Apparatus and Method for Separating a Composite Safety Glass Panel

The invention relates to a device for separating a composite safety glass panel along at least one predefinable dividing line, in particular to separate a composite safety glass sheet therefrom. The composite safety glass panel has at least one composite film and at least two glass panels, wherein the composite film is placed between the glass panels and the composite firm joins the glass panels to one another. The device also has at least one separating means for separating glass panels along the at least one dividing line, preferably by scoring and subsequently breaking it. The device also has at least one heating means that is used to heat the composite film at least along the dividing line.

The invention also relates to a method for separating a composite safety glass panel, wherein the method comprises at least the following steps:

- separating the two glass panels, in particular through mechanical scoring and breaking, along at least one predefinable dividing line,
- heating the composite film along the dividing line, in particular with a heating means,
- pulling the glass panels apart along the dividing line, in particular substantially orthogonal to the dividing line.

A composite safety glass pane is understood in general to be a glass sheet formed from two or more glass panels of the same or different thicknesses, wherein the glass panels are joined to one another by an intermediate layer made of plastic. Special composite safety glass panels contain, e.g. a first glass panel normally made of uncoated glass and a second glass panel made of a second glass, coated on the outer surface, in particular with a thermal protection layer. The two glass panels are glued together with a composite film.

This object is achieved with a device of this type according to the characterizing portion of claim 1 in that the heating means contains at least one laser device that has multiple adjacent laser beam sources. Multiple adjacent individual intensity profiles can be generated with the laser device to heat the composite film at least along one segment of the dividing line. The "individual intensity profile" describes the contour of the laser beams striking the surface of the composite safety glass panel, in particular in a perpendicular view of the surface from above. A laser beam source generates, for example, multiple individual intensity profiles, e.g. one individual intensity profile per laser diode, or each laser beam source generates a single individual intensity profile, e.g. an individual intensity profile comprised of all of the laser diodes in a laser beam source.

An individual intensity profile is substantially in the form of a dot, oval, ellipse, or line – individual laser line – by way of example, in particular when viewed from above. The individual laser lines are substantially parallel to the dividing line, at an angle to the dividing line, or orthogonal to the dividing line. The individual intensity profiles, in particular the individual laser lines, are arranged adjacently to one another on an imaginary axis, wherein the imaginary axis substantially follows the dividing line. "Arranged adjacently to one another" means that the individual intensity profiles are arranged such that they follow one another at substantially uniform spacings, preferably along the dividing line.

An individual laser line extends to a greater extent longitudinally than laterally. If the individual intensity profiles form individual laser lines, these are preferably arranged such that they follow one another longitudinally. The "length" and "width" of an individual intensity profile always refer to the length or width of an individual intensity profile on the surface, or where it passes through the surface, of the composite safety glass panel. Preferably, the length and/or width, or the diameter on a power inclusion relates to approx. 86.5% of the power. In particular if there is an "overlapping," the regions with a power inclusion of 86.5% of the power preferably overlap, at least in part.

individual laser lines. Alternatively, the individual intensity profiles, in particular the individual laser lines, can also be directly adjacent to one another.

The laser device is supported such that the multiple individual intensity profiles, in particular the multiple individual laser lines, or the laser line, can be generated along at least a segment of the dividing line, preferably at least along the entire length of the dividing line. By way of example, at least the laser device is supported such that it can move, so that the laser beam sources can be positioned such that the multiple individual intensity profiles, in particular the multiple individual laser lines, or the laser line, extend(s) along the dividing line, i.e. substantially coaxial to the dividing line.

The laser device is preferably supported in an adjustable manner, such that the multiple individual intensity profiles, in particular the multiple individual laser lines, or the laser line, can be guided on the composite safety glass panel, preferably in a direction orthogonal to the dividing line.

The multiple individual intensity profiles, in particular the multiple individual laser lines, or the laser line, are preferably slightly offset to the dividing line, in particular by between 0.1 mm and 0.7 mm, preferably 0.5 mm, to the dividing line. This offset ensures that the multiple individual intensity profiles, in particular the multiple individual laser lines, or the laser line, remains on at least one edge of the glass panel during the separation of the glass plates. A part of the composite safety glass panel is preferably held in place during the separation, and the other part is moved away. The offset is normally in the direction in which the section of the composite safety glass panel is moved away during the separation. This ensures that a maximum laser power enters the gap obtained between the sections of the composite safety glass panel.

It is particularly preferred that the positions of the multiple individual intensity profiles, in particular the multiple individual laser lines, or the laser line, can be adjusted orthogonally to the dividing line such that the multiple individual intensity profiles can be held in an

glass panel can at least be separated from one another along the dividing line. The heating of the composite film takes place until a temperature is reached at which the composite film is thermoplastically heated and becomes soft, but preferably at which no irreversibly damage to the composite film occurs.

This heating is advantageously reversible with respect to the composite film. In particular, the heating takes place such that no volatile substances are evaporated from the composite film, e.g. softening agents. The separation takes place advantageously such that the composite film can be separated with a knife along the dividing line between the glass panels after the two composite safety glass panel halves have been pulled apart during the thermoplastic deformation of the film between the composite safety glass panel halves.

The device is suitable in particular for straight separating cuts, and has the advantage over the prior art that in comparison with heating means known from the prior art, e.g. infrared projectors with reflectors, the heating can follow a narrow path in a targeted manner, such that the composite film remains unaffected, or is only slightly affected, outside the separating region. In particular, there is no unintentional delamination of the composite film from the glass panels in the edge regions. Consequently, channels are not formed that would allow ingress of liquids and gasses from the environment, and no tensions are generated in the glass panels in the edge regions thereof. The device is therefore suitable in particular for separating very thin composite safety glass panels, e.g. from the automotive industry or for entertainment electronics, in particular flat screens.

Furthermore, the heating along the dividing line can take place significantly more quickly with the device than with heating means known from the prior art, such that the cycle times for a complete separation process along the dividing line can be reduced by at least 30% to 70%.

high frequency oscillation of the laser beam sources. The beam-shaping assembly is stationary for this, or can likewise oscillate.

In particular to adjust the length of the combined multiple individual intensity profiles, in particular the combined length of the multiple individual laser lines, or the length of the laser line, to the width or length of a composite safety glass panel that is to be separated, it is provided according to another embodiment that the laser beam sources can be controlled individually. Individual laser beam sources are switched on or off to lengthen or shorten the length of the combined multiple individual intensity profiles, in particular the combined length of the multiple individual laser lines, or the length of the laser line, along the dividing line.

It is also provided that the laser beam sources can be rotated, in particular up to 90°, in order to align them along the dividing line. This is advantageous in particular with short individual laser lines, e.g. having a width of approx. 1 mm and a length of approx. 3 mm.

It is also provided that the laser beam sources can be controlled in groups in order to set the length of the combined multiple individual intensity profiles, in particular the combined length of the multiple individual laser lines, or the length of the laser line. By way of example, the multiple individual intensity profiles, in particular the laser lines, can be switched on and off in meter increments.

The device is designed and configured in particular to execute the method described below.

The aforementioned object of the invention is also achieved by a method for separating a composite safety glass panel, which comprises the following steps:

- separating, in particular scoring and breaking, the two glass panels along at least one predefinable dividing line;
- heating the composite film along the dividing line;

- pulling apart the glass panel along the dividing line;

The object is also achieved with a device for processing, in particular a composite safety glass panel, along at least one predefinable processing line. The processing line is the dividing line, for example, or a line, along which the at least two sections of a composite safety glass panel are connected, or another material that is to be heated. The device contains at least one heating means for heating along at least one segment of the processing line, that contains at least one laser device that has at least multiple adjacently arranged laser beam sources.

Multiple adjacently arranged individual intensity profiles can be generated with the laser device to heat at least one segment of the processing line. The device also contains the features and embodiments described above for the separating device. This applies in particular to the type, design and arrangement of the laser device, as well as, in particular, the oscillation or mobility. The description in reference to the dividing line can be applied to a processing line. Furthermore, the heating of the composite film can be applied to any arbitrary material that is to be heated along a processing line, and which absorbs laser radiation.

In particular, use of the device described above for joining at least two sections of composite safety glass has proven to be advantageous, in particular to heat the composite film for bonding purposes.

Furthermore, the device can be used to preheat a composite film in particular along a processing line, in particular a dividing line. By way of example, energy is absorbed along the processing line after preheating by other means, e.g. a focused laser.

In detail, there are now multiple design and development possibilities for the device and method according to the invention. Reference is made in this regard to both the claims dependent on claims 1 and 11 and the following description of preferred exemplary embodiments in conjunction with the drawings.
In a first aspect, the present disclosure provides a device for separating a composite safety glass panel along at least one predefinable dividing line, wherein the composite

safety glass panel has at least one composite film and at least two glass panels, wherein the composite film is placed between the glass panels and bonds the glass panels to one another, the device having at least one separating means for separating the glass panels along the at least one dividing line and at least one heating means for heating the composite film at least along the dividing line, characterized in that the heating means contains at least one laser device that has at least multiple adjacently arranged laser beam sources, and in that multiple adjacently arranged individual intensity profiles can be generated with the laser device to heat the composite film at least along a segment of the dividing line.

In a second aspect, the present disclosure provides a method for separating a composite safety glass panel, wherein the composite safety glass panel contains at least one composite film and at least two glass panels, wherein the composite film is placed between the glass panels and bonds the glass panels to one another, comprising the steps: separating, in particular mechanical scoring and breaking, the two glass panels along at least one predefinable dividing line; heating the composite film along the dividing line; pulling apart the glass panels along the dividing line; and separating the composite film; characterized in that the composite film is heated with multiple adjacently arranged individual intensity profiles along at least one segment of the dividing line with a laser device that has at least multiple adjacently arranged laser beam sources.

Therein:

Claims

1. A device (1) for separating a composite safety glass panel (2) along at least one predefinable dividing line (3), wherein the composite safety glass panel (2) has at least one composite film (4) and at least two glass panels (5), wherein the composite film (4) is placed between the glass panels (5) and bonds the glass panels (5) to one another, the device (1) having at least one separating means for separating the glass panels (5) along the at least one dividing line (3) and at least one heating means (6) for heating the composite film (4) at least along the dividing line (3),
   characterized in that
   the heating means (6) contains at least one laser device (7) that has at least multiple adjacently arranged laser beam sources (8), and in that multiple adjacently arranged individual intensity profiles (11) can be generated with the laser device (7) to heat the composite film (4) at least along a segment of the dividing line (3).

2. The device according to claim 1,
   characterized in that
   the multiple adjacently arranged individual intensity profiles (11) form a laser line (10), in particular that the individual intensity profiles (11) overlap at least in part in their edge regions, in order to form the laser line (10), preferably such that a length of an individual intensity profile (11) corresponds to approximately 2 times to 20 times the width of an individual intensity profile (11).

3. The device (1) according to claims 1 or 2,
   characterized in that
   the laser device (7) contains at least one beam-shaping assembly (9) for forming the individual intensity profiles (11), in particular in that the beam-shaping assembly (9) contains at least one lens assembly, preferably in that the lens

assembly contains a lens (12) for multiple laser beam sources (8), or contains at least one lens (12) for each laser beam source (8).

4. The device (1) according to claim 3,
characterized in that
the beam-shaping assembly (9) forms the individual intensity profiles (11), in particular the laser lines (10), from substantially parallel laser radiation in the direction of at least one axis, in particular from entirely parallel laser radiation in the direction of at least one axis.

5. The device (1) according to any of the claims 1 to 4,
characterized in that
the combined length of the multiple individual intensity profiles (11), in particular the length of the laser line (10), corresponds to 30 times the width of an individual intensity profile (11), in particular between 30 times and 1700 times, preferably between 30 times and 333 times the width, or that the combined length of the multiple individual intensity profiles (11), in particular the laser line (10), corresponds to at least the length of the dividing line (3).

6. The device (1) according to any of the claims 1 to 5,
characterized in that
the individual intensity profiles (11), in particular the laser line (10), are straight, or in that at least one individual intensity profile (11), in particular the laser line (10), is curved, at least in part.

7. The device (1) according to any of the claims 1 to 6,
characterized in that
each laser beam source (8) contains at least one laser diode, in particular in that each laser beam source (8) contains an arrangement of multiple laser diodes, preferably a laser diode stack.

8. The device according to any of the claims 1 to 7,
characterized in that
the output of the laser beam source (8) is between 5 W and 50 W, and/or in that the wavelength of the laser radiation emitted from the laser beam source (8) is between 1200 nm and 2200 nm, in particular between 1300 nm and 2100 nm.

9. The device (1) according to any of the claims 1 to 8,
characterized in that
at least a part of the laser device (7), in particular the laser beam sources (8) and/or the beam-shaping assembly (9), is supported such that it can oscillate and/or move, in particular in the longitudinal direction of the dividing line (3).

10. The device (1) according to any of the claims 1 to 9,
characterized in that
the laser beam sources (8) can be controlled individually, preferably in that the laser beam sources (8) can be controlled in groups, in order to set the number of individual intensity profiles (11) or the length of the laser line (10).

11. A method (100) for separating a composite safety glass panel (2), wherein the composite safety glass panel (2) contains at least one composite film (4) and at least two glass panels (5), wherein the composite film (4) is placed between the glass panels (4) and bonds the glass panels (5) to one another, comprising the steps:
- separating (101), in particular mechanical scoring (101a) and breaking (101b), the two glass panels (5) along at least one predefinable dividing line (3);
- heating (102) the composite film (4) along the dividing line (3);
- pulling apart (103) the glass panels (5) along the dividing line (3); and
- separating (104) the composite film (4);

characterized in that
the composite film (4) is heated with multiple adjacently arranged individual

intensity profiles (11) along at least one segment of the dividing line (3) with a laser device (7) that has at least multiple adjacently arranged laser beam sources (8).

12. The method (100) according to claim 11,
characterized in that
the multiple individual intensity profiles (11) collectively form a laser line (10).

13. The method (100) according to claim 11 or 12,
characterized in that
the composite film (4) is heated prior to pulling apart (103) the glass panels (5).

14. The method (100) according to any of the claims 11 to 13,
characterized in that
the composite film (4) is separated (104) by the pulling apart (103) after the heating (102) thereof.

15. The method (100) according to any of the claims 11 to 14,
characterized in that
the composite film (4) is heated (102) at least in part during the separation (101), in particular the breaking (101b), of the two glass panels (5).

16. The method (100) according to any of the claims 11 to 15,
characterized in that
the glass panels (5) are separated by the mechanical scoring (101a) and by the heating (102) of the composite film (4), or that the glass panels (4) are separated (101) by scoring, in particular filamentation, with at least one laser, and by heating the composite film (4).

17. The method (100) according to any of the claims 11 to 16,
characterized in that

the laser device (7) contains at least one beam-shaping assembly (9) for forming the individual intensity profiles (11), and at least a part of the laser device (7), in particular the laser beam sources (8) and/or the beam-shaping assembly (9), at least during the heating (102), is oscillated or moved, in particular in the longitudinal direction of the dividing line (3).

18. The method (100) according to claim 12,
characterized in that
the combined length of the multiple individual intensity profiles (11), in particular the length of the laser line (10), corresponds to at least 30 times the width of the individual intensity profiles (11), in particular between 30 times and 1700 times, preferably between 30 times and 333 times the width, or the combined length of the multiple individual intensity profiles (11), in particular the laser line (10), corresponds to at least the length of the dividing line (3).