CANDIDATE'S ANSWER

A, EQE 2018

Method and Glass Panes for Glazing Unit

Technical Field

The invention relates to a method of forming a glass pane suitable for vacuum-insulated-glass (VIG) glazing.

The invention also relates to glass panes for VIG glazing.

The invention also relates to VIG glazing units.

Background

A known method of providing glass panes, on which the preamble of Claim 1 is based, is described in D1.

The method of D1 forms irregular protrusions on glass panes by irradiating with a laser and terminating the irradiation to solidify the protrusions. Claim 1 is different because the protrusions are solidified while a stream of cooling air is passed over the glass.

A technical problem with D1 is that the protrusions are irregular which causes bad transparency.

D2 discloses glass panes for VIG glazing, but uses separate convex-shaped spacers with the panes, which is not ideal for transparency.

Summary of Invention

According to an aspect of the invention, there is provided a method as claimed in Claim 1.

Advantageously, by providing a stream of cooling air over the glass pane during solidification, convex-shaped protrusions may be formed as part of a monolithic structure with the glass pane. Convex-shaped protrusions formed this way provide an improvement in transparency of 20% to 40% with respect to conventional glazing.

Suitably, the stream of cooling air may be provided over the first surface of the glass pane on which the protrusion is formed.

A convex-shaped protrusion as described herein refers to a protrusion in the form of a hemisphere, that may also be flattened on its upper part.

According to another aspect of the invention, there is provided a glass pane as claimed in Claim 8.

As discussed, a monolithic structure of a glass pane with convex-shaped protrusions gives improved transparency.

According to another aspect, there is provided the use of cooling air as claimed in Claim 15.

Insulating glass is known in the art. It provides protection from cold and noise. An insulating glazing comprises two or more, for example three, glass panes, that are mounted spaced apart in a frame. The frame hermetically seals the spaces between the panes which in conventional insulating glazing are filled with a gas like krypton or argon. For example, windows can be manufactured with such insulating glazing.

Recently VIG-glazing was proposed for special applications. VIG-glazing comprises mainly the same components as conventional insulating glazing. In contrast to the latter, the spaces between the panes are not filled with gas but are under vacuum. We consider a pressure of less than 1 atmosphere a vacuum.

The glass panes of the present invention may be used in VIG glazing.

In order to prevent the glass panes from touching each other due to the vacuum applied during manufacturing of the insulating glazing, spacers must be provided between the panes. These are generally distributed over the panes in the required amount. They are typically elements not belonging to the glass panes and are made of plastic, aluminium, ceramics, or glass. These spacers are applied to the glass panes in a separate manufacturing step and are attached with glue for example.

By providing monolithic glass panes according to the present invention, additional steps pf providing separate spaces may be avoided as the protrusions act as spacers.

Preferably the protrusions are formed in more than one location to provide optimal spacing for VIG units.

Preferably [features of Claim 4] and [features of Claim 10].This allows the glass pane to be used as a central pane of a triple glazing unit and provides spacers on both surfaces.

Preferably the lasers are pulsed IR-lasers and/or pulsed UV lasers. It has been found that by using pulsed lasers, the heating of the glass may be quicker and so more economical.

Where protrusions are formed coincidentally on both sides of a pane, preferably a pulsed IR-laser is used. This minimises deformation of the protrusion on the opposite side advantageously.

Preferably [features of Claim 6] and [features of Claim 11]. By forming hemispherical protrusions with flattened tops, local stresses and subsequent damage at the glass contact area in a VIG unit may be avoided.

The obstacle element may be transparent (to the laser) material, for example sodium chloride or quartz glass.

Preferably, [features of Claim 7].

Preferably [features in Claim 9]. By having a protrusion height of 100µm or more, good insulation properties may be obtained when using the panes in VIG units.

By providing a use according to Claim 15, convex-shaped protrusions may be formed on a glass pane by quickly cooling the glass that is heated to flow locally.

Preferably, the use comprises heating the glass by irradiating with a UV and/or IR laser, preferably a pulsed laser.

Claims

1. A method of forming a glass pane (3) suitable for vacuum-insulated-glass glazing, the method comprising:
irradiating a glass pane with a UV laser (1) and/or an IR-laser (1) to create a protrusion at a first location on a first surface (4) of the glass pane facing the laser (1); and
terminating the irradiation to cause solidification of the protrusion;
characterised in that:
the solidification step occurs while a stream of cooling air is provided over the surface (4) of the glass pane (3) to form a convex-shaped protrusion.

2. The method of claim 1, wherein the UV-laser and/or the IR-laser are a pulsed UV-laser and/or a pulsed IR-laser.

3. The method of claim 1 or claim 2, comprising repeating the irradiation and solidification steps at one or more other locations on the glass pane to form a plurality of convex-shaped protrusions distributed over the glass pane.

4. The method of any one of the preceding claims, wherein one or more protrusions are formed on a second surface of the glass pane, substantially coincident with protrusions on the first surface, by either repeating the irradiation and

solidification steps on the second surface, or performing the steps on the second surface simultaneously.

5. The method of claim 4, wherein the laser is a pulsed IR-laser.

6. The method of any one of the preceding claims, wherein one or more protrusions are formed against an obstacle element transparent to the laser to form one or more convex-shaped protrusions that are in the form of a hemisphere flattened at its upper part.

7. The method of claim 6, wherein the obstacle element is in the form of a plate, spaced apart from the glass pane.

8. A glass pane (3) for vacuum-insulated-glass glazing comprising:
one or more convex-shaped protrusions extending from a first surface (4) of the glass pane (3);
characterised in that:
the glass pane (3) and the one or more convex-shaped protrusions form a monolithic structure.

9. The glass pane of claim 8, wherein the one or more protrusions have a height of 100 µm or more from the glass pane surface.

10. The glass pane of claim 8 or claim 9, wherein there are one or more of the one or more protrusions on a second surface of the glass pane, substantially coincident with one or more protrusions on the first surface.

11. The glass pane of any one of Claims 8 to 10, wherein one or more of the one or more protrusions are in the form of a hemisphere flattened at its upper part.

12. A vacuum-insulated-glass glazing unit formed from one or more glass panes as defined in any of Claims 8 to 11 and one or more glass panes without protrusions, wherein the panes are arranged so that the protrusions form one or more spacers between the panes.

13. The glazing unit of Claim 12, wherein the gazing unit is a double glazing unit formed from one glass pane as defined in any of Claims 8 to 11 and one glass pane without protrusions.

14. The glazing unit of Claim 12, wherein the glazing unit is a triple glazing unit formed from either:
one glass pane as defined in Claim 10, between two glass panes without protrusions; or
two glass panes as defined in any one of Claims 8, 9 or 11 and once glass pane without protrusions,
wherein the panes are arranged so that protrusions on separate panes are substantially coincident.

15. Use of cooling air to form a convex-shaped protrusion on a monolithic glass pane, where the protrusion is formed by heating the glass to cause it to flow locally.

Examination Committee I: Paper A - Marking Details - Candidate No

Category		Max. possible	Marks Marker 1	Marker 2
Claims	Method for making protrusions on glass sheet	25	25	25
Claims	Glass pane	25	25	25
Claims	Vacuum insulated glass	20	17	17
Dependent claims	Dependent claims	15	15	15
Description	Description	15	12	12
Total			**94**	**94**

Examination Committee I agrees on 94 points and recommends the grade PASS