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(54) GLASS MASKING METHOD USING LASERS

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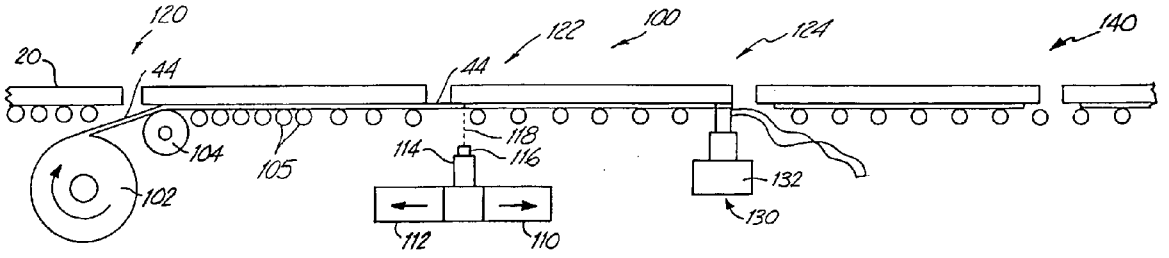
(52) **U.S. Cl.** **428/34**

(57) **ABSTRACT**

Methods and apparatus for masking glazing panels while leaving a peripheral region free of masking material. The method can include providing a masking material and applying the masking material to at least one major surface of the glazing panel. The glazing panel can be either a single glass pane or a multi-pane insulating glass unit. After application to at least one major surface, a laser can be used to describe a closed path on the major surface, thereby cutting or scoring the masking material through to the glass major surface. The path demarcates a central, masked region from a peripheral masked region of the glazing panel. In one method, the laser cuts a muntin bar pattern having several central regions. The laser power can be selected and/or adjusted such that the masking material is burned through, without damage to the underlying glass material and any coatings on the glass material. After cutting through the masking material to define the peripheral masked region, the peripheral masked region can be peeled or stripped off from the masked glazing panel. The remaining panel thus has a protective mask about the central region while leaving the peripheral region unprotected. The resultant masked glazing panel may be assembled into a window unit by mounting window frame members about the four sides of the glazing panel. The window frame members may thus have a tight and durable fit directly to the glass in the peripheral region, while the central region of the glazing panel remains protected by the masking material.



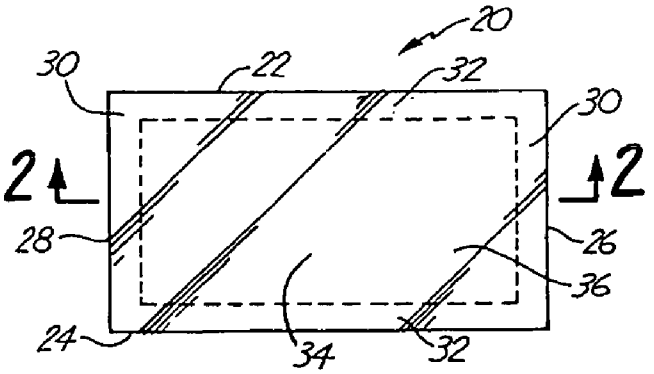


FIG. 1

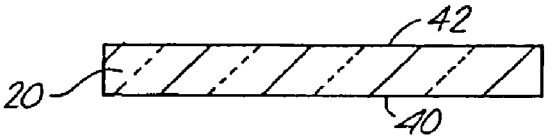


FIG. 2

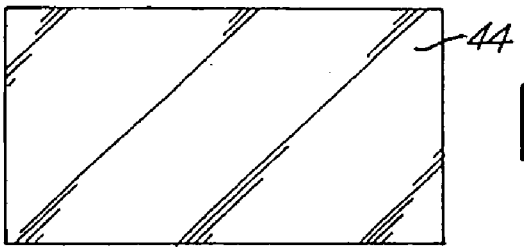


FIG. 3

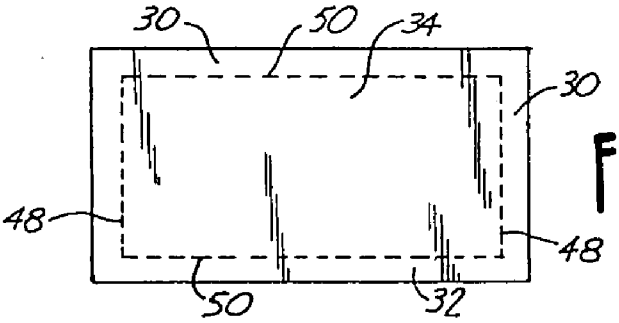


FIG. 4

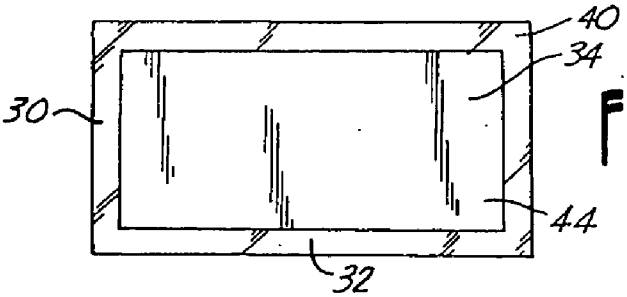


FIG. 5

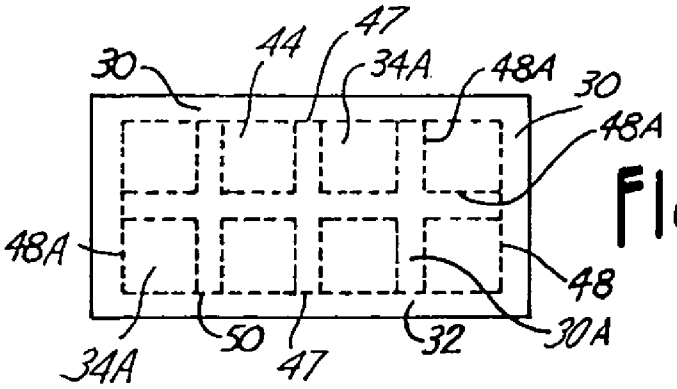

30
44
47
34A
48A
30
48A
48A
48
30A
34A
50
47
32

FIG. 4A

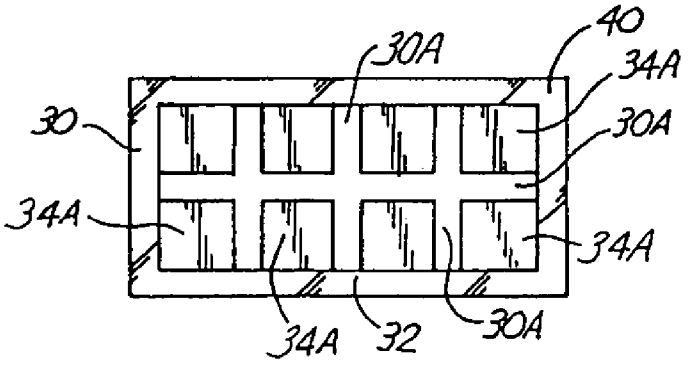

40
30A
34A
30
30A
34A
34A
34A
32
30A

FIG. 5A

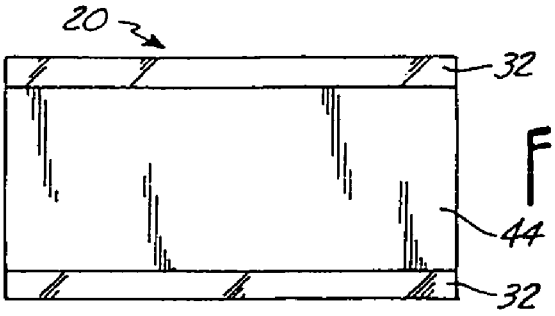


FIG. 6

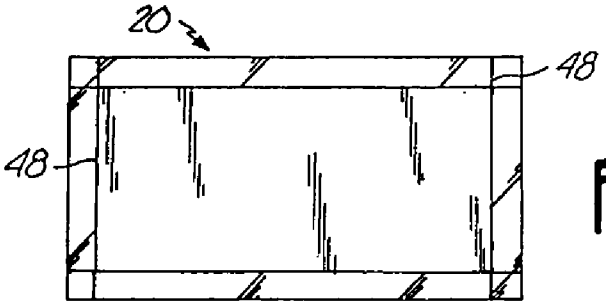


FIG. 7

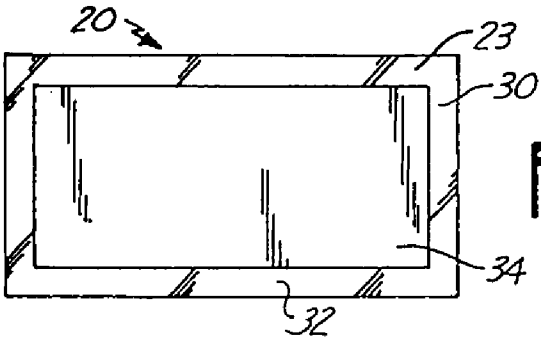


FIG. 8

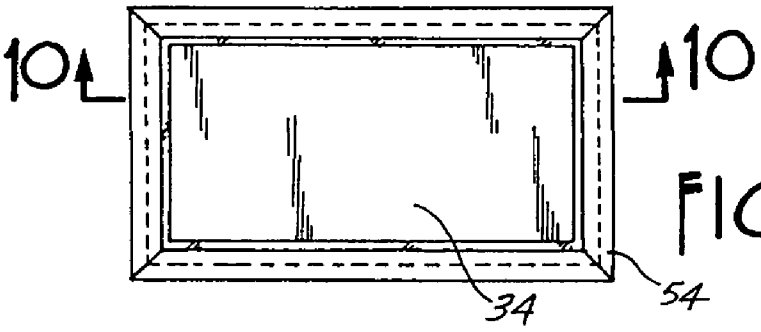


FIG. 9

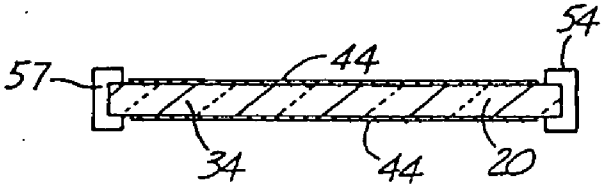


FIG. 10

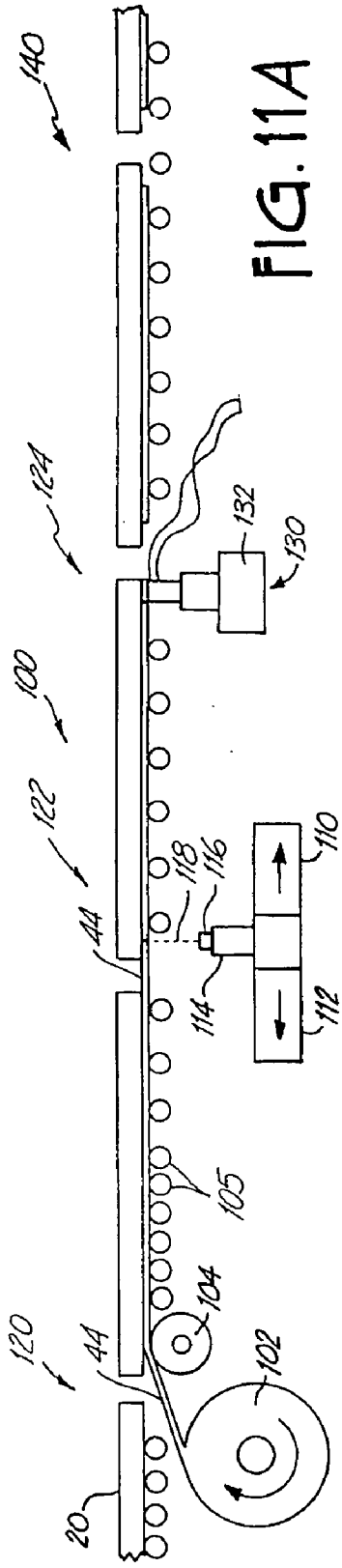


FIG. 11A

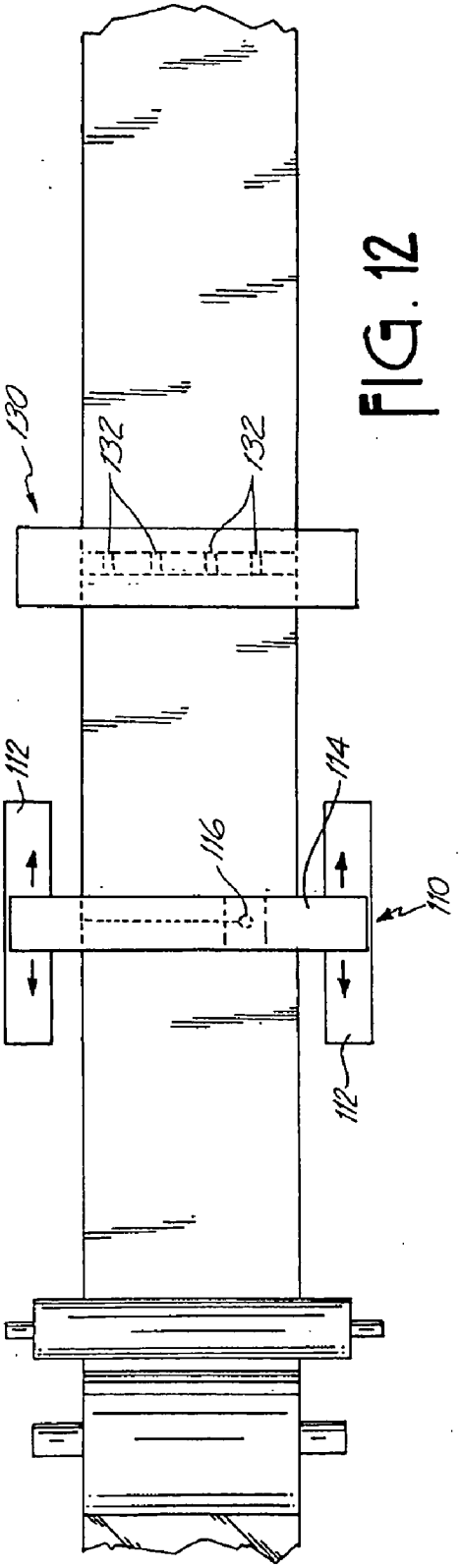


FIG. 12

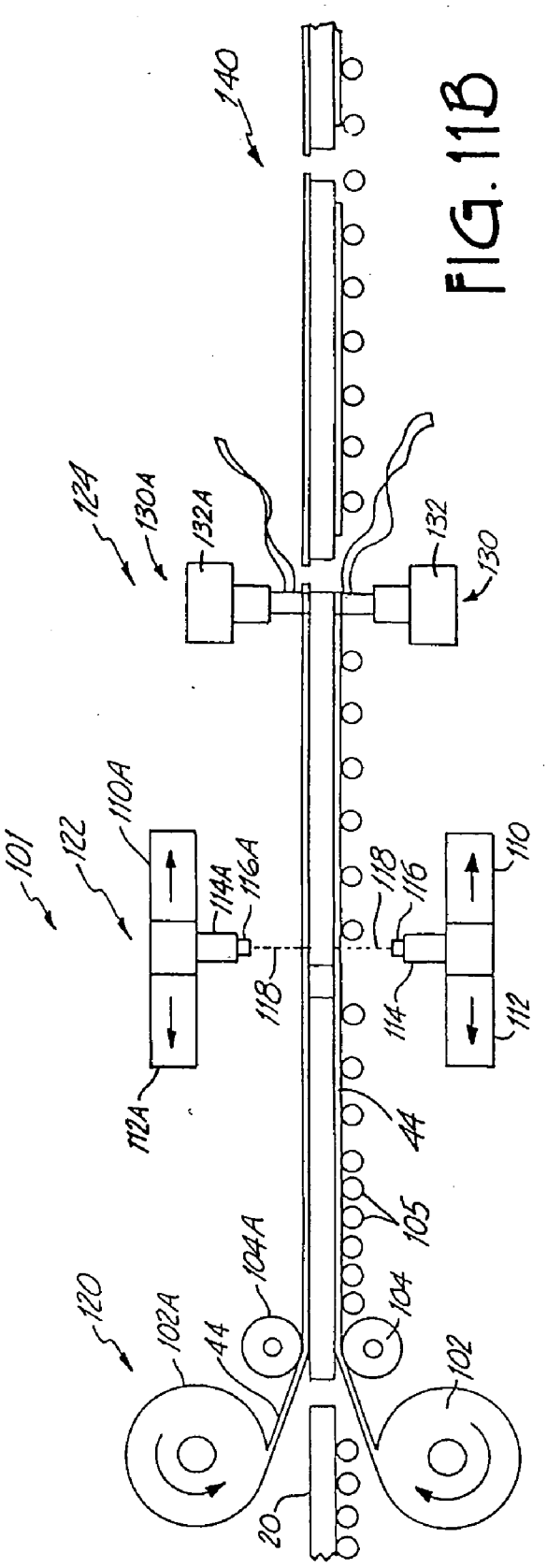

140
124
130A
132A
132
130
101
122
110A
114A
116A
118
116
110
112A
114
112
44
105
104A
104
120
102A
102
20

FIG. 11B

GLASS MASKING METHOD USING LASERS

BACKGROUND OF INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates generally to glass windows and doors. More specifically, the present invention relates to preparing glass panels for insertion into window frames. The present invention includes methods for protecting or masking glass panes to be disposed within window frames, while leaving the peripheral region free to be better sealed within a frame.

[0003] 2. Description of Related Art

[0004] Glazing panels are often mounted within frames such as window frames. The glazing panels can be single glass panes or multi-pane, insulating glass units. The window panes typically have first and second major surfaces with peripheral edges about the major surfaces, and peripheral regions within the peripheral edges. The peripheral regions bound a central region on each of the first and second major surfaces. The glass panes are typically ultimately disposed within frames, where the frames are dimensional and configured to accept only the peripheral regions of the glass panes, leaving the central regions of the window panes unoccluded. In some uses, the window panes are first formed into insulating glass units, having two or more substantially parallel window panes separated by spacers there between. In some insulating glass units, the parallel glass panes are sealed to the spacing member, and the air between the panes replaced with an inert gas. The resulting insulating glass unit can then be disposed within a window frame.

[0005] Old style windows were often made using several smaller panes of glass held within smaller frames, which were joined together into one window unit. Each portion of a double hung window might be formed of 4, 6 or 8 window panes held in place within a corresponding number of window frames. The additional frame members typically required additional glazing to secure the multiple window panes to the frame. The additional glazing represented additional labor and additional opportunities for air infiltration. Modern windows are typically formed of larger single panels, which are often insulating glass units. Some purchasers desire the older style appearance, but without the drawbacks. To achieve these goals, modern windows can have muntin bars placed over the single glass panels, to achieve the older style appearance of multiple panes, but without the disadvantages. The muntin bars thus represent another set of framing members to be disposed over the glass surface.

[0006] It is common for the glass panes and insulating glass units to be formed at one location, protected in some fashion, and shipped to another location. It is not until arrival at the second location that the glass panes or insulating glass units are mounted within window frames. Muntin bars may also be mounted at the second location The window frames are often then shipped to a third location, where they may be installed within homes, buildings, or automobiles.

[0007] There is an opportunity for damage to the glass panes at many points in the process, including the transport to the second location prior to framing, and subsequent to framing, prior to arrival at the building site. The glass major surfaces may also be damaged after installation in the building, for example, during building construction.

[0008] For the above-stated reasons, the glass pane major surfaces are often masked, for example, with a polymeric protective film. The protective film can provide some protection from abrasion and scratches to the surface during the transport or the building construction.

[0009] Sheets of masking material may be adhered to one or more of the glass pane surfaces to protect the surfaces from the scratching previously mentioned. Often, the entire glass pane is masked on at least one major surface. The masking material may be cut to the same size as a glass pane major surface. The glass pane may then be inserted within a window frame adapted in dimension to accept the peripheral region of the glass pane within the window frame. This can be done while the masking material is in place, leaving the glass major surface protected. This method, however, can leave polymeric material trapped along the peripheral region of the glass pane, between the glass surface and the enclosing frame member. The visible polymeric remnants may be unsightly, and may eventually degrade and/or be pulled out, reducing the integrity of the seal between the glass surface and the enclosing window frame. This can leave a gap between the glass surface and the window frame.

[0010] Cutting knives have been used to mechanically cut through the polymeric masking material while the masking material is on the glass surface. The peripheral strip of masking material thus delineated from the central region masking material may be peeled off, leaving the protected central region intact. The knife blade used to cut through the polymeric material may require an undue amount of adjustment, and may not provide exactly the needed pressure to cut through the polymeric film but not into the window pane. As windows are increasingly covered with coatings, the knife edge cutting through the outermost window coating can be very undesirable. What would be desirable are methods for removing the masking material that do not requiring touching the glass pane adhered to the masking material.

SUMMARY OF INVENTION

[0011] The present invention provides methods and apparatus for masking glazing panels with a protective layer, while leaving a peripheral region near the glazing panel edges free of masking material to allow better insertion and fit into a window frame. In one method, a masking material is applied over a first major surface of a glazing panel, followed by burning through the masking material along a cutting path which can follow inside of the edges of the glazing panel, demarcating a peripheral strip of masking material. In one method, a closed path within the periphery of the glazing panel is traveled by the laser beam, thereby forming a scored path through the masking material. The peripheral strip of masking material thus formed can be removed or peeled off by a stripper or finger mechanism. The final glazing panel thus has a central region covered with masking material and a peripheral region free of masking material, ready to be closely fit within a window frame.

[0012] In one method, the masking material is sized such that a top and bottom peripheral region is free of masking material prior to cutting by the laser beam. This method

requires fewer cuts through the masking material. In another method, the masking material is applied, then a muntin bar pattern is burned through the masking material. The masking material regions which are to lie under the muntin bars can be removed, and the frame and muntin bars mounted over the partially masked glass panel.

[0013] In still another method, a polymeric masking film is corona treated on one side and coated with an acrylic adhesive on the other side. The corona treated side is resistant to adhering to the adhesive, with the corona treatment obviating the need for a separate release liner. The adhesive coated masking material may be rolled up and the resulting supply roll provided to the masking line. In some methods, the adhesive force may be primarily a static electrical force.

[0014] In the glazing masking line, the masking material may be pulled from the supply rolls, and pressed against the glazing panels with applicator or pincher rolls. After application to the glass surface, a path within the periphery of the glazing panel may be described by the laser beam. In one method, a laser unit is mounted on a carriage mechanism which can travel with two degrees of freedom, to describe the desired path about the glass masked surface. In one exemplary method, the carriage mechanism has a vertical carriage mechanism mounted on a horizontal carriage mechanism. The path programmed for the carriage mechanism can vary from run to run. In another method, the laser unit remains stationary, while the laser beam is made to travel about the desired path using a movable mirror.

[0015] After a line has been scored or burned through the masking material about the periphery, the peripheral strips of masking material thus formed can be grasped by stripping or gripping fingers which can pull the peripheral strips of masking material from the glazing unit.

[0016] The present invention thus provides a rapid method for scoring the masking material, allowing precise definition of the peripheral strip size desired. The laser beam enables forming score lines through the masking material without burning the underlying glass and underlying glass coatings. The laser device, which does not physically contact the glass or masking material, is not subject to mechanical wear and will not damage the glass surface. The frequency and power of the laser beam can be selected to adequately burn through the masking material but not the underlying glass.

BRIEF DESCRIPTION OF DRAWINGS

[0017] **FIG. 1** is a highly diagrammatic, side view of a glazing panel to be masked where the glazing panel can be a glass pane or multi-pane insulating glass unit;

[0018] **FIG. 2** is a highly diagrammatic, top view of the glazing panel of **FIG. 1**, prior to masking;

[0019] **FIG. 3** is a highly diagrammatic, side view of the glazing panel of **FIG. 1**, after masking;

[0020] **FIG. 4** is a highly diagrammatic, side view of the masked glazing panel of **FIG. 3**, after scoring by a laser beam about the periphery;

[0021] **FIG. 4A** is a highly diagrammatic, side view of the masked glazing panel of **FIG. 3**, after scoring by a laser beam in a muntin bar pattern;

[0022] **FIG. 5** is a highly diagrammatic, side view of the scored, masked, glazing panel of **FIG. 4**, after the peripheral masking has been peeled off;

[0023] **FIG. 5A** is a highly diagrammatic, side view of the scored, masked, glazing panel of **FIG. 4A**, after the peripheral and muntin bar masking has been peeled off;

[0024] **FIG. 6** is a highly diagrammatic, side view of an alternate method of masking the glazing panel of **FIG. 1**, leaving the top and bottom peripheral regions initially free of masking material;

[0025] **FIG. 7** is a highly diagrammatic, side view of the masked glazing panel of **FIG. 6**, after lateral scoring by a laser beam;

[0026] **FIG. 8** is a highly diagrammatic, side view of the masked, scored, glazing panel of **FIG. 7**, after the lateral peripheral masking strips have been peeled off;

[0027] **FIG. 9** is a highly diagrammatic, side view, of the masked and peeled glazing panels of FIGS. **5** or **8**, after being disposed within a window frame;

[0028] **FIG. 10** is a highly diagrammatic, top, cross-sectional view of the window pane and frame of **FIG. 9**, illustrating the central masked portion of the finished glass unit;

[0029] **FIG. 11A** is a highly diagrammatic, top view of a single sided masking line including a supply roll, applicator roll, carriage mounted laser cutting beam free to move in two degrees of freedom, and a gripping or peeling mechanism;

[0030] **FIG. 11B** is a highly diagrammatic, top view of a two sided masking line including supply rolls, applicator rolls, carriage mounted laser cutting beam free to move in two degrees of freedom, and a gripping or peeling mechanism; and

[0031] **FIG. 12** is a highly diagrammatic, side view of the masking application line of **FIG. 11A**.

DETAILED DESCRIPTION

[0032] The following detailed description should be read with reference to the drawings, in which like elements in different drawings are numbered identically. The drawings, which are not necessarily to scale, depict selected embodiments and are not intended to limit the scope of the invention. Several forms of invention have been shown and described, and other forms will now be apparent to those skilled in art. It will be understood that embodiments shown in drawings and described above are merely for illustrative purposes, and are not intended to limit scope of the invention as defined in the claims which follow.

[0033] Referring now to **FIG. 1**, a glazing panel **20** is illustrated. Glazing panel **20** can be a single glass pane or an insulating glass unit including multiple glass panes separated by spacers. Glazing panel **20** includes generally a top edge **22**, a bottom edge **24**, a right side edge **26**, and a left side edge **28**. Glazing panel **20** includes generally a central region **34** surrounded by a peripheral or marginal region which includes a pair of longitudinal peripheral strips **32** and a pair of vertical or lateral peripheral strips **30**. While the central and peripheral regions are described separately for purposes of illustrating the invention, the glazing panel

typically is the same across the central and peripheral regions. Referring now to **FIG. 2**, glazing panel **20** is further illustrated from the top, having a first major surface **40** and a second major surface **42** substantially parallel to first major surface **40**.

[**0034**] Referring now to **FIG. 3**, glazing panel **20** is illustrated after application of a masking material **44** over at least one of the major surfaces **40** and **42**. In one method, only first major surface **40** is covered. In another embodiment, both the first and second major surfaces are covered with masking material **44**.

[**0035**] Referring now to **FIG. 4**, glazing panel **20** is illustrated after the laser cutting of a closed path of score lines through the masking material, but not through the underlying glass pane. Central region **34** may be seen to be surrounded by a pair of vertical or lateral score lines **48** and a pair of longitudinal score lines **50**. In a preferred embodiment, the score lines are burned entirely through the masking material in a closed path, leaving no masking material continuity between central region **34** and the surrounding peripheral regions. Referring now to **FIG. 5**, glazing panel **20** is illustrated after masking material **44** has been removed from peripheral regions **30** and **32**, leaving masking material in central region **34**.

[**0036**] Referring now to **FIGS. 4A and 5A**, another embodiment of the invention is illustrated, which can be used with muntin bars. **FIG. 4A** illustrates a method similar to the method of **FIG. 4**, sharing reference numerals for similar items. In **FIG. 4A**, masking material **34** is illustrated after having several closed paths **48**A burned through the masking material, as well as a peripheral closed path **48**. In some embodiments, a separate peripheral closed path **48** does not exist, and only the numerous separate closed paths **48**A are formed, which can result in a single contiguous piece of masking material requiring removal. In such an embodiment, line segments **47** are not burned through the masking material. Paths **48**A may be seen to form numerous closed paths, defining corresponding central regions **34**A within, and corresponding removable strips **30**A without.

[**0037**] **FIG. 5A** illustrates the masked and scored glass panel of **FIG. 4A**, after some of masking material **44** has been removed. Central masked regions **44**A may be seen to remain on the glass panel, while the masking over the removable strip areas **30**A has been stripped off. At some point in the manufacture, muntin bars can be disposed over the strip portions **30**A having no masking material. The masking material within each of the muntin bar faux window panes may be removed at a later time, typically after installation in a building.

[**0038**] Referring now to **FIG. 6**, an alternate method is illustrated for applying masking material **44** to glazing panel **20**. In this method, masking material **44** is sized so as to leave the glass top and bottom longitudinal peripheral strips **32** free of masking material **44**. Masking material **44** may be seen to cover the central region and the lateral regions on either end. Applying masking material **44** sized in this manner reduces the cutting requirement. In some methods, the top and bottom longitudinal strips **32** are already free of masking material to a sufficient degree and do not need to be further scored or cut by the laser beam. Referring now to **FIG. 7**, glazing panel **20** is illustrated after lateral score lines **48** have been burned through masking material **44** by the laser beam.

[**0039**] Referring now to **FIG. 8**, glazing panel **20** is illustrated after peripheral lateral masking material strips have been removed, leaving peripheral regions **30** and **32** free of masking material but leaving masking material **44** in central region **34**. It may be seen that the result of utilizing the method illustrated in **FIG. 6** can form a similar end result to that of **FIG. 5**.

[**0040**] Referring now to **FIG. 9**, further processing of the masked and stripped glazing panels of FIGS. **5** or **8** is illustrated. Glazing panel **20** has been disposed within a frame **54** about the peripheral region, leaving the central region **34** unoccluded. In embodiments having muntin bars, the muntin bars can be attached at this time, within frame **54**.

[**0041**] **FIG. 10** illustrates framed glazing panel **20** from the top, showing that central region **34** is masked by masking material **44**, while the peripheral region within frame **54** is free of the masking material, thereby allowing a tighter and/or more durable fit between glazing panel **20** and frame **54**.

[**0042**] Referring now to **FIG. 11A**, a single sided glazing masking line **100** is illustrated from the top. Glazing masking line **100** includes several glazing panels **20** being processed through the line. Glazing panels **20** may be seen to be carried through the line by number of conveyor rolls **1105**. Glass panels **20** can pass generally through a first station **120**, a second station **122**, and a third station **124**. First station **120** can be used to apply or adhere the masking material **44** to the glass panes **20**. Second station **122** may be used to form the score lines about the periphery of the glass panes. Third station **124** may be used to strip or peel off the masked peripheral regions. In first station **120**, a pair of masking material supply rolls **102** may be seen disposed on either side of glazing panels **20**, being applied to glazing panel **20** by applicator or pinch rollers **104**.

[**0043**] Second station **122** can include a carriage mechanism **110**, which can include a horizontal carriage **112** and a vertical carriage **114**, which can be slidably carried on horizontal carriage **112**. A laser unit **116** can be carried on vertical carriage **114** and may be seen to be emitting a laser beam **118** which impinges upon masking material **44** applied to glass pane **20**. In some embodiments, the horizontal and vertical carriages carry the laser **116** through a path sufficient to describe a closed, path within the edges of a glass pane, to allow later removal of the peripheral masking material. In other embodiments, a fixed laser is used, together with a mirror for sweeping the laser beam in a path about the periphery of the glass unit.

[**0044**] Third station **124** may be seen to include a stripper or peeler mechanism **130**. In one embodiment, stripper mechanism **130** includes numerous peeler or stripper fingers **132** which are biased against glass panel **20** in order to grasp and peel off masking material **44** in the peripheral regions. In some embodiments, stripper fingers **132** extend along the vertical edge of glazing panel in order to grasp the leading edge of the lateral or vertical peripheral strip to be removed as well as the lateral top and bottom strips to be removed. The finished, masked and stripped glazing panels may be seen as indicated at **140** in **FIG. 11A**.

[**0045**] Referring now to **FIG. 11B**, a double sided glazing masking line **101** is illustrated from the top. Double sided line **101** can be similar to line **100** of **FIG. 11A**. Double

sided line **101** has a second supply roll **102**A, a second applicator roll **104**A, a second side carriage mechanism **11**A having a horizontal carriage **112**A, a vertical carriage **114**A, and a laser **116**A. A second side stripper mechanism **130**A having numerous stripper fingers **132**A may also be seen. Double sided line **101** may be used when masking of both sides of a glass panel is desired.

[**0046**] Referring now to **FIG. 12**, the glazing masking line **100** of **FIG. 11A** is illustrated from the side. A carriage mechanism **110** may be seen to include the horizontal carriage component **112** and the vertical carriage component **114** for carrying laser **116** thereon. Stripper mechanism **130** may be seen to include numerous stripper fingers **132**.

[**0047**] In a preferred embodiment of the present invention, the path described by the laser cutting demarcates a central, masked region from a peripheral strip region which is to be removed. In one preferred embodiment of the invention, this path demarcates the central, masked region such that when the frame members and/or muntin bars are put in place over the glazing panel, the frame members and muntin bars do not overlie the central, masked region or regions. In this preferred embodiment, all peripheral edges of the central region may be disposed slightly inside of the surrounding frame members and/or muntin bars. This allows all edges of the central region to be grasped and peeled off, manually if need be. This also can provide a tight seal between the frame members and/or muntin bars, and the unmasked glazing panel directly underneath.

[**0048**] In another embodiment of the present invention, the path described by the laser cutting follows a path slightly inside of the region to be overlaid by the frame members and/or muntin bars. This path would thus be slightly outside of, and larger than, the path designed to have the central, masked region totally within the frame members and/or muntin bars. The central, masked region would thus be slightly overlaid by the frame members and/or muntin bars on one, some, or all peripheral edges of the central, masked region.

[**0049**] In one embodiment, the central, masked region is laser cut so as to have only one edge slightly underlying the overlying frame member and/or muntin bar. In another embodiment, two peripheral edges of the central, masked region are cut so as to slightly underlie the overlying frame members and/or muntin bars. The two, underlying edges may be adjacent edges, or opposing edges, depending on the embodiment. In yet another embodiment, all but one peripheral edge of the central, masked region slightly underlies the overlying frame members and/or muntin bars.

[**0050**] In one example of the invention, the central, masked region underlies the overlying frame members and/or muntin bars by about one millimeter, where the central, masked region is in fact underlying. In another example, the central, masked region underlies the overlying frame members and/or muntin bars by less than about two millimeters. The slightly underlying, central masked regions can provide benefits in certain situations. The slightly underlying central masked regions can provide total coverage and protection against glazing panel damage, rather than leaving a small, for example, one millimeter wide unprotected strip about the periphery of the central masked region. This total protection may be appropriate in situations where subsequent processing of the framed glazing panel may have a deleterious affect on the glazing panel. Having the central masked region slightly underlying a frame member or muntin bar along only one edge may also provide a more secure attachment of the masking material to the framed glazing panel. Allowing the central masked region to slightly underlie the framing member and/or muntin bars can also provide for a more secure attachment of the masking material to the framed glazing panel, where the adhesion of masking material to the glazing panel may otherwise be weak. This may be appropriate, for example, where the adhesion of masking material to glazing panel is intentionally weak, as when the use of adhesive is not desirable.

[**0051**] The slight underlying of the framing members and/or muntin bars is not believed to deleteriously affect the seal between the framing members and/or muntin bars and the underlying glazing panel, as the framing members and/or muntin bars still have a substantial surface area for direct contact to the underlying unmasked glazing panel. In one example, the framing member may be at least about three centimeters wide, providing more than sufficient width to allow a one or two millimeter wide inside peripheral strip of underlying masking material between the framing member and the underlying glazing panel. Thus, the great majority of the framing member may still directly contact the underlying glazing panel. In another example, a muntin bar may be about ten or fifteen millimeters in width, such that a one millimeter wide strip on either side of the muntin bar may still leave about 80% of the muntin bar to directly contact the underlying unmasked glazing panel. Allowing a slight underlying of the central masked region may thus provide many of the advantages of the present invention, while allowing the central masked region to be totally removed, by pulling the underlying peripheral regions out from under the overlying frame members and muntin bars at the time of masking material removal.

[**0052**] A variety of masking materials are suitable for use with the present invention. The masking material is preferably a polymeric film material which is sufficiently clear to allow viewing the glass through the masking material. Opaque masking materials, for example, paper are also believed suitable for use with the present invention. In some embodiments, polymeric film material is applied having a paper release liner there over, where the release liner can be removed from the central region of the glazing panel prior to removing the polymeric masking material.

[**0053**] Polyolefin films, for example, polyester or polyethylene, may be used to practice the present invention. In one method, a polyester film is used, well known to those skilled in the art. The polyester film may be supplied in a roll having an adhesive applied to one surface of the masking material and the other side of the polymeric masking material having a treated surface that resists adhesion to the adhesive. In some embodiments, a release liner is provided over the adhesive to prevent adhesion between the adhesive and the backside of the polymeric masking film. In one embodiment, the polyester film is roll coated with an acrylic adhesive, where the polyester film has been treated with a corona or UV treatment to prevent the acrylic adhesive from adhering or sticking to the polyester film surface. The masking material should be selected such that the material absorbs the laser beam in the laser wavelength utilized. Alternatively, the laser beam wavelength is selected to be absorbed by the masking material provided.

[0054] Various lasers may be used with the present invention. In one method, a 20 watt laser is utilized at approximately 4% power and a travel speed or burn speed of 9 inches per second. In another embodiment, a 10 watt laser is used and is operated at a minimum 8% power. In yet another embodiment, a 20 watt laser is operated at between 4% and 15% power. When using a 10 watt laser, the power range can be between 8% and 30% of full power.

1.-**18**. (canceled)

19. A glazing subassembly, comprising:

a glass panel including a central region disposed within a peripheral region; and

a masking material covering the central region and including a plurality of closed paths formed by cuts therethrough.

20. The subassembly of claim 19, wherein each of the plurality of closed paths encloses a separate sub-region, the sub-regions space apart from one another.

21. The subassembly of claim 19, wherein each of the plurality of closed paths form a rectangular shape.

22. The subassembly of claim 19, wherein one of the plurality of closed paths surrounds a remainder of the plurality of closed paths.

23. A glazing subassembly, comprising:

a glass panel including a central region disposed within a peripheral region; and

a plurality of masked sub-regions disposed within the central region and spaced apart from one another.

24. The subassembly of claim 23, further comprising a muntin bar disposed over the central region and extending between at least two of the plurality of masked sub-regions.

25. The subassembly of claim 23, wherein the sub-regions have a rectangular shape.

26. The subassembly of claim 23, further comprising a frame holding the peripheral region of the glass panel.

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