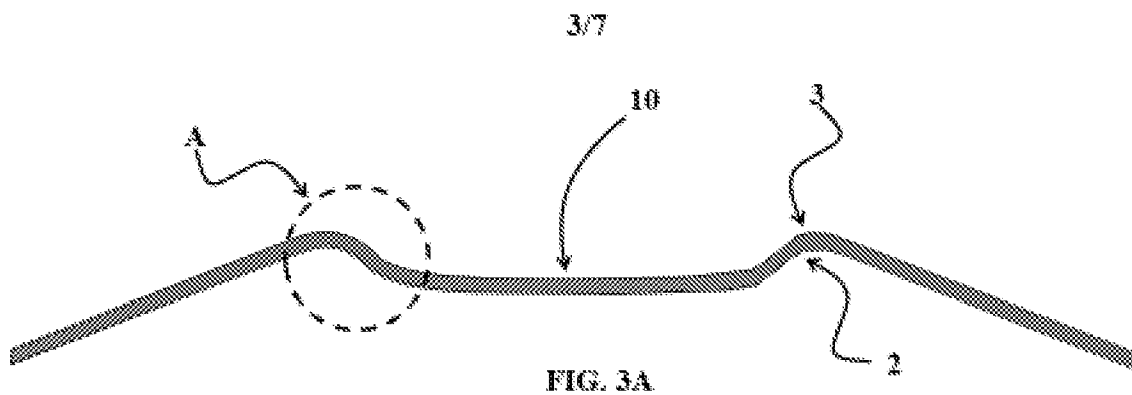
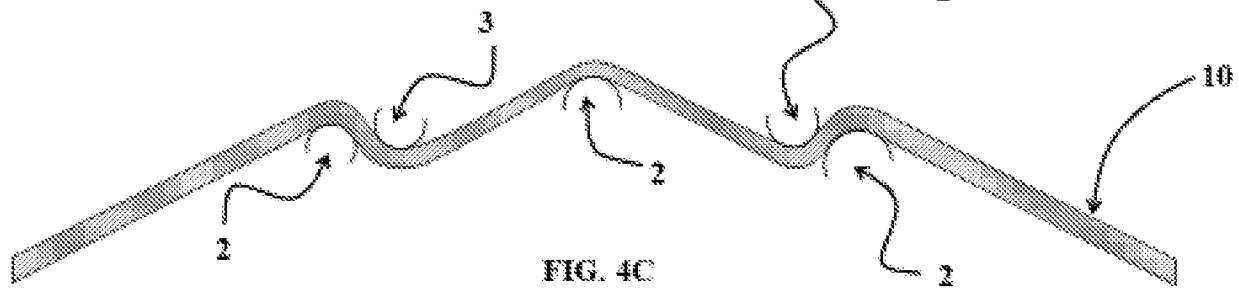
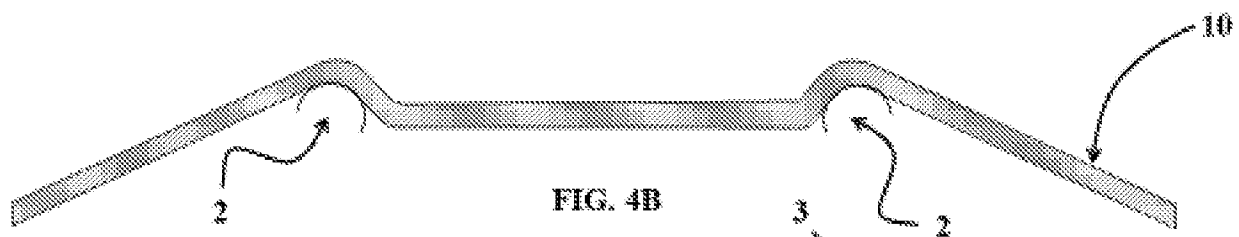
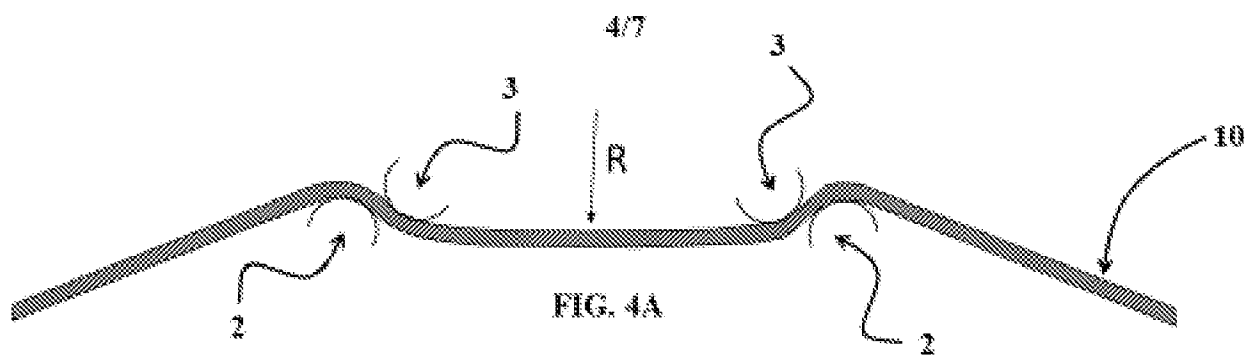


FIG. 2





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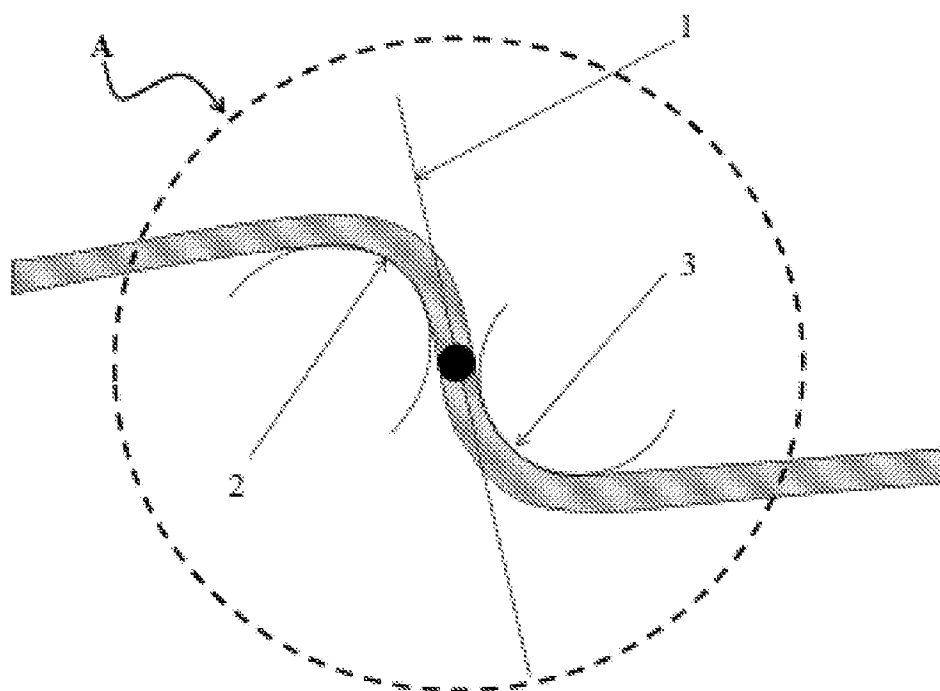


FIG. 5

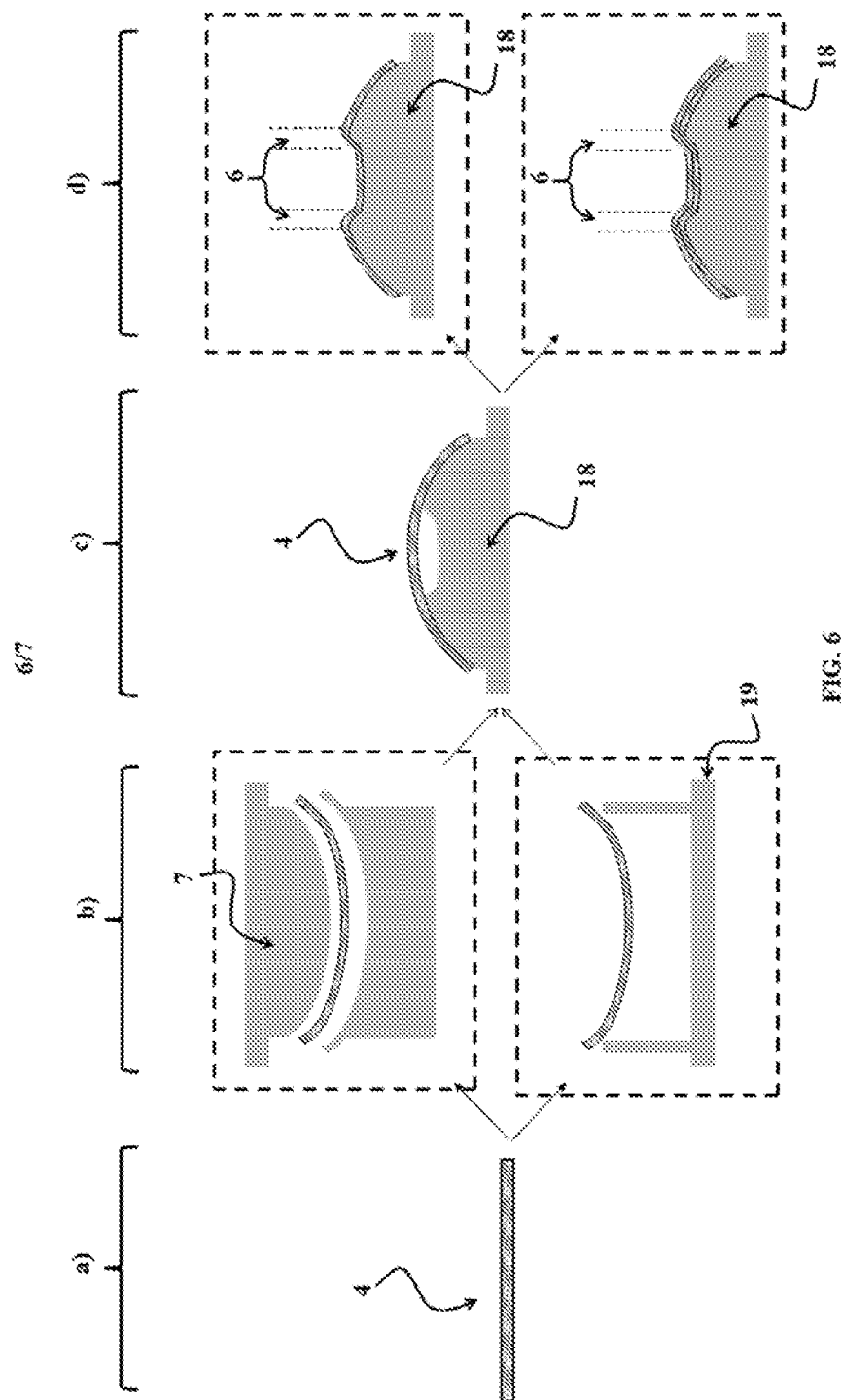
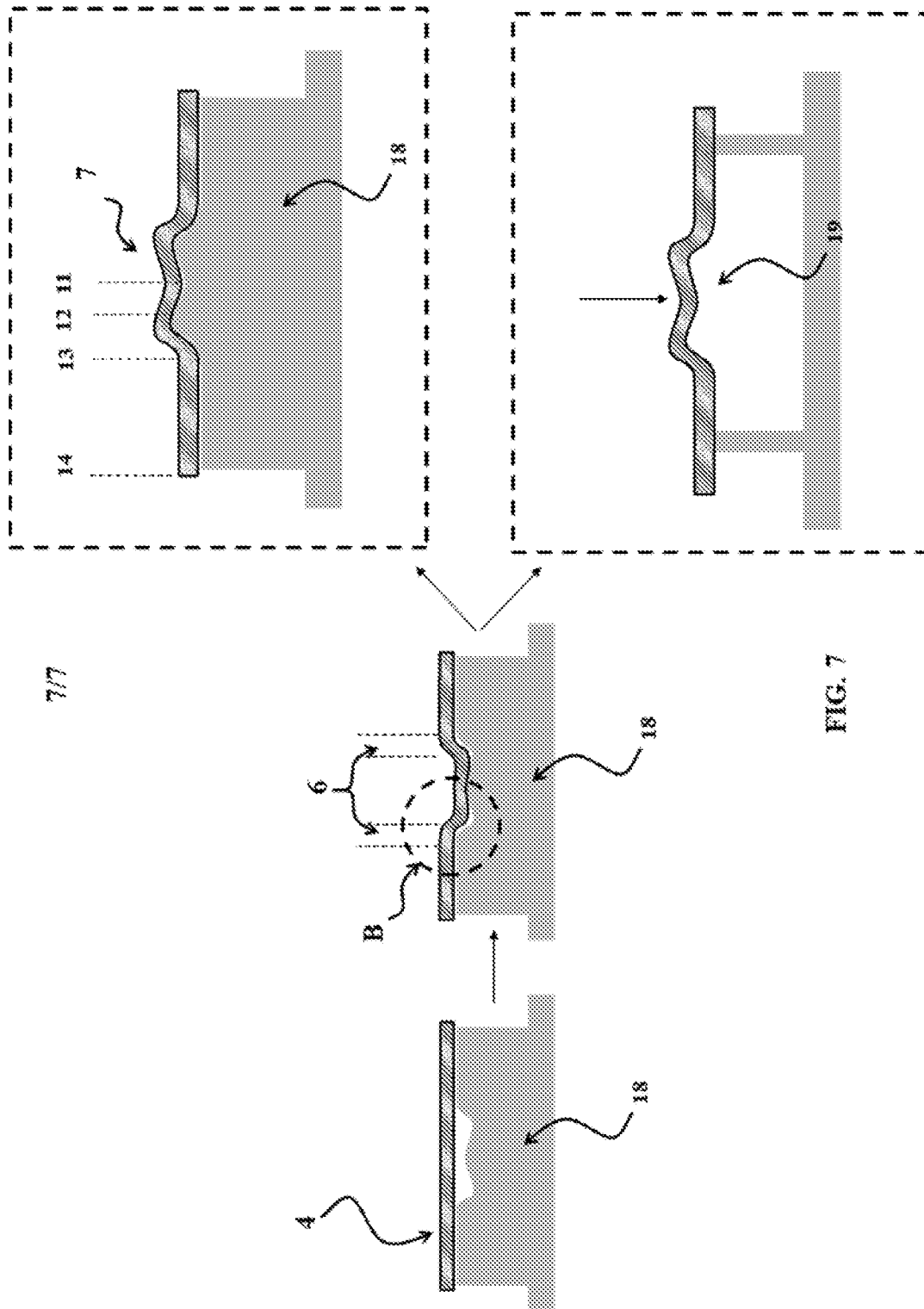


FIG. 6



Electronic Acknowledgement Receipt

EFS ID:	31373910
Application Number:	62612522
International Application Number:	
Confirmation Number:	1849
Title of Invention:	A Vehicle Glazing Having a Sharply Curved Portion and the Method for Bending
First Named Inventor/Applicant Name:	Mario Arturo Mannheim Astete
Customer Number:	130961
Filer:	Joseph L. Morales
Filer Authorized By:	
Attorney Docket Number:	1511.24800
Receipt Date:	31-DEC-2017
Filing Date:	
Time Stamp:	16:54:37
Application Type:	Provisional

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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	14285.PDF	1822957	no	8
			b6f2362de918bf92542c11f0df405f1fd813beb8		

Warnings:

Information:					
2	Provisional Cover Sheet (SB16)	14286.PDF	1477216	no	3
			b4f393f087c6256a2642708998d7052edb89c3fb		
Warnings:					
Information:					
3	Specification	14284.PDF	1158259	no	33
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