United States Patent [19]

De Torre

[11] **3,756,482**

[45] **Sept. 4, 1973**

[54] **METHOD OF REMOVING TRIM FROM PATTERNS**

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[73] Assignee: **PPG Industries, Inc.**, Pittsburgh, Pa.

[22] Filed: **Apr. 28, 1972**

[21] Appl. No.: **248,468**

Related U.S. Application Data

[63] Continuation-in-part of Ser. Nos. 57,574, July 23, 1970, abandoned, and Ser. No. 68,735, Sept. 1, 1970, abandoned, and Ser. No. 105,486, Jan. 11, 1971.

[52] **U.S. Cl.** **225/2**, 65/113, 225/93.5

[51] **Int. Cl.** **B26f 3/06**

[58] **Field of Search** 225/2, 93.5; 82/12; 30/164.95; 65/112, 113, 174

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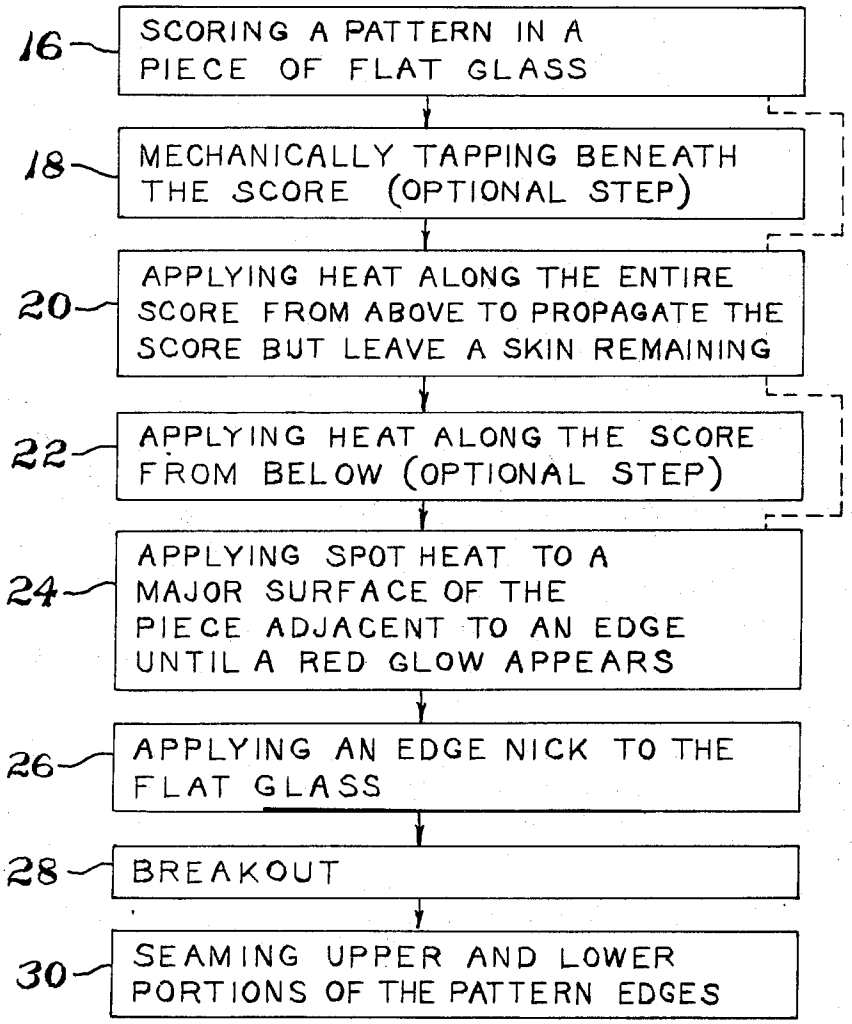
Primary Examiner—Frank T. Yost

Attorney—Russell A. Eberly

[57] **ABSTRACT**

A pattern is scored in a major surface of a piece of flat glass, and the score is propagated into a fracture that extends at least almost entirely to an opposite major surface of the piece. Heat is applied at a location adjacent to an edge of the piece until a red glow is visible at the glass surface. At that time, an edge nick is applied to the glass adjacent to the red glow to complete a vent from the edge nick to the fracture defining the pattern. This is repeated several times to free the pattern from its trim without damaging the edge of the pattern.

27 Claims, 13 Drawing Figures



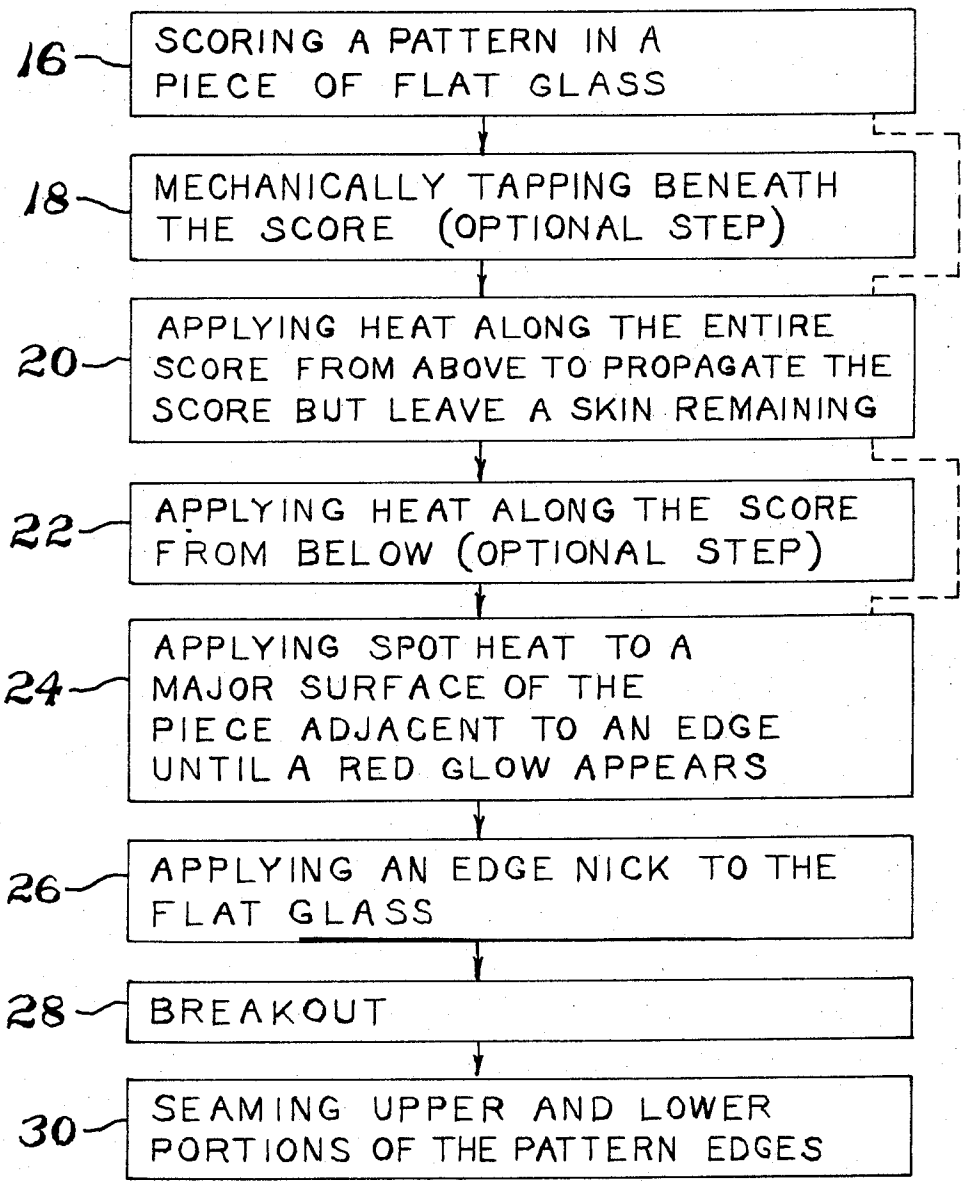

16
SCORING A PATTERN IN A PIECE OF FLAT GLASS
18
MECHANICALLY TAPPING BENEATH THE SCORE (OPTIONAL STEP)
20
APPLYING HEAT ALONG THE ENTIRE SCORE FROM ABOVE TO PROPAGATE THE SCORE BUT LEAVE A SKIN REMAINING
22
APPLYING HEAT ALONG THE SCORE FROM BELOW (OPTIONAL STEP)
24
APPLYING SPOT HEAT TO A MAJOR SURFACE OF THE PIECE ADJACENT TO AN EDGE UNTIL A RED GLOW APPEARS
26
APPLYING AN EDGE NICK TO THE FLAT GLASS
28
BREAKOUT
30
SEAMING UPPER AND LOWER PORTIONS OF THE PATTERN EDGES

FIG. 1

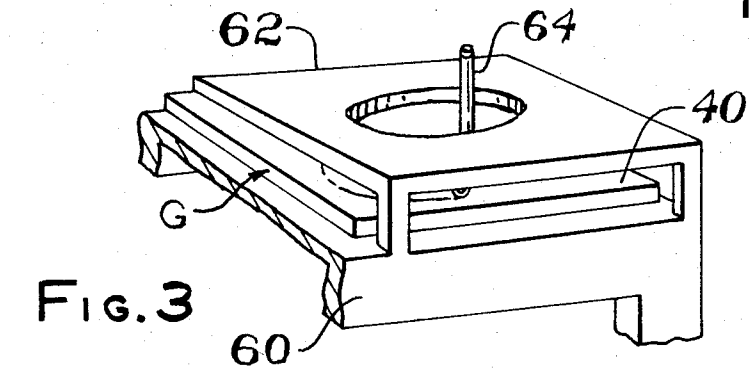

62
64
40
G
60

FIG. 3

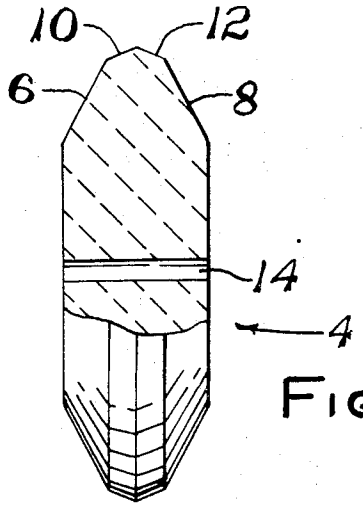


FIG. 2

FIG. 4

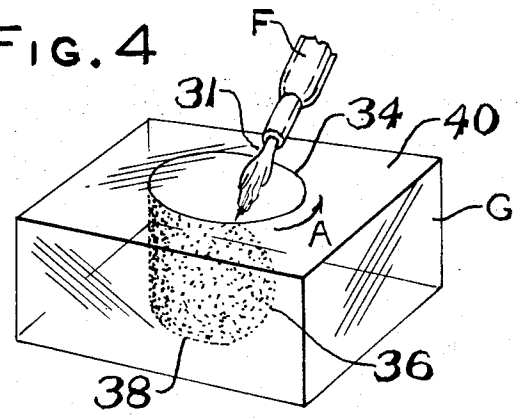


FIG. 5

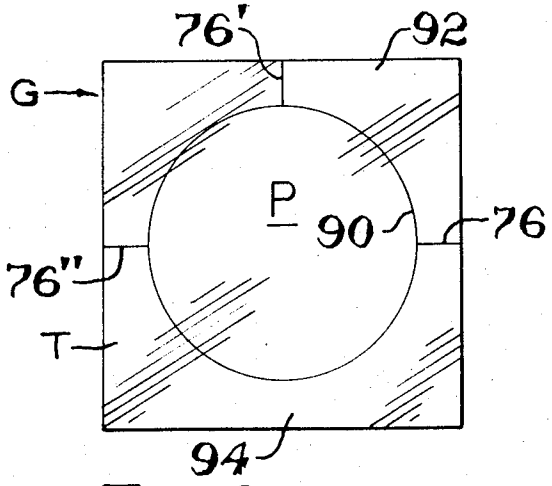


FIG. 6

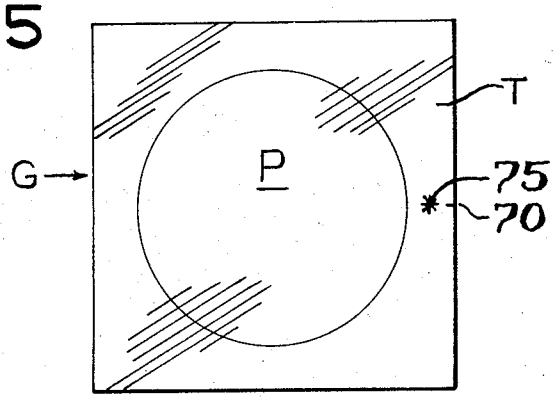
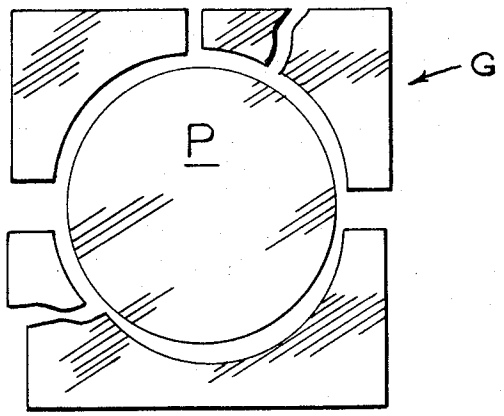


FIG. 7



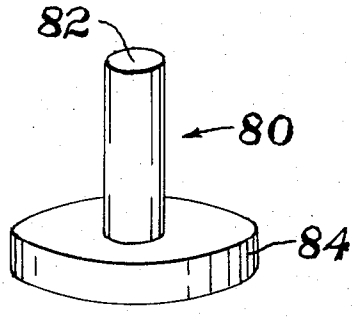


FIG. 13

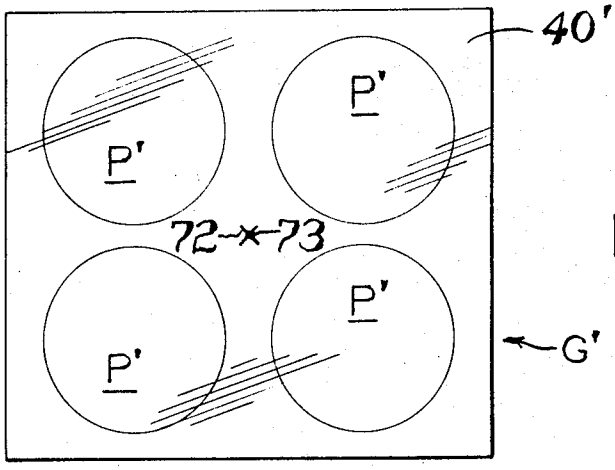


FIG. 8

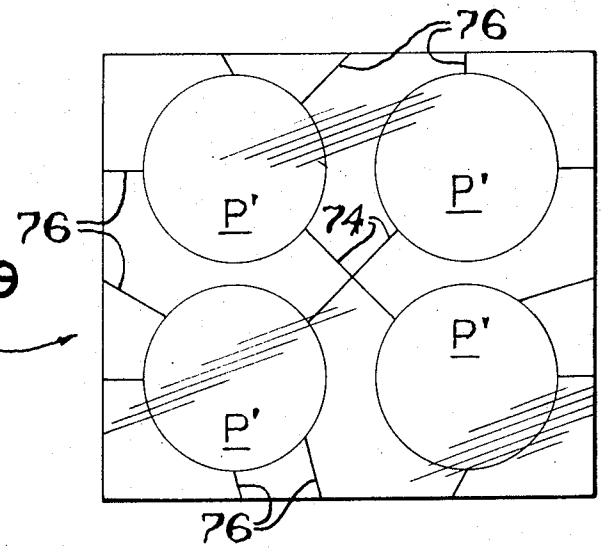


FIG. 9

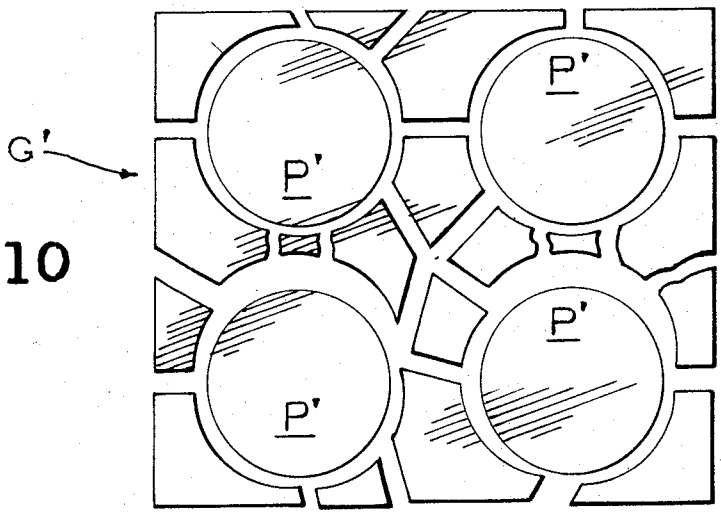


FIG. 10

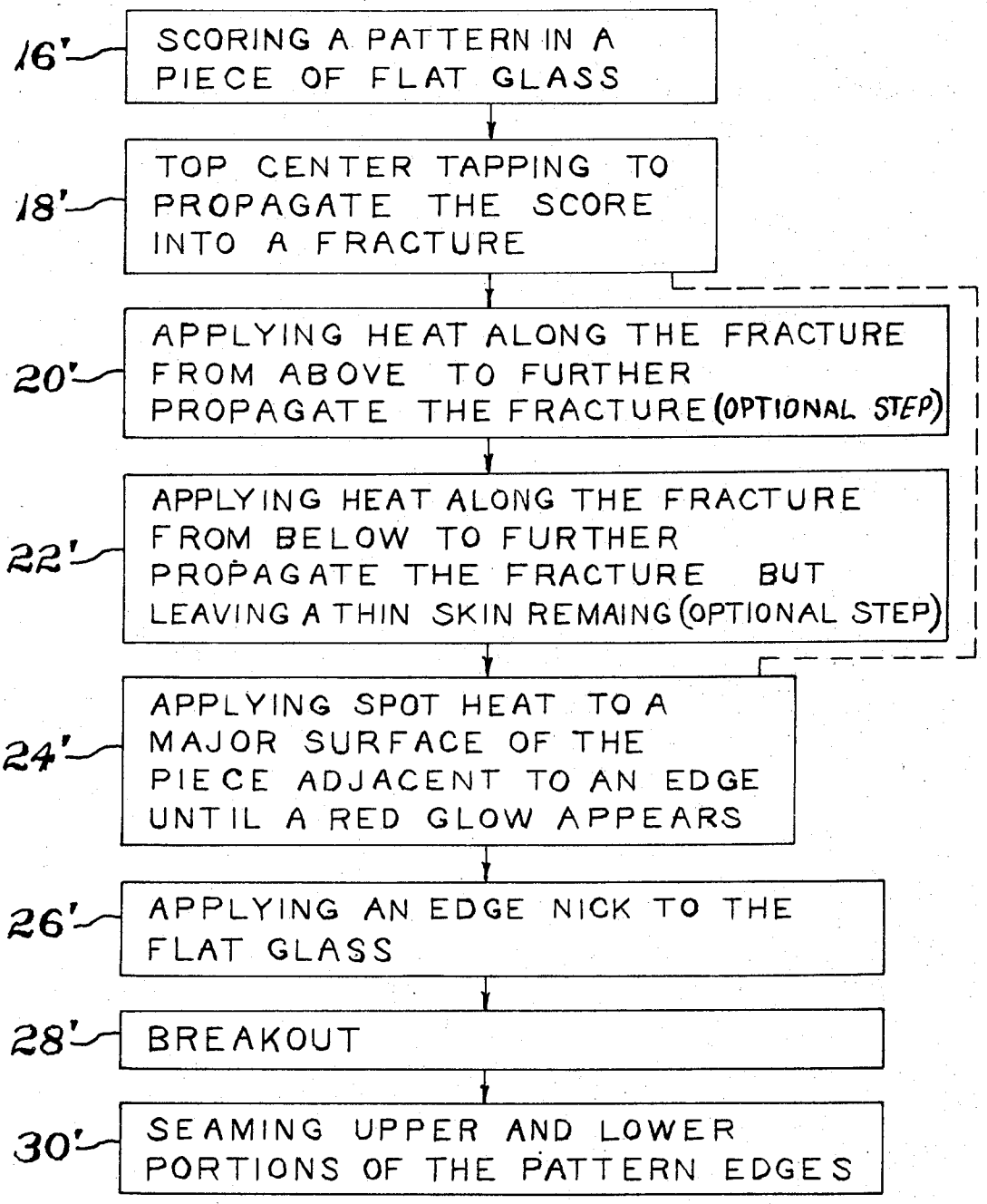

16'
SCORING A PATTERN IN A PIECE OF FLAT GLASS
18'
TOP CENTER TAPPING TO PROPAGATE THE SCORE INTO A FRACTURE
20'
APPLYING HEAT ALONG THE FRACTURE FROM ABOVE TO FURTHER PROPAGATE THE FRACTURE (OPTIONAL STEP)
22'
APPLYING HEAT ALONG THE FRACTURE FROM BELOW TO FURTHER PROPAGATE THE FRACTURE BUT LEAVING A THIN SKIN REMAING (OPTIONAL STEP)
24'
APPLYING SPOT HEAT TO A MAJOR SURFACE OF THE PIECE ADJACENT TO AN EDGE UNTIL A RED GLOW APPEARS
26'
APPLYING AN EDGE NICK TO THE FLAT GLASS
28'
BREAKOUT
30'
SEAMING UPPER AND LOWER PORTIONS OF THE PATTERN EDGES

FIG. 12

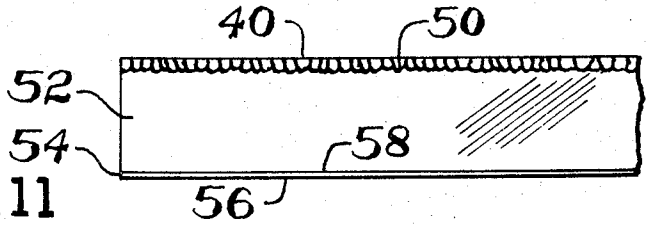

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FIG. 11

METHOD OF REMOVING TRIM FROM PATTERNS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of each of the following: U. S. application Ser. No. 57,574, filed July 23, 1970, now abandoned; U. S. application Ser. No. 68,735, filed Sept. 1, 1970, now abandoned; and U. S. application Ser. No. 105,486, filed Jan. 11, 1971.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method for cutting glass, and in particular, for the removal of glass trim from a pattern by a thermo-mechanical means without damaging the edge or edges of the pattern.

2. Description of the Prior Art

In the manufacture of glass patterns, it has hitherto been customary to place a score in the form of the pattern on a piece of flat glass and apply a mechanical bending moment about the score to separate the trim from the pattern. In this connection, reference may be made to Sherts, U. S. Pat. No. 1,887,564; Echter et al., U. S. Pat. No. 2,508,017; and Augustin et al., U. S. Pat No. 3,520,456. This procedure is disadvantageous because it causes edge damage (chipping of the bottom corner), which necessitates grinding and polishing.

It has been suggested that heat may be applied adjacent to a score to separate the trim from a pattern. In this connection, reference may be made to Chatelain et al., U. S. Pat. No. 3,474,944. However, the use of a thermal means alone requires a substantial amount of time to run a vent. In addition, if this vent is started adjacent to a score, the vent contacts the pattern with extreme violence, often causing chipping. Further, there is an increased possibility that the vent will cross the score and damage the pattern since the vent has more momentum at its conception.

SUMMARY OF THE INVENTION

According to an embodiment of the present invention, grinding to size and edge polishing, in the preparation of glass patterns, are advantageously avoided by use of a procedure that involves: (1) scoring a major surface of a piece of flat glass in the form of a pattern; (2) propagating the score into a fracture that extends at least almost entirely to an opposite major surface of the piece of glass; (3) heating the glass on the scored surface within about one inch of the edge of the piece until a red glow is visible on the surface; (4) applying a mechanical defect, such as an edge nick, to the edge of the piece adjacent to the red glow to create a vent from the edge to the fracture; and (5) repeating the heating and the applying of defects at various locations on the piece to complete a plurality of vents and "breakout" or separate the trim from the pattern.

According to an alternate embodiment of the present invention, edge nicks are applied to the piece of glass before the glass is heated. In this embodiment, heat is applied adjacent to the edge nicks after they are made.

When removing a pattern from a piece of flat glass, it is possible to damage the pattern edges in the scoring operation, the fracture propagation, or the "breakout." If the piece of glass is less than approximately 10 millimeters thick, a conventional score may be applied to the glass, followed by heat to propagate the score into a fracture that runs along the score at least almost entirely to the opposite major surface of the piece of glass without damaging the pattern edges. When removing a pattern from a piece of glass that is thicker than approximately 10 millimeters thick, it is advantageous to use the deep-scoring techniques taught in Belgian Patent No. 770,316, to insure that the edges of the pattern are not damaged during scoring or fracture propagation. To understand why this is so, one must realize that the major surfaces of a piece of flat glass are normally in compression with the central zone therebetween in tension. As the glass is heated, the center tension increases until it reaches at least approximately 1000 pounds per square inch and then the glass fails. If there is a score on a major surface of the piece of glass, and the glass is heated along the score, the resulting propagation will follow the score only if the score is deep enough to approach the zone of center tension and steer the fracture. With glass that is less than approximately **10** millimeters in thickness, a conventional score will penetrate the glass sufficiently to steer the fracture. With glass thicker than this, a conventional score will not penetrate the tension zone unless scoring pressures are so high as to crush the glass. The trick, therefore, is to get a score that is deep enough to penetrate the tension zone, without crushing the edge. A method and apparatus for performing this function is taught in the above-mentioned Belgian Patent.

The present invention prevents edge damage during "breakout" or separation of the trim from the pattern. It requires that a fracture (defining a pattern) extends between most of the thickness of the piece of glass so that the fracture will act as a dam to stop a vent from traveling into the pattern when it is freed from the trim. While the "breakout" method of the present invention will separate a pattern from a trim without in itself damaging the pattern edge, if the scoring techniques described above are not practiced, such that the pattern edges are damaged before the pattern is separated from the trim, the "breakout" method of the present invention cannot improve the edge. For this reason, deep-scoring techniques are normally used in combination with the "breakout" method of the present invention for thicker glass.

In accordance with the present invention, it is possible to remove trims from glass patterns while minimizing wastage of glass.

Further, in accordance with the present invention, it is possible to remove trims from glass patterns without damaging the edges of the pattern, so that only light seaming of the edges is required.

Further, in accordance with the present invention, it is now possible to remove a trim from a glass pattern leaving edges on the pattern that are smooth, strong, accurate and perpendicular to the major surfaces of the piece.

DESCRIPTION OF THE DRAWINGS

A complete understanding of the invention may be obtained from the foregoing and following description thereof, taken together with the appended drawings, which are not drawn to scale unless noted, in which:

FIG. 1 is a flow diagram of a process showing all steps thereof including both essential and optional steps in accordance with the present invention;

FIG. 2 is a vertical cross-sectional view of a typical cutting wheel used in the practice of the present invention;

FIG. 3 is a perspective view of a typical set-up for scoring circles in accordance with the present invention;

FIG. 4 is a perspective view of a jet heat source directing heat along a previously formed score line;

FIG. 5 is a top view of a glass surface with a circular pattern;

FIG. 6 is a top view of the surface of FIG. 5, after three vents have been created;

FIG. 7 is a top view of the glass in FIG. 6, after the pattern has been released from the trim;

FIG. 8 is a top view of a glass surface illustrating a layout of a plurality of patterns;

FIG. 9 is a top view of the glass surface in FIG. 8 after several vents have been completed;

FIG. 10 is a top view of the glass in FIG. 9, after the patterns have been released from the trim;

FIG. 11 is an elevation view (drawn to scale except for the bottom edge of the fissure which is diagrammatic) of an edge of a piece of glass cut in accordance with the instant invention;

FIG. 12 is a flow diagram of a process showing all steps thereof including both essential and optional steps in accordance with an additional embodiment of the present invention; and

FIG. 13 is a perspective view of a tool used to top center tap.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a flow diagram of a process in accordance with the present invention is shown. The scoring step of block 16 in the flow diagram of FIG. 1 may be either conventional scoring or deep-fissure scoring. With thinner glass, such as below approximately 10 millimeters in thickness, a conventional score suffices, though a deeper score can be used. With thicker glass, it is necessary to use deep-scoring techniques if the fracture is to follow the score.

Referring to FIG. 2, there is shown a cutting or scoring wheel 4 made of tungsten carbide or other suitable material of hardness of about 7 or more on Mohs' scale. For pieces of flat glass less than approximately 10 millimeters in thickness, a conventional wheel may be used, but it is preferred that it be blunt, such as about 160°. For pieces of flat glass greater than about 10 millimeters in thickness, the wheel should be constructed in accordance with the dimensions and characteristics set forth in Belgian Patent No. 770,316. Said patent states that the wheel should have a radius between approximately 6 to approximately 25 millimeters, and preferably between 9 and 16 millimeters. The base angle, i.e., the angle between the two sides 6 and 8, if extended, is about 120°and the angle between the sides 10 and 12 (the cutting angle) is between about 150° and about 165°, with 160° providing optimum results. The wheel has a central axle hole 14 which may have a diameter of about 2.4 millimeters. Hole 14 provides a means for rotatably mounting said wheel on a shaft that is passed through the axle hole 14.

Referring to FIG. 3, there is shown a typical set-up for scoring the circumference of a pattern P, such as a circle, on a piece of flat glass G in accordance with the present invention. The glass is placed on a cutting table 60 with a suitable template 62 mounted on the cutting table. Pneumatic means (not shown) may be used to supply force to the cutting tool 64. While a hand-held cutting tool 64 has been illustrated, it will be obvious to one skilled in the art that there are many commercially available means for housing the scoring wheel 4 and supplying a suitable scoring force.

Referring now to the block 18 of FIG. 1, there is indicated a step of mechanically tapping a portion of the score. This is done with a hammer or mallet, gently, from beneath the glass on the face opposite the score at one point of the score. The purpose of this operation is merely to start the opening to a considerable depth of the score and thereby diminish the capacity requirement of the thermal source to be used at the beginning of the immediately succeeding operation (block 20). The step of block 18 can be omitted entirely provided that dwell time of the heating process is increased to start the propagation of the deep fissure by mechanically tapping the glass before the heating process (block 20), about 10 to 15 seconds dwell time in 18-millimeter glass are saved.

Referring now to block 20, the next step of the process comprises applying heat along the score from the top and progressively along it to nearly open it. This may be done with a small hand-held blowtorch or the like. Various kinds of hand-held torches that burn propane or other suitable gaseous fuel are readily available and are familiar to those skilled in the art; these may be used. Other alternatives will suggest themselves to persons of ordinary skill in the art, such as the use of a flameless, electrically operated serpentine gas heater, producing an air flow of approximately 35 cubic feet per hour at an outlet temperature of approximately 1750°F. with a power utilization of approximately 470 watts. The rate of passage of the heating means with respect to the score along its length should depend, to some extent, upon the thermal output of the source and the thickness of the glass. It will probably be substantially slower than the rate of passage of the scoring apparatus. Since the speed of scoring is not critical, it is usually high (about 25 centimeters per second). The heat source generally proceeds along the score at about 5–12 centimeters per second. The operator can tell whether the rate of the passage used is satisfactory; as the heat source is moved along, the advancing front of the area that has been thermally opened in accordance with this step of the invention can be seen to precede the location of the source by approximately 20 to 60 millimeters. It is to be understood that the thermal opening that is practiced in accordance with this step of the invention does not usually cause the edge to be severed from the glass instantaneously. In the case of glass 18 to 19 millimeters thick, approximately 1 to 2 millimeters of glass usually remains unsevered at the bottom of the piece.

Referring to FIG. 4, there is shown a small, hand-held gas torch F with a flame 31 directed toward score 34. As the torch F is moved along score 34, in the direction of arrow A, a fracture 36 is propagated in a direction perpendicular to the major glass surface 40, leaving only a thin skin 38 holding the trim to the pattern. In the case of the use of a small hand-held gas torch, the flame should be directed at an angle of 20° to 70° with respect to a major surface of the glass.

Referring to block 22, it is desirable, when higher quality cuts are desired, to pass a torch underneath the intended line of cut and along its entire length, taking for example, something like 7 to 15 seconds to traverse a length of 5 to 6 meters. This further reduces the

thickness of skin **38** to aid in obtaining a cut of even higher quality. When this step is used, it must follow after, and not before, the top heating of the score or no benefit is obtained.

When removing a pattern, such as a circle or an oval, from a piece of flat glass, one is not likely to get a smooth edge by supporting the score and snapping the bottom skin, as is done when producing straight edges using the practice of deep scoring and then heat-propagating the score to near fracture.

Referring to block **24** of FIG. **1**, heat is preferably applied to the scored surface adjacent to an edge of the piece by holding a heat source, such as a gas flame, within approximately one inch of the glass edge until a hot spot is created on the glass surface, as indicated by a red glow. FIG. **5** shows the piece of glass G with a pattern P that has been produced by the process described hereinabove. Heat may be applied, for example, to the trim of a piece of flat glass, 19 millimeters (¾ inch) thick, at a location that is approximately 25 millimeters (approximately 1 inch) from the glass edge, by a torch with a 38-millimeter (1½-inch) propane flame for about 7 to 10 seconds to create a hot spot **75** having a surface temperature of approximately 1000°F., as indicated by a red glow. Referring to block **26** of FIG. **1**, an edge nick **70** is then applied to the piece G adjacent to the red glow to run a vent, such as the one illustrated in FIG. **6** at **76**, from the edge to the pattern P. It is possible to create vents without any nicks by merely heating the glass until sufficient tensile stresses develop to cause a fracture. This is a slow process and disadvantageous since the vent often strikes the pattern with extreme violence, causing edge damage.

If the operator continues to create vents, one at a time, from the edges of the piece G to the pattern P, eventually the scrap or trim T will separate from the finished pattern P. The trim T breaks free of the pattern P in a rather dramatic fashion, which is referred to in block **28** of FIG. **1** and throughout this disclosure as "breakout."

The phenomenon of "breakout" occurs because the interior edge **90** of trim T tends to be of greater length than the exterior edge of the pattern P. This is because the trim has been heated to create the hot spots. The heating of the glass along score **34** (blocks **20** and/or **22** of FIG. **1**) also stretches the interior trim edge **90** more than the exterior edge of the pattern P, even though the heat is applied along the score **34.** This is due to the relatively low mass of the trim T with respect to the pattern P, thus causing the trim T to get hotter than pattern P and therefore expand by a greater amount. It should be kept in mind that while the heating steps of blocks **20** and **22** aid in "breakout," the present invention is not limited to these steps since the heat placed in the glass when the hot spots are created is sufficient to produce satisfactory "breakout." Trim edge **90** tends to separate from the exterior edge of pattern P as soon as the first hot spot is created, but it is not until a sufficient number of vents are created that the pattern P is released from the trim T.

FIG. **6** shows the piece of glass G after vents **76, 76'** and **76''** have been created. It should be understood that it is unlikely that one could actually view the glass in such a state, since "breakout" would almost certainly occur with three vents placed as shown. If vent **76'** is omitted and vent **76''** is created immediately after vent **76,** "breakout" will usually occur with upper portion **92** separating from lower portion **94.** It is more advantageous to create vents successively about a pattern to minimize the possibility of large portions of trim separating from a pattern. Therefore, for best results, vent **76** should be created first; then vent **76'**; and then vent **76''**. This minimizes the violence during the separation and reduces or eliminates the edge chipping caused thereby.

Referring to FIG. **7,** there is shown a top view of the pattern P after it has been freed from trim T. The number of vents necessary for "breakout" depends on the complexity of the pattern. When removing a circular pattern from a rectangular piece of glass, two vents may be sufficient, but as pointed out hereinabove, three vents are preferred. It is difficult to say how soon the edge nick must be applied, but as long as the edge nick is applied while the red glow remains, a vent will run with no problems. Heat increases the tensile stresses in the glass, and the red glow on the glass surface indicates that these stresses are high enough that an edge nick adjacent to the red glow will cause a tensile failure or vent.

Referring to FIG. **8,** there is shown a view of the top major surface **40'** of a piece of flat glass G', illustrating a layout of circular patterns P' that has proven to be very convenient. The dimensions of the glass G' may be such that each side of the piece is twice the diameter of the circles to be cut plus approximately 6.5 centimeters (2.5 inches). FIG. **8** shows a center nick **72** between the four circular patterns P'. This center nick **72** is helpful where more than one pattern is to be removed from a piece. Heat may be applied adjacent to the center **73** of nick **72** to create vents **74** between the patterns P', as shown in FIG. **9.** Vents **76** are then created from the edges of the piece to the patterns P', as described hereinabove. As is the case with the glass illustrated in FIG. **6,** it is unlikely that one would ever see a view such as the one illustrated in FIG. **9,** since "breakout" would almost certainly occur with twelve vents **76.** FIG. **10** shows the circular patterns P' after they have been released from the trim.

It should be kept in mind that the present invention relates to removing all patterns from pieces of flat glass, and the circles illustrated are merely exemplary. Further, while there has been illustrated convenient locations for hot spots and edge nicks, these locations may be moved along the edge of the glass, if desired.

It is also possible to apply the edge nicks to the piece of glass before heat is applied. This will usually result in a pattern with edges of a quality that is equal to those produced by heating before edge nicking. However, the separation when edge nicking is done first is more violent than when heating is done first, and sometimes, with the former, there is contact between the edges of the pattern and the trim, causing damage. This is an infrequent occurrence, and the present process of separating a pattern from its trim is more desirable than those of the prior art, even if the edge nicks are applied before the heating. But, it is even more desirable to heat and then edge nick.

At this point, there may be conducted an inspection to determine the quality of the cut that has been opened. In the inspection along the cut edge, looking perpendicularly to the edge, it is customary to see a pattern such as that indicated in FIG. **11.** The top surface of the glass is there designated with the numeral **40,** and a short distance therebeneath is seen a marking

50 that has the appearance of a series of fine serrations and is indicative of the extent of the score caused by the penetration of the cutting wheel into the glass. In the case of a deep fissure, the marking **50** in glass 18 to 19 millimeters thick is at least 1.75 millimeters from the top surface of the glass. Normally, the region between surface **40** and marking **50** includes approximately 6 percent to 30 percent of the thickness of the glass. From the marking **50** to a faint line **58** there is a region **52** that is a smooth, planar fracture and, in the case of glass 18 to 19 millimeters thick, extends from the marking **50** for something like 15 to 17 millimeters of the thickness of the glass down its severed edge. Region **52** extends through the glass for about 60 to 90 percent of its thickness in a direction substantially perpendicular to the glass surfaces **40** and **56.** Below that is a region **54** that is relatively unmarked and extends from a faint line **58** to the bottom surface **56** of the glass. Faint line **58** is substantially parallel to the bottom surface **56** and is spaced therefrom by approximately 0.5 to approximately 2 millimeters and indicates the extent to which the fracture in the glass penetrates when it is thermally opened as taught hereinabove. The distance between line **58** and surface **56** corresponds to about 3 percent to about 10 percent of the thickness of the glass. Of course, the dimensions indicated above will vary somewhat with glass pieces of different thickness, but the general arrangement and relationship remains the same.

As used in this application, the terms "deep fissure," "fissure," "deep score" or "score" refer to the area between surface **40** and marking **50.** The term "fracture" can refer to the area between marking **50** and line **58,** and, in the relatively few instances where heat propagates the fracture through to the bottom surface of the glass, it can refer to the area between marking **50** and the bottom surface **56** (there is no line **58** under this circumstance). When used broadly, "fracture" includes both of these situations.

As a final step, indicated in block **30** of FIG. **1,** there is conducted a light seaming of only the upper and lower portions of the edges of the pattern being cut. This leaves a smooth edge with no evidence of marking **50** or line **58** remaining. There may be used, for example, a hand-held belt sander using a belt 75 millimeters wide by 600 millimeters long. This is a conventional operation, and it does not require further elaboration or explanation.

The result is that there is produced a finished piece of glass that compares favorably in its edge strength to similar pieces produced by the prior-art method of rough cutting, mechanical snapping, grinding to size, and then polishing. The pieces of the present invention have edge strength of about 4.35 to 4.63 kilograms per square centimeter in the conventional beam-loading test, in comparison with strengths such as 4.63 to 4.91 kilograms per square centimeter for the prior-art ground-and-polished pieces. Either will meet specifications on customary glazing installations. In achieving the edge-strength values indicated above, the final seaming operation is important. Without the final seaming operation, the edge strength is on the order of 3.27 to 3.60 kilograms per square centimeter.

Referring to FIG. **12,** there is shown a flow diagram of a process used for removing patterns from flat glass in accordance with an additional embodiment of the present invention. The additional embodiment differs from the one hereinabove described by the manner in which the score is propagated. Accordingly, only the differences between the two embodiments will be set forth in great detail.

The scoring step of block **16'** of FIG. **12** is identical to the scoring step of block **16** of FIG. **1.** The apparatus shown in FIGS. **2** and **3** is equally applicable to the second embodiment.

Referring to block **18'** of FIG. **12,** this step is similar to the step of block **18** of FIG. **1.** In block **18** of FIG. **1,** a mechanical tap from beneath a portion of the score is used to commence propagation of a fracture. According to the second embodiment, it has been discovered that by applying the tap from above at approximately the center of curvature of a curved score, a fracture not only propagates to a greater depth as in the case of a tap beneath the score (block **18**), but further, a tap at the center of curvature of the curved score propagates the fracture around the entire circumference of the curved score. It is important to point out that the mechanical tapping step of block **18** is not a critical part of the first-described embodiment. It merely reduces dwell time with the heat torch. However, the top center tapping of block **18'** of the second-described embodiment is an essential part of this embodiment, since it eliminates the necessity of top heating (block **20'**) except when edges of extremely high quality are desired, and it is faster to apply a firm tap to the approximate center of curvature of a curved score than to heat around the entire circumference. In other words, if the top center tap is omitted, one can use heat to propagate a fracture as in the first embodiment, but heating along a score is slower than top center tapping.

Referring to FIG. **13,** there is shown a tool **80** that may be used in the center tap step of block **18'.** The tool is placed at the approximate center of curvature of the curved score with portion **84** resting directly on the glass. The operator strikes the tool **80** at **82** from above with a hammer or mallet.

Referring to block **20'** of FIG. **12,** the next step may be to apply heat along the deep fissure from above to propagate the fracture. This is similar to the step recited in block **20** of FIG. **1.** As pointed out above, step **20'** is not essential in propagating the score into a fracture unless extremely high quality edges are desired, but it does aid in "breakout" since it supplies heat which helps to increase the length of the interior edge of the trim.

Referring to block **22'** of FIG. **12,** heat is applied along the fracture from below to propagate the fracture and leave a thinner skin. This step is similar to the heating of block **22** of FIG. **1** in that it conditions the glass for breakout by further propagating the fracture. As above, this step is not an essential part of the fracture propagation unless extremely high quality edges are desired, but it aids in the "breakout."

The steps of blocks **24'**, **26'**, **28'** and **30'** of FIG. **12** are identical to those described in connection with blocks **24, 26, 28** and **30** of FIG. **1** and a further description of these blocks is therefore deemed unnecessary.

Having now fully disclosed the invention, what I claim is as follows:

I claim as my invention:

1. A method of severing a trim from a pattern in a piece of flat glass comprising the steps of:

a. producing a fracture in the form of the pattern in the piece of flat glass,
b. creating a first vent from an edge of said piece to said fracture by heating an area of said trim and applying a mechanical defect to said edge adjacent to said area, and
c. creating additional vents to separate the trim from the pattern.

2. A method as set forth in claim **1,** further characterized in that said first vent is created by:
a. heating said trim on a major surface thereof to create a hot spot, and
b. applying said mechanical defect to said edge of said piece adjacent to said hot spot to complete said vent from said edge of said piece to said fracture.

3. A method as set forth in claim **2,** further characterized in that said defect is an edge nick.

4. A method as set forth in claim **3,** further characterized in that said trim is heated within approximately 25 millimeters of the edge.

5. A method as set forth in claim **2,** further characterized in that said additional vents are each created by heating said trim on a major surface thereof to create a hot spot and applying a mechanical defect to an edge of said piece adjacent to said hot spot to complete said vent from the edge of said piece to the fracture.

6. A method as set forth in claim **2,** further characterized in that said additional vents are each created by applying a mechanical defect to said edge of said piece, and heating said trim on a major surface thereof adjacent to said mechanical defect to complete a vent from said edge of said piece to said fracture.

7. A method as set forth in claim **2,** further characterized in that said vents are created one at a time.

8. A method as set forth in claim **7,** further characterized in that said pattern is in the form of a circle.

9. A method as set forth in claim **7,** further characterized in that a plurality of patterns are removed from a single piece of glass.

10. A method as set forth in claim **9,** further including the step of:
a. creating additional vents between the patterns.

11. A method as set forth in claim **10,** further characterized in that said additional vents are created by:
a. applying nicks in one of the major surfaces of the piece between the patterns, and
b. heating said nicks to create vents between the patterns.

12. A method as set forth in claim **11,** further characterized in that said fracture is produced by the steps of:
a. scoring a major surface of the piece in the form of the pattern, and
b. propagating said score into a fracture that extends at least almost entirely to an opposite major surface of said piece.

13. A method as set forth in claim **1,** further characterized in that said first vent is created by:
a. applying said mechanical defect to said edge of said piece, and
b. heating said trim on a major surface thereof adjacent to said mechanical defect to complete a vent from said edge of said piece to said fracture.

14. A method as set forth in claim **13,** further characterized in that said defect is an edge nick.

15. A method as set forth in claim **14,** further characterized in that said trim is heated within approximately 25 millimeters of the edge.

16. A method as set forth in claim **13,** further characterized in that said additional vents are each created by heating said trim on a major surface thereof to create a hot spot and applying a mechanical defect to an edge of said piece adjacent to said hot spot to complete said vent from the edge of said piece to the fracture.

17. A method as set forth in claim **13,** further characterized in that said additional vents are each created by applying a mechanical defect to said edge of said piece, and heating said trim on a major surface thereof adjacent to said mechanical defect to complete a vent from said edge of said piece to said fracture.

18. A method as set forth in claim **13,** further characterized in that said vents are created one at a time.

19. A method as set forth in claim **18,** further characterized in that said pattern is in the form of a circle.

20. A method as set forth in claim **18,** further characterized in that a plurality of patterns are removed from a single piece of glass.

21. A method as set forth in claim **20,** further including the step of:
a. creating additional vents between the patterns.

22. A method as set forth in claim **21,** further characterized in that said additional vents are created by:
a. applying nicks in one of the major surfaces of the piece between the patterns, and
b. heating said nicks to create vents between the patterns.

23. A method as set forth in claim **22,** further characterized in that said fracture is produced by the steps of:
a. scoring a major surface of the piece in the form of the pattern, and
b. propagating said score into a fracture that extends at least almost entirely to an opposite major surface of said piece.

24. A method of severing a trim from a pattern in a piece of flat glass comprising the steps of:
a. scoring a major surface of said piece in the form of said pattern,
b. tapping said score from below to start a fracture,
c. applying heat along said score from above to propagate said score into a fracture that extends at least almost entirely to an opposite major surface of said piece,
d. applying heat along said score from below,
e. applying spot heat to a major surface of said trim adjacent to an edge of said piece until a red glow appears,
f. applying a mechanical defect to said edge of said piece adjacent to said red glow to complete a vent from said edge of said piece to said fracture,
g. creating additional vents in said trim until said trim is separated from said pattern, and
h. seaming upper and lower portions of the pattern edge.

25. A method of severing a trim from a pattern in a piece of flat glass comprising the steps of:
a. scoring a major surface of said piece in the form of said pattern,
b. tapping said score from below to start a fracture,
c. applying heat along said score from above to propagate said score into a fracture that extends at least almost entirely to an opposite major surface of said piece,

d. applying heat along said score from below,
e. applying a mechanical defect to said edge of said piece,
f. heating said trim on a major surface thereof adjacent to said mechanical defect to complete a vent from said edge of said piece to said fracture,
g. creating additional vents in said trim until said trim is separated from said pattern, and
h. seaming upper and lower portions of the pattern edge.

26. A method of severing a trim from a pattern in a piece of flat glass comprising the steps of:
a. scoring a major surface of said piece in the form of said pattern,
b. applying a top center tap at the approximate center of curvature of said pattern to propagate the score into a fracture,
c. applying heat along the fracture from above to further propagate the fracture,
d. applying heat from below along the fracture to further propagate the fracture,
e. applying spot heat to a major surface of said trim adjacent to an edge of said piece until a red glow appears,
f. applying a mechanical defect to said edge of said piece adjacent to said red glow to complete a vent from said edge of said piece to said fracture,
g. creating additional vents in said trim until said trim is separated from said pattern, and
h. seaming upper and lower portions of the pattern edge.

27. A method of severing a trim from a pattern in a piece of flat glass comprising the steps of:
a. scoring a major surface of said piece in the form of said pattern,
b. applying a top center tap at the approximate center of curvature of said pattern to propagate the score into a fracture,
c. applying heat along the fracture from above to further propagate the fracture,
d. applying heat from below along the fracture to further propagate the fracture,
e. applying a mechanical defect to said edge of said piece,
f. heating said trim on a major surface thereof adjacent to said mechanical defect to complete a vent from said edge of said piece to said fracture,
g. creating additional vents in said trim until said trim is separated from said pattern, and
h. seaming upper and lower portions of the pattern edge.

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