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METHOD FOR STRENGTHENING AND BENDING GLASS SHEETS

Field of the invention

5

The present disclosed invention relates to a method for strengthening and bending glass sheets in a single step, and more particularly to a method for strengthening glass sheet by ion exchange using saturated solutions during bending process.

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Background of the invention

15 During glass manufacturing, several processes have to be performed in a specific sequence in order to obtain a desired result. Some of these processes are bending process and ion exchange process. In the bending process, a glass sheet is bent in order to adopt a specific permanent shape by using a bending technique such as gravity bending, press bending or hot bending. In the present invention cold bending, wherein a flat glass is bonded to a curved glass, has not being considered unless the previously curved glass is
20 the one subjected to the ion exchange process.

The gravity bending technique is a bending process in which the glass sheet is gradually heated in a furnace above its deformation point and where the force of gravity acts on the glass sheet, causing to sag under its own weight onto a concave or convex mold placed
25 horizontally in the furnace. Similarly, the press bending technique is a bending process in which the glass sheet is gradually heated in a furnace above its strain point while

compression forces are applied to the glass sheet by press members having complementary surfaces corresponding to the desired shape. In both techniques, after the desired shape is obtained, the glass sheet is cooled in a controlled manner.

- 5 Regarding the ion exchange process, it is performed after the glass is made into the final product, wherein smaller ions in the glass composition (e.g. sodium ions) are substituted with larger ions in a molten ionic salt (e.g. potassium ions) in order to improved/modified some properties in the surface of the glass sheet, such as strength. The ion exchange process creates a thin layer of high compression on the surface which results in a layer of maximum tension at the center. Conventional ion exchange technique is performed by
10 submerging the glass sheet into an ionic bath for several hours at temperatures usually below the strain point of the glass. This technique is widely used today to strengthen glass sheets that are used in mobile phones, televisions, automobiles, etc. In order to make this process manufacturable, large quantities of salt are melted in large stainless-steel vessels, where the glass sheets are ion exchanged following a specific temperature/time recipe,
15 i.e. the ionic bath with the glass sheets inside must be heating at a predetermined temperature T during a predetermined period of time t .

- For example, in a production process of chemically strengthened soda-lime glass sheets, according to the conventional ion exchange technique, an ionic bath composition is
20 prepared into a vessel by melting ionic salt KNO_3 with heat. Next, the glass sheets are preheated at 350°C inside a furnace for two hours, and the temperature of the ionic bath composition prepared is adjusted to about 450°C for chemical strengthening, wherein the glass sheets preheating temperature depends on the temperature at which the glass sheets will be immersed in the ionic bath. Next, the glass sheets are immersed in the ionic bath
25 composition for eight to twelve hours to allow the ion exchange to take place. Finally, the glass sheets are removed from the vessel to cool them gradually to room temperature inside a furnace for three hours.

- 30 Usually, a laminated glass production process requires both bending process and ion exchange process in order to combine two or more glass sheets with at least one sheet interlayer material that keeps the glass sheets bonded even when broken. In this process,

after cutting the glass sheets to a desired size and/or shape, the glass sheets are curved simultaneously by a bending process (for about ten minutes). Next, the glass sheets are chemically strengthened according to the conventional ion exchange technique (for thirteen to eighteen hours). Then, the glass sheets are cleaned and, finally, the glass sheets
5 are laminated together.

As can be noted, the processes are performed sequentially, and the ion exchange process is the most time-consuming process that consumes a considerable amount of energy not only because of the preheating and heating steps, which last several hours, but also
10 because of the bath preparation step. It is especially significant when different types of glasses are needed, each type of glass requiring different ionic bath compositions. Thus, between the processing of two different types of glasses, it is required to remove the current ionic bath composition from the vessel, clean the vessel and reload the vessel with the appropriate ionic bath composition, which can take several days. Therefore, the ionic
15 exchange process becomes the bottle neck of the entire production chain.

Another problem with this conventional technique is that the process is potentially dangerous for the following reasons: (a) it produces large amounts of nitrogen oxides (NO_x) because of the decomposition of the salt at the high temperature during the long
20 heating periods; (b) the salt can react violently with water at high temperature (e.g. a badly dried glass); and (c) the rate of vessel corrosion is elevated because of the high salt concentration. Another problem that arises with conventional technique is the salt cross contamination, i.e. as the salt is continuously used, the bath is progressively enriched with the original ions from the glass. The rate of ion exchange tends to decrease, and so does
25 the compressive stress. At some point, the salt must be changed.

As a partial solution to those problems, some research has proposed methods of strengthening glass, wherein an aqueous solution containing at least one ionic salt is used to provide a film on the glass surface before heat treating. For example, U.S. Pat. No.
30 3,498,773 uses an aqueous solution that changes its salt to water concentration due to the vaporization of water to provide a solid film on a glass surface, while U.S. Pat. No. 4,206,253 uses an aqueous solution containing a surfactant and potassium salts, wherein

the temperature of the aqueous solution is greater than that of the glass container, thereby depositing out the potassium salts on the surface of the glass.

5 However, both mentioned methods have restrictions on saturated solutions and types of glasses that can be used, in part due to the target application (bottle manufacturing). Furthermore, none of the methods describe how to optimize the production process of glass in which bending and ion exchange processes are required.

10 Consequently, there is a need in the art for methods for strengthening glass sheets that be broad in application scope and optimize the use of resources in glass production.

Summary of the invention

15 It is an object of the present invention to provide a method for strengthening glass sheets, which is used during re-forming glass sheets in order to decrease the process time, the energy consumption and the amount of salt used. Furthermore, it is an object of the invention to provide a method, which has no restriction on saturated solution and types of glasses being used. Moreover, it is an object of the present invention to improve extra
20 glass surface properties in addition to strength.

These objects can be attained by a method for strengthening a glass sheet while bending thereof, which comprises the steps of applying a saturated solution at temperature T_1 on the glass sheet at temperature T_2 , wherein the saturated solution contains an ionic salt and
25 a liquid solvent, and wherein $T_1 > T_2$; allowing the solution on the glass sheet to cool, thereby precipitating the ionic salt as soon as the solution temperature decrease, leaving a crust of salt adhered to the surface of the glass sheet; heating the glass sheet at a predetermined temperature T_3 for a predetermined period of time t_3 for bending it by a bending process, wherein the temperature T_3 ranges from the temperature at which the
30 viscosity of the glass sheet is $10^{14.6}$ poises to the temperature at which the viscosity of the glass sheet is $10^{7.6}$ poises, and the time t_3 is enough to impart a selected permanent curvature to the glass sheet; and cooling the glass sheet.

As can be noted, in the case of a saturated solution as the method described above, not as much salt is required as in the case of the conventional ion exchange method where a molten salt is needed. Additionally, since the ion exchange does not occur inside a container with the ionic solution, said solution does not become contaminated. Thus, the salt remaining in the saturated solution can be re-used efficiently for next ionic salt coatings and exchange processes. Furthermore, as the glass sheet does not require to be preheated prior to solution application and the heating step lasts much less than that of the conventional ion exchange method, time and energy consumed are improved significantly.

Also, as the saturated solution is prepared as it is needed and the heating time is reduced considerably, not as much NO_x is produced as in other methods. In addition, since the solution is a saturated solution, there is no probability of salt reacting violently with water as in the conventional method. Moreover, when different types of saturated solutions are needed, each of them can be prepared in a short time, even a previous saturated solution can be re-used to prepare new ones.

Finally, there is no particular limitation on the ionic salt, solvent and type of glass that can be used in the present invention and, therefore, it is possible to modified others glass surface properties in addition to strength.

Brief description of the drawings

These features and advantages of the present invention will become apparent from the detailed description of the following embodiments in conjunction with the accompanying drawings, wherein:

FIG. 1 shows a saturated solution application process according to one embodiment of the present invention.

FIG.2 shows an embodiment of the present invention wherein the bending process is carried out by the gravity bending technique.

FIG. 3 shows an embodiment of the present invention wherein the bending process is carried out by the press bending technique.

FIG. 4 shows a first example of a glass package configuration according to one embodiment of the present invention.

FIG. 5 shows a second example of a glass package configuration according to one embodiment of the present invention.

Detailed description of the invention

Referring now to the drawings, there are shown preferred embodiments of the method according to the present invention.

FIG. 1 shows spray means **1** applying a saturated solution **2** on a glass sheet **3**. The saturated solution **2** is previously prepared by dissolving ionic salt in a liquid solvent (e.g. deionized water) at a temperature T_1 , wherein the solubility of the salt is higher as T_1 increases according to the solubility curve of said salt which plots the changes of the solubility of a salt at different temperatures in a solvent. The ionic salt is a salt with the generic formula ANO_3 , or a mixed ionic salt $(A, B)NO_3$, or a mixture thereof; wherein both A and B are an alkali metal (e.g. $NaNO_3$, KNO_3 and $LiNO_3$, among others). The saturated solution **2** at temperature T_1 is applied on the glass sheet **3** at temperature T_2 , wherein T_1 is greater than T_2 . Next, the solution **2** on the glass sheet **3** is allowed to cool at a cooling rate from $1^\circ\text{C}/\text{min}$ to $100^\circ\text{C}/\text{min}$, thereby precipitating the ionic salt as soon as the solution temperature decrease along the solubility curve of said ionic salt, i.e. as temperature decreases it precipitates as much ionic salt as corresponds to the change of temperature at the curve. As a result, the glass sheet **3** is evenly coated with a recrystallized salt, forming a crust of salt on the surface of the glass sheet **3**. Next, the

glass sheet **3** is heated inside a heat source **8** (FIG. 2) at a predetermined temperature T_3 for a predetermined period of time t_3 for bending it by a bending process, wherein the temperature T_3 ranges from the temperature at which the viscosity of the glass sheet is $10^{14.6}$ poises to the temperature at which the viscosity of the glass sheet is $10^{7.6}$ poises, and the time t_3 is enough to impart a selected permanent curvature to the glass sheet **3**. Lastly, the glass sheet **3** is cooled inside the heat source in a controlled manner, preventing the glass sheets from shattering due to sudden temperature change.

FIG. 2 shows an embodiment wherein the bending process is carried out by the gravity bending technique. In this technique, between the step of allowing the solution on the glass sheet to cool and the step of heating the glass sheet, an additional glass sheet **4** is positioned below the glass sheet **3**, forming a glass package **5**, so that the crust of salt on the bottom surface **6** of the glass sheet **3** is retained in contact with said bottom surface **6** during the heating step. The glass package **5** is supported on a bending mold **7**, and then placed in the heat source **8** for performing the heating step, wherein the force of gravity acts on the glass package **5**, causing to sag under its own weight onto the bending mold **7**.

FIG. 3 shows an embodiment wherein the bending process is carried out by the press bending technique. In this technique, between the step of allowing the solution on the glass sheet to cool and the step of heating the glass sheet, the glass sheet **3** is sandwiched between two additional glass sheets **9**, forming a glass package **10**, so that the crust of salt on both top **11** and bottom **12** surfaces of the glass sheet **3** is retained in contact with said surfaces **11-12** during the heating step. The glass package **10** is heated inside a heat source and then compression forces are applied to it by press members **13-14** having complementary surfaces corresponding to the desired shape.

In certain applications, wherein it is required to bend two or more glass sheets simultaneously (e.g. production process of a laminated glass), the glass sheets are disposed one above the other, forming a glass package. Thus, depending on the glass package configuration, some of these glass sheets can be used as additional glass sheets. For example, according to the present invention, in a production process of two laminated

glass, wherein the selected bending technique is gravitational bending, the laminated glass having the follow composition:

Laminated glass I: a chemically strengthened alkali aluminosilicate glass sheet and a borosilicate glass sheet; and

- 5 Laminated glass II: two chemically strengthened alkali aluminosilicate glass sheets; the glass package **15**, in the former case, comprises a borosilicate glass sheet **16** at the bottom and an alkali aluminosilicate glass sheet **17** at the top (FIG. 4), wherein the alkali aluminosilicate glass sheet **17** has a crust of salt adhered to its surface, so that the borosilicate glass sheet **16** acts as an additional glass sheet, which retains in contact the
- 10 crust of salt on the bottom surface **18** of the alkali aluminosilicate glass sheet **17** with said surface **18** during the heating step.

- In the latter case, the glass package **19** comprises an alkali aluminosilicate glass sheet **20** sandwiched by a sacrificial glass sheet **21** (e.g. borosilicate glass sheet) at the bottom and
- 15 an alkali aluminosilicate glass sheet **22** at the top (FIG. 5), wherein both alkali aluminosilicate glass sheets **20, 22** have a crust of salt adhered to their surface. Despite not being part of the laminated glass composition, the sacrificial glass sheet **21** is required as an additional glass sheet during the heating step in order to retain in contact the crust of salt on the bottom surface **23** of the sandwiched alkali aluminosilicate glass sheet **20**
- 20 with said surface **23**.

In the embodiments depicted in FIG. 1-5, the heat source is a furnace. In all embodiments, the heat source is provided with at least one heat transfer mechanism selected from the group consisting of convection, radiation and conduction.

- 25 Moreover, in the embodiments depicted in FIG. 1-5, the thickness of the crust lies between 20 and 60 μm . However, in other embodiments, the thickness of the crust lies between 16 and 600 μm , preferably between 20 and 120 μm , and even more preferably between 20 and 60 μm .

- 30 Additionally, in the embodiment illustrated in FIG. 1, the saturated solution is atomized on the glass sheet. However, in other embodiments, the saturated solution is applied to

the glass sheet by others means. In an embodiment, the application step is performed by immersing the glass sheet in the saturated solution. In an alternative embodiment, the saturated solution is applied to glass sheet by painting a saturated solution via paint application means.

5

As can be noted, the present invention is not limited to a particular shape, geometry or size of the glass substrate. Furthermore, the invention can be used independently of the glass type and/or composition used, provided that the glass substrate contains alkalis or transition metals in its composition. Moreover, the present invention is able to take advantage of the chemical strengthening process to change others glass surface properties such as luminescence, index of refraction, antimicrobial properties and antibacterial properties, among others. Therefore, in the embodiments in which at least one of these properties are required, the ionic salt is a mixed ionic salt of the form $(C, D)NO_3$; wherein C is an alkali metal and D is selected from the group consisting of transition metal and rare-earth element.

15

Alternatively, in some embodiments, the ionic salt contains at least one salt selected from the group consisting of sulfides, chlorides, halides or hydrates.

In several embodiments, the glass substrates are made of soda-lime, alkali aluminosilicate, lithium aluminosilicate, alkali alkaline earth aluminosilicate or another silicate.

20

In all embodiments, the liquid solvent is water and/or at least one organic solvent (e.g. ammonia and glycerol, among others). In some embodiments, wherein the liquid solvent is water, the liquid solvent is selected from the group consisting of deionized water, distilled water and potable water.

25

Although, only two bending techniques were exemplified herein, one of ordinary skill in the art would appreciate that the present invention can be performed with other well-known bending techniques.

30

Subsequently, a practical example will be set forth to clarify the effects of the present invention.

Example

5 A mixture of equal parts of KNO_3 and deionized water were mixed at 80°C . The saturated solution was painted with a brush on a cold alkali aluminosilicate glass sheet (AAS). The KNO_3 precipitated almost immediately after contacting the surface of the glass sheet. The painted glass sheet was then sandwiched by a soda-lime silicate glass sheet at the bottom and a borosilicate glass sheet at the top, forming a glass package. The glass package entered to a gravity forming furnace preset at 625°C and hold it for 420 seconds. During this time, the glass package decreased the temperature to 576°C . After that, the furnace was allowed to cool down to about 300°C , before removing the curved glass. The total time of the glass package inside the furnace and above the melting point of KNO_3 was of 16 minutes. The result of the painted glass sheet is reported as follow:

15

TABLE 1

Type of glass	Compressive Stress – CS (MPa)	Depth of Layer – DOL (μm)
AAS	507	20

In the example, the compressive strength and depth of layer values obtained (TABLE 1) are typically what have been reported in the literature for the conventional ion exchange method.

It must be understood that this invention is not limited to the embodiments described and illustrated above. A person skilled in the art will understand that numerous variations and/or modifications can be carried out that do not depart from the spirit of the invention, which is only defined by the following claims.

CLAIMS

1. A method for strengthening a glass sheet while bending thereof, comprising the steps of:

- 5 (a) applying a saturated solution at temperature T_1 on the glass sheet at temperature T_2 , wherein the saturated solution contains an ionic salt and a liquid solvent, and wherein $T_1 > T_2$;
- (b) allowing the solution on the glass sheet to cool, thereby precipitating the ionic salt as soon as the solution temperature decrease, leaving a crust of salt adhered to the surface of the glass sheet;
- 10 (c) heating the glass sheet at a predetermined temperature T_3 for a predetermined period of time t_3 for bending it by a bending process, wherein the temperature T_3 ranges from the temperature at which the viscosity of the glass sheet is $10^{14.6}$ poises to the temperature at which the viscosity of the glass sheet is $10^{7.6}$ poises, and the time t_3 is enough to impart a selected permanent curvature to the glass sheet; and
- 15 (d) cooling the glass sheet.

2. The method of claim 1, further comprising, between the step of allowing the solution on the glass sheet to cool and the step of heating the glass sheet, the steps of: providing at least an additional glass sheet; and positioning the glass sheet in contact with said at least additional glass sheet, so that the crust of salt on the surface of the glass sheet become trapped between the surfaces in contact during the heating step.

20

25 3. The method of claim 1, wherein the step of applying the saturated solution comprises: immersing the glass sheet in the saturated solution; and immediately extracting the glass sheet from said solution.

4. The method of claim 1, wherein the step of applying the saturated solution comprises atomizing the solution on the glass sheet via spray means.

30

5. The method of claim 1, wherein the step of applying the saturated solution comprises painting the solution on the glass sheet via paint application means.

6. The method of claim 1, wherein the steps of heating the glass sheet and cooling the glass sheet are carried out by a heat source with at least one heat transfer mechanism selected from the group consisting of convection, radiation and conduction.
- 5 7. The method of claim 1, wherein in the step of allowing the solution on glass sheet to cool, the cooling rate is from 1°C/min to 100°C/min.
8. The method of claim 1, wherein in the step of allowing the solution on the glass sheet to cool, the thickness of the crust lies between 16 and 600 µm, preferably
10 between 20 and 120 µm, and even more preferably between 20 and 60 µm.
9. The method of claim 1, wherein the glass sheet is selected from the group consisting of soda-lime, alkali aluminosilicate, lithium aluminosilicate and alkali alkaline earth aluminosilicate.
- 15 10. The method of claim 1, wherein the ionic salt is selected from the group consisting of ionic salt of the form ANO_3 , mixed ionic salt of the form $(\text{A}, \text{B})\text{NO}_3$, and a mixture thereof; wherein both A and B are an alkali metal.
- 20 11. The method of claim 1, wherein the ionic salt is a mixed ionic salt of the form $(\text{C}, \text{D})\text{NO}_3$; wherein C is an alkali metal and D is selected from the group consisting of transition metals and rare-earth metals.
12. The method of claim 1, wherein the ionic salt contains at least one salt
25 selected from the group consisting of sulfides, chlorides, halides and hydrates.
13. The method of claim 1, wherein the liquid solvent is selected from the group consisting of water, at least one organic solvent, and a mixture thereof.
- 30 14. The method of claim 1, wherein in the step of heating the glass sheet, the bending process is carried out by a technique selected from the group consisting of gravity bending, press bending and techniques that are hybrids thereof.
15. The method of claim 14, wherein the selected technique is gravity bending,

further comprising, between the step of allowing the solution on the glass sheet to cool and the step of heating the glass sheet, the steps of: providing an additional glass sheet; and positioning the glass sheet above the additional glass sheet, so that the crust of salt on the bottom surface of the glass sheet is retained in contact with said bottom surface of the glass sheet during the heating step.

16. The method of claim 14, wherein the selected technique is press bending, further comprising, between the step of allowing the solution on the glass sheet to cool and the step of heating the glass sheet, the steps of: providing two additional glass sheets; and sandwiching the glass sheet between the additional glass sheets, so that the crust of salt on both top and bottom surfaces of the glass sheet is retained in contact with said surfaces of the glass sheet during the heating step.

Abstract

Method for strengthening and bending glass sheets, wherein a saturated saline solution is applied to glass sheets, followed by a rapid temperature change, allowing the salt to precipitate. The glass sheets are then evenly coated with a recrystallized salt. Subsequently, the glass sheets are ion exchanged and bent at a predetermined temperature for a predetermined period of time.

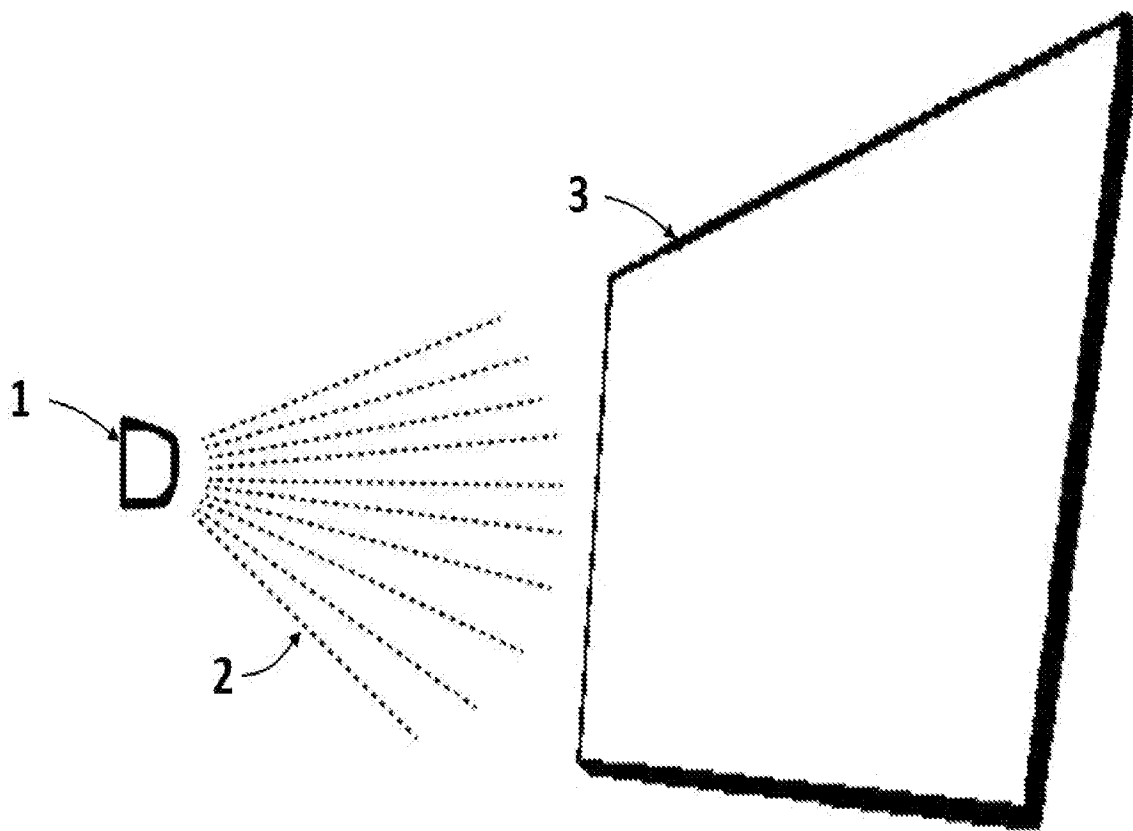


FIG. 1

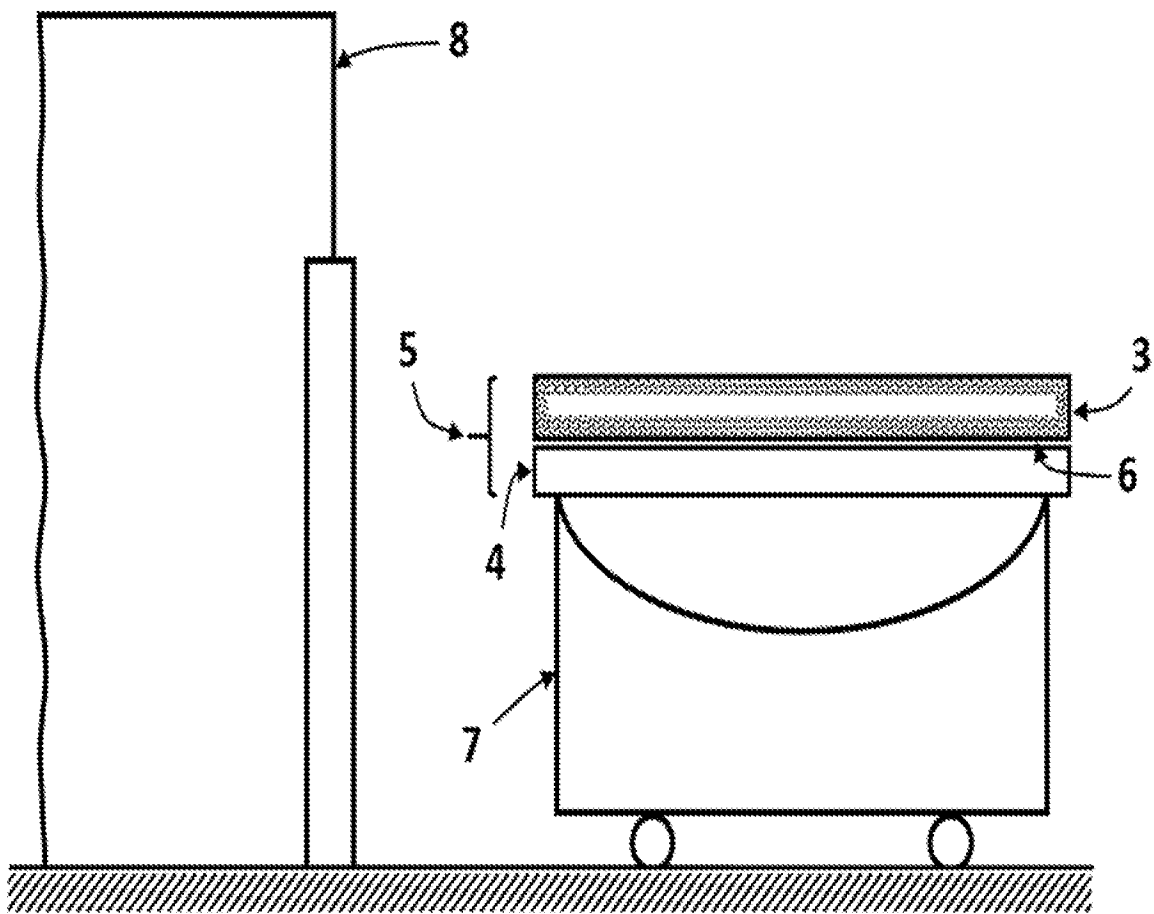


FIG. 2

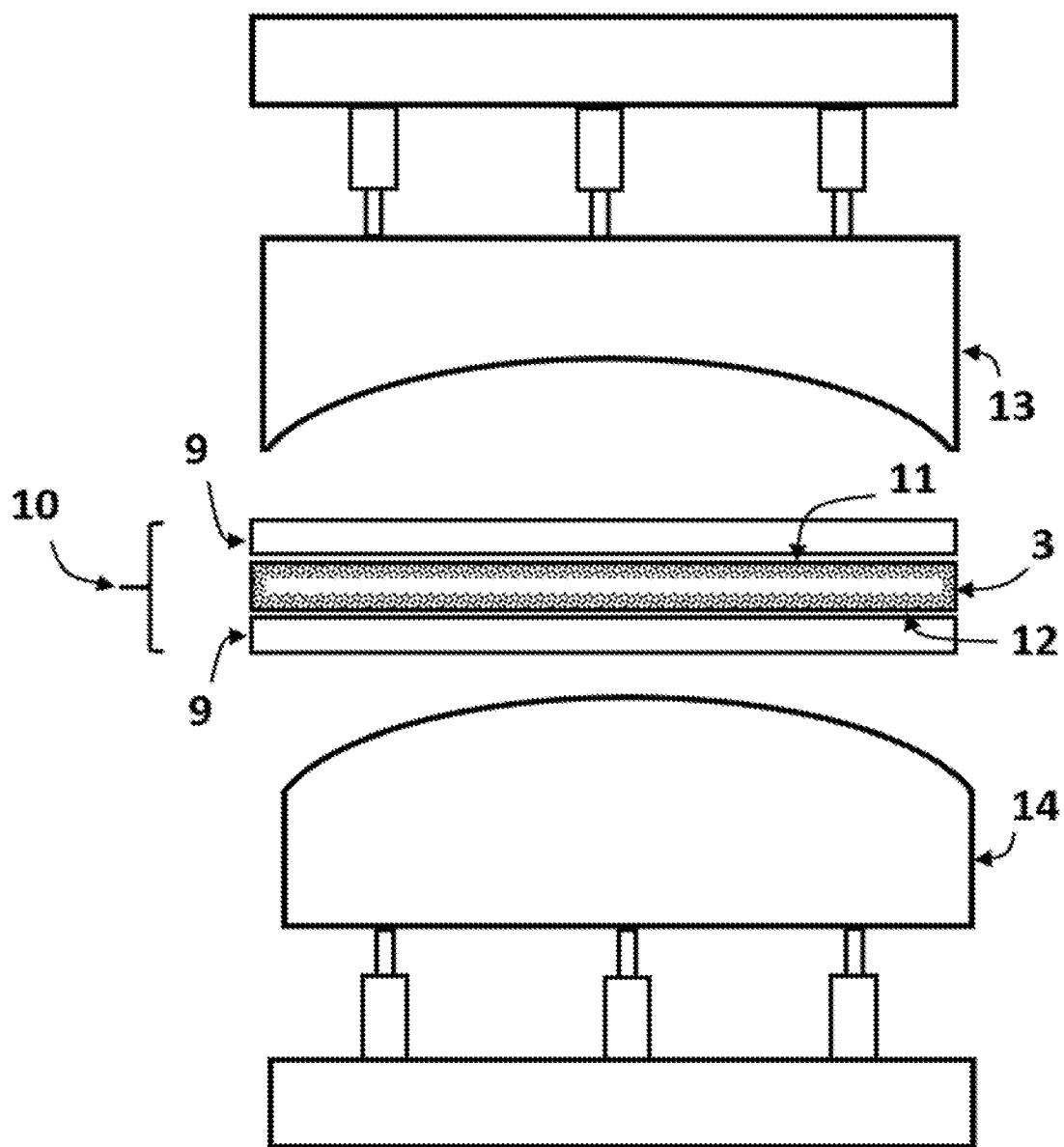


FIG. 3

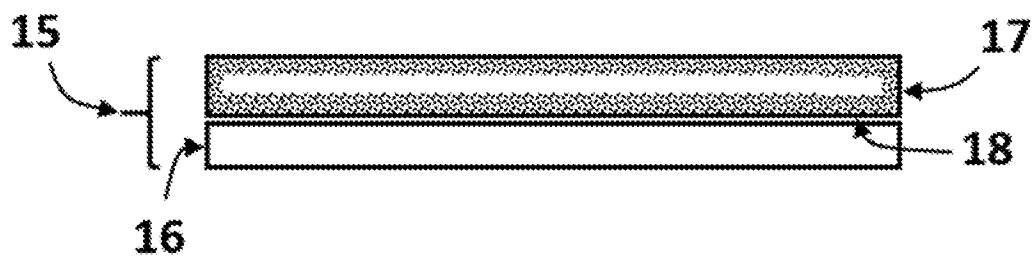


FIG. 4

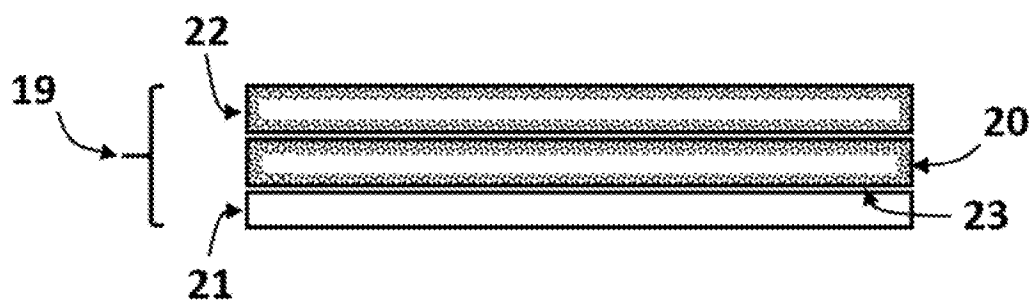


FIG. 5

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24200
		Application Number	
Title of Invention	Method for Strengthening and Bending Glass Sheets		
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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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24200
		Application Number	
Title of Invention	Method for Strengthening and Bending Glass Sheets		

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Title of the Invention	Method for Strengthening and Bending Glass Sheets		
Attorney Docket Number	1511.24200	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	Suggested Figure for Publication (if any)	

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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 ⁱ

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24200
		Application Number	
Title of Invention	Method for Strengthening and Bending Glass Sheets		

Publication Information:

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Prior Application Status		Remove	
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1511.24200
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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	1511.24200
		Application Number	
Title of Invention	Method for Strengthening and Bending Glass Sheets		

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	1511.24200
		Application Number	
Title of Invention	Method for Strengthening and Bending Glass Sheets		

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	MMG Tower, Piso 23	
Address 2	Avenida paseo del Mar	
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	1511.24200
		Application Number	
Title of Invention	Method for Strengthening and Bending Glass Sheets		

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)	2017-12-27
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	1511.24200
		Application Number	
Title of Invention	Method for Strengthening and Bending Glass Sheets		

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

ván

Arturo

Cornejo

Lima

PE

Inventor 3

Remove

Given Name

Middle Name

Family Name

City

State

Country j

Mauricio

Fernando

Cornejo Pol

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

Method for Strengthening and Bending Glass Sheets

Attorney Docket Number (if applicable)

1511.24200

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)	2017-12-27
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.

Electronic Acknowledgement Receipt

EFS ID:	31346474
Application Number:	62610755
International Application Number:	
Confirmation Number:	1059
Title of Invention:	Method for Strengthening and Bending Glass Sheets
First Named Inventor/Applicant Name:	Mario Arturo Mannheim Astete
Customer Number:	130961
Filer:	Joseph L. Morales
Filer Authorized By:	
Attorney Docket Number:	1511.24200
Receipt Date:	27-DEC-2017
Filing Date:	
Time Stamp:	16:47:24
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 260
RAM confirmation Number	122817INTEFSW16481100
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Specification	14207.PDF	343179	no	18
			30a56111fa88472f4c80eda323f13ee53b048495		
Warnings:					
Information:					
2	Application Data Sheet	14205.PDF	1823064	no	9
			85266278f0909f48cde2f3a2d8b9209705753844		
Warnings:					
Information:					
3	Provisional Cover Sheet (SB16)	14204.PDF	1477189	no	3
			ae2743b1c2ad73588befefdd96ef204893fe357c		
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	29667	no	2
			7c011f651f4510d140495710187e9331f08b4d2f		
Warnings:					
Information:					
Total Files Size (in bytes):			3673099		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

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

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.