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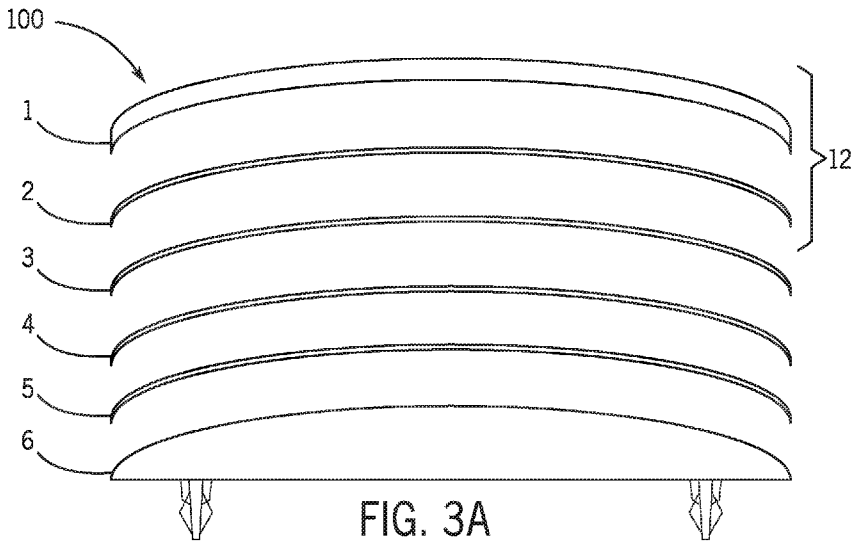


FIG. 3A

(57) Abstract: A vehicle interior component is disclosed. The component may comprise a decorative layer coupled or laminated to a base and coupled to a cover. The decorative layer may comprise a laminate of natural material. The cover may comprise a nonplanar inner layer and a nonplanar outer layer comprising glass or plastic. An adhesive may couple the decorative layer to the cover and transmit light from the cover to the decorative layer. The inner layer may comprise ink, paint, a foil, or a film to prevent visibility of the decorative layer. The inner layer may allow illumination to pass from a display to the outer layer. The inner layer may comprise an electrical circuit, a sensor, a capacitive switch, or a capacitive switch sensor. The cover may comprise an opening to expose the decorative layer. The decorative layer and cover may provide visual effects that together provide a composite visual effect.

WO 2018/129071 A1

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PATENT APPLICATION

VEHICLE INTERIOR COMPONENT

FIELD

[0001] The present invention relates to a vehicle interior component. The present invention also relates to a multi-layer construction of a vehicle interior component.

CROSS REFERENCE TO RELATED APPLICATIONS

[0002] The present application claims priority from and the benefit of U.S. Provisional Patent Application No. 62/443,452 filed January 6, 2017, entitled "Vehicle Interior Component". The entirety of this application is hereby incorporated herein by reference in its entirety.

BACKGROUND

[0003] Components in vehicle interiors are often given a cover intended to protect the component from damage. Such components (and cover) are typically formed from materials that are relatively cost-efficient for production methods (e.g. molded plastics) but may not be fully desired by interior designers wishing to present contoured surfaces (e.g. in forms that are aesthetically integrated) of materials typically considered more pleasing to vehicle occupants.

[0004] It would be advantageous to provide an improved component assembly for a vehicle interior that can provide an improved aesthetic opportunity/visual effect. It would also be advantageous to provide improved arrangement for providing a display assembly in a component in a vehicle interior. It would further be advantageous to provide an improved component assembly with contoured surface and improved visual appearance component decorated with materials such as wood, metal, stone, etc. (e.g. decorative, authentic material) but that does not add undesired mass to the vehicle.

SUMMARY

[0005] The present invention relates to a component for a vehicle interior with a surface intended to be visible to an occupant when the component is installed in the vehicle interior. The component may comprise a base, a decorative layer and a cover. The decorative layer may be coupled to the base. The cover may be coupled to the decorative layer. The cover may comprise an outer layer. The decorative layer may comprise a laminate. The base may comprise a nonplanar surface. The cover may comprise an inner layer. The inner layer of the cover and the outer layer of the cover may be nonplanar. The inner layer of the cover may be configured to align with the nonplanar surface of the base. The decorative layer may comprise a natural material. The decorative layer may be laminated to the base. The component may comprise an adhesive. The adhesive may be configured to couple the decorative layer to the cover. The adhesive may be configured to transmit light passing from the cover to the decorative layer. The cover may comprise glass. The cover may comprise plastic. The outer layer of the cover may comprise at least (a) glass (b) plastic. The inner layer of the cover may comprise at least a portion configured to prevent visibility of the decorative layer. The inner layer of the cover may comprise at least one of (a) ink (b) paint (c) a foil (d) a film configured to prevent illumination to pass from a display to the outer layer of the cover. The inner layer of the cover may comprise at least a portion configured to allow illumination to pass from a display to the outer layer of the cover. The inner layer may comprise at least one of (a) an electrical circuit (b) a sensor (c) a capacitive switch (d) a capacitive switch sensor. The cover may comprise an opening. The opening may be configured to at least one of (a) expose the decorative layer (b) uncover the decorative layer. The surface intended to be visible to an occupant may comprise a first portion comprising the cover and a second portion comprising the decorative layer. The decorative layer may be configured to provide a visual effect. The cover may be configured to provide a visual effect. The visual effect of the decorative layer and the visual effect of the cover may be configured to provide a composite visual effect.

[0006] The present invention also relates to a component for a vehicle interior providing a composite visual effect. The component may comprise a base, a decorative layer and a cover. The decorative layer may provide a visual effect. The decorative layer may be coupled to the base. The cover may provide a visual effect. The cover may be coupled over the decorative

layer. The composite visual effect may be provided by the visual effect of the decorative layer and the visual effect of the cover. The base may comprise a nonplanar surface. The cover may comprise an inner surface and an outer surface. The inner surface of the cover and the outer surface of the cover may be nonplanar. The inner surface of the cover may be configured to align with the nonplanar surface of the base. The outer surface of the cover may comprise at least one of (a) glass, (b) plastic. The cover may comprise a nonplanar form. The decorative layer may be laminated to the base. The decorative layer may comprise a sheet. The component may comprise an adhesive configured to couple the decorative layer to the cover. The adhesive may be configured to transmit light from the cover to the decorative layer. The visual effect of the cover may comprise at least one of: (a) transparent; (b) translucent; (c) opaque; (d) paint; (e) coating; (f) gradient; (g) transition; (h) shading; (i) material of construction; (j) plastic; (k) molded plastic; (l) contour; (m) surface effect; (n) contour shape; (o) nonplanar shape; (p) speckling; (q) partially transparent; (r) partially translucent; (s) partially opaque. The visual effect of the decorative layer may comprise at least one of: (a) composite wood; (b) metal; (c) texture; (d) wood; (e) wood grain; (f) laminate surface; (g) natural material; (h) authentic material; (i) foil; (j) contour; (k) curved edge; (l) fiber; (m) fabric; (n) stone; (o) mineral. The visual effect of the cover may comprise a transition between two visual effects. The cover may comprise a film. The film may comprise at least a portion configured to absorb light from a display.

[0007] The present invention further relates to a method of manufacturing a vehicle trim component comprising the steps of providing a base, joining a decorative layer to the base to create a decorative base and joining a cover to the decorative layer. At least a portion of the cover may be configured to allow illumination to pass from the cover to the decorative base. The method may comprise the step of applying at least one of (a) ink (b) paint (c) a foil (d) a film to an inner surface of the cover to create a cover assembly comprising a transparent portion and a partially opaque portion. The cover may comprise an inner layer and an outer layer. At least a portion of the inner layer of the cover may be configured to transmit light passing from a display to the outer layer of the cover. The method may comprise the step of applying at least one of (a) ink (b) paint (c) a foil (d) a film to the outer layer to create the inner layer. At least a portion of the inner layer may be configured to prevent transmission of light passing from the outer layer to the decorative base. The method may comprise the step of applying coating to at least a portion

of the cover to create a visual effect. The inner layer of the cover may comprise at least one of (a) an electrical circuit (b) a sensor (c) a capacitive switch (d) a capacitive switch sensor. Joining the cover to the decorative layer may comprise applying an adhesive to at least one of (a) the cover (b) the decorative layer. The adhesive may be configured to allow illumination to pass from the cover to the decorative base. The method may comprise the step of creating an opening in the cover. The opening may be configured to at least one of (a) expose the decorative base (b) uncover the decorative base.

FIGURES

[0008] FIGURE 1A is a schematic perspective view of a vehicle according to an exemplary embodiment.

[0009] FIGURE 1B is a schematic perspective cut-away view of a vehicle showing an interior according to an exemplary embodiment.

[0010] FIGURES 2A and 2B are schematic perspective views of a vehicle interior with components according to an exemplary embodiment.

[0011] FIGURE 3A is a schematic exploded side view of an assembly of a component according to an exemplary embodiment.

[0012] FIGURE 3B is a schematic side view of the component according to an exemplary embodiment.

[0013] FIGURE 4A is a schematic exploded side views of an assembly of a component according to an exemplary embodiment.

[0014] FIGURE 4B is a schematic side view of the component according to an exemplary embodiment.

[0015] FIGURES 5A to 5D are schematic side views of an assembly of a component according to an exemplary embodiment

[0016] FIGURES 6A to 6D are schematic side views of an assembly of a component according to an exemplary embodiment

[0017] FIGURE 7A is a schematic exploded side view of an assembly of a component according to an exemplary embodiment.

[0018] FIGURE 7B is a schematic side view of the component according to an exemplary embodiment.

[0019] FIGURES 8A to 8D are schematic side views of an assembly of a component according to an exemplary embodiment.

[0020] FIGURE 8E is a schematic side view of the component according to an exemplary embodiment.

[0021] FIGURE 8F is a schematic side view of the component according to an exemplary embodiment.

[0022] FIGURE 9A is a schematic perspective view of a component according to an exemplary embodiment.

[0023] FIGURE 9B is a schematic perspective view of a cover of a component according to an exemplary embodiment.

[0024] FIGURE 9C is a schematic perspective view of a decorative layer of a component according to an exemplary embodiment.

[0025] FIGURE 10A is a schematic exploded side view of an assembly of a component according to an exemplary embodiment.

[0026] FIGURE 10B is a schematic side view of the component according to an exemplary embodiment.

[0027] FIGURE 11A is a schematic exploded side view of an assembly of a component according to an exemplary embodiment.

[0028] FIGURE 11B is a schematic side view of the component according to an exemplary embodiment.

[0029] FIGURES 12A to 12C are schematic side views of an assembly of a component according to an exemplary embodiment.

[0030] FIGURE 12D is a schematic side view of the component according to an exemplary embodiment.

[0031] FIGURES 13A to 13D are schematic side views of an assembly of a component according to an exemplary embodiment.

[0032] FIGURE 14 is a schematic side view of treatment/assembly of a component according to an exemplary embodiment.

[0033] FIGURE 15A is a schematic exploded side view of an assembly of a component according to an exemplary embodiment.

[0034] FIGURE 15B is a schematic side view of the component according to an exemplary embodiment.

[0035] FIGURES 16 to 18 are schematic flow diagrams of methods to produce a component assembly according to an exemplary embodiment.

DESCRIPTION

[0036] According to an exemplary embodiment as shown schematically in FIGURES 1A and 1B, a vehicle V may include a vehicle interior I. The vehicle interior may provide components C such as panels, consoles, compartments, etc. Components C may provide a display D (e.g. display panel, illumination, data display, display screen, etc.) to present information, alerts, entertainment, data, etc. to a vehicle occupant (e.g. data/information as may be available from various sources such as image IM as shown in FIGURE 2A). The vehicle interior may be provided with a variety of display configurations in a variety of positions and locations to serve a variety of purposes. See e.g. FIGURES 1B and 2A-2B.

[0037] According to an exemplary embodiment, the component may comprise a trim component, panel, console, etc. provided within the vehicle interior (e.g. instrument panel, door, seat area, cockpit, center area, overhead, etc.). See e.g. FIGURES 1B and 2A-2B.

[0038] As indicated schematically according to an exemplary embodiment, the display D of the component may present an image and/or information (e.g. data/information, instrumentation, indicators, controls, entertainment, communications, etc.). See e.g. FIGURE 2A. According to an exemplary embodiment, the component C and/or display D (if provided on the component) may provide a contoured form/shape designed/intended to integrate with the interior design/aesthetic of the vehicle V. See e.g. FIGURES 1B and 2A-2B. According to an exemplary embodiment, the component C may be provided with a visual effect and formed (e.g. shaped/contoured). See e.g. FIGURES 1B, 2A-2B and 9A-9C.

[0039] According to an exemplary embodiment as shown schematically in FIGURE 3A, a component 100 for a vehicle interior may comprise a surface intended to be visible to an occupant when the component is installed in the vehicle interior. Component 100 may comprise a base 6, a decorative layer or laminate 4 and a cover 12 comprising an outer layer 1. Cover 12 may comprise an inner layer 2. Decorative layer 4 may be coupled to base 6. Decorative layer 4 may be laminated to base 6, or an adhesive 5 may couple decorative layer 4 and base 6. Cover 12 may be coupled to decorative layer 4. Adhesive 3 may couple cover 12 to decorative layer 4. Adhesive 3 may be configured to transmit light passing from cover 12 to decorative layer 4. Decorative layer 4 may comprise a laminate. Base 6 may comprise a nonplanar surface. Inner layer 2 of cover 12 and outer layer 1 cover 12 may be nonplanar. Inner layer 2 of cover 12 may

be configured to align with the nonplanar surface of base 6. Decorative layer 4 may comprise a natural material. Cover 12 may comprise glass. Outer layer 1 of cover 12 may comprise glass. Cover 12 may comprise plastic. Outer layer 1 of cover 12 may comprise plastic. Inner layer 2 of cover 12 may comprise at least a portion configured to prevent visibility of decorative layer 4. Inner layer 2 may comprise at least one of (a) an electrical circuit (b) a sensor (c) a capacitive switch (d) a capacitive switch sensor. Decorative layer 4 may be configured to provide a visual effect. Cover 12 may be configured to provide a visual effect. The visual effect of decorative layer 4 and the visual effect of cover 12 may be configured to provide a composite visual effect.

[0040] According to an exemplary embodiment as shown schematically in FIGURE 3A, a component for a vehicle interior 100 may provide a composite visual effect. Component 100 may comprise a base 6, a decorative layer 4 and a cover 12. Decorative layer 4 may provide a visual effect. Decorative layer 4 may be coupled to base 6. Cover 12 may provide a visual effect. Cover 12 may be coupled over decorative layer 4. The composite visual effect may be provided by the visual effect of decorative layer 4 and the visual effect of cover 12. Base 6 may comprise a nonplanar surface. Cover 12 may comprise an inner surface 2 and an outer surface 1. The inner surface 2 of cover 12 and the outer surface 1 of cover 12 may be nonplanar. The inner surface 2 of cover 12 may be configured to align with the nonplanar surface of base 6. The outer surface 1 of cover 12 may comprise at least one of (a) glass, (b) plastic. Cover 12 may comprise a nonplanar form. Decorative layer 4 may be laminated to base 6. Decorative layer 4 may comprise a sheet. Component 100 may comprise an adhesive 3 configured to couple decorative layer 4 to cover 12. Adhesive 3 may be configured to transmit light from cover 12 to decorative layer 4. The visual effect of cover 12 may comprise at least one of: (a) transparent; (b) translucent; (c) opaque; (d) paint; (e) coating; (f) gradient; (g) transition; (h) shading; (i) material of construction; (j) plastic; (k) molded plastic; (l) contour; (m) surface effect; (n) contour shape; (o) nonplanar shape; (p) speckling; (q) partially transparent; (r) partially translucent; (s) partially opaque. The visual effect of decorative layer 4 may comprise at least one of: (a) composite wood; (b) metal; (c) texture; (d) wood; (e) wood grain; (f) laminate surface; (g) natural material; (h) authentic material; (i) foil; (j) contour; (k) curved edge; (l) fiber; (m) fabric; (n) stone; (o) mineral. The visual effect of cover 12 may comprise a transition between two visual effects. Cover 12 may comprise a film 2.

[0041] According to an exemplary embodiment as shown schematically in FIGURE 3A, the component 100 may comprise a multi-section/multi-layer construction with an outer layer or cover 1 and a sheet material shown as decorative layer 4 that may be provided (e.g. attached, mounted, affixed, installed, etc.) on a base or structure shown as base/substrate 6. See e.g. FIGURES 3B and 9A. As shown schematically in FIGURES 3A and 3B, the cover 12 may be provided with a film layer 2 and attached to the sheet material 4 with an adhesive shown as transparent/optically clear adhesive sheet 3; the sheet material 4 may be attached to the base 6 by an adhesive shown as adhesive sheet 5 to form the component 100. See e.g. FIGURES 2A-2B and 3B.

[0042] According to an exemplary embodiment as shown schematically in FIGURES 4A and 4B, a cover assembly 12 may be formed for the component by attachment of film 2 (if used) to cover/layer 1. As shown indicated schematically in FIGURES 5A-5D, a base assembly 456 may be formed for the component by attachment of sheet material/decorative layer 4 to the base/substrate 6 with a bond by adhesive 5 (shown as a cured adhesive with curing by heat from a heating element H).

[0043] According to an exemplary embodiment as shown schematically in FIGURES 6A-6D, the cover assembly 12 may be attached/bonded to the base assembly 456 by an adhesive shown as (transparent/optically clear) liquid adhesive 3 applied from a dispensing system shown as dispenser P; the adhesive may be cured/set after application to form the bond between cover assembly 12 and base assembly 456 using a curing system shown as ultra-violet curing system UV. See FIGURE 6D.

[0044] According to an exemplary embodiment as shown schematically in FIGURES 7A and 7B, a component for a vehicle interior 200 may comprise a surface intended to be visible to an occupant when the component is installed in the vehicle interior. Component 200 may comprise a base 6, an adhesive 3 and a cover 12 comprising an outer layer 1. Cover 12 may comprise an inner layer 2. Base 6 may comprise a decorative base. Cover 12 may be coupled to decorative base 6 by adhesive 3. Adhesive 3 may be configured to transmit light passing from cover 12 to decorative base 6. Decorative base 6 may comprise a nonplanar surface. Inner layer 2 of cover 12 and outer layer 1 cover 12 may be nonplanar. Inner layer 2 of cover 12 may be configured to align with the nonplanar surface of decorative base 6. Decorative base 6 may comprise a natural material. Cover 12 may comprise glass. Outer layer 1 of cover 12 may comprise glass. Cover

12 may comprise plastic. Outer layer 1 of cover 12 may comprise plastic. Inner layer 2 of cover 12 may comprise at least a portion configured to prevent visibility of decorative base 6. Inner layer 2 may comprise at least one of (a) an electrical circuit (b) a sensor (c) a capacitive switch (d) a capacitive switch sensor. Cover 12 may comprise an opening or gap G. Opening G may be configured to at least one of (a) expose decorative base 6 or (b) uncover decorative base 6. The surface intended to be visible to an occupant may comprise a first portion comprising cover 12 and a second portion comprising decorative base 6. Decorative base 6 may be configured to provide a visual effect. Cover 12 may be configured to provide a visual effect. The visual effect of decorative base 6 and the visual effect of cover 12 may be configured to provide a composite visual effect.

[0045] According to an exemplary embodiment as shown schematically in FIGURES 7A and 7B, the component 200 may comprise (in whole or in sections/portions) or multi-layer construction where the cover 1 (with film 2 if used) is bonded to base/substrate 6 by adhesive material shown as adhesive sheet 3. See also FIGURES 8A-8D (e.g. formed component 1236). As shown schematically, the multi-layer construction may comprise a formed (e.g. molded, machined, etc.) gap G or space shown as exposing the material/surface of base 6 (e.g. to provide a functional and/or visual effect) for component 200. See e.g. FIGURES 7B and 8F.

[0046] According to an exemplary embodiment as shown schematically in FIGURES 8A-8E, adhesive material 3 applied to attach/bond layers of the component (shown as component 1236) will be actuated/cured (if required) such as by application from an element/system (such as ultra-violet light system UV) to form the multi-layer construction/assembly of the component. See e.g. FIGURES 8E and 8F. See also FIGURE 5C (showing heating system H). The formed/contoured shape of the component 1236 (as assembled) may comprise formed/bonded layers conforming to the design/intent of the component. See also FIGURES 2B, 3B, 9A and 15B.

[0047] According to an exemplary embodiment as shown schematically in the FIGURES, the component is configured to be installed/mounted (and integrated) in the vehicle interior (e.g. using mounting elements shown schematically as elements M). The multi-layer construction of the component may provide a structure with a visual effect provided by the decorative layer/sheet material conformed between the cover and the base/substrate; as shown schematically the component may be provided with the visual effect of the material (e.g. wood, etc.) of the

decorative layer/sheet visible through the transparent section/body of the cover. See e.g. FIGURES 9A-9C.

[0048] According to an exemplary embodiment as shown schematically in FIGURES 9A -9C and 10A, a component for a vehicle interior 300 may comprise a surface intended to be visible to an occupant when the component is installed in the vehicle interior. Component 300 may comprise a base 16, a decorative layer or laminate 4 and a cover 1112 comprising an outer layer 11. Cover 1112 may comprise an inner layer 12. Decorative layer 4 may be coupled to base 16. Decorative layer 4 may be laminated to base 16, or an adhesive 5 may couple decorative layer 4 and base 16. Cover 1112 may be coupled to decorative layer 4. Adhesive 3 may couple cover 1112 to decorative layer 4. Adhesive 3 may be configured to transmit light passing from cover 1112 to decorative layer 4. Decorative layer 4 may comprise a laminate. Base 16 may comprise a nonplanar surface. Inner layer 12 of cover 1112 and outer layer 11 of cover 1112 may be nonplanar. Inner layer 12 of cover 1112 may be configured to align with the nonplanar surface of base 16. Decorative layer 4 may comprise a natural material. Cover 1112 may comprise glass. Outer layer 11 of cover 1112 may comprise glass. Cover 1112 may comprise plastic. Outer layer 11 of cover 1112 may comprise plastic. Inner layer 12 of cover 1112 may comprise at least a portion configured to prevent visibility of decorative layer 4. Inner layer 12 of cover 1112 may comprise at least one of (a) ink 12A, 12C, 12D, 12E (b) paint 12A, 12C, 12D, 12E (c) a foil 12A, 12C, 12D, 12E (d) a film 12A, 12C, 12D, 12E configured to prevent illumination to pass from a display 17 to outer layer 11 of cover 1112. Inner layer 12 of cover 1112 may comprise at least a portion 12B configured to allow illumination to pass from display 17 to outer layer 11 of cover 1112. Inner layer 12 may comprise at least one of (a) an electrical circuit (b) a sensor (c) a capacitive switch (d) a capacitive switch sensor. Decorative layer 4 may be configured to provide a visual effect. Cover 1112 may be configured to provide a visual effect. The visual effect of decorative layer 4 and the visual effect of cover 1112 may be configured to provide a composite visual effect.

[0049] According to an exemplary embodiment as shown schematically in FIGURES 9A and 10A, a component for a vehicle interior 300 may provide a composite visual effect. Component 300 may comprise a base 16, a decorative layer 4 and a cover 1112. Decorative layer 4 may provide a visual effect. Decorative layer 4 may be coupled to base 16. Cover 1112 may provide a visual effect. Cover 1112 may be coupled over decorative layer 4. The composite visual effect

may be provided by the visual effect of decorative layer 4 and the visual effect of cover 1112. Base 16 may comprise a nonplanar surface. Cover 1112 may comprise an inner surface 12 and an outer surface 11. The inner surface 12 of cover 1112 and the outer surface 11 of cover 1112 may be nonplanar. The inner surface 12 of cover 1112 may be configured to align with the nonplanar surface of base 16. The outer surface 11 of cover 1112 may comprise at least one of (a) glass, (b) plastic. Cover 1112 may comprise a nonplanar form. Decorative layer 4 may be laminated to base 16. Decorative layer 4 may comprise a sheet. Component 300 may comprise an adhesive 3 configured to couple decorative layer 4 to cover 1112. Adhesive 3 may be configured to transmit light from cover 1112 to decorative layer 4. The visual effect of cover 1112 may comprise at least one of: (a) transparent; (b) translucent; (c) opaque; (d) paint; (e) coating; (f) gradient; (g) transition; (h) shading; (i) material of construction; (j) plastic; (k) molded plastic; (l) contour; (m) surface effect; (n) contour shape; (o) nonplanar shape; (p) speckling; (q) partially transparent; (r) partially translucent; (s) partially opaque. The visual effect of decorative layer 4 may comprise at least one of: (a) composite wood; (b) metal; (c) texture; (d) wood; (e) wood grain; (f) laminate surface; (g) natural material; (h) authentic material; (i) foil; (j) contour; (k) curved edge; (l) fiber; (m) fabric; (n) stone; (o) mineral. The visual effect of cover 1112 may comprise a transition between two visual effects. Cover 1112 may comprise a film 12. Film 12 may comprise at least a portion configured to absorb light from a display 17.

[0050] According to an exemplary embodiment as shown schematically in FIGURES 9A -9C, component 300 may comprise a multi-layer/multi-section construction providing the physical form/shape and multiple visual effects (e.g. facilitation, aesthetic integration) for the vehicle interior. As shown schematically, the component 300 is provided with a cover 1112 that provides/define the form/shape (e.g. molded plastic, glass, polymer, etc. material) over a sheet material shown as laminate 4 that provides/defines the general visual effect (e.g. natural/authentic material such as wood with visible texture/grain appearance through transparent section/body of cover) on the base/substrate structure. See FIGURE 9A. According to an exemplary embodiment as shown schematically in FIGURES 9A-9C and 10A, the cover 1112 comprises a generally transparent body section 12F and other sections such as transparent section 12B for display 17 and opaque sections 12A, 12C, 12D and transition/speckled sections 12E. See FIGURE 9A. As indicated schematically in FIGURES 9A-9C, the sheet material shown as

laminate sheet 4 and the cover as comprised/formed with multiple sections (e.g. generally transparent, transition/speckled, opaque/colored, etc.) may combine to provide a composite visual effect (e.g. blended, integrated, sectioned, etc.) for the component shown as component 300. See also FIGURES 10A-10B, 11A-11B, 12A-12D and 13A-13D. As shown schematically in FIGURES 10A and 10B, the component of multi-layer/multi-section construction may provide a structure 18 with a display panel 17 (e.g. visible through a transparent section 12B of the cover). See also FIGURES 1B and 2A-2B.

[0051] According to an exemplary embodiment as shown schematically in FIGURES 11A through 13D, a method of manufacturing a vehicle trim component may comprise the steps of providing a base 16, joining a decorative layer 4 to base 16 to create a decorative base 4516 and joining a cover 1112 to decorative layer 4. At least a portion of cover 1112 may be configured to allow illumination to pass from cover 1112 to decorative base 4516. The method may comprise the step of applying at least one of (a) ink (b) paint (c) a foil (d) a film to an inner surface 12 of cover 1112 to create a cover assembly 1112 comprising a transparent portion and a partially opaque portion. Cover 1112 may comprise an inner layer 12 and an outer layer 11. At least a portion of inner layer 12 of cover 1112 may be configured to transmit light passing from a display to outer layer 11 of cover 1112. The method may comprise the step of applying at least one of (a) ink (b) paint (c) a foil (d) a film to outer layer 11 to create inner layer 12. At least a portion of inner layer 12 may be configured to prevent transmission of light passing from outer layer 11 to decorative base 4516. The method may comprise the step of applying coating to at least a portion of cover 1112 to create a visual effect as shown schematically in FIGURE 14. Inner layer 12 of cover 1112 may comprise at least one of (a) an electrical circuit (b) a sensor (c) a capacitive switch (d) a capacitive switch sensor. Joining cover 1112 to decorative layer 4 may comprise applying an adhesive 3 to at least one of (a) cover 1112 or (b) decorative layer 4. Adhesive 3 may be configured to allow illumination to pass from cover 1112 to decorative base 4516. The method may comprise the step of creating an opening in cover 1112. The opening may be configured to at least one of (a) expose decorative base 4516 (b) uncover decorative base 4516.

[0052] According to an exemplary embodiment as shown schematically in FIGURES 11A, 11B and 14, the visual effect/structure at the cover of the component may be provided by a layer/material shown as sheet material or by application of a material layer (such as coating,

paint, enamel, lacquer, etc.) by an applicator or dispenser (shown as spray dispenser B); as shown schematically the layer or coating may be applied in a manner to create multiple sections/transitions with opaque and/or transparent and/or translucent areas to provide an intended visual effect through cover (e.g. with laminate).

[0053] As indicated schematically in FIGURES 12A-12D, the laminate sheet 4 is bonded to the base/substrate 16 by an adhesive (shown as adhesive sheet/tape or strip 5) that may be activated and/or cured (e.g. by application of heat from heating element H) to form a base assembly 1415 for application of the cover/cover assembly 1112 (see FIGURES 9B and 11B) bonded by an adhesive (shown as liquid adhesive 3) that may be activated and/or cured by application of ultra-violet light (e.g. from system UV) to form the component (e.g. cover assembly on base assembly). See also FIGURES 13A-13D.

[0054] According to an exemplary embodiment as shown schematically in FIGURES 14, 15A and 15B, a component 400 may comprise an outer layer/cover shown as formed structure 411 with a coating shown as paint P applied (e.g. from dispensing system B); cover/structure 411 with coating P may be bonded to a sheet material shown as laminate 414 (e.g. by suitable bonding/attachment) and may be attached/bonded to the base or substrate/structure 16 to form the component 400. As shown schematically, the visual effect or appearance of the component 400 may be a composite effect of the appearance/form of the cover 411 with coating P (e.g. inner layer) and appearance of the laminate/sheet material 414 (e.g. visible through transparent/translucent sections of the cover). See FIGURES 15A-15B. See also FIGURES 9A-9C. According to an exemplary embodiment as indicated schematically in FIGURES 15A and 15B, the component 400 may provide a display panel 17 on structure 18 of base 16 visible at cover 411 (e.g. through a transparent section on cover). As shown schematically, lighting beneath cover (e.g. from base) may be made visible through transparent/translucent sections provided in the cover (see FIGURE 9A).

[0055] Methods of producing the component are shown schematically according to an exemplary embodiment in FIGURES 16-18.

[0056] According to an exemplary embodiment, a component for a vehicle interior may provide a form and a composite visual effect. The component may comprise a base, a material layer providing a visual effect and coupled to the base and a cover assembly providing a visual effect and coupled over the material layer; the composite visual effect may be provided by the visual

effect of the material layer and the visual effect of the cover assembly. The base may comprise a nonplanar surface and the cover assembly may comprise an inner surface and an outer surface; the inner surface of the cover assembly and the outer surface of the cover assembly may be nonplanar. The inner surface of the cover may be configured to align with the nonplanar surface of the base. The base may be nonplanar. The material layer may be laminated to the base. The component may comprise an adhesive configured to couple the material layer to the cover assembly. The adhesive may be configured to transmit light from the cover assembly to the material layer. The outer surface may comprise at least one of (a) glass or (b) plastic. The visual effect of the cover assembly may comprise at least one of: (a) transparent; (b) translucent; (c) opaque; (d) paint; (e) coating; (f) gradient; (g) transition; (h) shading; (i) material of construction; (j) plastic; (k) molded plastic; (l) contour; (m) surface effect; (n) contour shape; (o) nonplanar shape; (p) speckling; (q) partially transparent; (r) partially translucent; (s) partially opaque. The visual effect of the material layer may comprise at least one of: (a) composite wood; (b) metal; (c) texture; (d) wood; (e) wood grain; (f) laminate surface; (g) natural material; (h) authentic material; (i) foil; (j) contour; (k) curved edge; (l) fiber; (m) fabric; (n) stone; (o) mineral, etc. The visual effect of the cover assembly may comprise a transition or gradient (e.g. sharp or gradual) between two visual effects.

[0057] According to an exemplary embodiment, a component for a vehicle interior may provide a form and a composite visual effect. The component may comprise a base, a laminate sheet providing a visual effect and coupled to the base and a cover assembly providing a visual effect and coupled over the laminate sheet; the composite visual effect may be provided by the visual effect of the laminate sheet and the visual effect of the cover assembly.

[0058] According to an exemplary embodiment, a component for a vehicle interior may comprise a surface intended to be visible to an occupant when the component is installed in the vehicle interior. The component may comprise a substrate, a decorative layer coupled to substrate and a cover coupled to the decorative layer comprising an outer layer and a film. The decorative layer may comprise a laminate comprising a natural material. The substrate may comprise a nonplanar surface and the cover may comprise an inner surface and an outer surface; the inner surface of the cover and the outer surface of the cover may be nonplanar. The inner surface of the cover may be configured to align with the nonplanar surface of the substrate; the substrate may be nonplanar. The laminate may be laminated to the substrate. The component

may comprise an adhesive configured to couple the laminate to the cover; the adhesive may be configured to allow illumination to pass from the cover to the laminate. The outer layer may comprise at least one of (a) glass or (b) plastic. The film may comprise at least a portion configured to prevent illumination to pass from the display to the cover. See generally FIGURES and Appendix.

Materials/Construction

[0059] According to an exemplary embodiment, the method comprises use of thin laminates of authentic materials to provide the look of the authentic materials without the cost and mass of using machined blocks of the authentic materials. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

[0060] According to an exemplary embodiment, a layer (e.g. laminate, laminate sheet, strip, sheet, composite, layer, etc.) of the authentic material (or visual environment) may be laminated to base or substrate to form the component; the component may provide or contain attachments, mounting features and any other necessary features required for normal component operation. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

Outer Layer

[0061] According to an exemplary embodiment, the outer layer may be made of glass or plastic. Plastic outer layers may be made of vacuum formed acrylic or cast urethane. The layer may be clear or tinted (not opaque). It is typically desired to provide the outer layer have a contoured or curved surface for styling and harmony with other parts of the vehicle interior. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

Inner Layer or Film

[0062] According to an exemplary embodiment, when the outer layer is made of glass, a clear or tinted film is applied to the glass for safety. In the event of a shattering or breaking of the glass, the film prevents shards of the glass from separating away. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

[0063] According to an exemplary embodiment, the film may also be designed to provide decoration or to make certain areas of the outer layer opaque or blacked out. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

Assembly of Film and Outer Layer to Create a Cover

[0064] According to an exemplary embodiment, depending on the material used for the outer layer, multiple methods may be used to assemble the film and the outer layer to create a cover. See e.g. FIGURES 16-18.

[0065] According to an exemplary embodiment, when the outer layer is made of plastic, the following methods may be used: in mold decoration; in mold lamination; printing ink on the interior surface of the outer layer, or a portion; spraying ink on the interior surface of the outer layer, or a portion. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

[0066] According to an exemplary embodiment, when the outer layer is made of glass, the film may be adhered to the interior surface of the glass using pressure and a bladder that is used to push any air gaps between the film and the glass to the periphery of the film and ultimately away from the film and the glass. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

Assembly of Laminate and Base

[0067] According to an exemplary embodiment, an adhesive may be used to assemble the laminate to the base; heat and pressure may be used in the process; the laminate is thin and flexible enough to conform to the contour of the base. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

Assembly of Cover to Laminated Base

[0068] According to an exemplary embodiment, an optically clear adhesive may be used to assemble the cover to the laminated base to ensure the laminate is visible to vehicle occupants. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

[0069] According to an exemplary embodiment, the component may be formed with a base made from an authentic material such as wood, metal, stone, etc. attached or bonded to a cover (e.g. clear/transparent cover or layer). Material of the cover and the base may then be machined away to expose the authentic material just below the surface of the cover. The component provides an occupant to experience the touch and feel of the authentic material. According to an exemplary embodiment, in providing the component the machined areas may be made or formed in various shapes or patterns (e.g. decorative shape, patterns, etc.) or may form features in the component such as trays, storage locations or pockets, etc. See e.g. FIGURES 3A-3B, 9A-9C, 14, 15A-15C and 16-18.

* * *

[0070] It is important to note that the present inventions (e.g. inventive concepts, etc.) have been described in the specification and/or illustrated in the FIGURES of the present patent document according to exemplary embodiments; the embodiments of the present inventions are presented by way of example only and are not intended as a limitation on the scope of the present inventions. The construction and/or arrangement of the elements of the inventive concepts embodied in the present inventions as described in the specification and/or illustrated in the FIGURES is illustrative only. Although exemplary embodiments of the present inventions have been described in detail in the present patent document, a person of ordinary skill in the art will readily appreciate that equivalents, modifications, variations, etc. of the subject matter of the exemplary embodiments and alternative embodiments are possible and contemplated as being within the scope of the present inventions; all such subject matter (e.g. modifications, variations, embodiments, combinations, equivalents, etc.) is intended to be included within the scope of the present inventions. It should also be noted that various/other modifications, variations, substitutions, equivalents, changes, omissions, etc. may be made in the configuration and/or arrangement of the exemplary embodiments (e.g. in concept, design, structure, apparatus, form, assembly, construction, means, function, system, process/method, steps, sequence of process/method steps, operation, operating conditions, performance, materials, composition, combination, etc.) without departing from the scope of the present inventions; all such subject matter (e.g. modifications, variations, embodiments, combinations, equivalents, etc.) is intended to be included within the scope of the present inventions. The scope of the present inventions is not intended to be limited to the subject matter (e.g. details, structure, functions, materials, acts, steps, sequence, system, result, etc.) described in the specification and/or illustrated in the FIGURES of the present patent document. It is contemplated that the claims of the present patent document will be construed properly to cover the complete scope of the subject matter of the present inventions (e.g. including any and all such modifications, variations, embodiments, combinations, equivalents, etc.); it is to be understood that the terminology used in the present patent document is for the purpose of providing a description of the subject matter of the exemplary embodiments rather than as a limitation on the scope of the present inventions.

[0071] It is also important to note that according to exemplary embodiments the present inventions may comprise conventional technology (e.g. as implemented and/or integrated in exemplary embodiments, modifications, variations, combinations, equivalents, etc.) or may

comprise any other applicable technology (present and/or future) with suitability and/or capability to perform the functions and processes/operations described in the specification and/or illustrated in the FIGURES. All such technology (e.g. as implemented in embodiments, modifications, variations, combinations, equivalents, etc.) is considered to be within the scope of the present inventions of the present patent document.

CLAIMS

1. A component for a vehicle interior with a surface intended to be visible to an occupant when the component is installed in the vehicle interior comprising:

(a) a base;

(b) a decorative layer coupled to the base; and

(c) a cover coupled to the decorative layer comprising an outer layer;

wherein the decorative layer comprises a laminate.

2. The component of Claim 1 wherein the base comprises a nonplanar surface and the cover comprises an inner layer; wherein the inner layer of the cover and the outer layer of the cover are nonplanar.

3. The component of Claim 2 wherein the inner layer of the cover is configured to align with the nonplanar surface of the base.

4. The component of Claim 1 wherein the decorative layer comprises a natural material.

5. The component of Claim 1 wherein the decorative layer is laminated to the base.

6. The component of Claim 1 further comprising an adhesive configured to couple the decorative layer to the cover.

7. The component of Claim 6 wherein the adhesive is configured to transmit light passing from the cover to the decorative layer.

8. The component of Claim 1 wherein the cover comprises glass.

9. The component of Claim 1 wherein the cover comprises plastic.

10. The component of Claim 1 wherein the cover comprises an inner layer; wherein the outer layer comprises glass and the inner layer comprises at least a portion configured to prevent visibility of the decorative layer.

11. The component of Claim 1 wherein the cover comprises an inner layer; wherein the outer layer comprises plastic and the inner layer comprises at least a portion configured to prevent visibility of the decorative layer.

12. The component of Claim 10 or Claim 11 wherein the inner layer of the cover comprises at least one of (a) ink (b) paint (c) a foil (d) a film configured to prevent illumination to pass from a display to the outer layer of the cover.

13. The component of Claim 10 or Claim 11 wherein the inner layer of the cover comprises at least a portion configured to allow illumination to pass from a display to the outer layer of the cover.

14. The component of Claim 1 wherein the cover comprises an inner layer; wherein the inner layer comprises at least one of (a) an electrical circuit (b) a sensor (c) a capacitive switch (d) a capacitive switch sensor.

15. The component of Claim 1 wherein the cover comprises an opening; wherein the opening is configured to at least one of (a) expose the decorative layer (b) uncover the decorative layer.

16. The component of Claim 1 wherein the surface intended to be visible to an occupant comprises a first portion comprising the cover and a second portion comprising the decorative layer.

17. The component of Claim 1 wherein the decorative layer is configured to provide a visual effect; wherein the cover is configured to provide a visual effect; and wherein the visual effect of the decorative layer and the visual effect of the cover are configured to provide a composite visual effect.

18. A component for a vehicle interior providing a composite visual effect comprising:

(a) a base;

(b) a decorative layer providing a visual effect, the decorative layer coupled to the base; and

(c) a cover providing a visual effect, the cover coupled over the decorative layer;

wherein the composite visual effect is provided by the visual effect of the decorative layer and the visual effect of the cover.

19. The component of Claim 18 wherein the base comprises a nonplanar surface and the cover comprises an inner surface and an outer surface; wherein the inner surface of the cover and the outer surface of the cover are nonplanar.

20. The component of Claim 19 wherein the inner surface of the cover is configured to align with the nonplanar surface of the base.

21. The component of Claim 19 wherein the outer surface of the cover comprises at least one of (a) glass, (b) plastic.

22. The component of Claim 18 wherein the cover comprises a nonplanar form.

23. The component of Claim 18 wherein the decorative layer is laminated to the base.

24. The component of Claim 18 wherein the decorative layer comprises a sheet.

25. The component of Claim 18 further comprising an adhesive configured to couple the decorative layer to the cover.

26. The component of Claim 25 wherein the adhesive is configured to transmit light from the cover to the decorative layer.

27. The component of Claim 18 wherein the visual effect of the cover comprises at least one of: (a) transparent; (b) translucent; (c) opaque; (d) paint; (e) coating; (f) gradient; (g) transition; (h) shading; (i) material of construction; (j) plastic; (k) molded plastic; (l) contour; (m) surface effect; (n) contour shape; (o) nonplanar shape; (p) speckling; (q) partially transparent; (r) partially translucent; (s) partially opaque.

28. The component of Claim 18 wherein the visual effect of the decorative layer comprises at least one of: (a) composite wood; (b) metal; (c) texture; (d) wood; (e) wood grain; (f) laminate surface; (g) natural material; (h) authentic material; (i) foil; (j) contour; (k) curved edge; (l) fiber; (m) fabric; (n) stone; (o) mineral.

29. The component of Claim 18 wherein the visual effect of the cover comprises a transition between two visual effects.

30. The component of Claim 18 wherein the cover further comprises a film; wherein the film comprises at least a portion configured to absorb light from a display.

31. A method of manufacturing a vehicle trim component comprising the steps of:
(a) providing a base;
(b) joining a decorative layer to the base to create a decorative base; and
(c) joining a cover to the decorative layer;
wherein at least a portion of the cover is configured to allow illumination to pass from the cover to the decorative base.

32. The method of Claim 31 comprising the step of applying at least one of (a) ink (b) paint (c) a foil (d) a film to an inner surface of the cover to create a cover assembly comprising a transparent portion and a partially opaque portion.

33. The method of Claim 31 wherein the cover comprises an inner layer and an outer layer and wherein at least a portion of the inner layer of the cover is configured to transmit light passing from a display to the outer layer of the cover.

34. The method of Claim 33 comprising the step of applying at least one of (a) ink (b) paint (c) a foil (d) a film to the outer layer to create the inner layer.

35. The method of Claim 33 wherein at least a portion of the inner layer is configured to prevent transmission of light passing from the outer layer to the decorative base.

36. The method of Claim 31 comprising the step of applying coating to at least a portion of the cover to create a visual effect.

37. The method of Claim 31 wherein the cover comprises an inner layer and an outer layer; wherein the inner layer comprises at least one of (a) an electrical circuit (b) a sensor (c) a capacitive switch (d) a capacitive switch sensor.

38. The method of Claim 31 wherein joining the cover to the decorative layer comprises applying an adhesive to at least one of (a) the cover (b) the decorative layer; wherein the adhesive is configured to allow illumination to pass from the cover to the decorative base.

39. The method of Claim 31 comprising the step of creating an opening in the cover; wherein the opening is configured to at least one of (a) expose the decorative base (b) uncover the decorative base.

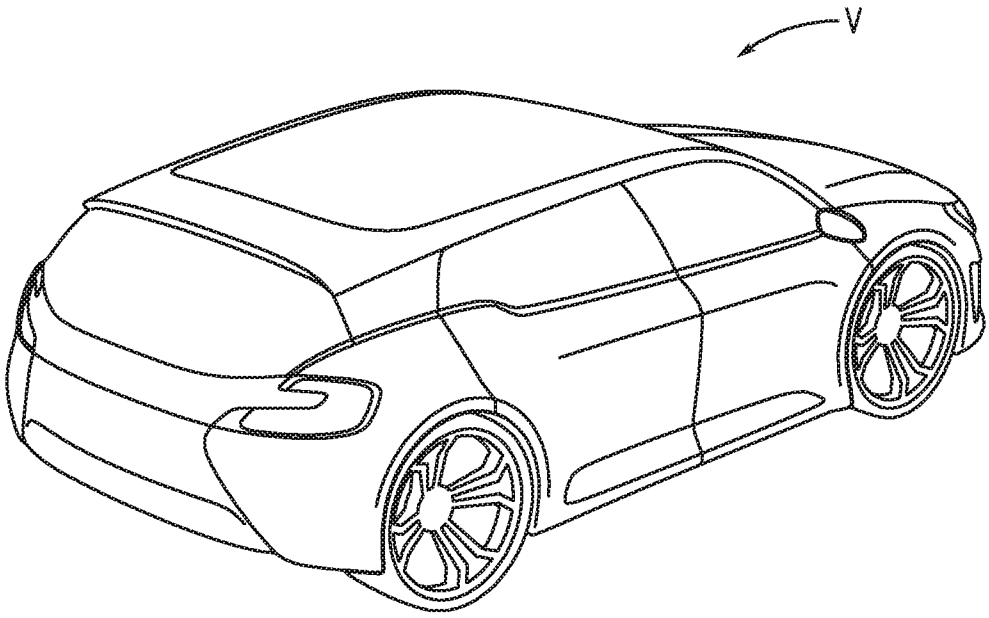


FIG. 1A

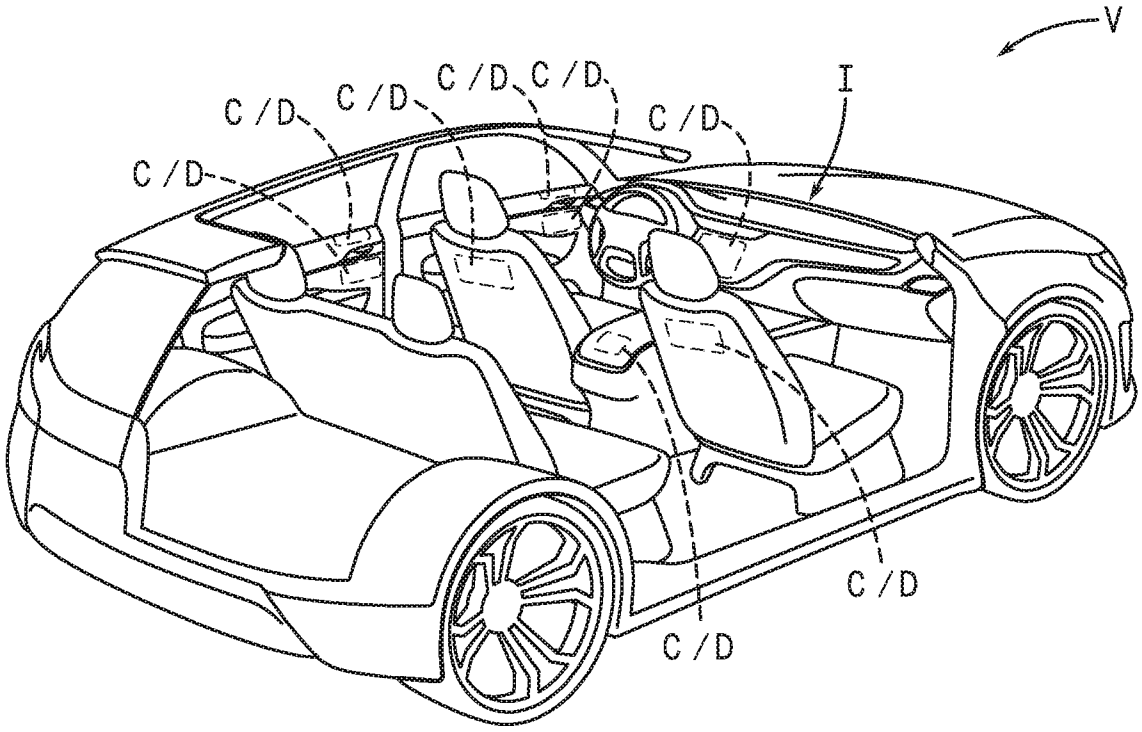


FIG. 1B

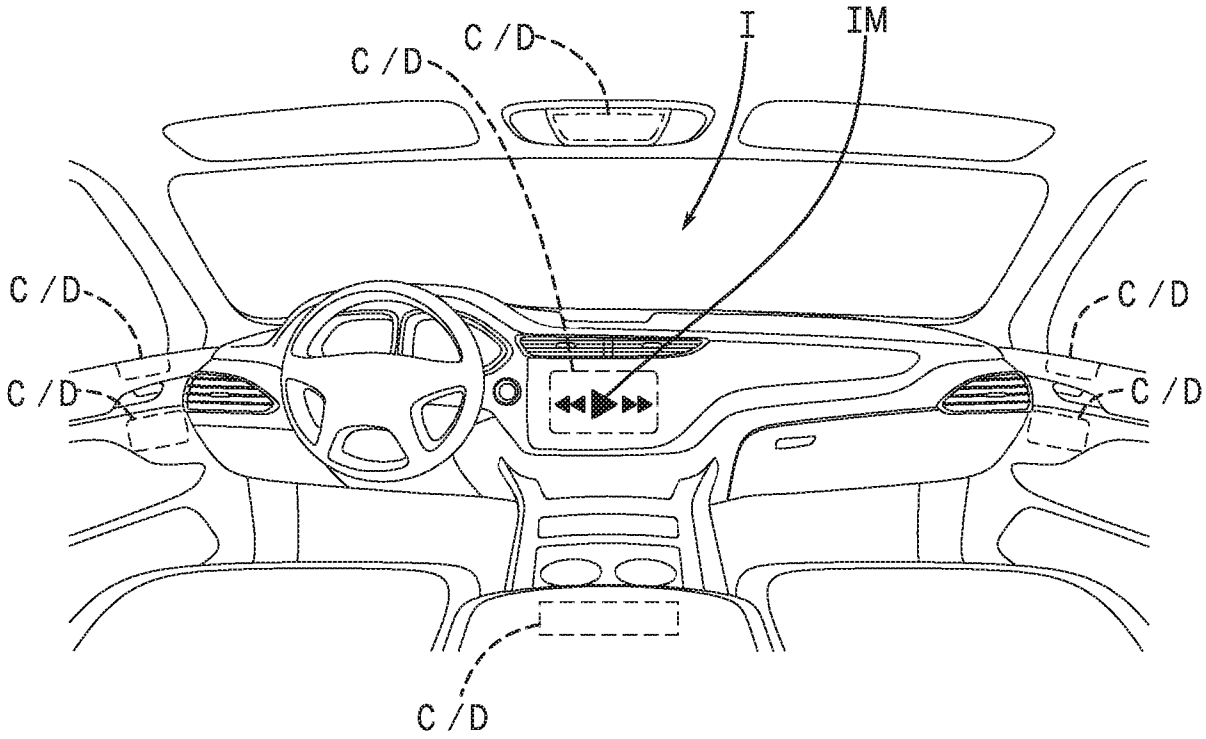


FIG. 2A

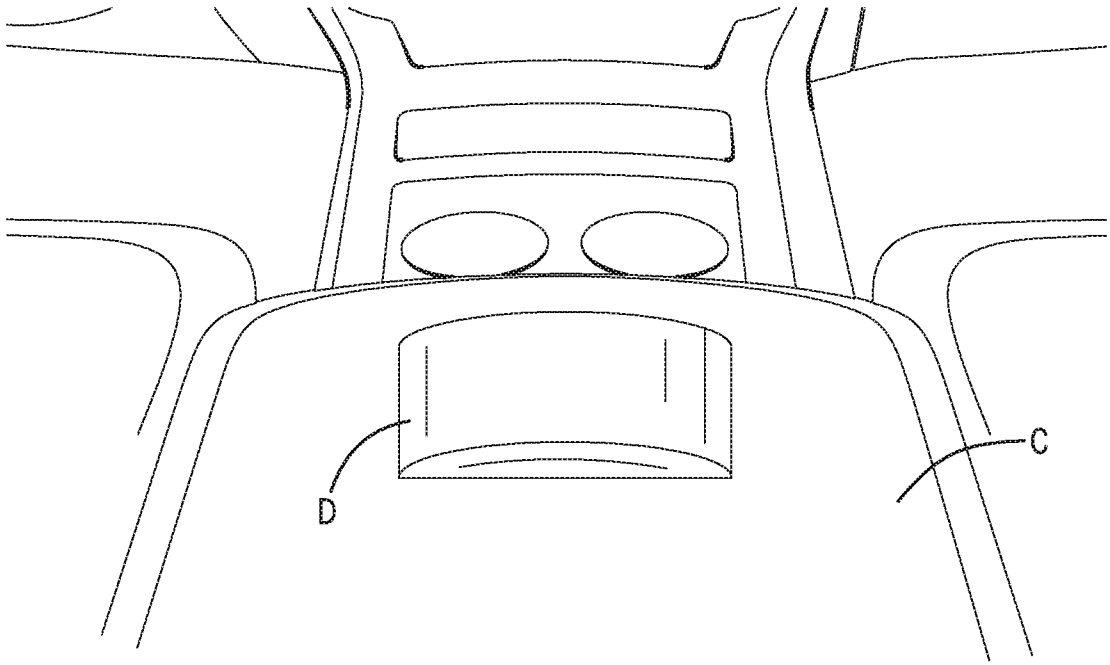


FIG. 2B

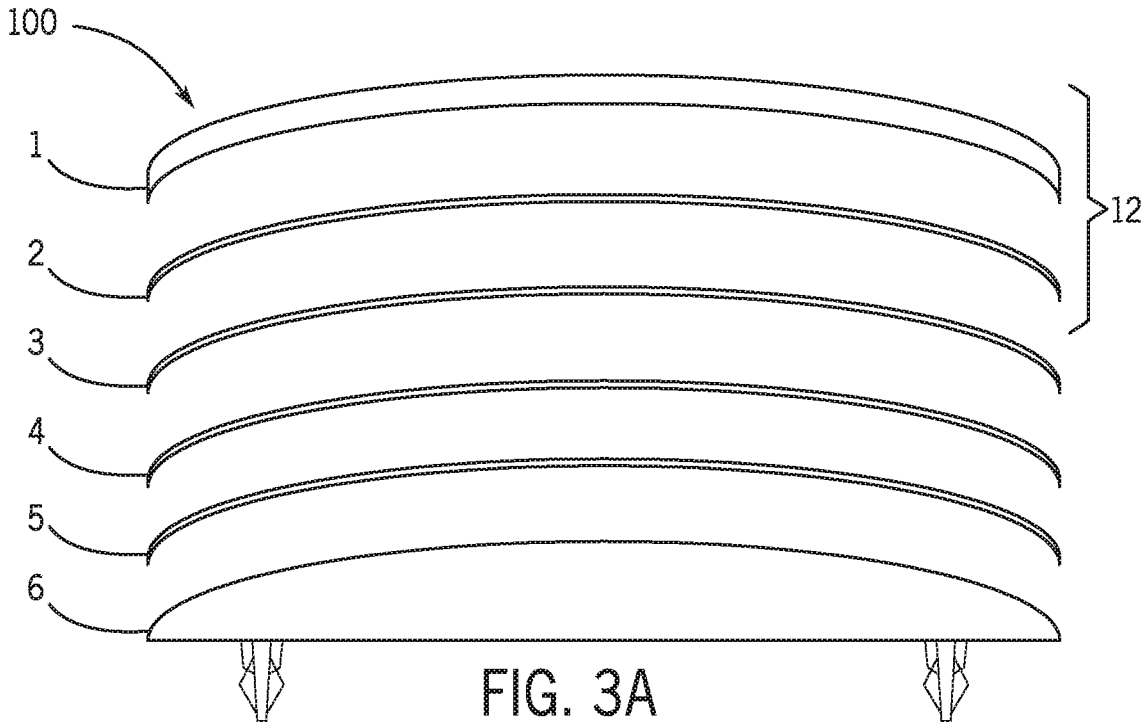


FIG. 3A

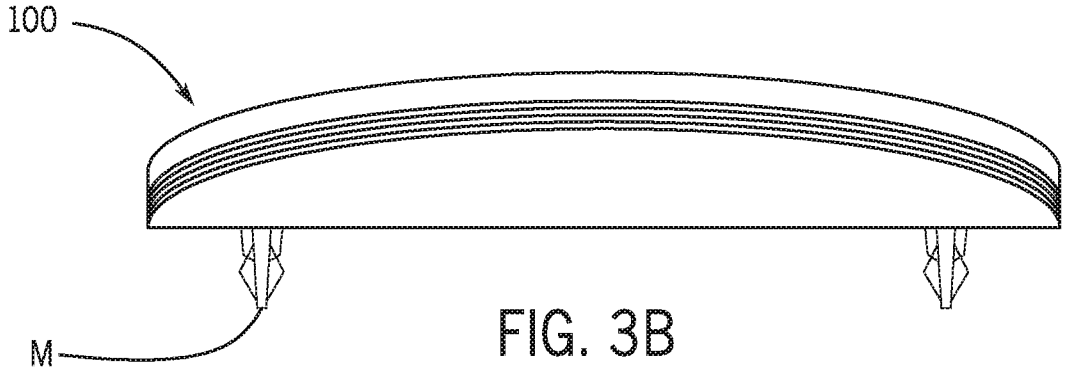


FIG. 3B

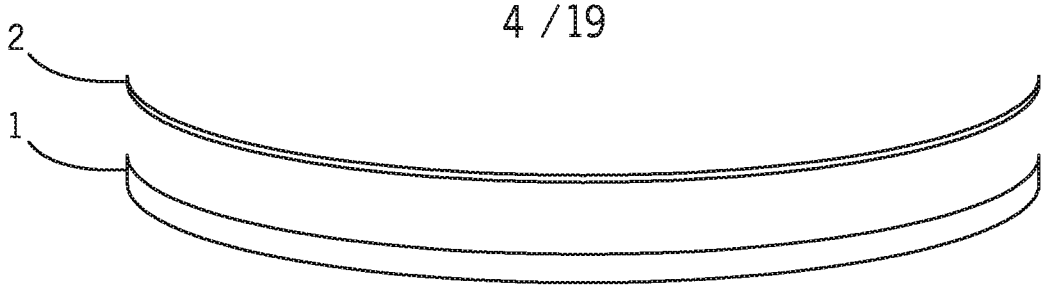


FIG. 4A

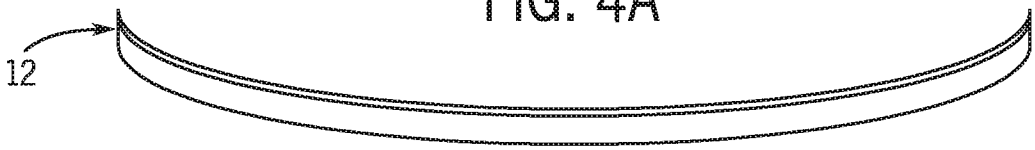


FIG. 4B

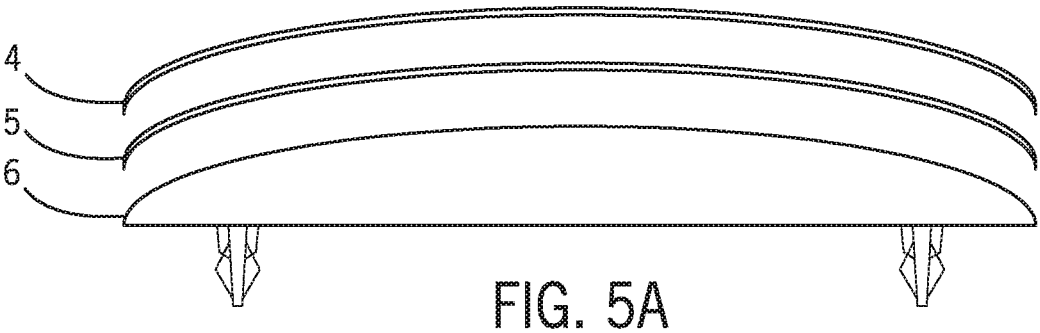


FIG. 5A

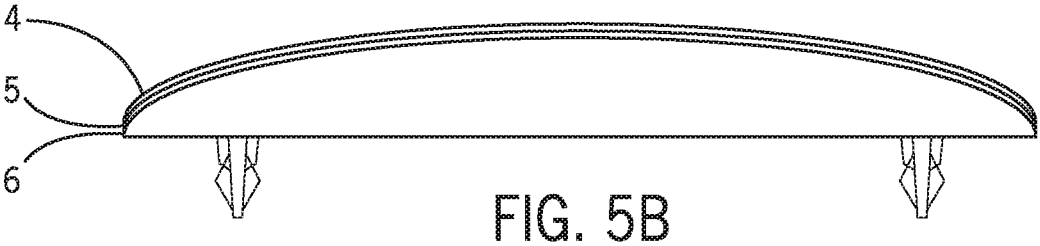


FIG. 5B

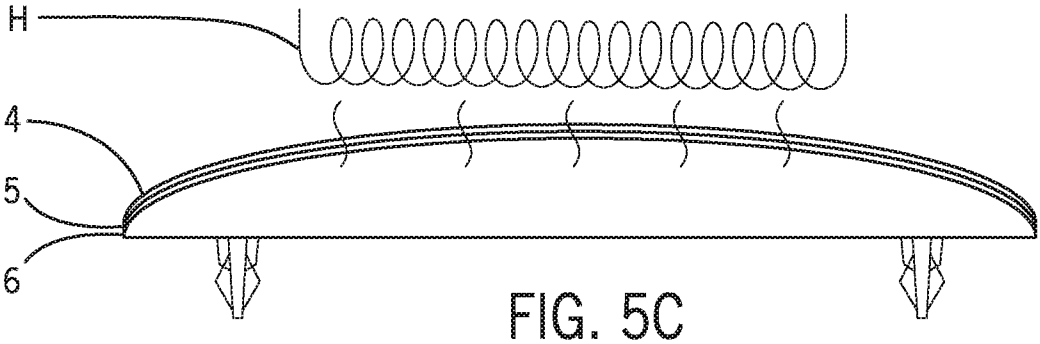


FIG. 5C

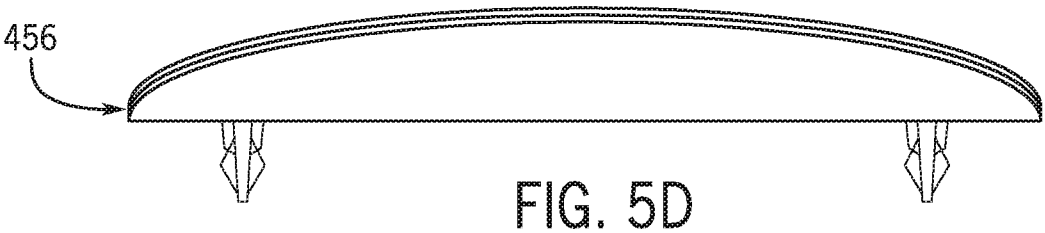


FIG. 5D

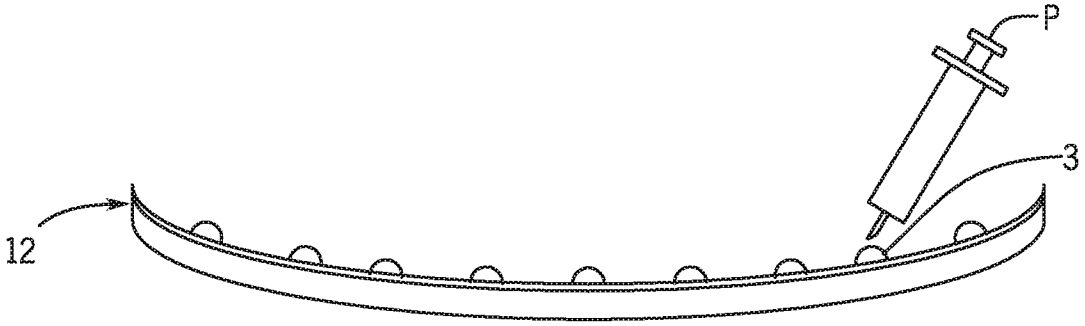


FIG. 6A

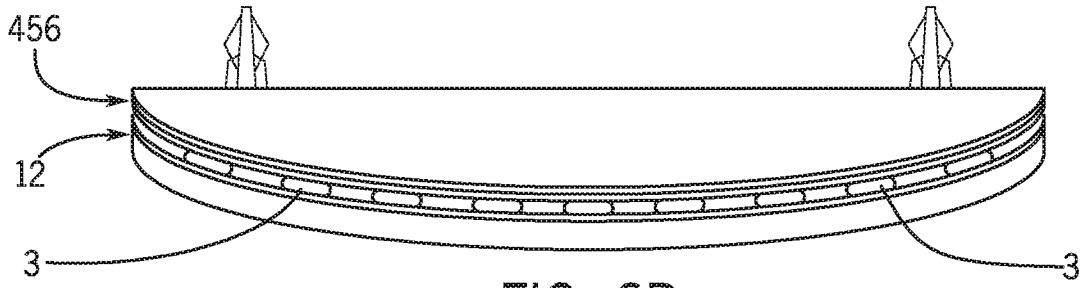


FIG. 6B



FIG. 6C

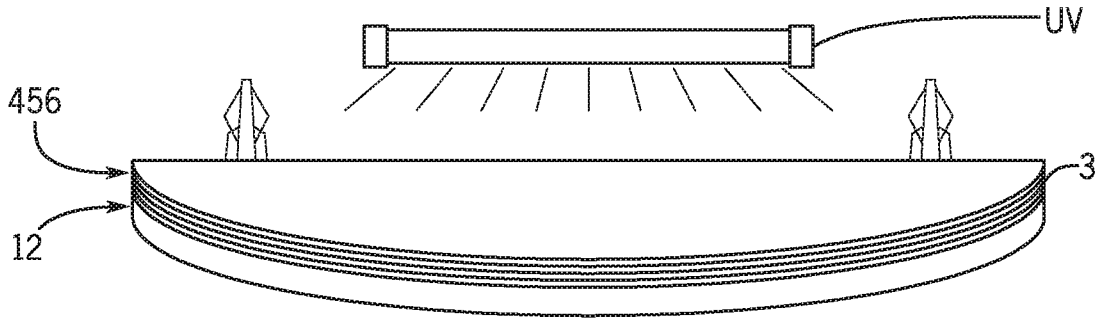


FIG. 6D

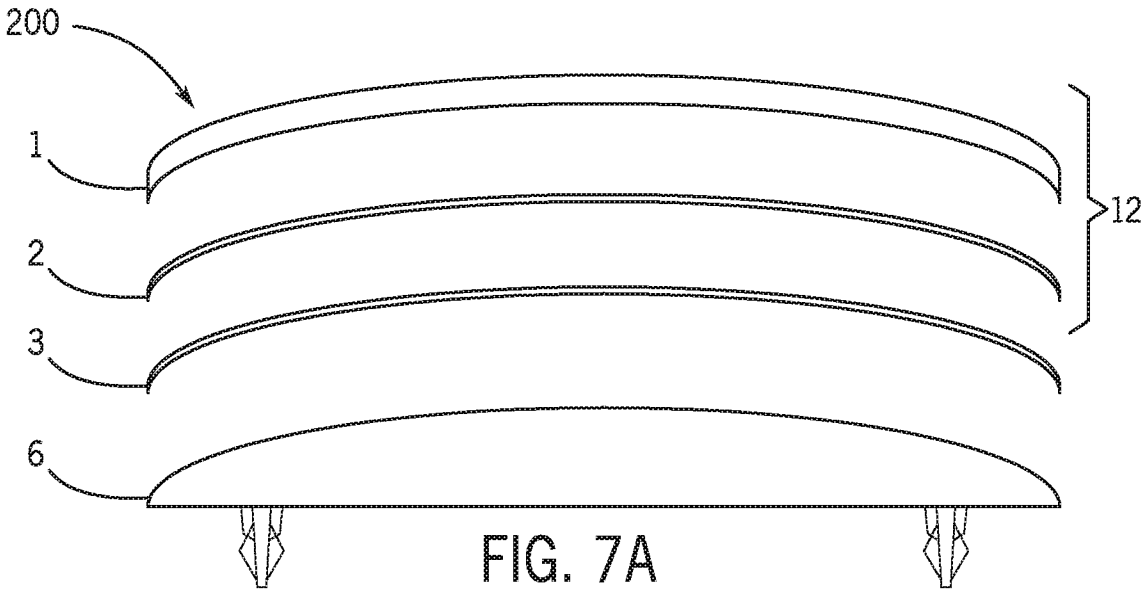


FIG. 7A

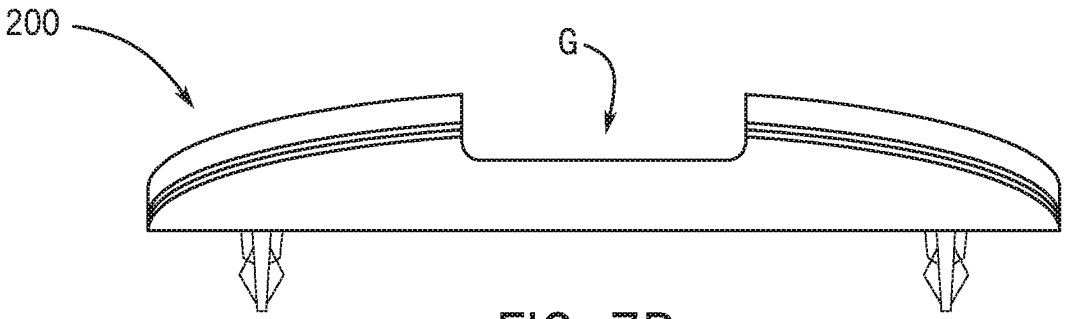


FIG. 7B

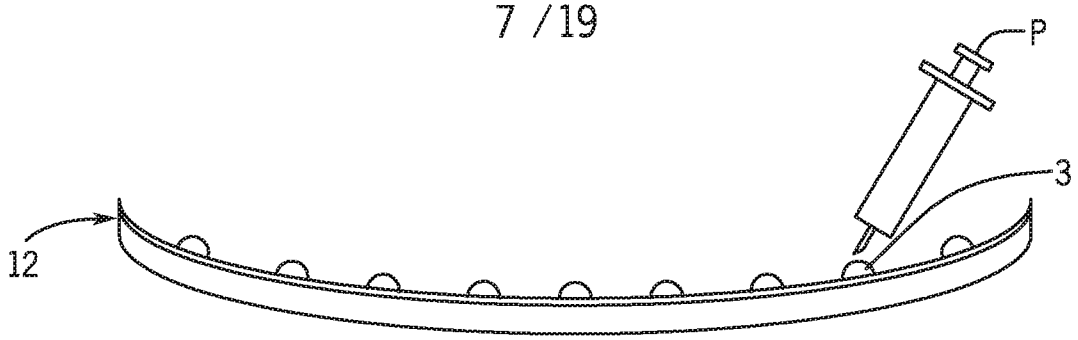


FIG. 8A

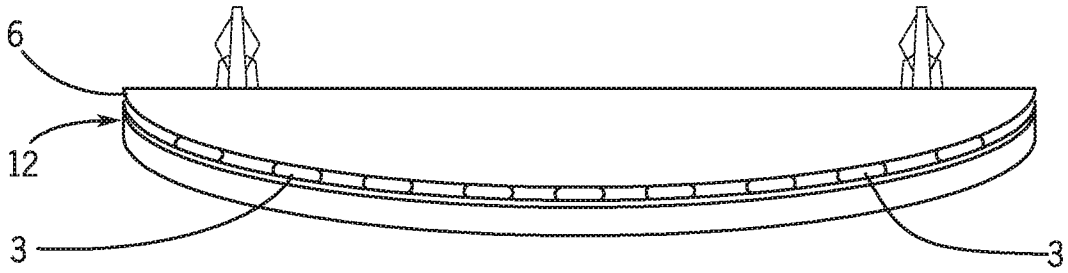


FIG. 8B

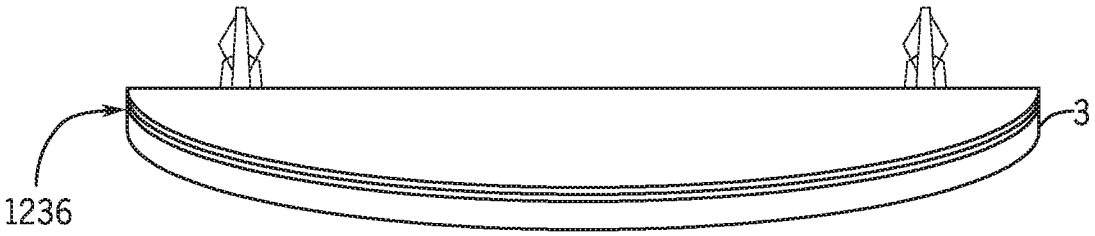


FIG. 8C

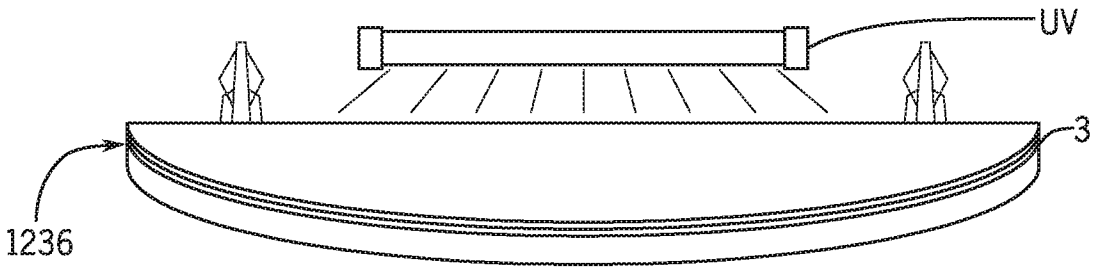


FIG. 8D



FIG. 8E

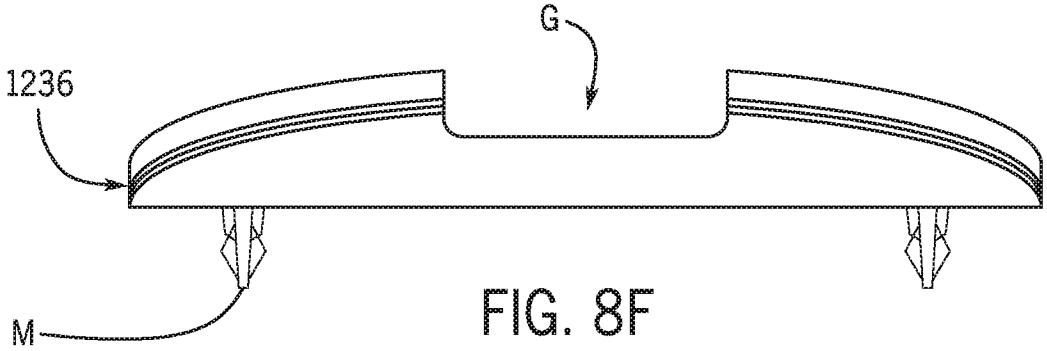


FIG. 8F

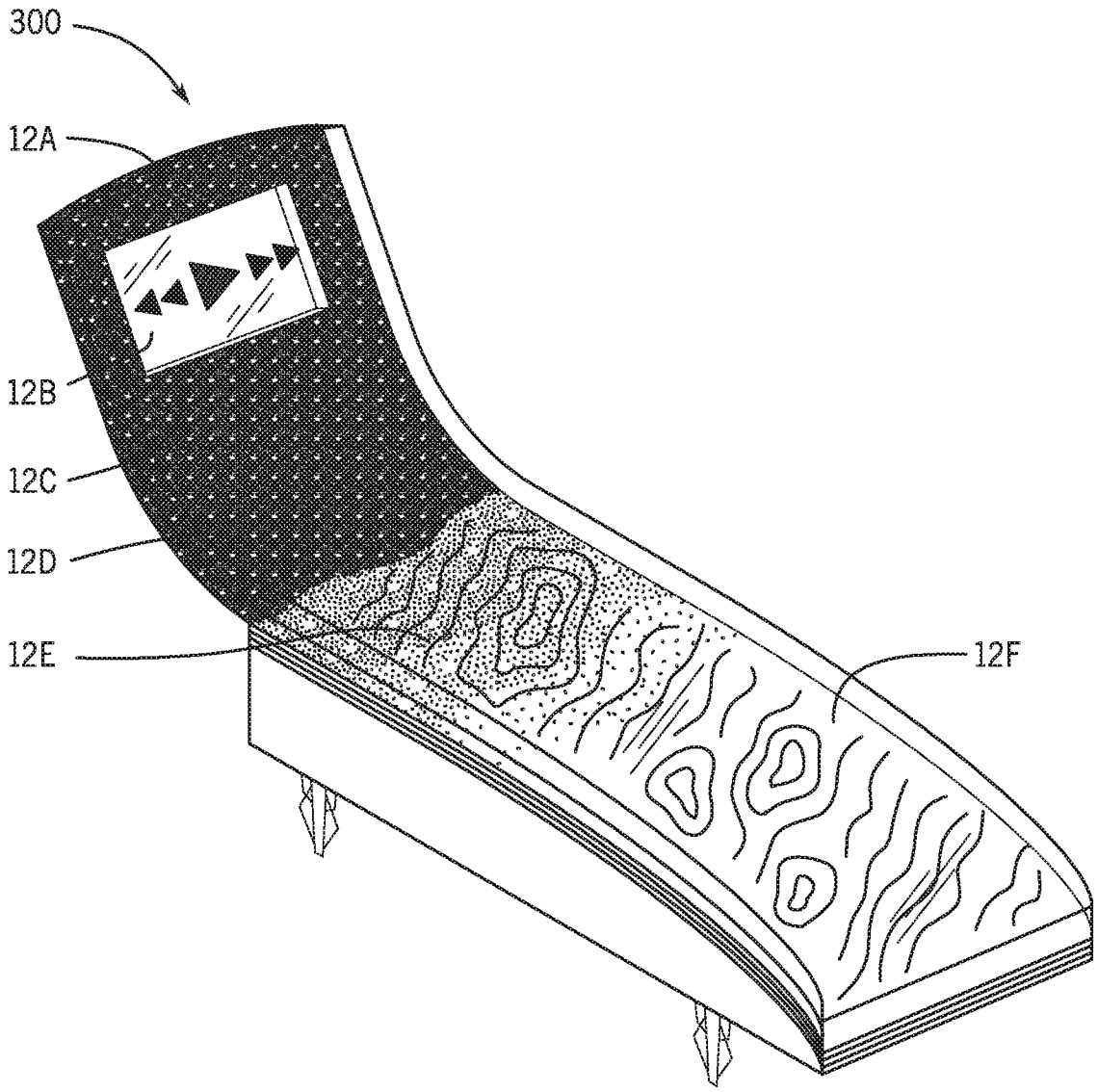


FIG. 9A

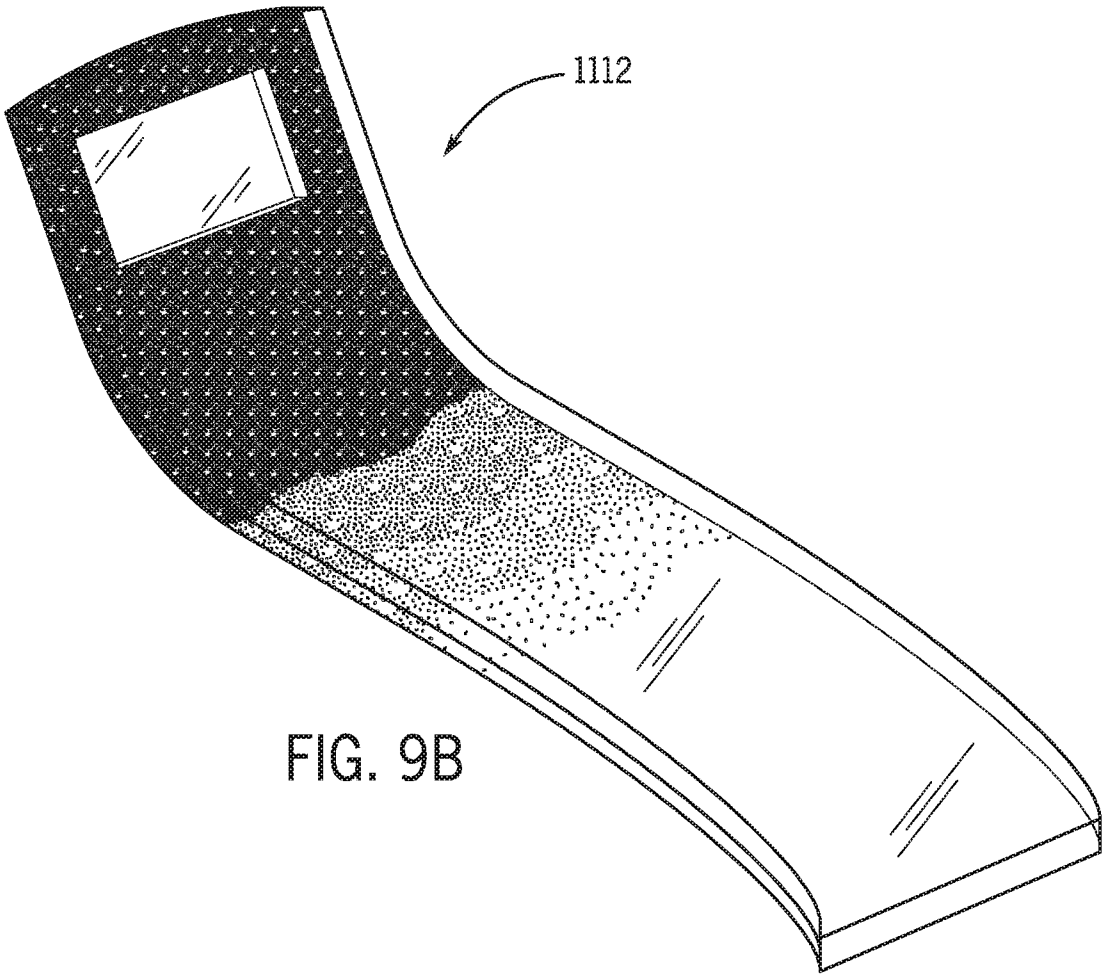


FIG. 9B

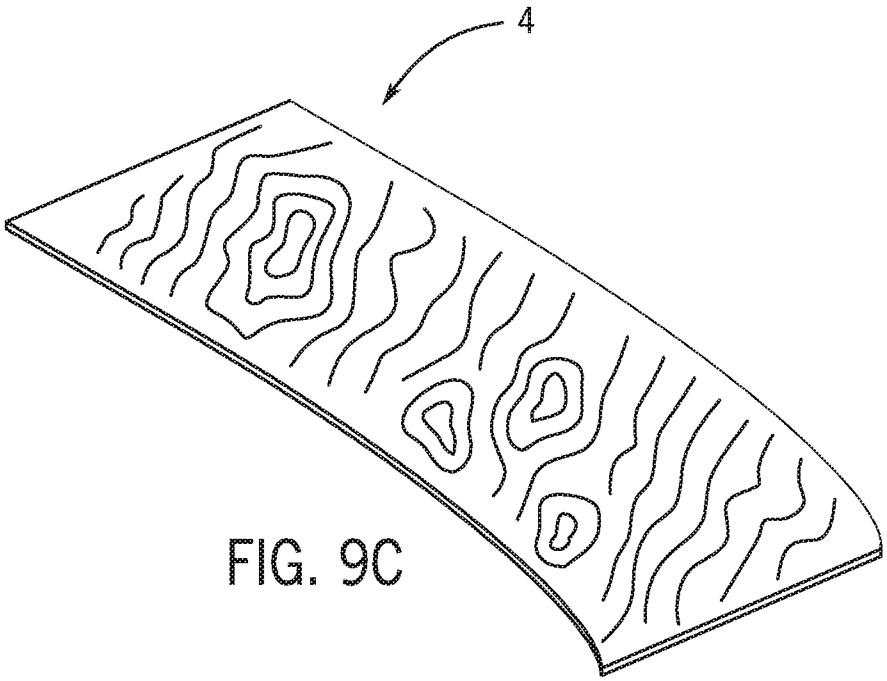


FIG. 9C

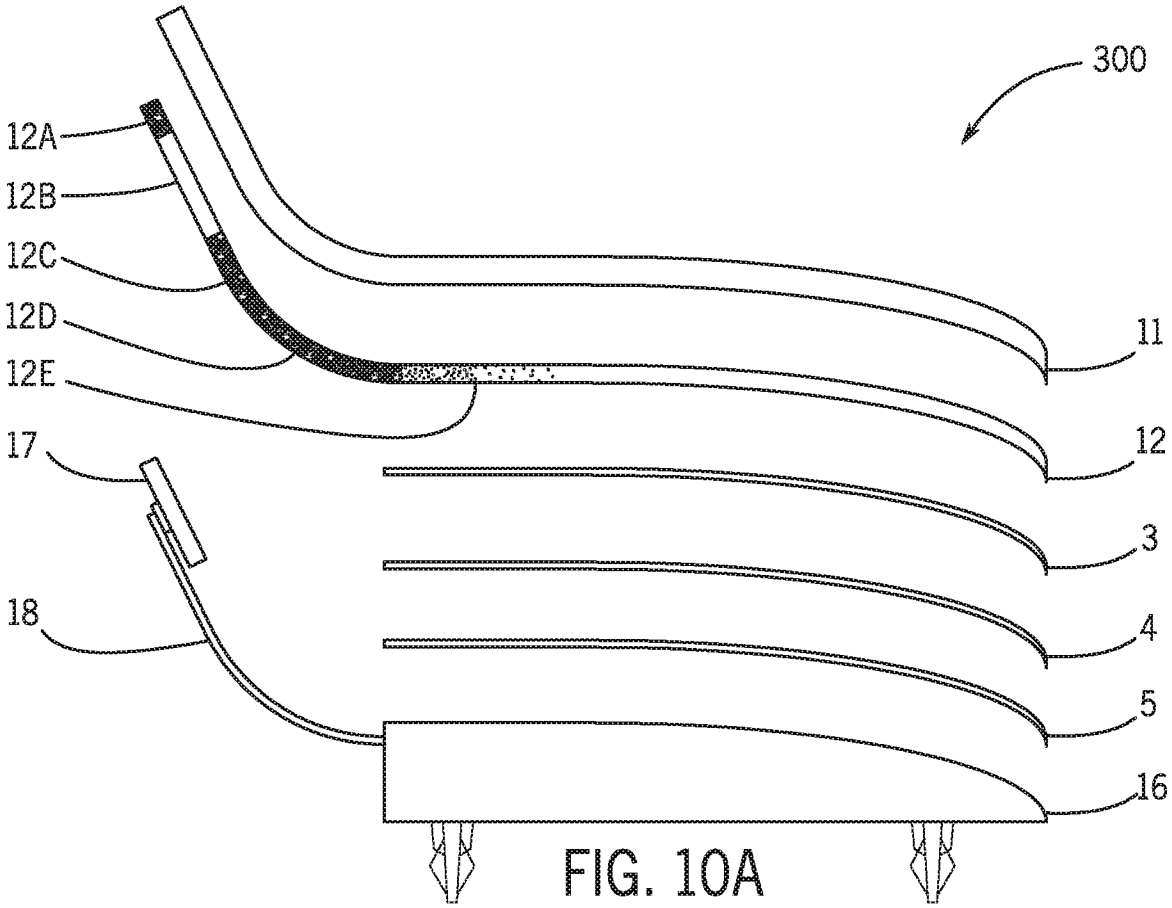


FIG. 10A

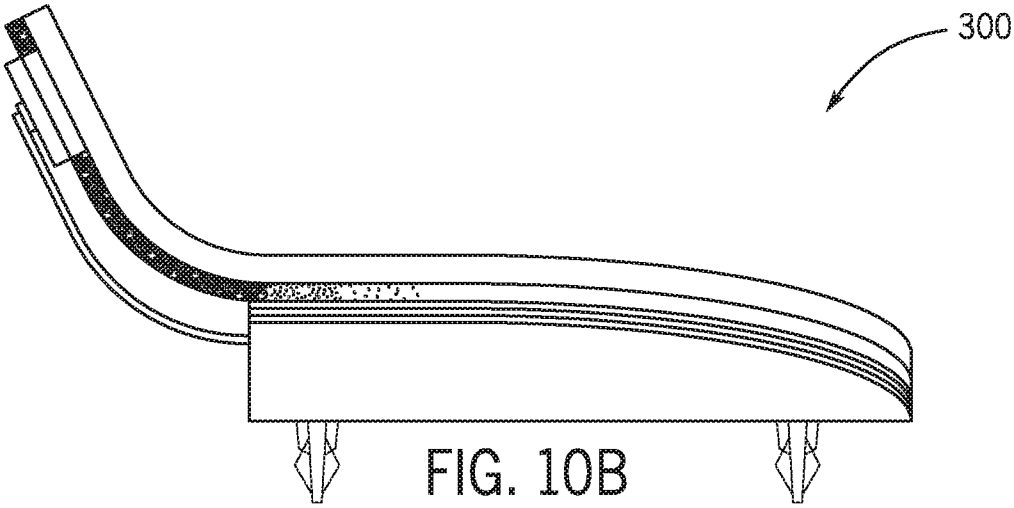


FIG. 10B

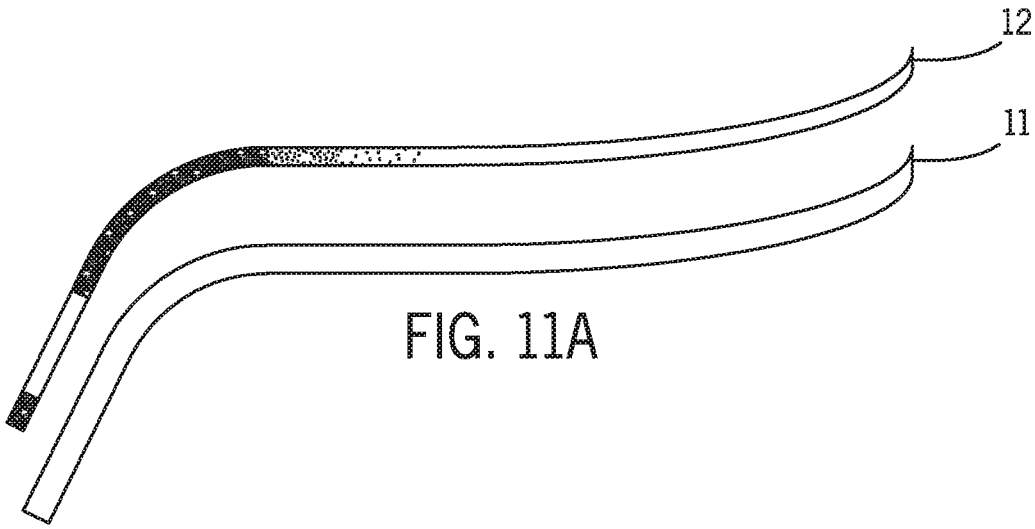


FIG. 11A

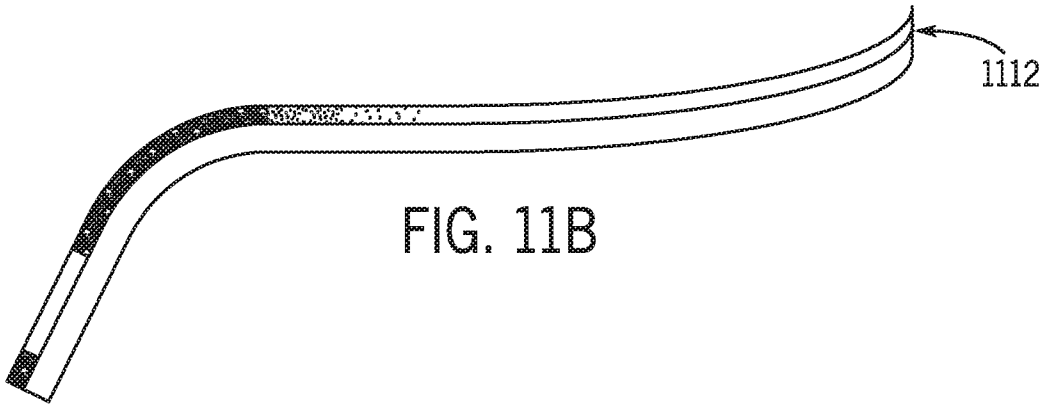


FIG. 11B

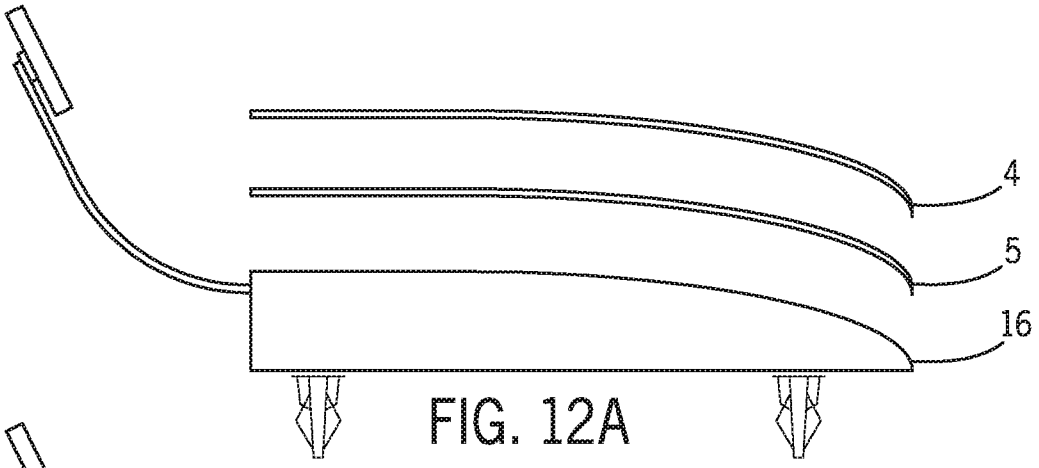


FIG. 12A

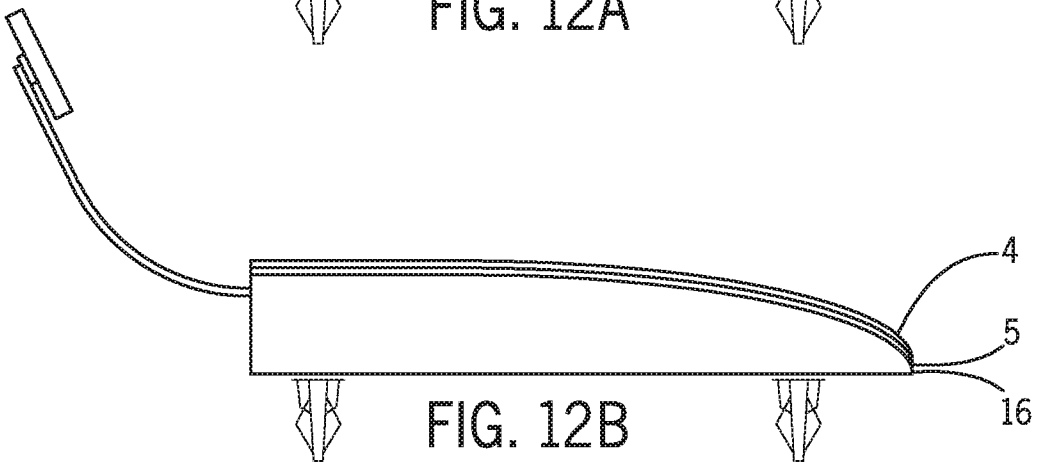


FIG. 12B

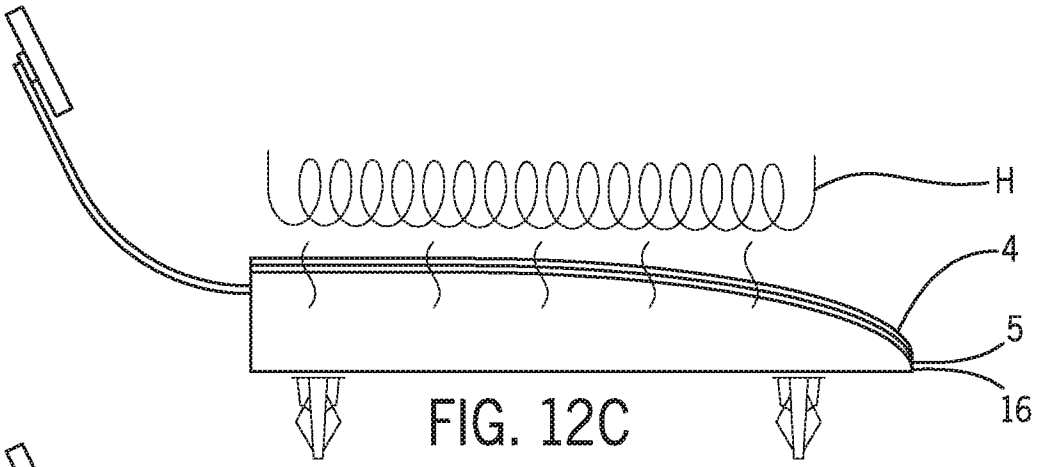


FIG. 12C

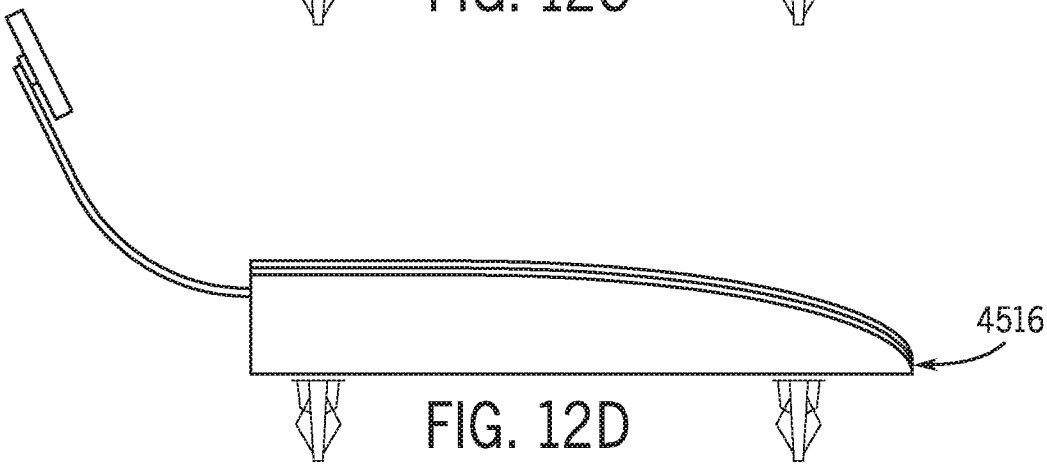


FIG. 12D

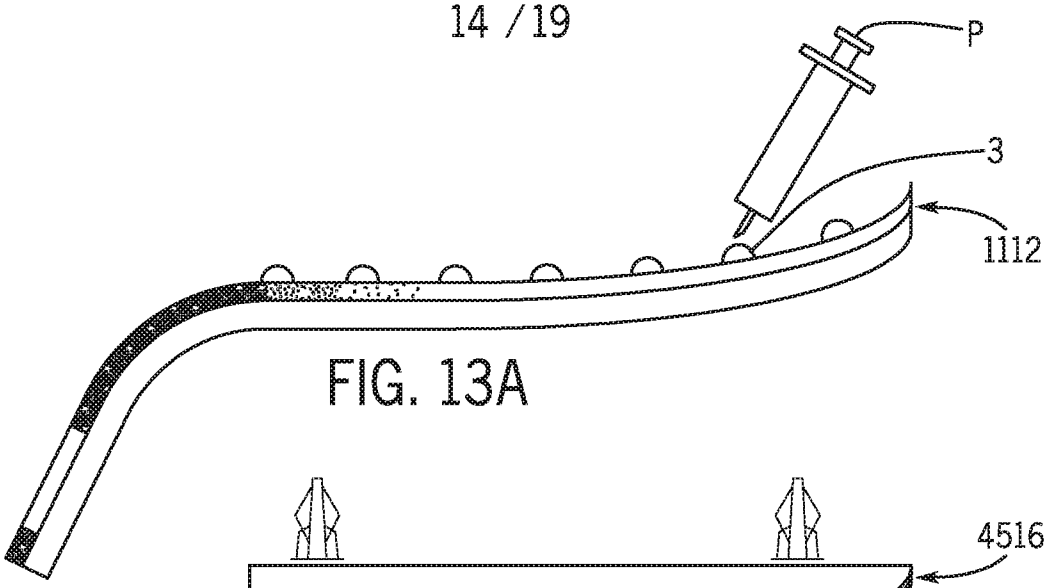


FIG. 13A

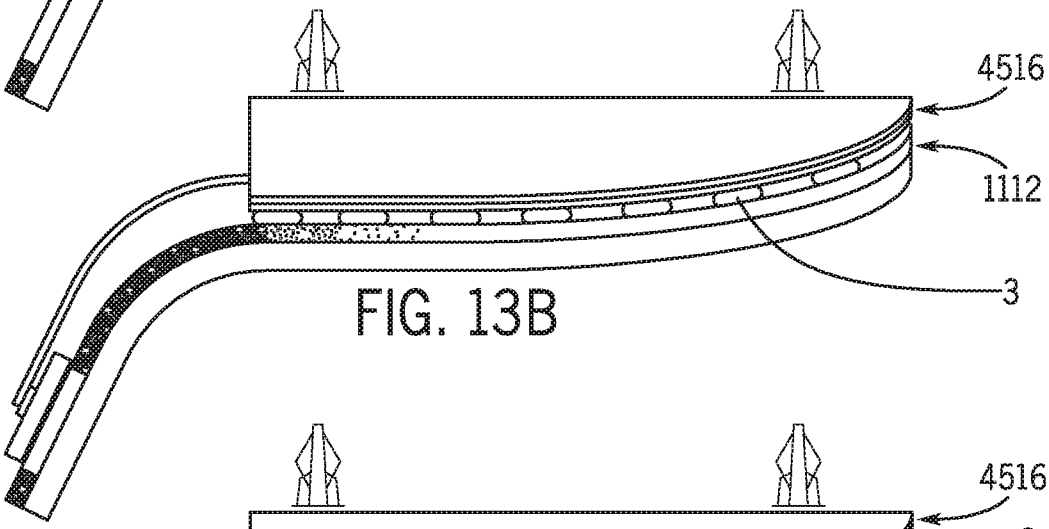


FIG. 13B

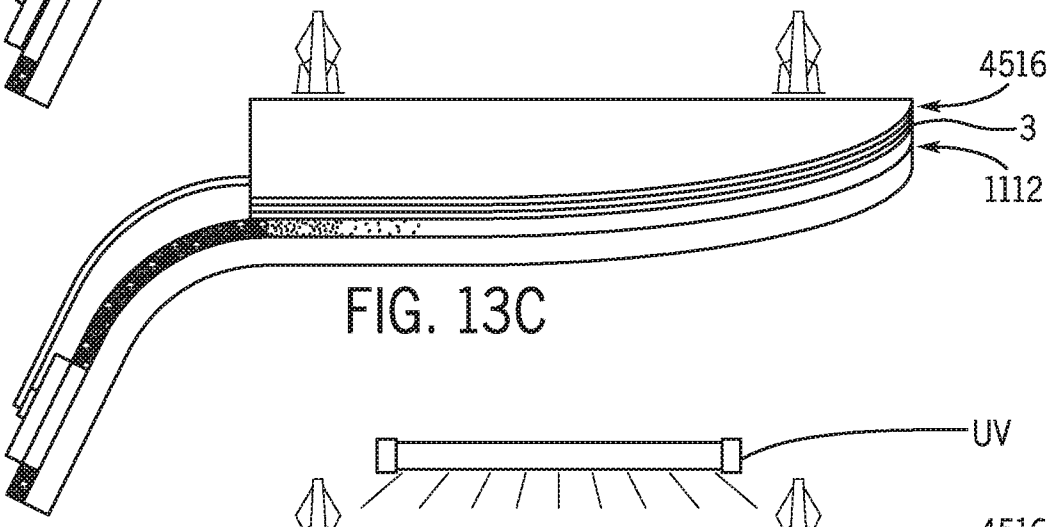


FIG. 13C

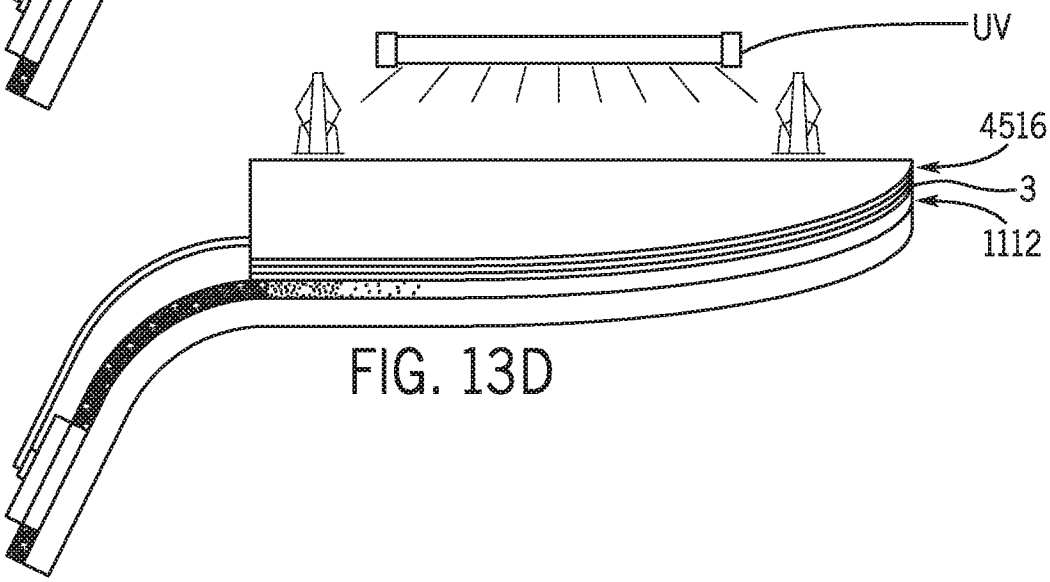


FIG. 13D

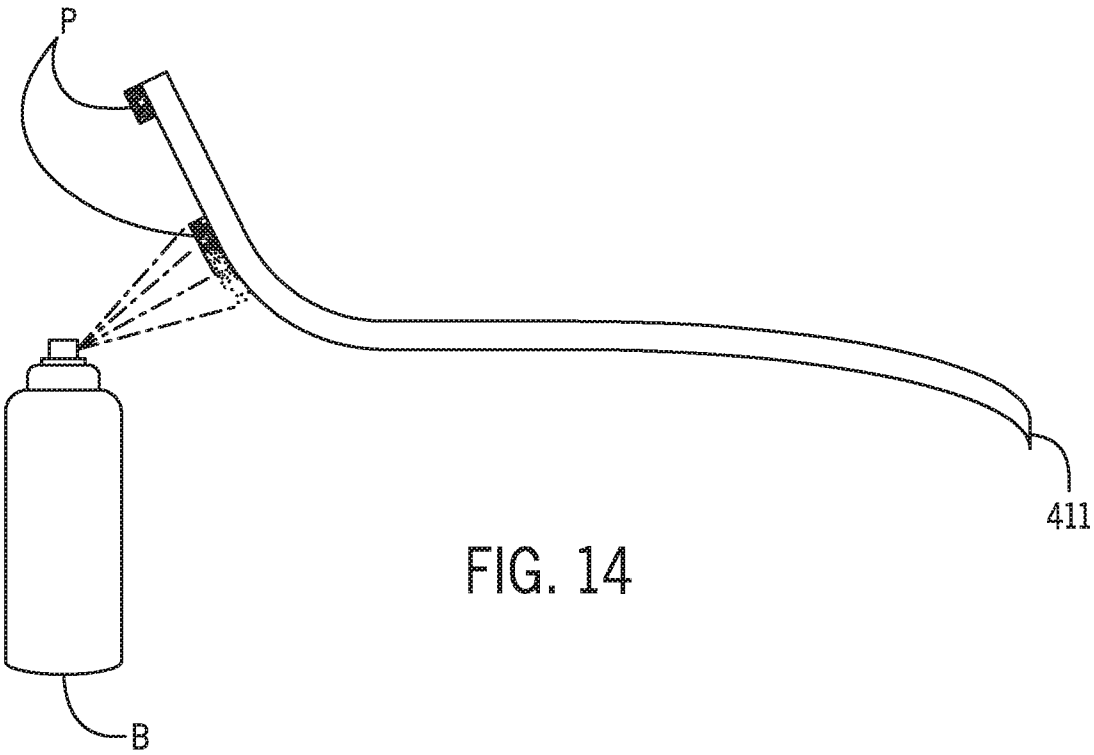


FIG. 14

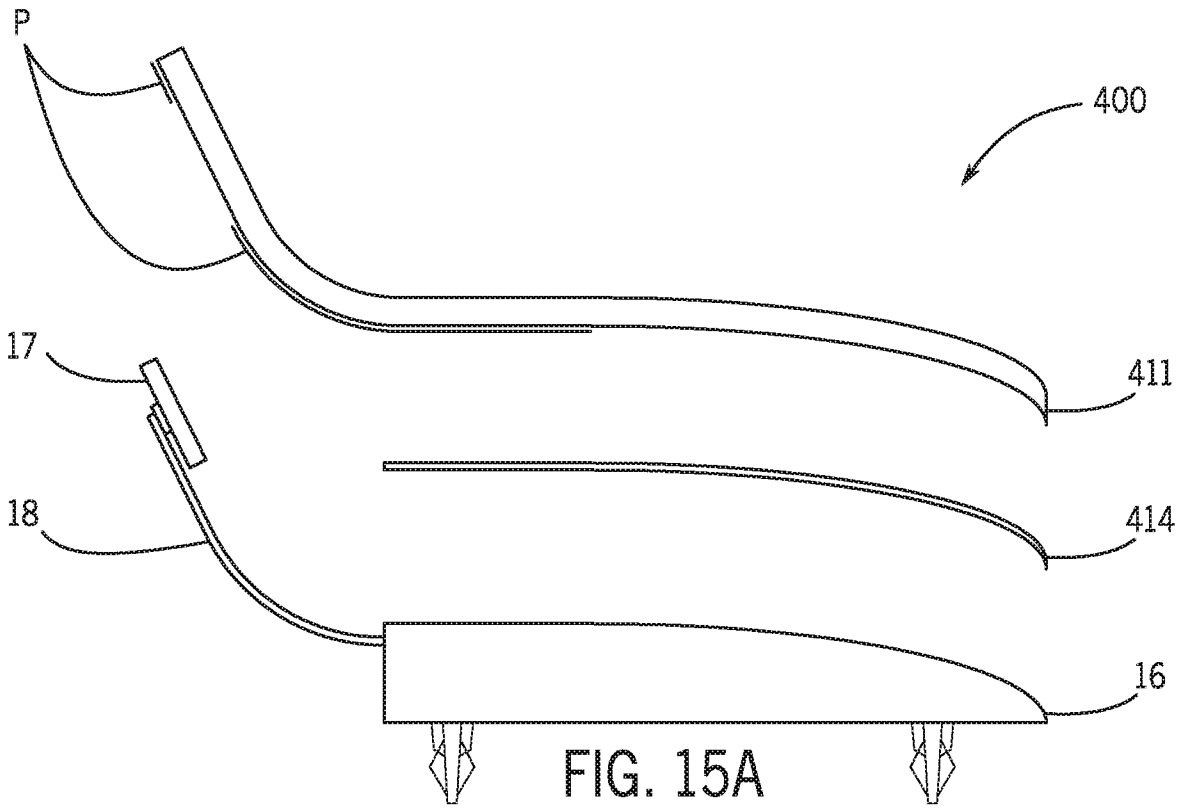


FIG. 15A

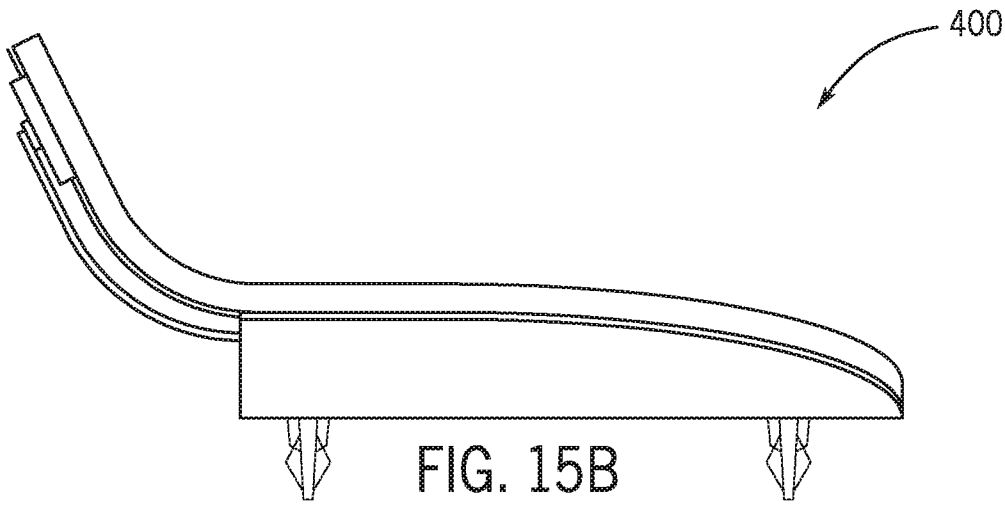


FIG. 15B

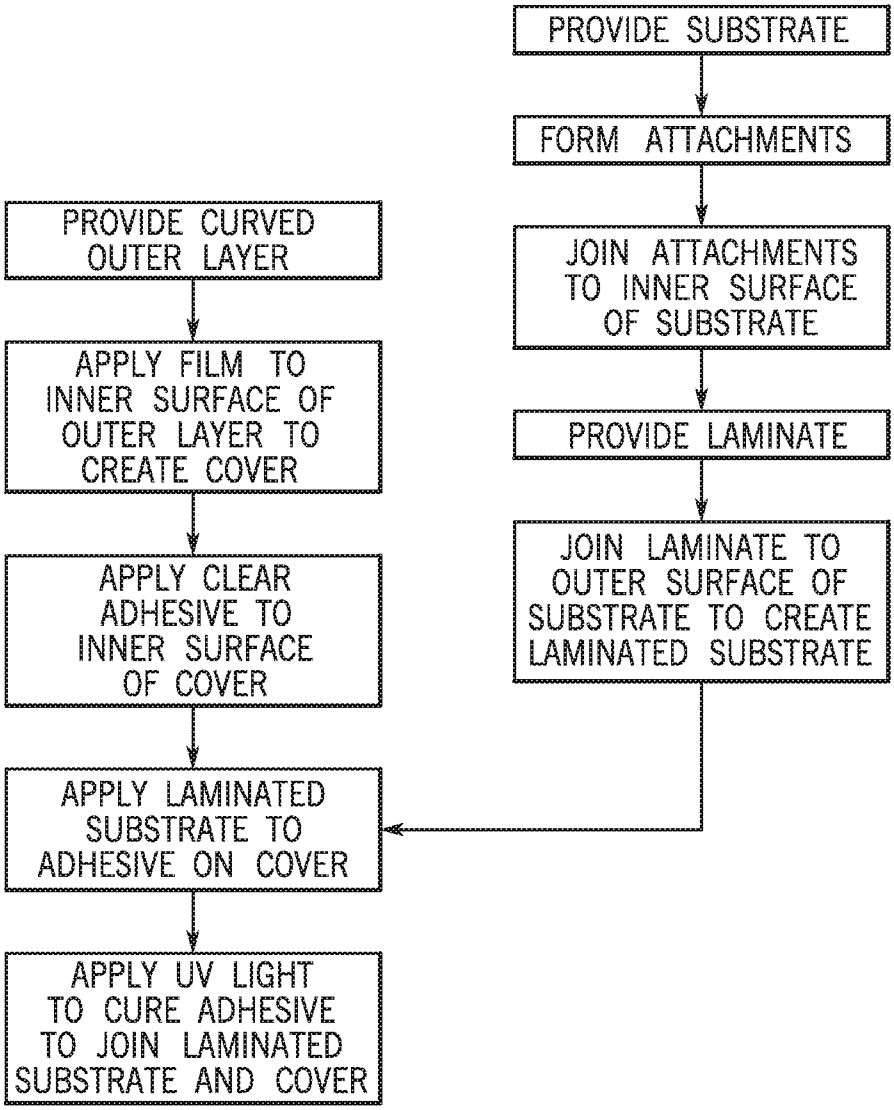

PROVIDE SUBSTRATE
FORM ATTACHMENTS
JOIN ATTACHMENTS TO INNER SURFACE OF SUBSTRATE
PROVIDE LAMINATE
JOIN LAMINATE TO OUTER SURFACE OF SUBSTRATE TO CREATE LAMINATED SUBSTRATE
PROVIDE CURVED OUTER LAYER
APPLY FILM TO INNER SURFACE OF OUTER LAYER TO CREATE COVER
APPLY CLEAR ADHESIVE TO INNER SURFACE OF COVER
APPLY LAMINATED SUBSTRATE TO ADHESIVE ON COVER
APPLY UV LIGHT TO CURE ADHESIVE TO JOIN LAMINATED SUBSTRATE AND COVER

FIG. 16

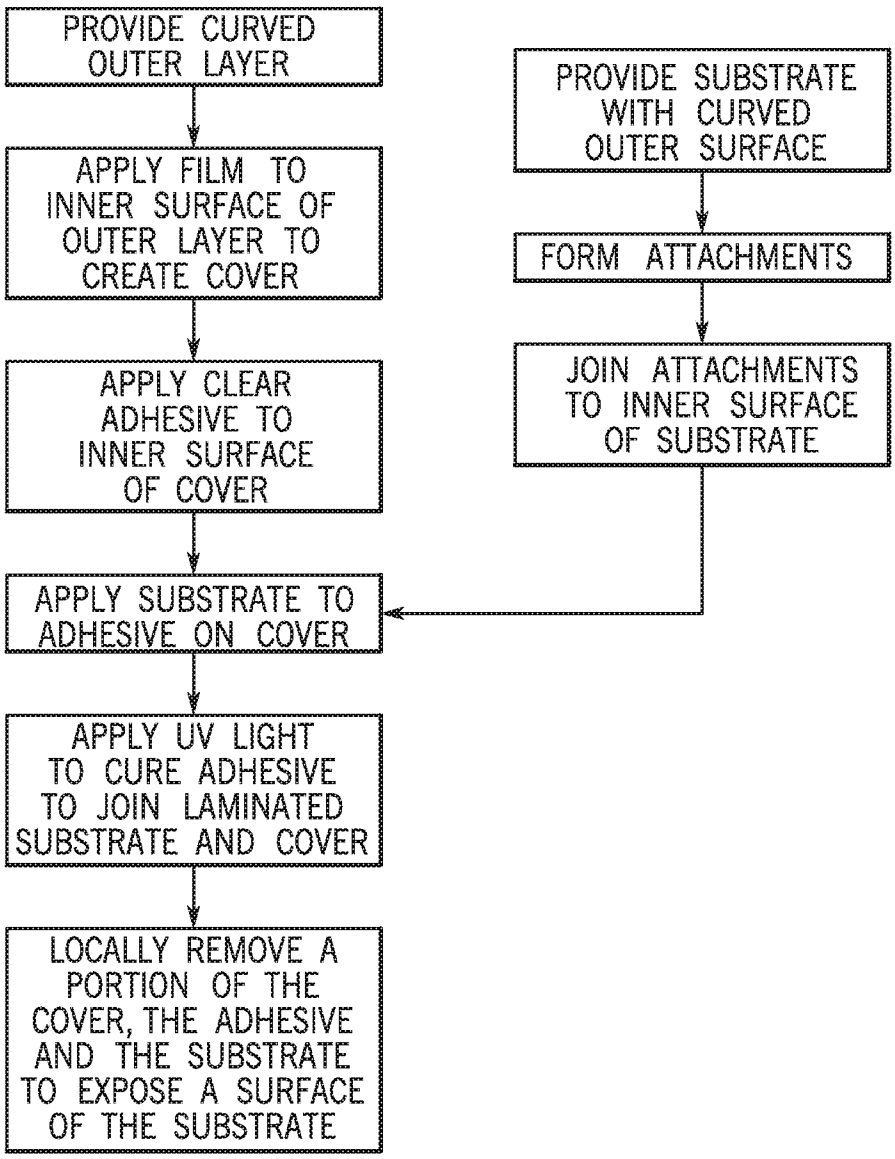

PROVIDE CURVED OUTER LAYER
APPLY FILM TO INNER SURFACE OF OUTER LAYER TO CREATE COVER
APPLY CLEAR ADHESIVE TO INNER SURFACE OF COVER
PROVIDE SUBSTRATE WITH CURVED OUTER SURFACE
FORM ATTACHMENTS
JOIN ATTACHMENTS TO INNER SURFACE OF SUBSTRATE
APPLY SUBSTRATE TO ADHESIVE ON COVER
APPLY UV LIGHT TO CURE ADHESIVE TO JOIN LAMINATED SUBSTRATE AND COVER
LOCALLY REMOVE A PORTION OF THE COVER, THE ADHESIVE AND THE SUBSTRATE TO EXPOSE A SURFACE OF THE SUBSTRATE

FIG. 17

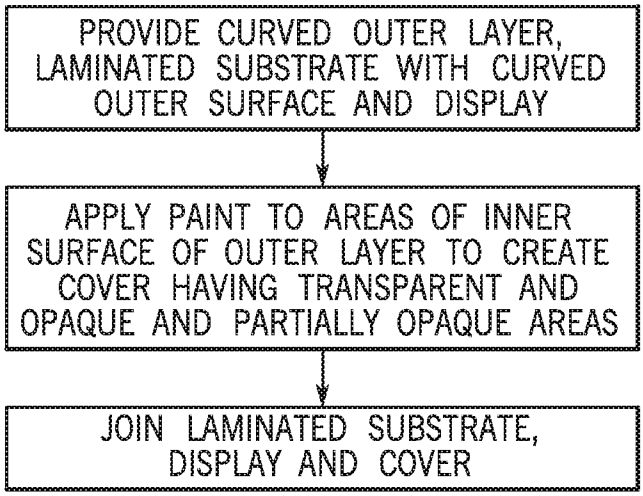

PROVIDE CURVED OUTER LAYER, LAMINATED SUBSTRATE WITH CURVED OUTER SURFACE AND DISPLAY
APPLY PAINT TO AREAS OF INNER SURFACE OF OUTER LAYER TO CREATE COVER HAVING TRANSPARENT AND OPAQUE AND PARTIALLY OPAQUE AREAS
JOIN LAMINATED SUBSTRATE, DISPLAY AND COVER

FIG. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 18/12225

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B32B 27/06, B32B 27/08, B32B 27/20 (2018.01)
CPC - B32B 2255/10, B32B 2255/26, B32B 2264/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History Document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/0075290 A1 (YANFENG US AUTOMOTIVE INTERIOR SYSTEMS I LLC) 17 March 2016 (17.03.2016); Fig. 2-4; para [0003] [0017-0019] [0021] [0023] [0025] [0029] [0033] [0040] [0042]	1-39
A	US 2011/0183120 A1 (SHARYGIN et al.) 28 July 2011 (28.07.2011); entire document	1-39
A	WO 2016/120287 A1 (SHANGHAI YANFENG JINQIAO AUTOMOTIVE TRIM SYSTEM CO., LTD) 4 August 2016 (04.08.2016); entire document	1-39
A	US 2009/0174121 A1 (HAYES et al.) 9 July 2009 (09.07.2009); entire document	1-39
A	US 2010/0133866 A1 (HIPSHIER) 3 June 2010 (03.06.2010); entire document	1-39
A	US 2005/0276874 A1 (MENALDO et al.) 15 December 2005 (15.12.2005); entire document	1-39

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 February 2018	26 MAR 2018

Name and mailing address of the ISA/US	Authorized officer
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)