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(54) **WINDOW DEFROSTER ASSEMBLY WITH LIGHT CONTROL**

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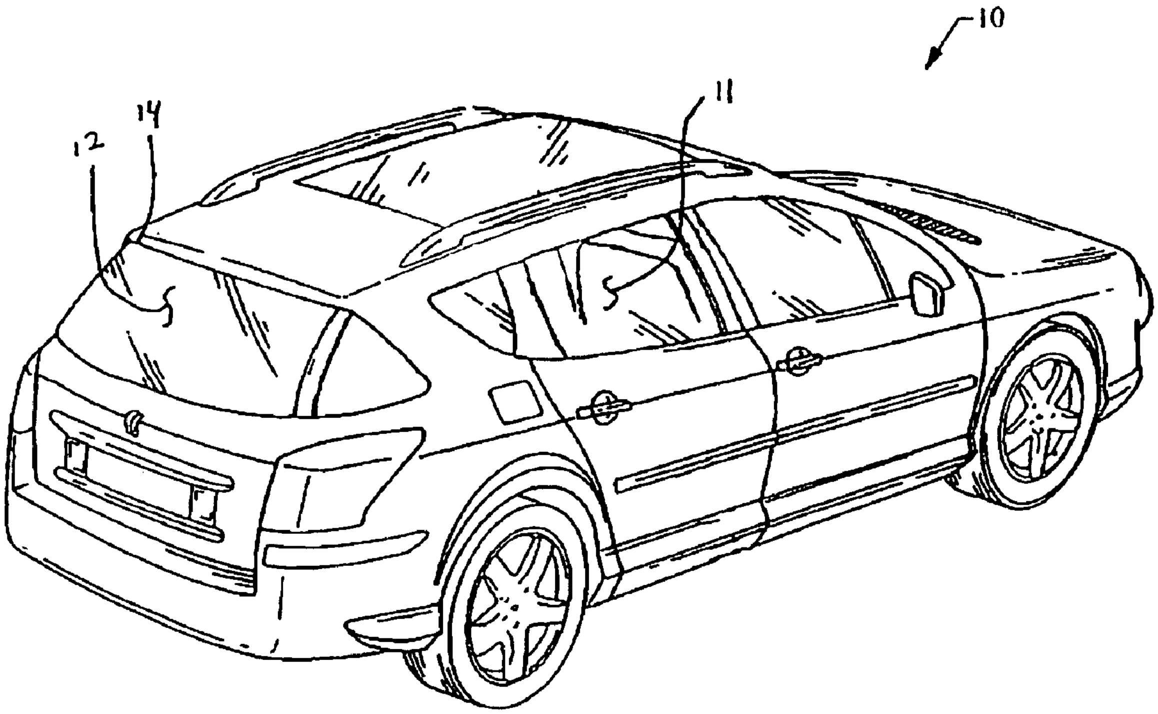
(57) **ABSTRACT**

A window defrost assembly having a substrate, a polycarbonate film adjacent to the substrate, a heater grid located between the substrate and the polycarbonate film, and a light control layer located between the polycarbonate film and the heater grid. The heater grid includes first and second bus bars and a plurality of grid lines extending between and connecting to the first and second bus bars.



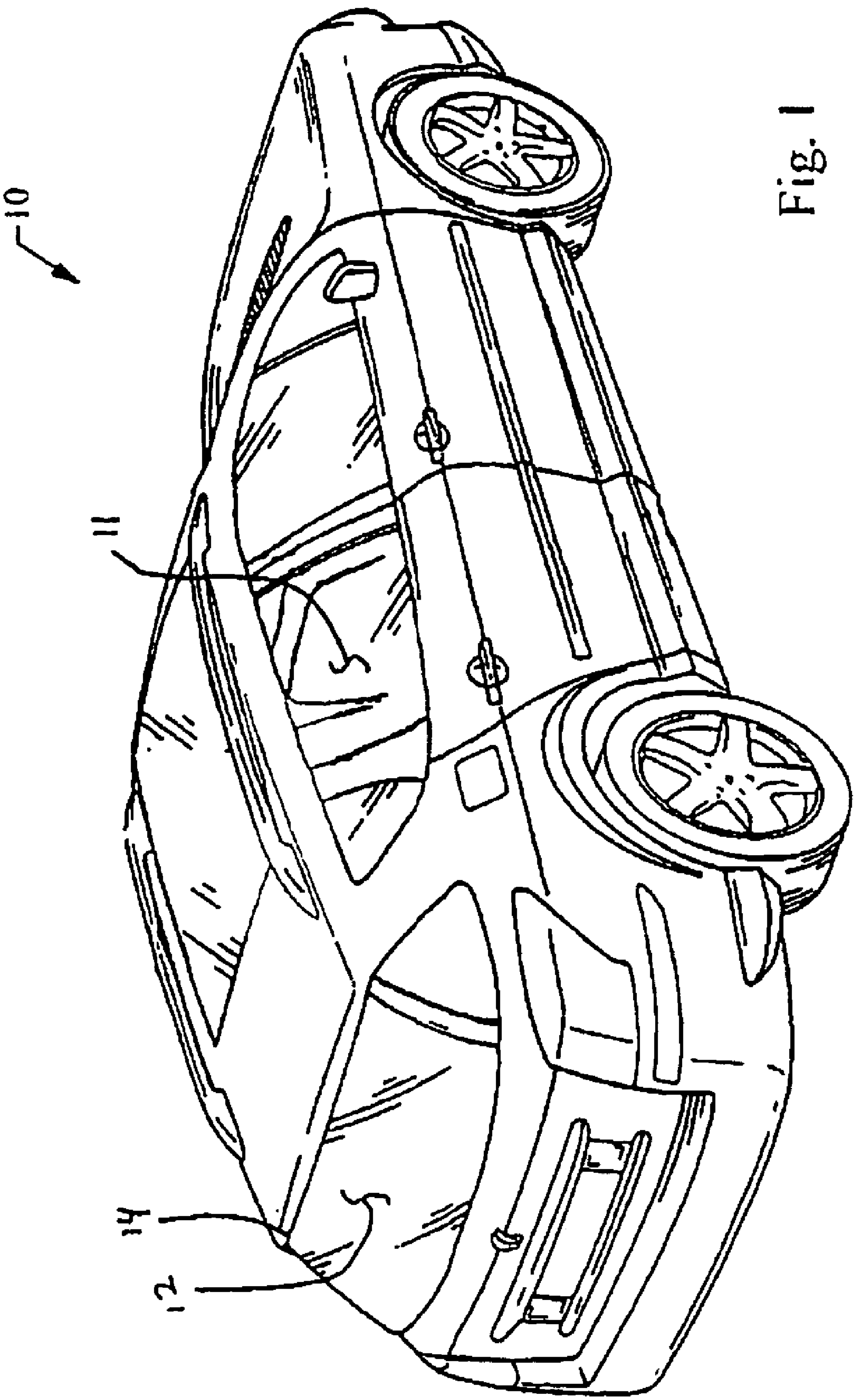


Fig. 1

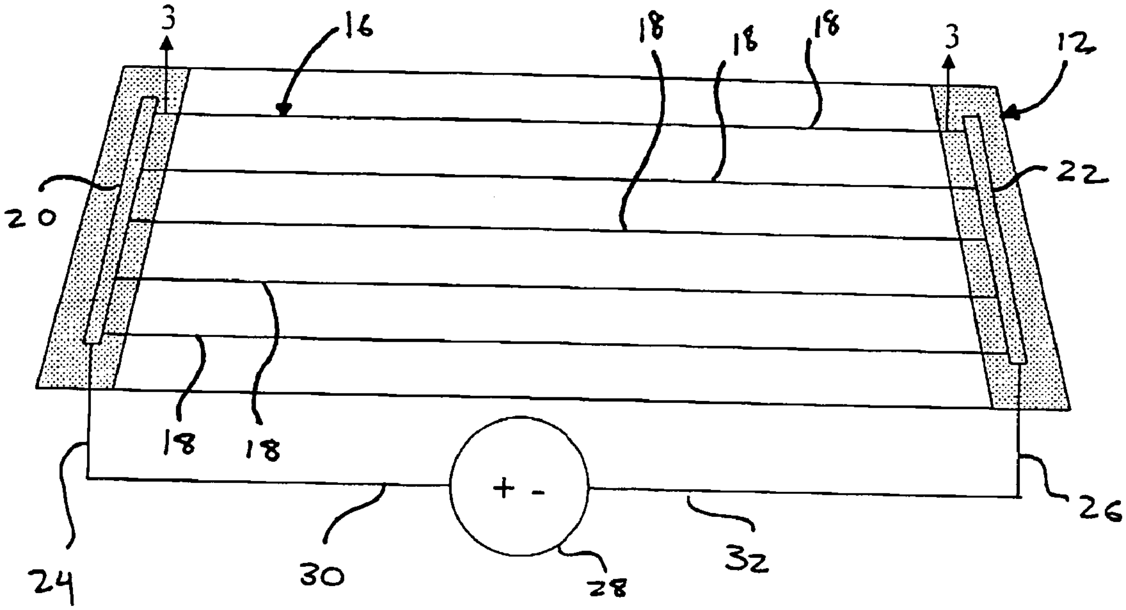


Fig. 2

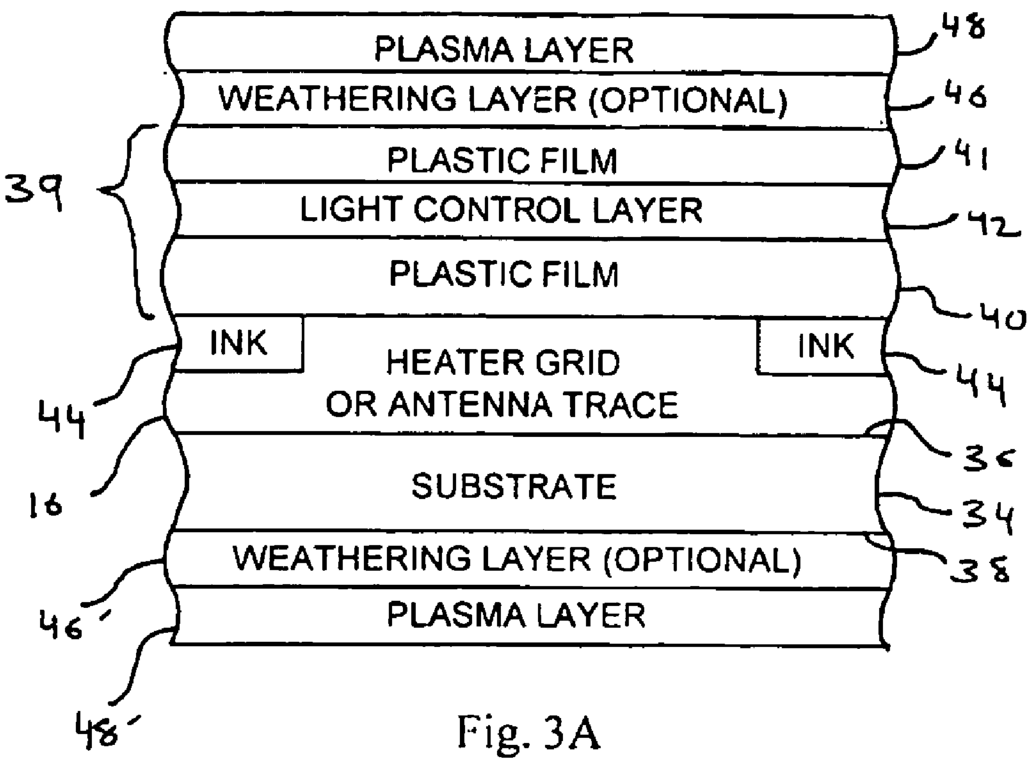
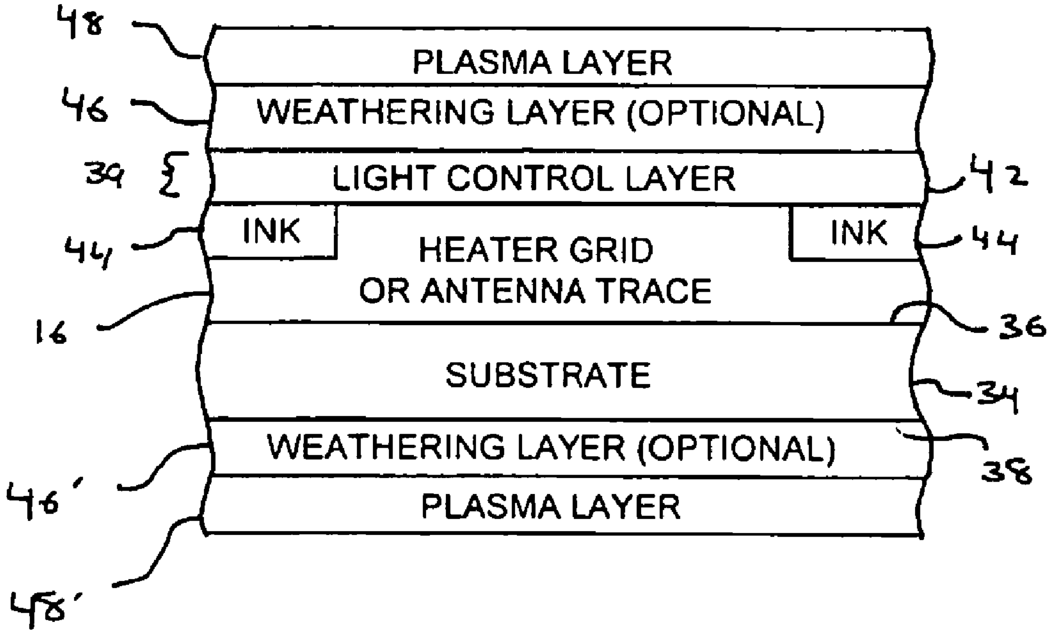

PLASMA LAYER
WEATHERING LAYER (OPTIONAL)
PLASTIC FILM
LIGHT CONTROL LAYER
PLASTIC FILM
INK
HEATER GRID
OR ANTENNA TRACE
INK
SUBSTRATE
WEATHERING LAYER (OPTIONAL)
PLASMA LAYER
48
46
41
42
40
44
36
34
38
39
44
16
46'
48'

Fig. 3A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WEATHERING LAYER (OPTIONAL)
LIGHT CONTROL LAYER
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HEATER GRID
OR ANTENNA TRACE
INK
SUBSTRATE
WEATHERING LAYER (OPTIONAL)
PLASMA LAYER
48
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39
44
16
46'
48'
42
44
36
34
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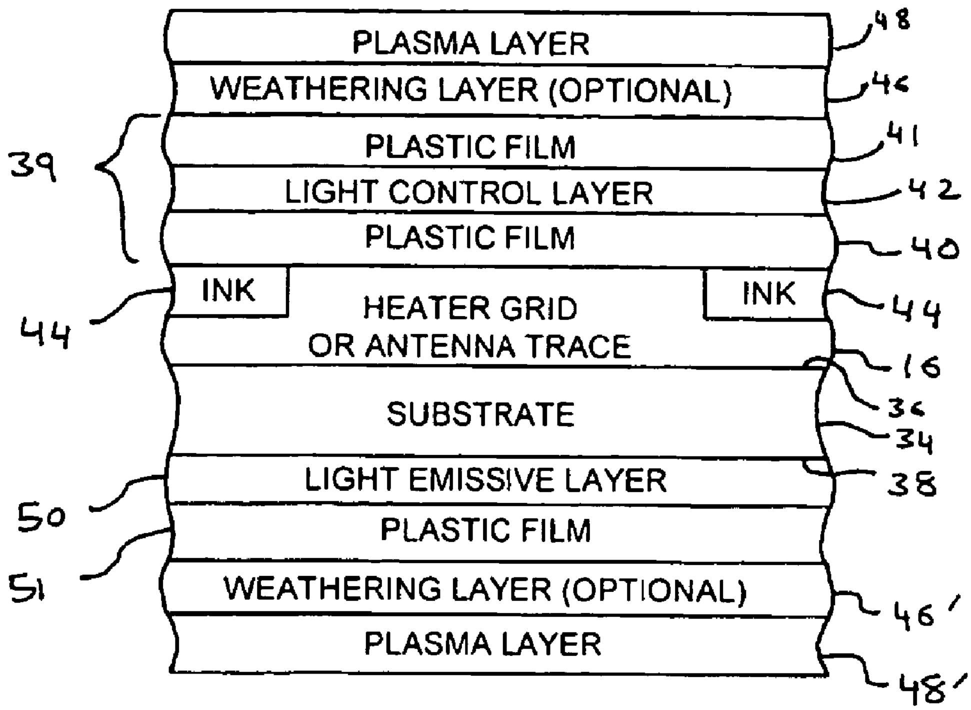
Fig. 3B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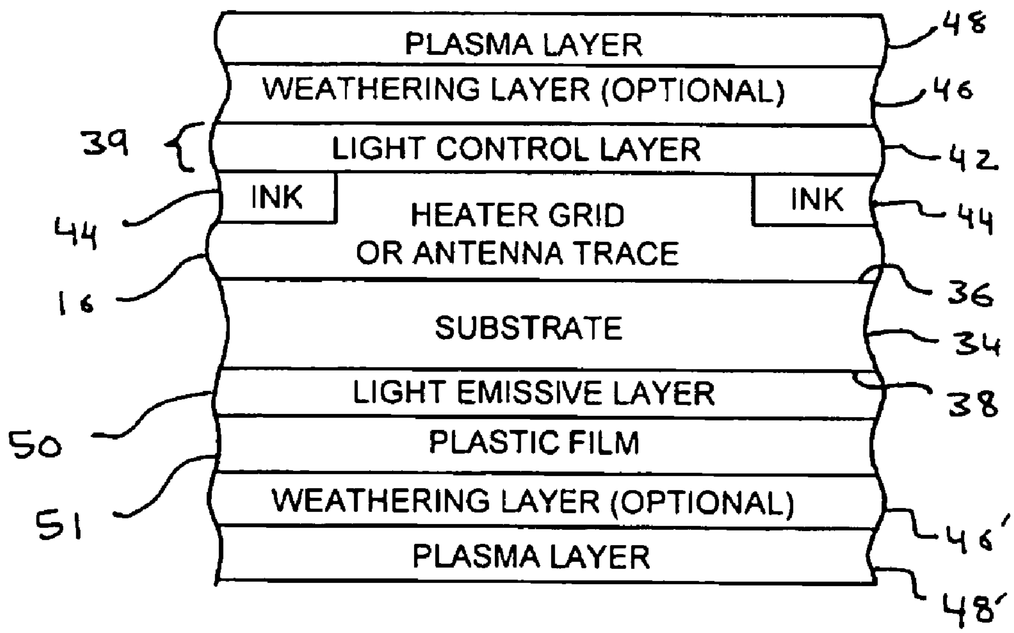
WEATHERING LAYER (OPTIONAL)
PLASTIC FILM
LIGHT CONTROL LAYER
PLASTIC FILM
INK
HEATER GRID
OR ANTENNA TRACE
INK
SUBSTRATE
LIGHT EMISSIVE LAYER
PLASTIC FILM
WEATHERING LAYER (OPTIONAL)
PLASMA LAYER
48
46
39
41
42
40
44
44
16
36
34
38
50
51
46'
48'

Fig. 3C


PLASMA LAYER
WEATHERING LAYER (OPTIONAL)
LIGHT CONTROL LAYER
INK
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INK
SUBSTRATE
LIGHT EMISSIVE LAYER
PLASTIC FILM
WEATHERING LAYER (OPTIONAL)
PLASMA LAYER
48
46
39
42
44
44
16
36
34
38
50
51
46'
48'

Fig. 3D

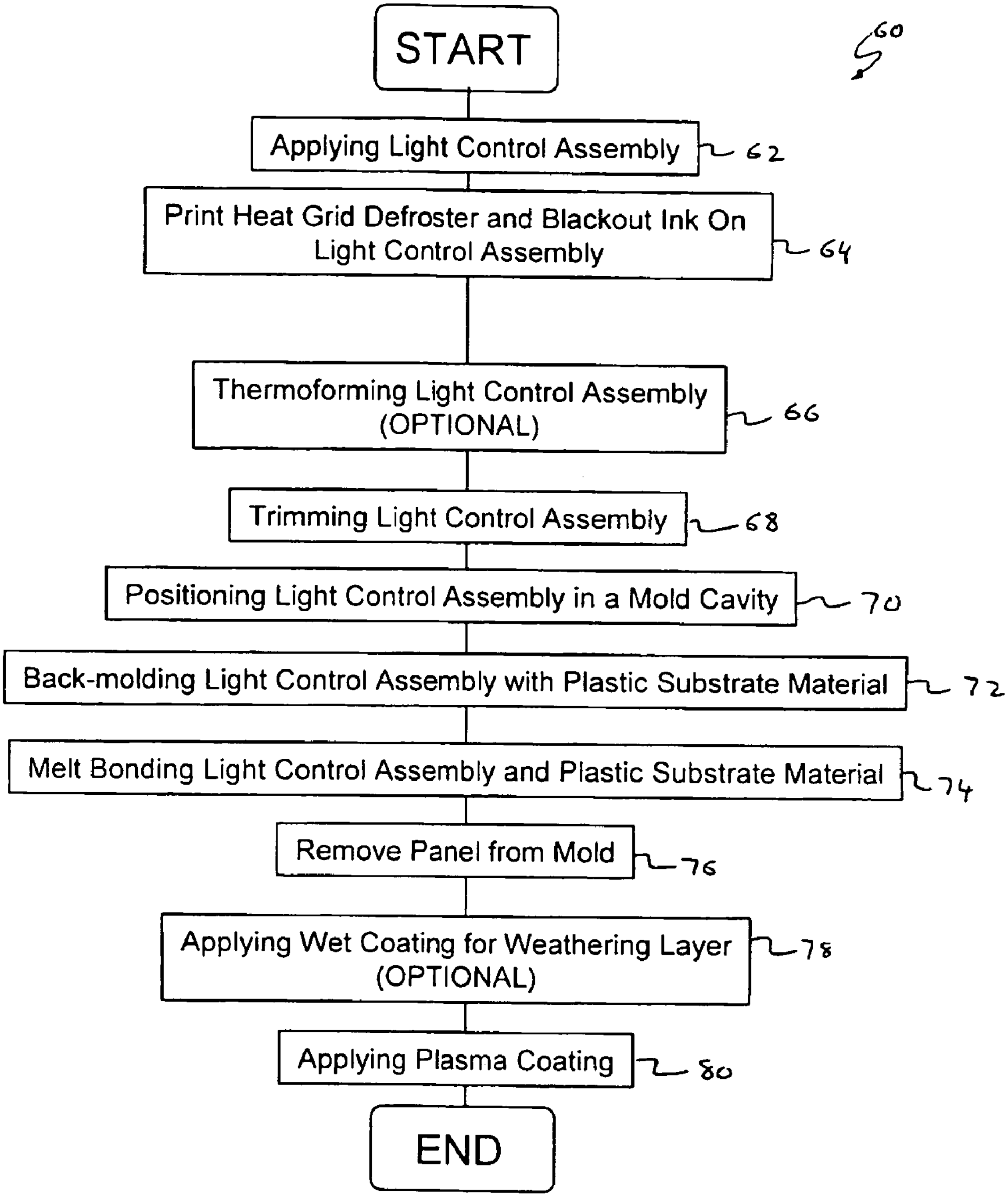
60
START
Applying Light Control Assembly
62
Print Heat Grid Defroster and Blackout Ink On Light Control Assembly
64
Thermoforming Light Control Assembly (OPTIONAL)
66
Trimming Light Control Assembly
68
Positioning Light Control Assembly in a Mold Cavity
70
Back-molding Light Control Assembly with Plastic Substrate Material
72
Melt Bonding Light Control Assembly and Plastic Substrate Material
74
Remove Panel from Mold
76
Applying Wet Coating for Weathering Layer (OPTIONAL)
78
Applying Plasma Coating
80
END

Fig. 4

WINDOW DEFROSTER ASSEMBLY WITH LIGHT CONTROL

BACKGROUND

[0001] 1. Field of the Invention

[0002] This invention relates to a conductive heater grid design that provides performance characteristics making it amenable for use in defrosting plastic and glass panels, such as windows in vehicles.

[0003] 2. Related Technology

[0004] Plastic materials, such as polycarbonate (PC) and polymethylmethyacrylate (PMMA), are currently being used in the manufacturing of numerous automotive parts and components, such as B-pillars, headlamps, and sunroofs. Automotive rear window (backlight) systems represent an application for these plastic materials due to their many identified advantages, particularly in the areas of styling/design, weight savings, and safety/security. More specifically, plastic materials offer the automotive manufacturer the ability to reduce the complexity of the rear window assembly through the integration of functional components into the molded plastic system, as well as the ability to distinguish their vehicles by increasing overall design and shape complexity. Being lighter in weight than conventional glass backlight systems, their incorporation into the vehicle may facilitate both a lower center of gravity for the vehicle (and therefore better vehicle handling & safety) and improved fuel economy. Further, enhanced safety is realized, particularly in a roll-over accident because of a greater probability of the occupant or passenger being retained in a vehicle.

[0005] Although there are many advantages associated with implementing plastic windows, these windows are not without technical hurdles that must be addressed prior to wide-scale commercial utilization. Limitations relating to material properties include the stability of plastics during prolonged exposure to elevated temperatures and the limited ability of plastics to conduct heat. Regarding the latter, in order to be used as a rear window or backlight on a vehicle, the plastic material must be compatible with the use of a defroster or defogging system. For commercial acceptance, a plastic backlight must meet the performance criteria established for the defrosting or defogging of glass backlights.

[0006] The difference in material properties between glass and plastics becomes quite apparent when considering heat conduction. The thermal conductivity of glass (T_c=22.39 cal/cm-sec-° C.) is approximately 4-5 times greater than that exhibited by a typical plastic (e.g., T_c for polycarbonate=4.78 cal/cm-sec-° C.). Thus a defroster or defogger (hereafter just "defroster") designed to work effectively on a glass window may not necessarily be efficient at defrosting, defogging or deicing (hereafter just "defrosting" or "defrost") a plastic window. The lower thermal conductivity of the plastic may limit the dissipation of heat from the heater grid lines across the surface of the plastic window. Thus, at a similar power output, a heater grid on a glass window may defrost the entire viewing area, while the same heater grid on a plastic window may only defrost those portions of the viewing area that are close to the grid lines.

[0007] A second difference between glass and plastics that must be overcome is related to the electrical conductivity exhibited by a printed heater grid. The thermal stability of glass, as demonstrated by a relatively high softening temperature (e.g., T_{soften}>>1000° C.), allows for the sintering of a metallic paste on the surface of the glass window to yield a substantially inorganic frit or metallic wire. Since the softening temperature of glass is significantly greater than the glass transition temperature of a typical plastic resin (e.g., polycarbonate T_g=145° C.), a metallic paste cannot be sintered onto a plastic panel. Rather, it must be cured on the panel at a temperature lower than the T_g of the plastic resin.

[0008] From the above, it is seen that there is a need in the industry for a system that will effectively defrost a plastic window with performance characteristics similar to that of a conventional glass window.

SUMMARY

[0009] In overcoming the drawbacks and limitations of the known art, the present invention provides a window assembly having defrosting capabilities. The window assembly includes a substrate, a plastic film adjacent to one side of the substrate, a heater grid located between the substrate and the plastic film and a light control layer located between the plastic film and the heater grid. The light control layer may be an electrochromic layer or a photochromic layer, or a thermochromic layer, or solar control layer.

[0010] The heater grid or conductive elements includes two generally opposed bus bars having a plurality of lines extending between the bus bars. Upon the application of a voltage to the heater grid, a current will flow through the grid lines from one bus bar to the other. As a result, the grid lines will heat up via resistive heating.

[0011] Further objects, features and advantages of this invention will become readily apparent to persons skilled in the art after a review of the following description, with reference to the drawings and claims that are appended to and form a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** is a perspective view of an automobile having a window panel assembly embodying the principles of the present invention;

[0013] FIG. **2** is a diagrammatic representation of a heater grid incorporated into a window panel assembly embodying the principles of the present invention;

[0014] FIG. **3**A is a diagrammatic sectional view of a portion of the window assembly generally taken along lines **3-3** in FIG. **2**;

[0015] FIG. **3**B is a cross sectional view similar to FIG. **3**A of the window assembly and further having a coating layer on both sides of the window assembly;

[0016] FIG. **3**C is a diagrammatic sectional view similar to FIG. **3**A of the window assembly and further having a light emissive layer;

[0017] FIG. **3**D is a diagrammatic sectional view of similar to FIG. **3**A of the window assembly and further having a light emissive layer and a weathering layer; and

[0018] FIG. **4** illustrates a method of making the window assembly embodying the principles of the present invention.

DETAILED DESCRIPTION

[0019] Referring to FIG. **1**, an automobile **10** incorporating the present invention is shown therein. The automobile **10** has an occupant compartment **11** located within. The automobile **10** includes a window defroster assembly **12** mounted via a frame **14** to the automobile **10**.

[0020] Although this description describes using the window defroster assembly **12** as a rear window, the invention is equally applicable to other areas of the automobile **10**. For example, the window defroster assembly **12** may be appropriately located and dimensioned to be used as a driver side window, a passenger side window, rear windows, a front windshield and/or any other windows the automobile **10** may have.

[0021] Referring to FIG. **2**, a more detailed view of the window defroster assembly **12** is shown. The window defroster assembly **12** includes a heater grid **16** having a series of grid lines **18** extending between generally opposed bus bars **20**, **22**. As further discussed below, the heater grid **16** is embedded within the window defroster assembly **12**.

[0022] The bus bars **20**, **22** are respectively designated as positive and negative bus bars. The bus bars **20**, **22** each are accordingly coupled in one or more places to leads **24**, **26**. Lead **24** is coupled to a positive terminal **30** of a voltage source **28**, while lead **26** is coupled to a negative (ground) terminal **32** of the a voltage source **28**, thereby establishing an electric circuit. The voltage source **28** may be the electrical system of the automobile **10**. Such an electrical system is typically a 12 volt system. Upon the application of voltage to the heater grid **16**, a current will flow through the grid lines **18** from the positive bus bar **20** to the negative bus bar **22** and, as a result, the grid lines **18** will heat up via resistive heating.

[0023] Referring to FIG. **3**A, a cross section of a portion of the window defroster assembly **12**, generally taken along lines **3-3** in FIG. **2**, is shown therein. The window defroster assembly **12** includes a substrate **34** having a first side **36** and a bottom side **38**. Generally, the second side **38** of the substrate **34** faces towards the occupant compartment **11** of the automobile **10** while the first side **36** of the substrate **34** faces away from the occupant compartment **11** of the automobile **10**. The substrate **34** may be made of polycarbonate (PC), polymethylmethyacrylate (PMMA), polyester, thermoplastic polyurethane (TPU), PX/polyester blends, PC/ABS or PC/ASA blend with/without glass fibers, and any combination thereof. Preferably, the substrate **34** is transparent.

[0024] Located above the first side **36** of the substrate **34** is a light control assembly **39**. In this embodiment, the light control assembly **39** includes a light control layer **42**, a first plastic film **40** and/or a second plastic film plastic film **41**. In one embodiment, the light control assembly **42** is sandwiched between the first plastic film **40** and the second plastic film plastic film **42**. Generally, the first and second plastic films **40**, **41** are made of at least PC, PMMA polyester, TPU, and combinations thereof.

[0025] The light control layer **42** may be made of a photochromic, an electrochromic or a thermochromic device, or a solar control device. The photochromic material is a material that changes from being transparent to less transparent or even opaque when the photochromic material is exposed to light and reverts to transparency when the light is dimmed or blocked. The electrochromic layer may be multi-layer system, is at least one of liquid-crystal based, suspended particle device (SPD) based, inorganic, organic, or hybrid based materials.

[0026] The electrochromic device consists of a sandwich of materials. One embodiment of this sandwich but not limited to this, comprises two electrode layers sandwiching an ion storage layer, an ion conductor/electrolyte layer and an electrochromic material layer. The photochromic can be single or multi-layer, it is at least one of TPU, PC, PMMA, polyester or other transparent thermoplastic or thermosetting material/component further comprising photochromic dyes or pigments or additives. When a voltage is applied to the electrochromic device a small electric charge consisting of ions flows from the ion storage layer into the electrochromic material layer via the ion conductor/electrolyte layer thus causing a chemical reaction in the electrochromic material layer which results in a change from transparent to less transparent or even opaque. When the voltage direction is reversed the ions flow back to the ion storage layer so that the electrochromic device reverts to transparency.

[0027] The thermochromic device contains materials change reversibly color with changes in temperature, or allow for a visual response to changes in temperature. When the temperature is raised to a specified temperature the pigment goes from colorless or light color to colored or dark color. The pigment returns to the original color as it cools down. The thermochromic material can be made as semiconductor compounds, from liquid crystals or using metal compounds, or organic pigments which are composed of micro capsules.

[0028] The solar control device may utilize solar absorbing pigment/additive or solar reflective coating/ink/pigment to control the amount of infrared light into the occupant compartment of the vehicle. A solar control layer suitable for incorporation in the present invention is described in U.S. application Ser. No. 11/450,732, which is herein incorporated by reference and is commonly owned.

[0029] Located between the light control assembly **39** and the first side **36** of the substrate **34** is the heater grid **16**. The heater grid **16** may include all or a portion of the grid lines **18** and the bus bars **20**, **22** as best shown in FIG. **2**. The heater grid **16** may be printed directly onto the first plastic film **40** and/or the light control layer **42**. Printing may be affected using a conductive ink or paste and any method known to those skilled in the art including, but not limited to, screen-printing, pad printing, ink jet, or automatic dispensing. Automatic dispensing includes techniques known to those skilled in the art of adhesive application, such as drip & drag, streaming, and simple flow dispensing. Additionally or alternatively, an antenna trace similar to the heater grid **16**, may be printed directly on the plastic film **40** and/or the light control layer **42**.

[0030] The heater grid **16** may be formed from any conductive material including conductive pastes, inks, paints, coatings, wires/thin wires, or films known to those skilled in the art. If the conductive element is a paste, ink, or paint, it is preferred that they include conductive particles (and nano-particles), flakes, or powders dispersed in a polymeric matrix. This polymeric matrix is preferably an epoxy resin, a polyester resin, a polyvinyl acetate resin, a polyvinylchloride resin, a polyurethane resin or mixtures, blends, and copolymers of the like.

[0031] The conductive particles, flakes or powders may be of a metal including, but not limited to, silver, copper, zinc, aluminum, magnesium, nickel, tin, or mixtures and alloys of the like, as well as any metallic compound, such as a metallic dichalcongenide. These conductive particles, flakes, or powders may also be any conductive organic material known to those skilled in the art, such as polyaniline, amorphous carbon, carbon-graphite and carbon nanotubes. Although the particle size of any particles, flakes, or powders may vary, a diameter of less than about 40 μm is preferred with a diameter of less than about 1 μm being specifically preferred. Any solvents, which act as the carrier medium in the conductive pastes, inks, or paints, may be a mixture of any organic that provides solubility for the organic resin. Examples of metallic pastes, inks, or paints include silver-filled compositions commercially available from DuPont Electronic Materials, Research Triangle Park, N.C. (5000 Membrane Switch, 5029 Conductor Composition, 5021 Silver Conductor, and 5096 Silver Conductor), Acheson Colloids, Port Huron, Mich. (PF-007 and Electrodag SP-405), Methode Engineering, Chicago, Ill. (31-1A Silver Composition, 31-3A Silver Composition), Creative Materials Inc., Tyngsboro, Mass. (118-029 2k Silver), and Advanced Conductive Materials, Atascadero, Calif. (PTF-12).

[0032] An ink layer **44** may be disposed between the heater gird **16** and the first plastic film **40** and/or the light control layer **42**. The ink layer **44** may be disposed such that to cover areas of the heater grid **16**, such as the bus bars **20**, **22** from view. Additionally, the ink layer **44** may be stylized in such a way to provide for manufacturers to differentiate their window defroster assembly **12** from competitors. As such, the ink layer **44** may be stylized in any one of a number of patterns.

[0033] Placed above the light control assembly **39** are an optional first weathering layer **46** and a first plasma layer **48** respectively. The first weathering layer **46** may be a material that includes the basic chemistry of acrylic, polyurethane, siloxane, or a combination of these materials to provide high weatherablity and long term ultraviolet. Further, the first weathering layer **46** may also include a material having lonomer or flouropolymer chemistry or similar material. Moreover, in another embodiment of the present invention silicon/nanoparticles may be blended into the material of the first weathering layer **46** or a silioxyane copolymer is formed into the weathering layer **46** by polymerization. The weathering layer **46** may be applied by one method selected from the group of flow coating, dip coating, spray coating, in-mold coating, curtain coating, and the like. If it's a weathering film, the weathering layer **46** is produced by extrusion, co-extrusion, lamination, extrusion-lamination, extrusion-coating, roller-coating, and the like. The weathering layer **46** may include ultraviolet absorbers.

[0034] The first plasma layer **48** is a "glass-like" coating deposited on the weathering layer **46** by plasma enhanced chemical vapor deposition (PECVD) process, expanding thermal plasma PECVD, plasma polymerization, photochemical vapor deposition, ion beam deposition, ion plating deposition, cathodic arc deposition, sputtering, evaporation, hollow-cathode activated deposition, magnetron activated deposition, activated reactive evaporation, thermal chemical vapor deposition, and a sol-gel coating process or the like. An optional second weathering layer **46'** and a second plasma layer **48'** may be deposited on the second side **38** of the substrate **34**. The plasma layers **48**, **48'** may be multiple layers and may contain an ultraviolet absorber.

[0035] The plasma layers **48**, **48'** may be made of aluminum oxide, barium fluoride, boron nitride, hafnium oxide, lanthanum fluoride, magnesium oxide, scandium oxide, silicon monoxide, silicon dioxide, silicon nitride, silicon oxy-nitride, silicon oxy-carbide, hydrogenated silicon oxy-carbide, silicon carbide, tantalum oxide, titanium oxide, tin oxide, yttrium oxide, zinc oxide, zinc selenide, zinc sulphide, zirconium oxide, and zirconium titanate. Furthermore, the plasma layers **58**, **60** may comprise multiple sub-layers differing in composition or structure.

[0036] Referring to FIG. **3**B, an alternative embodiment of the window defroster assembly **12** is shown. This embodiment is similar to the embodiment shown in FIG. **3**A. The difference is that this the light control assembly **39** does not include the first and second plastic film **40**, **41**.

[0037] Referring to FIG. **3**C, another alternative construction for the window defroster assembly **12** is shown. While this embodiment is similar to the embodiment shown in FIG. **3**A, it varies in that it includes a light emissive layer **50** and a plastic film layer **51** located between the second side **38** of the substrate **34** and the second plasma layer **48'**. The light emissive layer **50** may emit light through the plastic film layer **51** to the second plasma layer **48'** and into the occupant compartment **11** of the automobile **10** as best shown in FIG. **1**. A light emissive layer **50** suitable for incorporation in the present invention is described in U.S. application Ser. No. 11/317,587 which is herein incorporated by reference and is commonly owned.

[0038] Referring to FIG. **3**D, another alternative construction for the window defroster assembly **12** is shown. While this embodiment is similar to the embodiment shown in FIG. **3**B, it varies in that it includes a light emissive layer **50** and a plastic film layer **51** located between the second side **38** of the substrate **34** and the second plasma layer **48'**. The light emissive layer **50** may emit light through and the plastic film layer **51** to the second plasma layer **48'** and into the occupant compartment **11** of the automobile **10** as best shown in FIG. **1**.

[0039] Referring to FIG. **4**, a method **60** of producing the window assembly **12** is shown. First, as indicated by block **62**, the light control assembly is formed. The light control assembly may be formed by extrusion, co-extrusion, lamination, extrusion-lamination, printing, coating, solvent casting, sputtering, electrochemical deposition, or similar process.

[0040] As shown in block **64**, an ink layer and heater grid may be applied to the light control assembly. The stylized ink layer and the heater grid may be applied by screen printing, pad printing, membrane image transfer printing, transfer printing, ink jet printing, digital printing, robotic dispensing, or mask and spray. Optionally, as indicated by block **66**, the light control assembly may be thermoformed. This thermoforming process may be done by vacuum thermoforming, pressure assisted thermoforming, drape forming or cold forming.

[0041] Thereafter, as shown in blocks **68** and **70**, the light control assembly is then trimmed and positioned to fit in a mold cavity. Once in the mold cavity, as shown in block **72**, the light control assembly is back molded with a substrate material. This may be accomplished by utilizing injection molding, compression molding, injection-compression molding, multi-component molding, multi-color molding or multi-material molding process. The same method may apply when incorporating a light emissive layer.

[0042] Afterwards, as indicated by blocks **74** and **76**, the light control assembly and substrate material are hot melted, thereby forming the window panel, which is then removed from the mold cavity. As shown in block **78**, an optional weathering layer may be applied to the window assembly. Thereafter, a plasma coating is applied to the window assembly via a PECVD process as shown in block **80**.

[0043] The method **60** may also be executed when incorporating a light emissive layer. This act would include the steps of the forming a light emissive assembly, trimming the light emissive assembly, position the light emissive assembly in the mold cavity, back molding the light emissive assembly to the plastic substrate material, melt bonding the light emissive assembly to form the window assembly, removing the window assembly from the mold cavity, and applying a plasma coating on at least one side of the window assembly.

[0044] As a person skilled in the art will readily appreciate, the above description is meant as an illustration of implementation of the principles of this invention. This description is not intended to limit the scope or application of this invention in that the invention is susceptible to modification, variation and change, without departing from spirit of this invention, as defined in the following claims.

1. A window defroster assembly having defrosting properties, the window assembly comprising:
- a transparent substrate having a first side and a second side;
- a light control assembly overlying the first side of the substrate; and
- a heater grid having first and second bus bars and a plurality of grid lines extending between and connected to the first and second bus bars, the heater grid located between the first side of the substrate and the light control assembly.

2. The assembly of claim **1**, wherein the substrate is made from a material selected from the group including at least one of polycarbonate, polymethyl methacrylate, polyester, polyurethane, thermoplastic polyurethane, polyamide, blends or copolymers, and combinations thereof.

3. The assembly of claim **1**, wherein the light control assembly comprises a first plastic film, a second plastic film and a light control layer, the light control layer being located between the first and second plastic films.

4. The assembly of claim **1**, wherein at least on of the first and second plastic films are made from a material selected from the group including at least one of polycarbonate, polymethyl methyacrylate, polyester, polyurethane, thermoplastic polyurethane, polyamide, blends or copolymers, and combinations thereof.

5. The assembly of claim **1**, further comprising a weathering layer applied over or within the light control assembly.

6. The assembly of claim **5**, wherein the weathering layer is made from at least one of acrylic, polyurethane, siloxane, silicone coating, lonomer, flouropolymer, ultraviolet absorbers, ultraviolet stabilizers, and combinations thereof.

7. The assembly of claim **5**, further comprising a plasma layer applied over the weathering layer.

8. The assembly of claim **1**, further comprising a plasma layer overlying the second side of the substrate.

9. The assembly of claim **8**, further comprising a weathering layer located between the second side of the substrate and the plasma layer.

10. The assembly of claim **9**, wherein the weathering layer is made from at least one material selected from the group of acrylic, polyurethane, siloxane, silicone coating, lonomer, flouropolymer, ultraviolet absorbers, ultraviolet stabilizers, and combinations thereof.

11. The assembly of claim **1**, further comprising a light emissive layer located between the second side of the substrate and the plasma layer.

12. The assembly of claim **1**, wherein the heater grid is made of conductive material.

13. The assembly of claim **12**, wherein the conductive material is at least one of silver, copper, zinc, aluminum, magnesium, nickel, tin and combinations thereof.

14. The assembly of claim **1**, wherein the heater grid is at least one of a conductive paste, a conductive ink and a conductive paint/coating, a conductive wire and combinations thereof.

15. The assembly of claim **1**, wherein the light control assembly is an electrochromic layer.

16. The assembly of claim **15**, wherein the electrochromic layer is at least one of liquid-crystal based, suspended particle device (SPD) based, inorganic, organic, or hybrid based materials.

17. The assembly of claim **1**, wherein the light control assembly is a photochromic layer.

18. The assembly of claim **17**, wherein the photochromic layer is at least one of TPU, PC, PMMA, polyester or other transparent thermoplastic or thermosetting material/component further comprising photochromic dyes or pigments or additives.

19. The assembly of claim **1**, wherein the light control assembly is a thermochromic layer.

20. The assembly of claim **19**, wherein the thermochromic material layer is at least one of semi-conductor compounds, metal compounds and organic pigments.

21. The assembly of claim **1**, wherein the light control assembly is a solar control layer, which may comprise of IR absorbers/layers or IR reflective coating/ink/pigments.

22. The assembly of claim **1**, further comprising an ink layer located between the heater grind and the light control assembly.

23. A method of producing a window assembly, the method comprising the steps of:
- forming a light control assembly;
- trimming the light control assembly;
- positioning the light control assembly in a mold cavity;
- back molding the mold cavity with a plastic substrate material;
- melt bonding the light control assembly to the plastic substrate material to form the window assembly;
- removing the window assembly from the mold cavity; and
- applying a plasma coating on at least one side of the window assembly.

24. The method of claim **23**, further comprising the step of printing a stylized ink on the light control assembly.

25. The method of claim **23**, further comprising the step of thermoforming the light control assembly.

26. The method of claim **23**, further comprising the step applying a weathering layer to the window assembly.

27. The method of claim **23**, wherein the light control assembly further comprising a heater grid.

28. The method of claim **23**, further comprising the steps of:
- forming a light emissive assembly;
- trimming the light emissive assembly;
- position the light emissive assembly in the mold cavity;
- back molding the light emissive assembly to the plastic substrate material;
- melt bonding the light emissive assembly to form the window assembly;
- removing the window assembly from the mold cavity; and
- applying a plasma coating on at least one side of the window assembly.

* * * * *