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(54) **Title:** ELECTROCHROMIC WINDOW FRAMING SYSTEMS WITH ACCESSIBLE WIRING AND COMPONENTS

(57) **Abstract:** Assemblies having first and second insulated glass units with one or more IGU cables and frame having an intermediate horizontal member interposed between IGUs, wherein the frame is configured to pass the one or more IGU cables into the intermediate horizontal member.

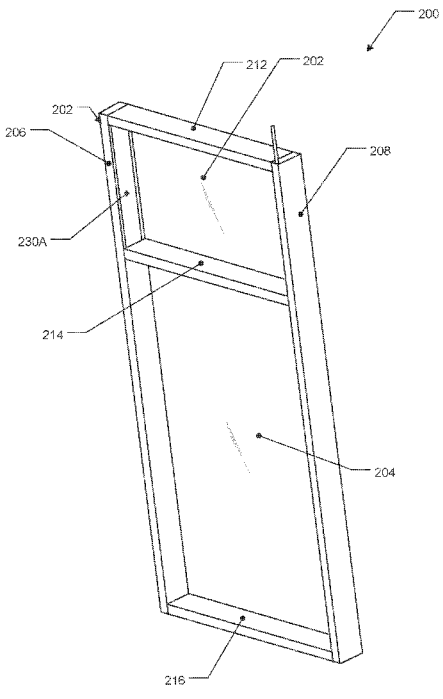


FIG. 2

WO 2024/091649 A1

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ELECTROCHROMIC WINDOW FRAMING SYSTEMS WITH ACCESSIBLE WIRING AND COMPONENTS

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] This application claims benefit of and priority to U.S. Provisional Application 63/419,794, titled "ELECTROCHROMIC WINDOW FRAMING SYSTEMS WITH ACCESSIBLE WIRING AND COMPONENTS," and filed on October 27, 2022 and to U.S. Provisional Application 63/419,987, titled "ELECTROCHROMIC WINDOW FRAMING SYSTEMS WITH ACCESSIBLE WIRING AND COMPONENTS," and filed on October 27, 2022; each of these applications is hereby incorporated by reference in its entirety and for all purposes.

BACKGROUND

[0002] Electrochromism is a phenomenon in which a material exhibits a reversible electrochemically-mediated change in an optical property when placed in a different electronic state, typically by being subjected to a voltage change. The optical property is typically one or more of color, transmittance, absorbance, and reflectance. One well known electrochromic material is tungsten oxide (WO3). Tungsten oxide is a cathodic electrochromic material in which a coloration transition, transparent to blue, occurs by electrochemical reduction.

[0003] Electrochromic materials may be incorporated into, for example, windows for residential, commercial, and other uses. The color, transmittance, absorbance, and/or reflectance of such windows may be changed by changing a feature of the electrochromic material, that is, electrochromic windows are windows that can be darkened or lightened electronically. A small voltage applied to an electrochromic device of the window will cause them to darken; reversing the voltage causes them to lighten. This capability allows control of the amount of light that passes through the windows, and presents an opportunity for electrochromic windows to be used as energy-saving devices.

[0004] While electrochromism was discovered in the 1960s, electrochromic devices, and particularly electrochromic windows, still suffer various problems and have not begun to realize their full commercial potential despite many recent advancements in electrochromic

technology, apparatus, software, and related methods of making and/or using electrochromic devices.

SUMMARY

[0005] Certain embodiments pertain to assemblies having a plurality of insulated glass units (IGUs) and a frame having one or more intermediate horizontal members, each intermediate horizontal member interposed between two of the IGUs. At least one of the IGUs has an IGU cable and the frame is configured to pass the IGU cable into the one or more intermediate horizontal members.

[0006] Some embodiments pertain to assemblies having a first IGU, a second IGU, a frame having an intermediate horizontal member and a first vertical member, and one or more IGU cables in electrical communication with the first and second IGUs. The intermediate horizontal member is interposed between the first and second IGUs. The frame is configured to pass the one or more IGU cables from the first and second IGUs into the intermediate horizontal member and through the first vertical member. In some cases, the frame is configured to pass the one or more IGU cables from the first vertical member to outside the assembly. In some cases, the assembly includes a controller within the frame. In some cases, the assembly includes one or more additional IGUs and their respective cable(s). In some cases, the intermediate horizontal member includes a seat element upon which one of the IGUs is seated.

[0007] Some embodiments pertain to assemblies having a smart window controller (SWC) comprising a memory configured to store information about an insulated glass unit. The assemblies also include an SWC cable in electrical communication with the smart window controller and an IGU cable in electrical communication with an insulated glass unit and with the SWC cable. The assemblies also include a third cable in electrical communication with the SWC and a second controller.

[0008] Some embodiments pertain to assemblies having first and second insulated glass units (IGUs) and a frame comprising an intermediate horizontal member and a first vertical member, wherein the intermediate horizontal member is interposed between the first and second IGUs. The assemblies also include a first IGU cable in electrical communication with the first IGU and a second IGU cable in electrical communication with the second IGU. In addition, the assemblies include a first smart window controller within a body of the

intermediate horizontal member, the smart window controller configured to store information about the first IGU, wherein the frame is configured to pass the first IGU cable from the first IGU into the intermediate horizontal member to connect to the first smart window controller.

[0009] Some embodiments pertain to methods of fabricating an assembly comprising first and second insulated glass units and a frame, the frame comprising a first vertical member and an intermediate horizontal member interposed between the first and second insulated glass units. The method includes routing a first IGU cable from the first insulated glass unit into the intermediate horizontal member and routing the first IGU cable through a hole in the vertical member and passing the first IGU cable through the vertical member.

[0010] These and other features and embodiments will be described in more detail with reference to the drawings.

[0011] Additional aspects and advantages of the present disclosure will become readily apparent to those skilled in this art from the following detailed description, wherein only illustrative embodiments of the present disclosure are shown and described. As will be realized, the present disclosure is capable of other and different embodiments, and its several details are capable of modifications in various obvious respects, all without departing from the disclosure. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **Figure 1A** is a drawing depicting an off-angle view of an assembly having two insulated glass units with one or more cables routed through structural members, according to embodiments.

[0013] **Figure 1B** is a drawing depicting an off-angle view of an assembly having four insulated glass units with one or more cables routed through structural members, according to embodiments.

[0014] **Figure 2** is a drawing depicting an off-angle view of an assembly with two insulated glass units, two vertical structural members, and three horizontal structural members, according to embodiments.

[0015] **Figure 3** is a drawing depicting a cross-sectional side view of a portion of an assembly in a stick build configuration with two insulated glass units, a pressure plate, and a horizontal member having a seat for an IGU, according to embodiments.

[0016] **Figure 4** is a drawing depicting a cross-sectional side view of a portion of an assembly in a stick build configuration with two insulated glass units, a pressure plate, and a horizontal member configured to connect with a structural member having a seat for an IGU, according to embodiments.

[0017] **Figure 5** is a drawing depicting a cross-sectional side view of the horizontal member in **Figure 4** with the removable cover exploded away from the horizontal member.

[0018] **Figure 6** is a drawing depicting an assembly having two insulated glass units with cable retention features including clips, according to embodiments.

[0019] **Figure 7A** is a drawing depicting a cross-sectional side view of a portion of a unitized assembly in a structural silicone configuration, according to embodiments.

[0020] **Figure 7B** is a drawing depicting a cross-sectional side view of a portion of a unitized assembly in a structural silicone configuration, according to embodiments.

[0021] **Figure 8** is a drawing depicting an off-angle view of an example of components of an assembly, according to an implementation.

[0022] **Figure 9** is a drawing depicting an off-angle view of another example of components of an assembly, according to an implementation.

[0023] **Figure 10** is a drawing depicting an off-angle view of an example of components of an assembly with two insulated glass units and a controller positioned inside an intermediate horizontal structural member, according to an implementation.

[0024] **Figure 11** is a drawing depicting an off-angle view of an example of components of an assembly with two insulated glass units and a controller positioned inside a horizontal structural member, according to an implementation.

[0025] **Figure 12** is a drawing depicting an off-angle view of an example of components of an assembly with two insulated glass units and a controller positioned outside of the envelope of the assembly, according to an implementation.

[0026] **Figure 13** is a drawing depicting an off-angle view of a portion of the assembly in **Figure 12.**

[0027] **Figure 14** is a drawing depicting an off-angle view of an example of components of an assembly with four insulated glass units, according to various embodiments.

[0028] **Figure 15** is a schematic drawing depicting an assembly including a smart window controller (SWC), an IGU, and a controller, according to embodiments.

[0029] **Figure 16A** is a schematic drawing depicting an example of a wire and cable configuration of an assembly including a smart window controller, according to embodiments.

[0030] **Figure 16B** depicts a plan view of components of the assembly in **Figure 16A**.

[0031] **Figure 17** depicts a flowchart including operations of a manufacturing technique or method of fabrication of an assembly having two or more IGUs, according to various implementations.

[0032] The figures and components therein may not be drawn to scale.

DETAILED DESCRIPTION

[0033] Different aspects are described below with reference to the accompanying drawings. The features illustrated in the drawings may not be to scale. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the presented implementations. The disclosed implementations may be practiced without one or more of these specific details. In other instances, well-known operations have not been described in detail to avoid unnecessarily obscuring the disclosed implementations. While the disclosed implementations will be described in conjunction with specific examples, it will be understood that it is not intended to limit the disclosed implementations.

[0034] Numeric ranges are inclusive of the numbers defining the range. It is intended that every maximum numerical limitation given throughout this specification includes every lower numerical limitation, as if such lower numerical limitations were expressly written herein. Every minimum numerical limitation given throughout this specification will include every higher numerical limitation, as if such higher numerical limitations were expressly written herein. Every numerical range given throughout this specification will include every

narrower numerical range that falls within such broader numerical range, as if such narrower numerical ranges were all expressly written herein.

[0035] The term "tintable window" refers to a window (e.g., an architectural window) comprising one or more optically switchable devices (e.g., electrochromic devices). An example of a tintable window is an electrochromic window having one or more tintable devices. In examples involving commissioning of tintable windows, a tintable window is sometimes referred to as an "insulated glass unit" or "IGU."

[0036] The headings provided herein are not intended to limit the disclosure.

[0037] Unless defined otherwise herein, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art. Various scientific dictionaries that include the terms included herein are well known and available to those in the art. Although any methods and materials similar or equivalent to those described herein find use in the practice or testing of the embodiments disclosed herein, some methods and materials are described.

[0038] The terms defined immediately below are more fully described by reference to the Specification as a whole. It is to be understood that this disclosure is not limited to the particular methodology, protocols, and reagents described, as these may vary, depending upon the context they are used by those of skill in the art.

[0039] As used herein, the singular terms "a," "an," and "the" include the plural reference unless the context clearly indicates otherwise.

I. Introduction

[0040] Certain embodiments described herein are new and novel apparatuses and methods relating to multiple insulated glass units (IGU), that each have an optically switchable device, positioned within and secured by structural elements, and having one or more cables electrically connected to the IGUs and routed through the structural elements. In some cases, the apparatuses may further include a controller that is configured to control operation of the IGUs and that is positioned within one of the structural elements. In some cases, the methods provided herein relate to manufacturing and assembling certain examples of apparatuses described herein.

[0041] IGUs with optically switchable devices such as, e.g., electrochromic devices, provide numerous advantages to a building, such as controlling light, heat, health, energy usage and savings, and occupant comfort, for example, of the building. However, the installation of such IGUs, corresponding cables and wires, and optionally controllers can be challenging, costly, time-consuming, and can lead to inconsistent results, damaged elements, and an inability to perform maintenance on elements of the IGU system.

[0042] For example, in some cases, each IGU may include one or more cables exiting the sealed portion of the IGU that is electrically connected to a controller configured to control the optically switchable device (e.g., electrochromic device) of that IGU. Each IGU may also include a plurality of bus bars electrically connected one or more layers of the optically switchable device. Each IGU may also be a two-pane or three-pane unit, for example, with each pair of panes separated by a spacer and the optically switchable devices may be sealed within the IGU. Electrical wires are electrically connected to the bus bars and one or more of these wires may exit the sealed portion of the IGU through the spacer, or some other location of the IGU, so that it may be electrically connected to the controller. The electrical connection between the IGU and the controller may include a plurality of connected cables or wires, such as two, three, or four. The controller is configured to control the IGU's optically switchable device by applying voltages to the bus bars.

[0043] In certain instances, some assemblies also include a smart window controller (SWC) or other controller that has a memory that can store various information about an IGU of the assembly such as the lite or IGU ID, IGU dimensions, etc. For example, an IGU cable may be connected to the SWC and the SWC is then electrically connected to the controller. The controller may be located within a structural member of the assembly. In other certain instances, the controller may be located outside the assembly and the IGU cables are routed to a position at the edge of the assembly to electrically connect to the controller outside the assembly.

[0044] During fabrication and/or installation of these IGUs and controllers, the controllers may be positioned away from the IGUs, i.e., not directly next to or adjacent each other, thereby requiring the routing of wires between the IGU and the controller. For some implementations, one single controller may be used to control multiple IGUs, such as two or four IGUs, and the cables from each IGU is to be routed to the single controller. Provided

herein are apparatuses and methods relating to structural elements holding two or more IGUs and configured to receive and position cables and wires.

[0045] Some embodiments include assembling structural elements, IGUs, cables, and also the controller in some instances, to create a single unit or unitized package or assembly. Such single unit, or unitized assembly, may be manufactured and assembled at one location, such as a factory or shop, then transported to a location where a building is under construction, and then positioned into a frame of the building and thereby become a part of the building envelope. Using a unitized assembly can result in numerous benefits, such as a more uniform, robust, and reliable construction of the building while reducing damage, delays, needs for repairs, and costs of manufacturing and installation. Further, a unitized assembly can be commissioned and readied for integration with the building before installation, thereby reducing commissioning time, efforts, and cost. For example, a unitized assembly may a fully framed unit with cabling through structural members to a standardized location at an edge or corner of the unit to electrically connect to a standardized location at a building at which the unitized assembly is being installed. In some cases, the unitized assembly has an intermediate horizontal member interposed between two insulated glass units (IGUs) and IGU cables from the two IGUs enter the intermediate horizontal member (e.g., IGU cables 1218A and 1218B enter intermediate horizontal member 1214 in Figure 13) and the IGU cables can pass through a horizontal member to a standardized location to electrically connect to components of the building at installation. Figures 7A and 7B depict examples of unitized systems 700 and 701.

[0046] Some embodiments relate to an assembly of IGUs, cables, and also a controller in some instances, in a "stick build" configuration. In a stick build configuration, the IGUs may be connected together to create a single unit at one location and transported to the building for installation or alternatively connected together at the building. For example, an assembly in a stick build configuration may have an intermediate horizontal member (e.g., horizontal member 314 in Figure 3 or horizontal member 414 in Figure 4) with a pressure plate (e.g., pressure plate 327 in Figure 3 or pressure plate 427 in Figure 4) for connecting the IGUs. The IGU cables may pass through structural members of the assembly from the IGUs to a standardized location to electrically connect to components of the building at installation. Using an assembly in a stick build configuration in a single unit provide benefits such as more uniform, robust, and reliable construction of the building while reducing damage to the

components, delays, needs for repairs, and costs of manufacturing and installation. Further, such an assembly can be commissioned and readied for integration with the building before installation, thereby reducing commissioning time, efforts, and cost.

[0047] **Figures 1A** and **1B** depict assemblies **100** and **101**, where one or more IGU cables may be routed through structural members of their frames such that these assemblies can be commissioned and ready for integration with a building. The assemblies may be unitized assemblies or assemblies in a stick build configuration. Assembly **100** includes a frame **101** having a plurality of horizontal and vertical structural members and two insulated glass units (IGUs) **102, 104**. As denoted by the dashed line, assembly **100** can be installed into a frame **191** of a building **190** such that a distal end **181** of one or more cables can be electrically connected to one or more electrical connectors **192** at a centralized location at frame **191** of the building **190**. Assembly **101** includes a frame **102** having a plurality of horizontal and vertical structural members and four IGUs **105**, **106**, **107**, and **108**. As denoted by the dashed line, assembly **100** can be installed into a frame **193** of the building **190** such that a distal end **182** of one or more cables can be electrically connected to one or more electrical connectors **194** at a centralized location at frame **193** of the building **190**.

[0048] **II. Examples of Assemblies**

[0049] In various embodiments, an assembly may include various numbers of IGUs, vertical structural members, and horizontal structural members. In some embodiments, an assembly may include two IGUs, two vertical structural members, and three horizontal structural members. In another embodiment, an assembly may include four IGUs, three vertical structural members, and six horizontal structural members. In another embodiment, an assembly may include four IGUs, three vertical structural members, and four horizontal structural members. In other embodiments, an assembly may include four IGUs, three vertical structural members, and five horizontal structural members.

[0050] For example, **Figure 2** is a schematic drawing depicting an assembly **200** that includes two IGUs **202** and **204** and a frame **201** having two vertical structural members **206** and **208** (also referred to herein as "vertical members") and three horizontal structural members **210**, **212**, and **214** (also sometimes referred to herein as "horizontal members"), for example. IGU **202** is positioned above (relative orientation in drawing) IGU **204** and horizontal structural member **214** is interposed between IGU **202** and **204**. Horizontal

structural member **212** may sometimes be referred to herein as an "intermediate horizontal member" or "intermediate horizontal." Vertical structural member **206** includes a cover **230A** (e.g., a removable cover) that allows access to one or more cables in the raceway of the vertical member **206**, for example, while the assembly **200** is installed within a frame of a building. Assembly **200** may be a unitized assembly or an assembly in a stick build configuration.

[0051] IGU **202** and IGU **204** each have an IGU cable that is routed through a hole or port in one or more of the horizontal structural members **212**, **214**, and **216**. For example, IGU **202** may have an IGU cable that extends through intermediate structural member **212** (sometimes referred to herein as "top horizontal member") and IGU **204** may have an IGU cable that extends through intermediate horizontal **214**. In some instances, both these IGU cables from IGU **202** and IGU **204** may extend through intermediate horizontal **214**.

[0052] As another example, **Figure 14** is a schematic drawing depicting an assembly **1400** that includes four IGUs **1402**, **1403**, **1404**, and **1405**, and a frame **1401** having three vertical members 1406, 1407, 1408 and six horizontal members 1411, 1412, 1414, 1415, 1416, and 1419. Assembly **1400** may be a unitized assembly or an assembly in a stick build configuration. IGU **1402** is positioned above (relative orientation in drawing) IGU **1404** and intermediate horizontal member **1414** is interposed between IGU **1402** and **1404**. IGU **1403** is positioned above (relative orientation in drawing) IGU **1405** and intermediate horizontal member **1415** is interposed between IGU **1403** and **1405**. The assembly **1400** is shown with the removable covers on vertical members 1407 and 1408 removed. IGU **1402** includes cable **1418A**, IGU **1404** includes cable **1418B**, IGU **1403** includes cable **1418C**, and IGU **1404** includes cable **1418D**. Cable **1418A** of IGU **1402** extends through horizontal member **1414** and along the cavity in horizontal member **1414**, through a hole in vertical member **1406** and in its raceway upwards, then through another hole in vertical member **1406** and into top horizontal member **1411**, through a hole in vertical member **1407**, and out a common area **1452**. Cable **1418B** of IGU **1404** follows the same path as IGU cable **1418A**. Cables **1418C** of IGU **1403** and **1418D** of IGU **1404** extend into horizontal **1415**, through a hole of vertical **1407**, in the raceway of vertical member **1407** and out common area **1452**. In some implementations, these IGU cables **1418A–D** may be connected to a single controller (not shown).

[0053] Assembly **1400** also includes a plurality of horizontal and vertical structural members. Vertical structural member **1408** and vertical structural member **1406** are on opposing sides of IGUs **1402** and **1404** such that these IGUs are interposed between these members **1408** and **1406**, like with Figure 2, for example. An intermediate horizontal member **1414** spans between vertical structural member **1406** and **1408** and between IGUs **1402** and **1404**, similar to Figure 2 and horizontal member **214** described herein. Similarly, vertical structural members **1406** and **1407** are on opposite sides of IGUs **1403** and **1405** such that these IGUs are interposed between the vertical members **1406** and **1407**. An intermediate horizontal **1415** spans between vertical members **1406** and **1407** and between IGUs **1403** and **1405**, similar to horizontal member **214** in Figure 2.

- **Examples of internal features of assemblies**

[0054] The structural members may have various features that enable the creation of the assembly with accessible internal features. For instance, a horizontal structural member may include a removable access cover that can be removed repeatedly and that can provide access to the internal aspects of the member for manufacturing and servicing, cable retention features configured to interface with one or more cables and retain the cable in one or more positions or areas, and in some instances, retention features for positioning an SWC and/or controller. In some instances, a vertical structural member may also or alternatively include a removable cover to provide access to cables, controllers, or other components therein. A removable access cover may provide access while the assembly is installed within a frame of a building in certain aspects.

[0055] The middle or intermediate horizontal structural member may also be configured in various ways to connect with the IGUs. In some instances, for example, an intermediate horizontal member may have a seat on which an IGU sits, directly or indirectly, and a pressure plate that is used to provide lateral force to help secure the IGUs to the horizontal member.

[0056] For example, **Figure 3** depicts a cross-sectional side view of a portion of an assembly (e.g., assembly 200 in Figure 2) including IGUs **302** and **304** and a horizontal member **314** with a seat **325** upon which IGU **302** sits and a pressure plate **327**. Pressure plate **327** is secured to seat **325** and horizontal member **314** in order to secure IGUs **302** and **304** to horizontal member **314**. In some instances, this may be considered an example of a "stick

build" or "captured glazing" configuration. In some other embodiments, the intermediate horizontal may have structural and sealing silicone as well as a backing rod that is used to secure the IGUs to the horizontal member. This configuration may be considered a "structural silicone glazing" configuration. An example of a "structural silicone glazing" configuration is illustrated in **Figures 7A** and **7B**.

[0057] In **Figure 3**, IGU **302** is positioned on seat **325** of horizontal member **314** and IGU **304** is beneath IGU **302** and seat **325**. Horizontal member **314** includes three retention features **324A–C**. Each cable retention feature **324A–C** has a partial circle wall **326** with an opening **328** through which the cable can be placed, e.g., a C-shaped opening. IGU **302** includes an IGU cable **318A** that extends from IGU **302**, through a portion of horizontal member **314**, e.g., through a hole **320**, into a cavity **322** of horizontal member **314**, and into cable retention feature **324A**. Cable retention feature **324A** is configured to receive a cable such as IGU cable 318 and restrain the cable in one or more directions of movement or area. A grommet **333** may be used to position IGU cable **318** within hole **320** and prevent the material of horizontal member **314** from damaging IGU cable **318**.

[0058] Horizontal member **314** also includes a removable cover **330**. Removable cover **330** is configured to be connected to a body **332** of horizontal member **314** with an elastic member **334** and a clip **336** offset from each other. Elastic member **334** has a U-shape and is deformable in a lateral direction denoted as X, e.g., towards and away from IGUs 302 and 304. When removable cover **330** is pushed towards IGU **302** (such as with suction cups), elastic member **334** is elastically deformed and allows for clip **336** to become unrestrained or unseated from a notch, divot, or seat in body **332**. The notch **337A** of body **332** is configured to engage with elastic member **334** and notch **337B** of body **332** is configured to engage with clip **336**. Once clip **336** is free from body **332**, cover **330** can be removed and the internal features of cavity **322** of horizontal member **314** can be accessed for maintenance or service, for example. Horizontal member **314** also includes four connection means **342**, e.g., holes, each connection means 342 can be, for example, threaded in order to each receive a screw passed through a vertical member and into horizontal member **314**.

[0059] As another example, **Figure 4** depicts a cross-sectional side view of a portion of an assembly (e.g., assembly 200 in Figure 2) including IGUs **402** and **404** and a horizontal member **414** and a pressure plate **427**. Pressure plate **427** is secured to seat **425** and horizontal member **414** in order to secure IGUs **402** and **404** to horizontal member **414**. Horizontal

member **414** has a body **432** that includes a recess **443** having a boundary element **447** that extends into a cavity **422** and is configured to receive and connect with a structural member **445** including seat **425**. This structural member **445** may be a single unitary, monolithic body, e.g., made of a single piece of material, that includes a seat **425** for supporting IGU **402**. In some cases, structural member **445** may also be used to provide additional support to assembly **414**.

[0060] In **Figure 4**, IGU **402** is positioned on seat **425** of horizontal member **414** and IGU **404** is beneath IGU **402** and seat **425**. Horizontal member **414** include two holes 420A and 420B through which IGU cables **418A** and **418B** from IGUs **402** and **404**, respectively, extend into cavity **422** of horizontal member **414**, along with corresponding grommets 433A and 433B. Horizontal member 414 also includes one or more clips 424 that may be used to restrain some movement of IGU cables 118A and 118B. Horizontal member 314 includes a first notch 441A and a second notch 441B that are configured to receive portions of clip 424 and restrain at least some movement of clip 424. In some implementations, like in Figure 4, the horizontal member may also include one or more clip retention features, such as notches, grooves, channels, slots, or other features that are configured to receive a portion of the clips and restrain at least some movement of the clips.

[0061] Grommet **333A** may be used to position IGU cable **418A** within hole **420A** and prevent the material of horizontal member **414** from damaging IGU cable **418A**. Grommet **333B** may be used to position IGU cable **418B** within hole **420B** and prevent the material of horizontal member **414** from damaging IGU cable **418B**. Horizontal member **414** also includes four connection means **442**, e.g., holes, that can be threaded in order to each receive a screw passed through a vertical member of the assembly into the horizontal member **414**.

[0062] Horizontal member **414** also includes a removable cover **430**. Removable cover **430** is configured to be connected to a body **432** of horizontal member **414** with an elastic member **434** and a clip **436** offset from each other. Elastic member **434** has a U-shape and is deformable in a lateral direction denoted as X, e.g., towards and away from IGUs 402 and 404. When removable cover **430** is pushed towards IGU **402** (such as with suction cups), elastic member **434** is elastically deformed and allows for clip **436** to become unrestrained or unseated from a notch, divot, or seat in body **432**. The notch **437A** of body **432** is configured to engage with elastic member **434** and notch **437B** of body **432** is configured to engage with clip **436**. Once clip **436** is free from body **432**, cover **430** can be removed and the internal

features of cavity **422** of horizontal member **414** can be accessed for maintenance or service, for example. Figure 5 depicts the horizontal member 414 in Figure 4 with removable cover 430 exploded away from the horizontal member 414. The cover 430 is configured to be connected with body 432 of horizontal member 414 without using adhesives, screws, or nails, but rather with an elastic member 434 and a clip 436 offset from each other. Horizontal member **414** also includes four connection means **442**, e.g., holes, each connection means 442 can be, for example, threaded in order to each receive a screw passed through a vertical member and into horizontal member **414**.

[0063] In some implementations, a horizontal member may be used with a pressure plane similar to the pressure plate 327 in Figure 3 or the pressure plate 427 shown in Figure 4. In some other embodiments, a horizontal member may be used without a pressure plate in, for example, a structural silicone glazing configuration such as illustrated in **Figures 7A** and **7B**.

[0064] In some instances, a horizontal structural member of an assembly, including cable retention features, may have a single profile that can be extruded, or manufactured by extrusion. In some embodiments, the cable retention features may extend for the entire length of the horizontal member (e.g., intermediate horizontal member), while in some other embodiments the cable retention features may be less than the length, such as at least about 95% of the length, at least about 85% of the length, at least about 75% of the length, at least about 65% of the length, at least about 55% of the length, at least about 45% of the length, at least about 35% of the length, or at least about 25% of the length.

[0065] In some implementations, a structural member (e.g., horizontal member and/or vertical member) of an assembly may include a removable cover that covers the recess and that can be non-destructively removed to allow for maintenance and servicing of internal components within the structural member. In some cases, the removable cover is secured to the structural member without using adhesives, screws, or nails, but rather with, e.g., an elastic member that can be elastically deformed and seated within a notch, divot or seat in a body of the structural member.

[0066] An example of a removable cover is the removable cover **430** shown in **Figures 4** and **5**. In **Figure 5**, removable cover **430** is shown removed from body **432** of horizontal member **414**. Removable cover **430** is configured to be connected with the body **432** of the horizontal member **414** without using adhesives, screws, or nails, but rather with an elastic

member **434** and a clip **436** offset from each other. The elastic member **434** has a U-shape and is deformable in a lateral direction X, e.g., towards and away from the IGUs. When the removable cover **430** is pushed towards IGU **402** (such as with suction cups), the elastic member **434** is elastically deformed and allows for clip **436** to become unrestrained or unseated from a notch, divot, or seat in body **432**. In **Figures 4** and **5**, notch **437A** of body **432** is configured to engage with elastic member **434** and notch **437B** of body **432** is configured to engage with clip **436**. Once clip **436** is free from body **432**, cover **430** can be removed and the internal features of cavity **422** of the horizontal member **414** can be accessed for maintenance or service, for example.

[0067] Another example of a removable cover is cover **330** in **Figure 3**. The removable cover **330** is configured to be connected with body **332** of horizontal member **314** with an elastic member **334** and a clip **336** offset from each other. Elastic member **334** has a U-shape and is deformable in a lateral direction X, e.g., towards and away from the IGUs. When removable cover **330** is pushed towards IGU **302** (such as with suction cups), elastic member **334** is elastically deformed and allows for clip **336** to become unrestrained or unseated from a notch, divot, or seat in body **332**. The notch **337** of body **332** is configured to engage with elastic member **334** and notch **337** of body **332** is configured to engage with clip **336**. Once clip **336** is free from body **332**, cover **330** can be removed and the internal features of cavity **322** of horizontal member **314** can be accessed for maintenance or service, for example. As another example, horizontal member **614** and vertical member **608** are shown in **Figure 6** with their removable covers removed.

[0068] In some embodiments, to make the connection between a cover and the body of a horizontal member aesthetically pleasing, a mating edge of the cover may be at an angle that is complimentary to a mating edge of the body. For example, in **Figures 4** and **5**, a mating edge at removable cover **430** and is at an angle (e.g., about 45 degrees) that is complimentary to a mating edge of the body **432** of horizontal member **414**. As another example, in **Figure 3**, a mating edge at removable cover **330** and is at an angle (e.g., about 45 degrees) that is complimentary to a mating edge of the body **332** of horizontal member **314**. By having these angles complimentary, or substantially complimentary (e.g., within 5% of complimentary), a seam between the cover and body may not be visible, or noticeably visible. For example, in some embodiments, each of these mating edges may be 45 degrees.

[0069] In some embodiments, cable retention features may be used to interface with one or more cables and retain the one or more cables in position(s) or area(s). For example, in **Figure 3**, horizontal member **314** includes three retention features **324A–C**. Each cable retention feature **324A–C** has a partial circle wall **326** with an opening **328** through which the cable can be placed, e.g., a "C-shape." In some instances, the opening may be sized larger than, or smaller than, the diameter of the cable **318**. By having the opening smaller, the cable may be pressed through the opening and then prevented from at least some movement out of the opening. In other embodiments, other cable retention features may be used, such as a plurality of clips or fasteners for each cable that are offset from each other along a portion of the horizontal member.

[0070] As another example, **Figure 4** depicts a cross-sectional side view of a portion of an assembly including IGUs **402** and **404** and a horizontal structural member **414** with one or more clips 424 that may be used to restrain some movement of IGU cables 418A and 418B. The assembly may be a unitized assembly or an assembly in a stick build configuration. Horizontal member **414** in Figures **4** and **5** includes some features and configurations that are the same as horizontal member **314** in **Figure 3**, and some that are different than those of horizontal member **314** in **Figure 3**. Horizontal member **414** of **Figures 4** and **5** includes a removable cover **430** and features for connecting with removable cover **430** which may be the same as those of removable cover **330** in **Figure 3**. **Figure 5** depicts the horizontal structural member **414** in **Figure 4** with removable cover 330 removed.

[0071] One or both of the vertical members may be configured to have one or more cables routed from a horizontal structural member, through the vertical member, and to a common location of the unitized assembly or outside the unitized assembly. In some instances, the common location may be where the plurality of cables terminate at the controller. The configuration of the vertical members may include, in some embodiments, a channel or "raceway", where one or more cables may be positioned and routed, as well as a hole aligned with a horizontal structural member that's configured to allow one or more cables to extend between the vertical member and the horizontal structural member. In some embodiments, the vertical members may also have a cover similar to that of the horizontal member cover 330 or 430 described above to allow access to the cables in the vertical members raceway. These covers may be on the internal side that are adjacent to the IGU. Figure 3 identifies one example of such cover as 330. Figure 4 identifies one example of such cover as 430.

[0072] **Figure 6** depicts a partial off-angle view of the assembly **600** having a frame **601** with a first horizontal member **612** having cable retention features that may be similar to horizontal member **312** of Figure 3, for example. Assembly **600** may be a unitized assembly or an assembly in a stick build configuration. Assembly **600** also includes two IGUs **602**, **604**. The frame **601** includes two vertical members **606**, **608**, the first horizontal member **612**, a second horizontal member **614**, and a third horizontal member (not shown). Second horizontal member **614** is interposed between IGU **602** and **604** and is considered an intermediate horizontal member. Vertical member **608** includes a removable cover (not shown) and intermediate horizontal member **614** includes a removable cover (not shown). Intermediate horizontal member **614** and vertical member **608** are shown without their removable covers in order to view internal components.

[0073] In **Figure 6**, intermediate horizontal member **614** includes cable retention features that are clips **624A** and **624B** for retaining some movement of IGU cable **618A**. The clips in an assembly may be spaced apart from each other by various distances. As also seen in Figure 6, vertical member **608** includes cable retention features that are clips **624C-E** configured to retain IGU cables 618A and 618B positioned in the raceway or other cable routing features of vertical member **608**.

[0074] In **Figure 6**, IGU **602** has an IGU cable **618A** and IGU **604** has an IGU cable **618B** that are routed through a hole or port in one or more of the structural members to a common location **652** to electrically connect to a controller **648** configured to control the IGUs **602**, **604**. IGU cable **618A** extends through intermediate horizontal member **614**. In other instances, both IGU cables **618A** and **618B** may extend through intermediate horizontal member **614**. Intermediate horizontal member **614** also includes two cable retention features **624A** and **624B** that are configured to receive IGU cable **618A** and restrain the cable in one or more directions of movements or areas. In some instances, cable retention features **624A** and **624B** may be similar to cable retention features **324A-324C** in **Figure 3**. Vertical member **608** includes three cable retention features **624C-E** that are configured to receive IGU cables **618A** and **618B** and restrain the cables in one or more directions of movements or areas.

[0075] As noted above, in some embodiments the intermediate horizontal may be configured with structural and sealing silicone as well as a backing rod that is used to secure the IGUs to the horizontal member as opposed to a seat (e.g., seat 325 in **Figure 3** or seat

425 in Figure 4). **Figures** 7A and 7B depict two examples of such intermediate horizontal member configurations.

[0076] **Figure** 7A is an illustrative diagram of components of an assembly **700** having two IGUs **702** and **704** and a horizontal member **714**, according to an implementation. The body of a horizontal member may sometimes be referred to as a "mullion." First IGU **702** includes an IGU spacer **705** and a seal between the spacer **705** and the two lites. First IGU **702** also includes a bus bar **706**. Second IGU **704** includes an IGU spacer **707** and a seal between the spacer **707** and the two lites. Second IGU **704** also includes a bus bar **708**. Further, the IGUs **702** and **704** are secured to the horizontal member **714** with a structural seal **731A** (e.g., structural silicone) and structural seal **731B**, spacers **733A** and **733B**, a weather sealant **709** (e.g., silicone sealant), and a backer rod **710**. Structural seal **731A** is between first IGU **702** and horizontal member **714**. Structural seal **731B** is between second IGU **704** and horizontal member **714**. Spacer **733A** is between first IGU **702** and horizontal member **714**. Spacer **733B** is between second IGU **704** and horizontal member **714**. Backer rod **710** is vertically interposed between the IGUs **702** and **704**. Weather seal sealant **709** is placed on the backer rod **710**.

[0077] **Figure** 7B is an illustrative image of components of an assembly **701** having two IGUs **712** and **714** and a horizontal member **724**, according to an implementation. First IGU **712** includes an IGU spacer **715**. Second IGU **714** includes an IGU spacer **717**. IGUs **712** and **714** are secured to horizontal member **724** with structural silicone **741A** and **741B**, spacers between the IGUS **712** and **714** and the horizontal member **724**, a backer rod **720**, and weather seal silicone sealant placed on the backer rod **720**. Structural silicone **741A** is between first IGU **712** and horizontal member **724**. Structural silicone **741B** is between second IGU **714** and horizontal member **724**. Backer rod **720** is vertically interposed between the IGUs **712** and **714**.

[0078] **Figure 8** depicts an off-angle view of an example of components of an assembly **800** that may be part of assembly **200** in **Figure 2**, according to one implementation. Assembly **800** may be a unitized assembly or an assembly in a stick build configuration. Assembly **800** includes a horizontal member **814** with its cover being transparent or its cover removed. Here, vertical structural member **808** includes a hole **838** aligned with the horizontal structural member **814** and that provides an opening for the cable **818** to pass through in order to extend into the raceway (not visible in this Figure) of the vertical member **808**.

[0079] In examples with an alignment between the hole and the horizontal structural member, the alignment may include the horizontal structural member covering or extending around the hole (e.g., hole **838**), such as depicted in **Figure 8**. It may be advantageous to configure the size and/or shape of the hole to allow the cable passing through the hole some movement and flexibility for routing and positioning during manufacturing, assembly, and service, for example. The shape may be a circle, rectangle, obround, elliptical, square, for instance. In some cases, the hole may also have one or more polymer members or other protective materials on at least one or more edges or surfaces of the hole to prevent the metal vertical member from damaging or impinging the cable. For example, hole **838** in **Figure 8** includes one or more polymer members **840** on one or more edges or surfaces of hole **838** to prevent the metal vertical member from damaging or impinging the cable **818**. As another example, For example, hole **1038** in **Figure 10** includes one or more polymer members **1040** on one or more edges or surfaces of hole **1038** to prevent the metal vertical member from damaging or impinging the cable **1018B**.

[0080] As noted above, at least one vertical member of an assembly may have, in some implementations, a removable cover to allow access to one or more cables in the raceway. For example, vertical member **808** in **Figure 8** includes a removable cover **830**. The removable cover and vertical member may have similar connection features as described herein with respect to **Figure 3**, such as an elastic member **334** and a clip **336**.

[0081] **Figure 9** depicts an off-angle view of an example of components of an assembly **900** that may be another part of assembly **200** in **Figure 2**, according to one implementation. Assembly **900** may be a unitized assembly or an assembly in a stick build configuration. This example shows the top of vertical member **908** visible and a portion of the top horizontal member **912**. The vertical member **908** includes a raceway **944**, encompassed by the dashed line shape, and a cavity that is U-shaped for containing a structural beam **946**, e.g., a steel beam. The IGU cables (not shown) extending from horizontal member **912** can be positioned in raceway **944** so that the IGU cables can be routed vertically within assembly **900**. Other cables may also be positioned in raceway **944**, such as a trunkline (e.g., a coax cable connected to another controller or control panel, such as a Class 1 or Class 2 control panel, or a drop line from a trunkline).

[0082] In some instances, the connection between vertical member and the horizontal members may use a shear block. The shear block may be secured to the vertical member and

the horizontal member may be slid onto the shear block and then secured to the shear block. In some other instances, the connection between vertical member and the horizontal members may not use a shear block. In some implementations, for example, the horizontal member may include a plurality of connection means, such as threaded holes, or bolt through holes, to receive a screw or bolt passed through a hole on the vertical member. Referring back to **Figure 3**, for example, horizontal member **314** includes four connection means **342**, e.g., holes, that can be threaded in order to each receive a screw passed through the vertical member and into the horizontal member. As another example, referring back to **Figure** horizontal member **414** includes four connection means **442**, e.g., holes, that can be threaded in order to each receive a screw passed through the vertical member and into the horizontal member.

[0083] In some embodiments, the single controller that is connected to, and configured to control, the IGUs (e.g., IGUs **202** and **204**) in an assembly (e.g., assembly **200**) may be positioned inside a horizontal structural member (e.g., horizontal member **212**, **214**, or **216** in **Figure 2**) or inside a vertical structural member (e.g., vertical member **206** or **208** in **Figure 2**). In some implementations, the controller may be positioned in a horizontal member and this member may include one or more connection features for connecting to the controller, such as threaded connections. For example, **Figure 10** depicts an off-angle view of an example of components of an assembly **1000** with two IGUs and a controller **1048** positioned inside an intermediate horizontal structural member **1014**, according to an implementation. The assembly includes IGU cables **1018A**, **1018B** from the IGUs that may both enter into horizonal member **1014** and connect to the controller **1048**. For instance, cable **1018A** from a first IGU and cable **1018B** from a second IGU both enter into the cavity of horizontal member **1014** and connected to the controller **1048** also positioned in the member **1014**.

[0084] In some instances, a controller may be connected to another cable that may be electrically connected to a network or infrastructure of a building, such as a trunk line that is connected, directly or indirectly, to the control panel. For example, in **Figure 10**, controller **1048** is connected to a cable **1050** that may be electrically connected to a network or infrastructure of a building. This other cable, sometimes referred to as a dropline, may extend through the raceway of a vertical member (e.g., vertical member **1006** or **1008**) and the corresponding hole (e.g., hole **1038**) in the vertical member in order to reach the controller in the horizontal member (e.g., horizontal member **1014**). For example, in **Figure**

10, cable **1050** extends through the raceway of vertical member **1008** and the corresponding hole **1038** in the vertical member **1008** in order to electrically connect to the controller **1048** in horizontal member **1014**. In another example, the controller may be positioned in the top or bottom horizontal member and the cable of the adjacent IGU may extend through that horizontal member and connected to the controller. The other IGU cable may pass through one of the other horizontal members, through the raceway of a vertical member, and then through the horizontal member where the controller is positioned. The dropline may also run through the horizontal member where the controller is positioned.

[0085] As another example, **Figure 11** depicts an off-angle view of an example of components of an assembly **1100** with two IGUs **1102**, **1104** and a controller **1148** positioned inside a first horizontal member **1112**, according to an implementation. Assembly **1100** may be a unitized assembly or an assembly in a stick build configuration. Assembly **1100** also includes an intermediate (second) horizontal member **1114**, a third horizontal member **1116**, and two vertical members **1106**, **1108**. The assembly 1100 also includes IGU cables **1118A**, **1118B** from IGUs **1102**, **1104** respectively that both enter horizonal member **1114** and connect to controller **1148**. For instance, cable **1118A** from IGU 1104 and cable **1018B** from IGU 1102 both enter into the cavity of horizontal member **1112** and connected to controller **1148** also positioned in the member **1112**. In **Figure 11**, IGU cable **1118A** of IGU **1102** extends through first horizontal member **1112** and to controller **1148**, and IGU cable **1118B** of IGU **1104** extends through second horizontal member **1114**, the hole on vertical member **1106**, through the raceway of vertical member **1106**, through another hole in vertical member **1106** aligned with first horizontal member **1112**, and through first horizontal member **1112** to controller **1148**. This same configuration could be mirrored with the second horizontal member **1114**.

[0086] In some embodiments, the controller may be positioned outside of the assembly, such as depicted in **Figures 12** and **13**. In such implementations, it may be advantageous to route the cables within the assembly so they exit the assembly envelope/boundary at a common location. For example, **Figure 12** depicts an off-angle view of an example of components of an assembly **1200** with two IGUs 1202, 1204 and a controller **1248** positioned outside of the envelope of the assembly **1200**, according to an implementation. Assembly **1200** may be a unitized assembly or an assembly in a stick build configuration. Assembly **1200** also includes a frame **1201** having an intermediate (second) horizontal member **1214**, a

third horizontal member **1216**, and two vertical members **1206**, **1208**. The assembly 1200 also includes IGU cables **1218A, 1218B** of the IGUs **1202**, **1204** respectively. Assembly **1200** also includes a horizontal member **1214** with its removable cover being transparent or its cover removed.

[0087] In **Figure 12**, IGU cables **1218A, 1218B** of the IGUs 1202, 1204 extend through the intermediate horizontal member 1214, into vertical member 1206, and out of that member to the controller **1248**. IGU cable **1218A** of IGU **1202** extends into horizontal **1214**, then through a hole in vertical **1206** and into the raceway of vertical **1206**, and out the top of vertical **1206**. This opening in the vertical **1206** where the IGU cables **1218A** and **1218B** exit may be the common location **1252**. IGU cable **1218B** of IGU **1204** also extends into the intermediate horizontal **1214**, then through the same hole in vertical **1206** and into the same raceway of vertical **1206**, and out the top of vertical **1206**. These two cables **1218A** and **1218B** then may be electrically connected to the controller **1248**. Similar cable routing may be seen in **Figure 6**. IGU cable **618A** is routed through intermediate horizontal **614** and both IGU cables **618A** and **618B** are routed through the raceway of vertical member **608** and out common area **652** to controller **648**. IGU cable **618B** may also be routed through horizontal member **614** according to another implementation.

[0088] **Figure 13** depicts a partial magnified view of a portion of assembly **1200** in **Figure 12**, according to an implementation. In the illustrated example, the cover of the horizontal member **1214** is transparent or removed. In **Figure 13**, IGU cables **1218A** and **1218B** are shown entering the same intermediate horizontal **1214**, extending through the same hole **1238** of the vertical **1206**, through the raceway of vertical **1206**, and out the top of vertical **1206** at the common location **1252** and to the controller **1248**. The hole **1238** may also have one or more polymer members **1240** on at least one or more edges or surfaces of the hole **1238** to prevent the metal vertical member from damaging or impinging the cable.

[0089] In some embodiments, one or more of assembly **100** of **Figure 1**, assembly **200** of **Figure 2**, assembly **500** of **Figure 5**, assembly **700** of **Figure 7**, assembly **800** of **Figure 8**, assembly **900** of **Figure 9**, assembly **1000** of **Figure 10**, assembly **1100** of **Figure 11**, assembly **1200** of **Figures 12** and **Figure 13**, or assembly **1400** of **Figure 14** may be considered a single "unit" that is a unitized assembly or an assembly of a stick build configuration. Further, some embodiments of this single unit may have the cables from both IGUs extending into the intermediate horizontal member, into one vertical member, along its

raceway and out its top. One example is shown in **Figures 12** and **13**. Here, the intermediate horizontal member is configured to receive and route both cables, e.g., by using clips or other retention features, to one of the vertical members. The intermediate horizontal member is configured to have a removable cover as described herein, for example. The vertical member **1206** may also have a removable cover, such as at the location where the cables are routed, e.g., the top portion where IGU **1202** is located. By using this configuration, the top and bottom horizontal members **1212** and **1216**, respectively, may not need or have a cover; instead they may have a body that is a unitary body that may be extruded, for example. Further, one or both the vertical members may have the raceway for routing the cables; in some instances only one vertical member, e.g., member **1206** has a raceway while member **1208** does not.

[0090] One or more of assembly **100** of **Figure 1**, assembly **200** of **Figure 2**, assembly **500** of **Figure 5**, assembly **700** of **Figure 7**, assembly **800** of **Figure 8**, assembly **900** of **Figure 9**, assembly **1000** of **Figure 10**, assembly **1100** of **Figure 11**, assembly **1200** of **Figures 12** and **13**, or assembly **1400** of **Figure 14** provided herein may be configured to be connected to and interfaced with other such assemblies. This may include providing male and female features on the vertical members. Further, in some implementations, the IGUs and cables of two assemblies may be connected to one single controller that is configured to control four IGUs.

[0091] In some embodiments, the controller may be connected to the assembly at a later stage of fabrication. For example, assembly **200** of **Figure 2** may be manufactured and/or assembled at one location or stages, then at a later stage or at a different location, the controller may be connected to the IGU cables of the assembly.

[0092] Some embodiments may have structural members and four IGUs that may be connected to a single controller. In some instances, the controller may be positioned within one of the structural members and in other instances, the controller may be positioned outside of the envelope of the assembly. **Figure 14** depicts an assembly **1400** that includes structural members and four IGUs 1402, 1403, 1404, and 1405 with their cables 1418A, 1418B, 1418C, and 1418D routed through the members. Assembly **1400** may be a unitized assembly or an assembly in a stick build configuration.

[0093] In Figure 14, IGU **1402** has a cable **1418A**, IGU **1404** has a cable **1418B**, IGU **1403** has a cable **1418C**, and IGU **1404** has a cable **1418D**. Assembly **1400** also includes a

plurality of horizontal and vertical structural members. Vertical structural member **1406** and vertical structural member **1408** are on opposing sides of IGUs **1402** and **1404** such that these IGUs are interposed between these vertical structural members **1406** and **1408**, like with Figure 1B, for example. An intermediate horizontal member **1414** spans between vertical structural member **1406** and **1408**. Similarly, vertical structural members **1406** and **1407** are on opposite sides of IGUs **1403** and **1405** such that these IGUs are interposed between the members **1406** and **1407**. An intermediate horizontal **1415** spans between vertical members **1406** and **1407**.

[0094] The top and bottom horizontal members may be configured in various ways in order to accomplish structural and/or aesthetic purposes. In some embodiments, the top horizontal member may be a single piece that spans between the two outer vertical members. In some of these instances, the middle vertical may meet or interface with a bottom surface or portion of the top horizontal member. For example, referring to **Figure 14**, although not depicted in this Figure, the top horizontal, represented by line **1413**, may span between vertical members **1407** and **1408** and the middle vertical member **1406** may intersect and interface with a bottom portion of this top horizontal member.

[0095] In some other embodiments, the top of the assembly **1400** may have two horizontal structural members like shown in **Figure 14**. Here, the top horizontal member **1412** spans between vertical structural member **1406** and **1408**, and the top horizontal member **1411** spans between vertical structural member **1406** and **1407**. The middle vertical member **1406** in this implementation may form a portion of the top surface of assembly **1400**.

[0096] In some cases, the bottom horizontal member may be similarly configured like the top and intermediate horizontal members. For example, the bottom horizontal member may be a single body **1417** that extends between the outer vertical members **1407** and **1408**, like top horizontal member **1411**. In some other implementations, the bottom horizontal section may have two horizontal members that each span between the middle vertical member **1406** and one of the outer vertical members, **1407** or **1408**. In **Figure 14** this is illustrated with the horizontal member **1416** extending between vertical members **1407** and **1408**.

[0097] In some instances, both the top and bottom horizontal members may be configured the same, such as having two top horizontal members and two bottom horizontal members, like shown in **Figure 14**. In some other embodiments, the top and bottom horizontal members

may each be a single member extending between the outer vertical members, like with arrows **1413** and **1417**. In some other embodiments, the top and bottom may have different configurations from each other, such as the top section having the single member, like arrow **1413**, while the bottom section having two horizontal members, like in **Figure 14**.

[0098] The IGU cables of assembly **1400** may be routed within the horizontal and vertical members of the assembly in various manners. This routing may be similar to that described herein above. For example, each IGU cable may extend through one or more of the horizontal members, along the horizontal member and positioned in or restrained by cable retention features 124A–C described above, through a hole in a vertical member, and through the raceway of the vertical member. **Figure 14** illustrates one example routing and positioning of the IGUs cables. Here, for example, cable **1418A** of IGU **1402** extends through horizontal member **1414** and along this member **1414**'s cavity, through a hole in vertical member **1406** and in its raceway upwards, then through another hole in the vertical member **1406** and into the top horizontal member **1411**, and through a hole in vertical member **1407**, and out the common area **1452**. Cable **1418B** may also follow the same path as IGU cable. Cables **1418C** and **1418D** extend into horizontal **1415**, through a hole of vertical **1407**, in the raceway of vertical **1407** and out the common area **1452**. In some implementations these cables **1418A–D** may be connected to a single controller (not depicted here).

[0099] In some implementations, the horizontal and vertical members are configured to enable and accommodate bending and routing the cables with the optimal bend radius which may be, for instance, ten times the diameter of the cable. In some instances, the cables provided herein may be coaxial cables which may require large bend radiuses as compared to thinner electrical wires.

[0100] Although "IGU cables" have been used throughout, these "IGU cables" may be considered representative of an electrical pathway between the IGU and the controller, and this pathway may be comprised of multiple segments of cable electrically connected to the IGU. For example, the IGU may have a cable with a connector and this connector and cable may extend through the intermediate horizontal (e.g., intermediate horizontal **214** in **Figure 2**), for instance. An SWC and additional cable and connector may be connected to the IGU cable's connector to create a longer cable. In some instances, another cable may be connected to the SWC and routed directly to the controller.

[0101] Further, any IGU cable described herein can also be another cable that can be routed within a framing system with IGUs. For example, a cable routed through a hole in an intermediate horizontal member (e.g., intermediate horizontal member **214**) or in a vertical member (e.g., vertical member **206** or **208**) could include routing cables for one or more transparent displays, e.g., TOLED, positioned on the IGUs. Examples of transparent displays on IGUs are described in U.S. Patent Application No. 17/904,156, filed August 12, 2022, and titled "DATA AND POWER NETWORK OF A FACILITY," U.S. Patent Application No. 16/608,157, filed October 24, 2019, and titled "DISPLAYS FOR TINTABLE WINDOWS," U.S. Patent Application No. 17/083,128, filed October 28, 2020, and titled "BUILDING NETWORK", U.S. Patent Application No. 16/608,159, filed October 24, 2019, and titled "TINTABLE WINDOW SYSTEM COMPUTING PLATFORM USED FOR PERSONAL COMPUTING", U.S. Patent Application No. 17/232,598, filed April 16, 2021, and titled "TANDEM VISION WINDOW AND MEDIA DISPLAY," PCT Application No. PCT/US2021/052587, filed September 29, 2021, and titled "DISPLAY CONSTRUCT FOR MEDIA PROJECTION AND WIRELESS CHARGING," PCT Application No. PCT/US2021/052595, filed September 29, 2021, and titled "CONFIGURATION ASSOCIATED WITH MEDIA DISPLAY OF A FACILITY," and PCT Application No. PCT/US2021/052597, filed September 29, 2021, and titled "DISPLAY CONSTRUCT AND FRAMING FOR MEDIA PROJECTION," all of which are incorporated by reference in their entireties for all purposes.

[0102] Such a cable could also be for a sensor, such as a sensor suite positioned in the mullion like described in PCT Application No. PCT/US2021/030798, filed on May 5, 2021, and titled "DEVICE ENSEMBLES AND COEXISTENCE MANAGEMENT OF DEVICES", U.S. Patent Application No, 16/447,169, filed June 20, 2019, and titled "SENSING AND COMMUNICATIONS UNIT FOR OPTICALLY SWITCHABLE WINDOW SYSTEMS", PCT Application No. PCT/US2022/014135, filed January 27, 2022, and titled "MULTI-SENSOR SYNERGY", PCT Application No. PCT/US2021/015378, filed January 28, 2021, and titled "SENSOR CALIBRATION AND OPERATION", all of which are incorporated by reference in their entireties for all purposes.

[0103] Such a cable or cables could also be related to cameras, movable window actuators, switches, trunk lines, detachable power transfers, or a combination thereof. For instance, one of the IGUs of assembly **100** of **Figure 1**, assembly **200** of **Figure 2**, assembly **500** of **Figure**

5, assembly **700** of **Figure 7**, assembly **800** of **Figure 8**, assembly **900** of **Figure 9**, assembly **1000** of **Figure 10**, assembly **1100** of **Figure 11**, assembly **1200** of **Figures 12** and **13**, or assembly **1400** of **Figure 14** may be configured to be movable with a movable window actuator and cables for powering the movable window actuator could be routed within the raceways, horizontal member, or both as provided herein in order to provide power to such movable window power actuator. Similarly, a detachable power transfer power contact could have its electrical cables or wires routed through a hole in a horizontal or vertical member and routed through within the raceways, horizontal member, or both as provided herein in order to provide to that contact; the cable may be connected to the controller as described herein.

[0104] Additionally, a trunk line and/or drop line from a trunk line may be routed through a raceway and/or horizontal and connect to a controller, for example. Examples of trunk lines and power systems for buildings and IGUs are described in U.S. Patent Application No. 17/904,156, filed August 12, 2022, and titled "DATA AND POWER NETWORK OF A FACILITY", U.S. Patent Application No, 16/447,169, filed June 20, 2019, and titled "SENSING AND COMMUNICATIONS UNIT FOR OPTICALLY SWITCHABLE WINDOW SYSTEMS," both of which are incorporated by reference in their entireties for all purposes.

– **Smart window controller (SWC)**

[0105] Some IGUs may include a smart window controller (SWC) having a memory or controller chip with memory such as an electrically erasable programmable read-only memory (EEPROM) chip. The memory can store information about the IGU, such as the lite ID and one or more parameters that may be used to drive the tinting and clearing of one or more optically switchable devices of the IGU. In some cases, an IGU cable may be electrically connected to the SWC, directly or via other cabling and connectors, and the SWC is electrically connected to a controller.

[0106] In some instances, the SWC is connected directly to the IGU cable of each IGU and the SWC is positioned in the horizontal member where the IGU cable passes through.

[0107] In some implementations, one or more SWCs and the controller may be positioned in one horizontal or vertical member.

[0108] **Figure 15** is a schematic drawing depicting an assembly including a smart window controller (SWC) **1590**, an IGU **1502**, and a controller **1548**, according to embodiments. **Figure 15** illustrates an electrical connection pathway between IGU **1602** and controller **1548** with multiple cables (cable C1 **1572**, cable C2 **1574**, and cable C3 **1576**) and electrical connectors (connector C1 **1582**, connector C2 **1584**, and connector C3 **1586**). In other examples, additional or fewer cables and/or connectors may be employed. For example, cable C3 **1576** may include multiple cables electrically connected end to end with each other or cable C3 **1576** may include multiple cables in parallel. Each cable may include one or more wires.

[0109] In **Figure 15**, IGU **1502** includes cable C1 **1572** depicted extending from its body and having a connector C1 **1582** disposed at a distal end. A proximal end of cable C1 **1572** may be electrically connected to one or more bus bars or an electrical connector in electrical communication with the one or more bus bars at IGU **1502**. Connector C1 **1582** is electrically connected to connector C2 **1584** at a distal end of cable C2 **1574**. Cable C2 1574 is seen extending from SWC **1590**. A proximal end of Cable C2 **1574** is electrically connected to SWC **1590** and a distal end is electrically connected to connector C2 **1584**. Cable C3 **1576** is seen extending from the SWC **1590** to controller **1548**. A proximal end of cable C3 **1576** is electrically connected to SWC **1590** and a distal end is electrically connected to controller **1548**. In this illustrated example, IGU **1502** is part of an assembly including another IGU and a horizontal member (e.g., intermediate horizontal). One or more of the electrical connectors and cables may be positioned inside the horizontal member as represented, for example, by dashed box **1514**.

[0110] In some instances, an "IGU cable" provided herein, such as IGU cables **318A**, **318B** in **Figure 3**, IGU cables **418A, 418B** in **Figure 4**, IGU cables **618A, 618B** in **Figure 6**, IGU cable **818** in **Figure 8**, IGU cables **1018A, 1018B** in **Figure 10**, IGU cables **1118A, 1118B** in **Figure 11**, IGU cables **1218A** and **1218B** in **Figures 12** and **13**, IGU cables **1418A** and **1418B** in **Figure 14**, etc., may include one or more of components described with reference to **Figure 15** such as, for example, (i) cable C1 **1572** and connector C1 **1582**, (ii) cable C1 **1572**, connector C1 **1582**, cable C2 **1574**, and SWC **1590**, or (iii) cable C1 **1572**, connector C1 **1582**, cable C2 **1574**, connector C2 **1584**, SWC **1590**, and cable C3 **1576**. Further, some of these components may be positioned inside an intermediate horizontal of an assembly, as represented, for example, by dashed box **1514** in **Figure 15**. This may include a portion of cable C1 **1572**, the connector C1 **1582**, connector C2 **1584**, SWC **1590**, and a portion of cable

C3 **1576**. Another portion of cable C3 **1576** may extend through a vertical member of the assembly **1500** in **Figure 15**. Assembly **1500** may be a unitized assembly or an assembly in a stick build configuration.

[0111] In some instances, an IGU cable that extends directly from the IGU may have one or more wires that are connected to another wire connected to the SWC, and the SWC may be connected to one or more other cables. As mentioned above, the SWC may include a chip with memory, such as an electrically erasable programmable read-only memory (EEPROM) chip, that may store information about the IGU, such as the lite ID and one or more parameters used to drive the tinting and clearing of the IGU.

[0112] **Figure 16A** is a schematic drawing depicting an example of a wire and cable configuration of an assembly including an SWC **1690**, according to embodiments. **Figure 16B** depicts a plan view of components of the assembly in **Figure 16A**. The assembly includes components of an assembly having an IGU **1602** and an intermediate horizontal member, **1614** (denoted by dashed line box). The assembly may be a unitized assembly or an assembly in a stick build configuration.

[0113] In **Figures 16A** and **16B**, an IGU cable **1672** extends from IGU **1602**. IGU cable **1672** may include two or more wires such as, e.g., a red wire and a black wire, that may be positive and negative terminals, respectively, for IGU **1602**. IGU cable **1672** may be electrically connected to one or more bus bars of IGU **1602** and extend through one or more seals of IGU **1602**. In some implementations, an end of IGU cable **1672** may have one or more exposed portions of a wire, such as a metal portion without insulation. In addition, another cable **1676** extends from SWC **1690** to a controller **1648**. One end of cable **1676** is electrically connected to SWC **1690** and another end is electrically connected to controller **1648**.

[0114] Also shown is SWC **1690** with components encompassed by the dotted line. SWC **1690** includes an SWC body **1685** and an SWC cable **1674**. SWC body **1685** includes a SWC connector **1684**. IGU cable **1672** may be physically and electrically connected to SWC cable **1674**, such as by splicing cable **1672** and SWC cable **1674** together at a splice point or junction **1683**. In some implementations, a bare, exposed wire of IGU cable **1672** may be physically and electrically connected to a bare, exposed wire of SWC cable **1674** at splice point or junction **1682**. In some other implementations, similar to **Figure 15**, IGU cable **1672**

may have one or more connectors (e.g., connector **1582** in **Figure 15**) and SWC cable **1676** may have one or more connectors (e.g., connector **1584** in **Figure 15**) configured to interface and connect with each other to physically and electrically connect these cables.

[0115] In some embodiments, an SWC may include a connector for connecting with another cable that may be electrically connected (e.g., via an electrical connector) to a controller. This other cable maybe interposed between the SWC and the controller in some cases. In certain implementations, the SWC body may include a connector for connecting with a connector of another cable, such as a connector at an end of the SWC cable that extends from the SWC body to the controller. For example, in **Figures 16A** and **16B**, SWC **1690** includes SWC body **1685** that includes a SWC connector **1685** for connecting to connector **1686** at an end of cable **1676** where the other end of cable **1676** may be electrically connected to controller **1648**.

[0116] In some embodiments, an IGU cable extending from an IGU of an assembly may extend into an intermediate horizontal member. In addition or alternatively, the electrical connection between the SWC and a cable extending from the controller may be made in the intermediate horizontal member. For example, in **Figures 16A** and **16B**, IGU cable **1672** extends into intermediate horizontal member **1614** where IGU cable **1672** is physically and electrically connected to SWC **1690**, including to SWC cable **1674**. In addition, electrical connector **1686**, which establishes electrically connection between SWC **1690** and cable **1676** extending from controller **1648**, is within intermediate horizontal member **1614**.

[0117] As shown in **Figures 16A** and **16B**, IGU cable **1672** may be routed into horizontal member **1614**, connected with SWC cable **1674** at connection point **1683** in horizontal member **1614**. In one implementation, SWC **1672** may also be connected with another cable **1682** in the horizontal member **1614**, and that other cable **1682** may be routed through the horizontal member **1614**, into a vertical member of the assembly, and electrically connected to controller **1648** (not shown in **Figure 16B**) as described herein.

[0118] The configurations of **Figures 16A** and **16B** may differ from other IGUs of other configurations which may have the connection point between the SWC and the IGU cable, e.g., connection point **1678** in **Figures 16A and 16B**, may be within the IGU seal in some implementations. The implementations in **Figures 16A** and **16B** may provide significant advantages, such as, e.g., the ability to relocate and reposition a connection point (e.g.,

connection point **1683**) of an SWC and an IGU cable, flexibility in routing the IGU cable extending from the IGU through a hole in the horizontal member (e.g., horizontal member **1614**, horizontal member **214**, horizontal member **314**, horizontal member **414**, horizontal member **614**, horizontal member **714**, horizontal member **724**, horizontal member **814**, horizontal member **1014**, horizontal member **1114**, horizontal member **1214**, horizontal member **1414**, and horizontal member **1514**, and horizontal member **1614**), ease of placing the SWC body within the framing such as within the horizontal member or vertical member, etc.

[0119] In **Figures 16A** and **16B**, the assembly includes cables (e.g., cable **1672**, SWC cable **1674**, and cable **1676**) and electrical connectors (e.g., connector **1684** and connector **1686**). In other examples, additional or fewer cables and/or connectors may be employed. One or more of the electrical connectors and cables may be positioned inside the horizontal member of the assembly as represented, for example, by dashed box **1614**.

II. Methods of fabrication

[0120] The assemblies provided herein may be manufactured in various manners and techniques. **Figure 17** depicts a flowchart including operations of a manufacturing technique or method of fabrication of an assembly having two or more IGUs, according to various implementations. The method of fabrication can be employed to manufacture, for example, various assembles provided herein such (A) assemblies having two IGUs such as such as assembly **100** in **Figure 1A**, assembly **200** in **Figure 2**, assembly **300** in **Figure 3**, assembly **400** in **Figures 4** and **5**, assembly **600** in **Figure 6**, assembly **700** in **Figure 7A**, assembly **701** in **Figure 7B**, assembly **800** in **Figure 8**, assembly **900** in **Figure 9**, assembly **1000** in **Figure 10**, assembly **1100** in **Figure 11**, and/or assembly **1200** in **Figures 12** and **13** or (B) assemblies having four IGUs such as assembly **101** in **Figure 1B** and/or assembly **1400** in **Figure 14**. The manufacturing technique or method fabrication may include at least two or more of the steps in block **1720**, which may be performed in different sequences and order. For example, an intermediate horizontal member may be connected to vertical members. In **Figure 2**, for instance, intermediate horizontal member **214** may be connected to vertical members **206** and **208**. As another instance, in **Figure 14**, intermediate horizontal members **1414** and **1415** may be connected to vertical members **1407**, **1406**, and **1408**. As another example, a first (e.g., top) horizontal member may be connected to vertical members. In **Figure 2**, for instance, first horizontal member **211** may be connected to vertical members

106 and **108**. As another instance, in **Figure 14**, horizontal member **1411** may be connected to vertical members **1407**, **1406**, and **1408**. As another example, a second (e.g., bottom) horizontal member may be connected to vertical members. In **Figure 2**, for instance, first horizontal member **216** may be connected to vertical members **106** and **108**. As another instance, in **Figure 14**, horizontal members **1416** and **1419** may be connected to vertical members **1407**, **1406**, and **1408**. As another example, one or more IGU cables of an IGU may be routed into an intermediate horizontal member. In **Figure 12**, for instance, IGU cable **1218A** and/or IGU cable **1218B** may be routed into intermediate horizontal member **1214**. As another instance, in **Figure 14**, one or more of IGU cables **1418A**, **1418B**, **1418C**, or **1418D** may be routed into one or both of intermediate horizontal members **1414** and **1415**. As another example, one or more IGU cables of an IGU may be secured in an intermediate horizontal member. In **Figure 12**, for instance, IGU cable **1218A** and/or IGU cable **1218B** may be secured in intermediate horizontal member **1214**. As another instance, in **Figure 14**, one or more of IGU cables **1418A**, **1418B**, **1418C**, or **1418D** may be secured in one or both of intermediate horizontal members **1414** and **1415**. As another example, one or more IGU cables of an IGU may be routed through a hole in one of the vertical members. In **Figure 12**, for instance, IGU cable **1218A** and/or IGU cable **1218B** may be routed through a hole in one of the vertical members **1206** and **1208**. As another instance, in **Figure 14**, one or more of IGU cables **1418A**, **1418B**, **1418C**, or **1418D** may be routed through a hole in one of the vertical members **1407**, **1406**, and **1408**. As another example, one or more IGU cables of an IGU may be positioned in a raceway of one of the vertical members. In **Figure 12**, for instance, IGU cable **1218A** and/or IGU cable **1218B** may be positioned in a raceway of one of the vertical members **1206** or **1208**. As another instance, in **Figure 14**, one or more of IGU cables **1418A**, **1418B**, **1418C**, or **1418D** may be positioned in a raceway of one of the vertical members **1407**, **1406**, or **1408**.

[0121] Returning to **Figure 17**, optionally (denoted by dashed line) the manufacturing technique or method of fabrication may include one or more of the steps in block **1760**, which may be performed in different sequences and order. For example, a cover (e.g., a removable cover) may be positioned and secured onto an intermediate horizontal member. In **Figure 4**, for instance, removable cover **430** may be positioned and secured onto intermediate horizontal member **214**. As another instance, in **Figure 14**, removable covers (e.g., removable covers **430** in **Figure 4**) may be positioned and secured onto intermediate horizontal members **1414** and **1415**. As another example, one or more IGU cables (e.g., 218A

and 218B) may be connected with an SWC for the corresponding IGU (e.g., 202 and 204). In **Figure 15**, for instance, IGU cable 1572 of IGU 1502 may be connected to SWC 1590 for that IGU 1502 via connectors 1572 and 1582. As another example, one or more IGU cables may be routed from the SWC to a common area (e.g., common area 652 in Figure 6, common area **1252** in **Figures 12** and **13**, and common area **1452** in **Figure 14**). As another example, one or more IGU cables may be connected to a controller configured to control the IGUs in the assembly. In **Figure 11**, for instance, IGU cables 1118A and 1118B may be electrically connected to controller **1148** to control IGUs **1102** and **1104**. As another instance, in **Figure 12**, IGU cables 1218A and 1218B may be connected to controller 1248 to control IGUs 1202 and 1204. In yet another instance, in Figure 15, IGU cable 1572 may be electrically connected to controller 1548 via cables and connectors. As another instance, in **Figure 15**, IGU cables **1518A** and **1518B** may be connected to controller **1548** to control IGUs **1502** and **1504**. As another instance, in **Figures 16A** and **16B**, IGU cables **1618A** and 1618B may be connected to controller **1648** to control IGUs 1602 and 1604. As another example, an assembly may be connected to one or more additional single unit assemblies to form a combined assembly. For instance, assembly 200 having two IGUs in Figure 2 may be connected to another assembly 200 having two IGUs. In one aspect, the IGU cables of the combined assembly may be connected to a single controller configured to control all the IGUs. For instance, assembly 200 having two IGUs in Figure 2 may be connected to another assembly 200 having two IGUS and the four IGU cables may be connected to a single controller configured to control the four IGUs.

[0122] Although the foregoing embodiments have been described in some detail to facilitate understanding, the described embodiments are to be considered illustrative and not limiting. It will be apparent to one of ordinary skill in the art that certain changes and modifications can be practiced within the scope of the appended claims.

[0123] Modifications, additions, or omissions may be made to any of the above-described implementations without departing from the scope of the disclosure. Any of the implementations described above may include more, fewer, or other features without departing from the scope of the disclosure. Additionally, the steps of described features may be performed in any suitable order without departing from the scope of the disclosure. Also, one or more features from any implementation may be combined with one or more features of any other implementation without departing from the scope of the disclosure. The

components of any implementation may be integrated or separated according to particular needs without departing from the scope of the disclosure.

[0124] Any of the software components or functions described in this application, may be implemented as software code using any suitable computer language and/or computational software such as, for example, Java, C, C#, C++ or Python, LabVIEW, Mathematica, or other suitable language/computational software, including low level code, including code written for field programmable gate arrays, for example in VHDL. The code may include software libraries for functions like data acquisition and control, motion control, image acquisition and display, etc. Some or all of the code may also run on a personal computer, single board computer, embedded controller, microcontroller, digital signal processor, field programmable gate array and/or any combination thereof or any similar computation device and/or logic device(s). The software code may be stored as a series of instructions, or commands on a CRM such as a random access memory (RAM), a read only memory (ROM), a magnetic medium such as a hard-drive or a floppy disk, or an optical medium such as a CD-ROM, or solid stage storage such as a solid state hard drive or removable flash memory device or any suitable storage device. Any such CRM may reside on, or within, a single computational apparatus, and may be present on or within different computational apparatuses within a system or network. Although the foregoing disclosed implementations have been described in some detail to facilitate understanding, the described implementations are to be considered illustrative and not limiting. It will be apparent to one of ordinary skill in the art that certain changes and modifications can be practiced within the scope of the appended claims.

[0125] The terms "comprise," "have" and "include" are open-ended linking verbs. Any forms or tenses of one or more of these verbs, such as "comprises," "comprising," "has," "having," "includes" and "including," are also open-ended. For example, any method that "comprises," "has" or "includes" one or more steps is not limited to possessing only those one or more steps and can also cover other unlisted steps. Similarly, any composition or device that "comprises," "has" or "includes" one or more features is not limited to possessing only those one or more features and can cover other unlisted features.

[0126] All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (*e.g.*, "such as") provided with respect to certain implementations herein is intended merely to better illuminate the present disclosure and does

not pose a limitation on the scope of the present disclosure otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the present disclosure.

[0127] Groupings of alternative elements or implementations of the present disclosure disclosed herein are not to be construed as limitations. Each group member can be referred to and claimed individually or in any combination with other members of the group or other elements found herein. One or more members of a group can be included in, or deleted from, a group for reasons of convenience or patentability. When any such inclusion or deletion occurs, the specification is herein deemed to contain the group as modified thus fulfilling the written description of all Markush groups used in the appended claims.

CLAIMS

What is claimed is:

1. An assembly comprising:

first and second insulated glass units (IGUs);

a frame comprising an intermediate horizontal member and a first vertical member, wherein the intermediate horizontal member is interposed between the first and second IGUs; and

one or more IGU cables in electrical communication with the first and second IGUs;

wherein the frame is configured to pass the one or more IGU cables from the first and second IGUs into the intermediate horizontal member and through the first vertical member.

2. The assembly of claim 1, wherein the frame is configured to pass the one or more IGU cables from the first vertical member to outside the assembly.

3. The assembly of claim 1, wherein the frame is configured to pass the one or more IGU cables from the first vertical member to outside the assembly to electrically connect to a controller.

4. The assembly of claim 1, wherein the frame further comprises a top horizontal member, wherein the one or more IGU cables are configured to pass from the first vertical member into the top horizontal member.

5. The assembly of claim 1, further comprising a controller within the frame, the controller in electrical communication with the one or more IGU cables.

6. The assembly of claim 1, further comprising a controller within a body of the intermediate horizontal member, the controller in electrical communication with the one or more IGU cables.

7. The assembly of claim 5, further comprising a cable in electrical communication with the controller and in electrical communication with a network or infrastructure of a building.

8. The assembly of claim 5, wherein the controller is a smart window controller having a memory configured to store information about the first IGU and/or the second IGU.

9. The assembly of claim 1, wherein the intermediate horizontal member comprises a port or a hole configured to receive at least one of the one or more IGU cables.

10. The assembly of claim 9, further comprising a protective material on at least one edge of the port or hole.

11. The assembly of claim 9, wherein the first vertical member comprises a port or a hole configured to receive the at least one IGU cable from the intermediate horizontal member.

12. The assembly of claim 10, wherein the first vertical member is configured to pass the one or more IGU cables to outside the assembly.

13. The assembly of claim 1, wherein the one or more IGU cables are in electrical communication with bus bars of optically switchable devices of the first and second IGUs.

14. The assembly of claim 1, wherein the frame further comprises a second vertical member, a top horizontal member, and a bottom horizontal member, wherein the intermediate horizontal member, the top horizontal member, and the bottom horizontal member span between the first and second vertical members.

15. The assembly of claim 1, further comprising:

a third IGU;

a fourth IGU;

a second intermediate horizontal member interposed between the third IGU and the fourth IGU; and

one or more additional IGU cables in electrical communication with the third IGU and the fourth IGU.

16. The assembly of claim 1, further comprising a first removable cover configured to connect to the intermediate horizontal member and configured to be removed by a non-destructible means.

17. The assembly of claim 16, wherein the non-destructible means comprise a suction cup.

18. The assembly of claim 16, further comprising a second removable cover configured to connect to the first vertical member and configured to be removed by non-destructible means.

19. The assembly of claim 1, wherein the frame further comprises a second vertical member, a top horizontal member, and a bottom horizontal member, wherein the intermediate horizontal member, the top horizontal member, and the bottom horizontal member span between the first and second vertical members.

20. The assembly of claim 1, further comprising one or more cable retention features configured to restrain position or movement of the one or more IGU cables.

21. The assembly of claim 20, wherein the one or more cable retention features comprises a clip connected to a body of the intermediate horizontal member.

22. The assembly of claim 20, wherein the one or more cable retention features are integral to a body of the intermediate horizontal member.

23. The assembly of claim 1, wherein the frame further comprises a seat element upon which the first IGU is seated.

24. The assembly of claim 1, wherein the intermediate horizontal member comprises a seat element upon which the first IGU is seated.

25. The assembly of claim 24, wherein the frame further comprises a pressure plate connected to the seat element, the first IGU and the second IGU.

26. The assembly of claim 1, further comprising:

a backer rod and a sealant between the first IGU and the second IGU; and

a structural seal between the intermediate horizontal member and the first IGU and between the intermediate horizontal member and the second IGU.

27. An assembly comprising:

a smart window controller (SWC) comprising a memory configured to store information about an insulated glass unit;

a SWC cable in electrical communication with the smart window controller;

an IGU cable in electrical communication with an insulated glass unit and with the SWC cable; and

a third cable in electrical communication with the smart window controller and a second controller.

28. The assembly of claim 27, further comprising a junction or splice point configured to electrically connect the IGU cable with the SWC cable.

29. The assembly of claim 27, further comprising a first connector at an end of the IGU cable and a second connector at an end of the SWC cable, the second connector configured to connect to the first connector.

30. An assembly comprising:

first and second insulated glass units (IGUs);

a frame comprising an intermediate horizontal member and a first vertical member, wherein the intermediate horizontal member is interposed between the first and second IGUs;

a first IGU cable in electrical communication with the first IGU and a second IGU cable in electrical communication with the second IGU; and

a first smart window controller within a body of the intermediate horizontal member, the smart window controller configured to store information about the first IGU, wherein the frame is configured to pass the first IGU cable from the first IGU into the intermediate horizontal member to connect to the first smart window controller.

31. The assembly of claim 30, further comprising another cable in electrical communication with the smart window controller at a proximal end and in electrical communication with another controller at a distal end.

32. A method of fabricating an assembly comprising first and second insulated glass units and a frame, the frame comprising a vertical member and an intermediate horizontal member interposed between the first and second insulated glass units, the method comprising:

routing a first IGU cable from the first insulated glass unit into the intermediate horizontal member; and

routing the first IGU cable through a hole in the vertical member and passing the first IGU cable through the vertical member.

33. The method of claim 32, further comprising electrically connecting another cable in electrical communication with the smart window controller at a proximal end and in electrical communication with another controller at a distal end.

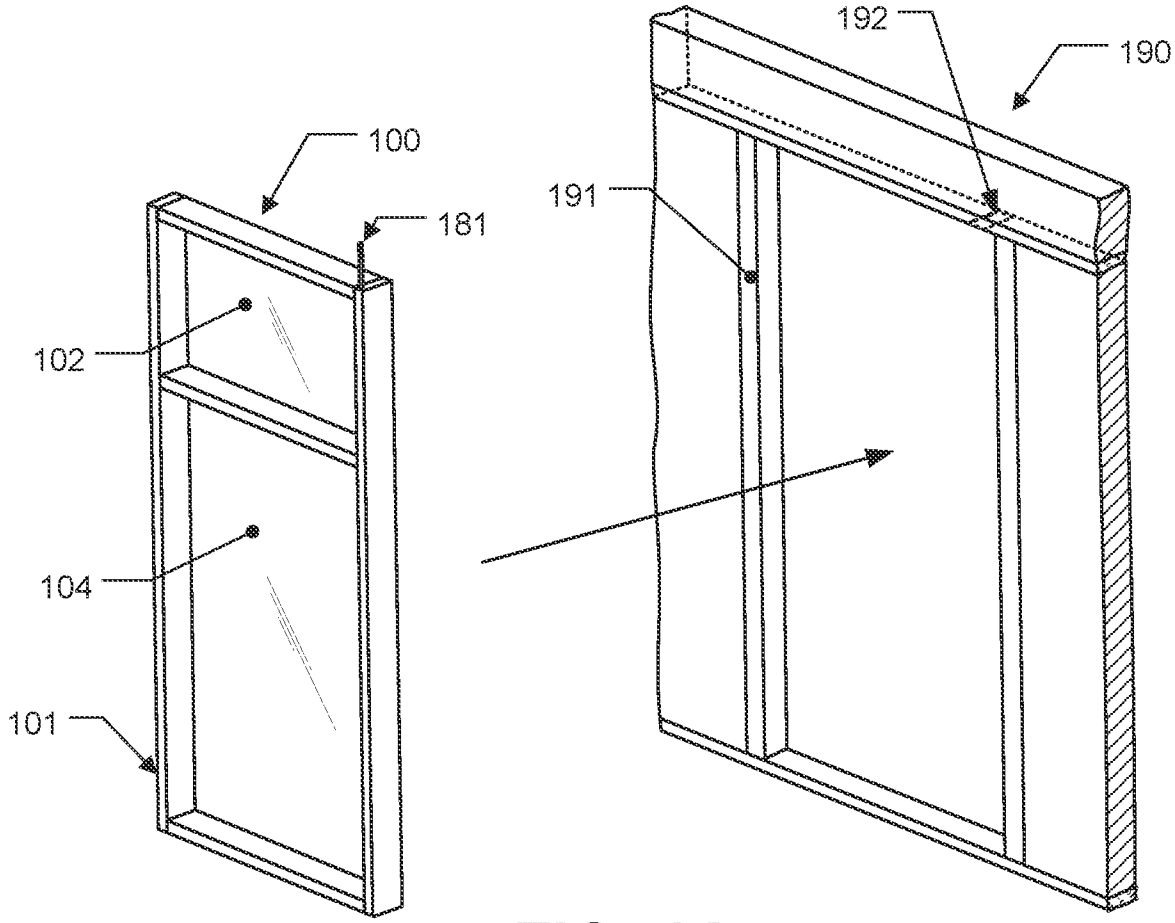

192
190
100
181
191
102
104
101

FIG. 1A

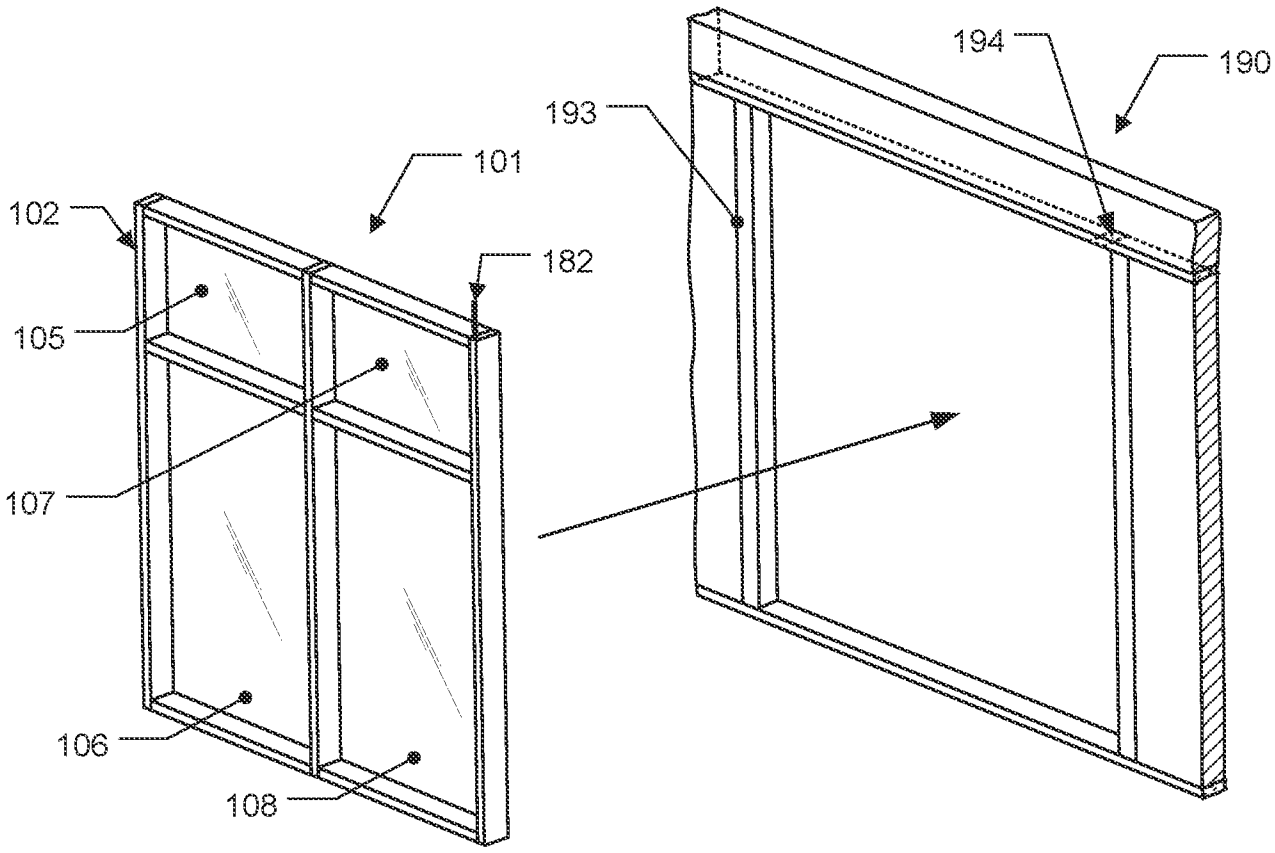

194
190
193
101
102
182
105
107
106
108

FIG. 1B

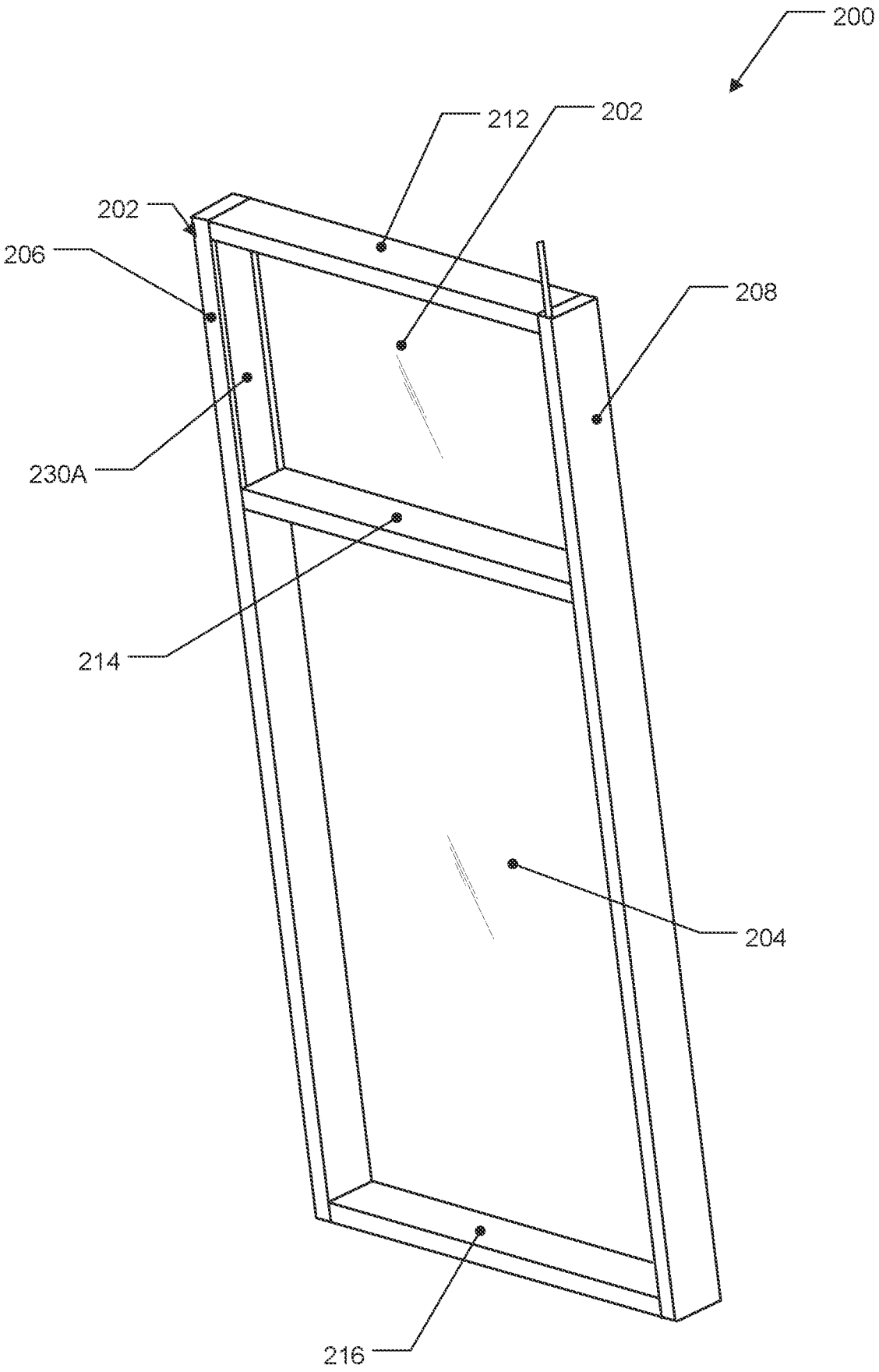


FIG. 2

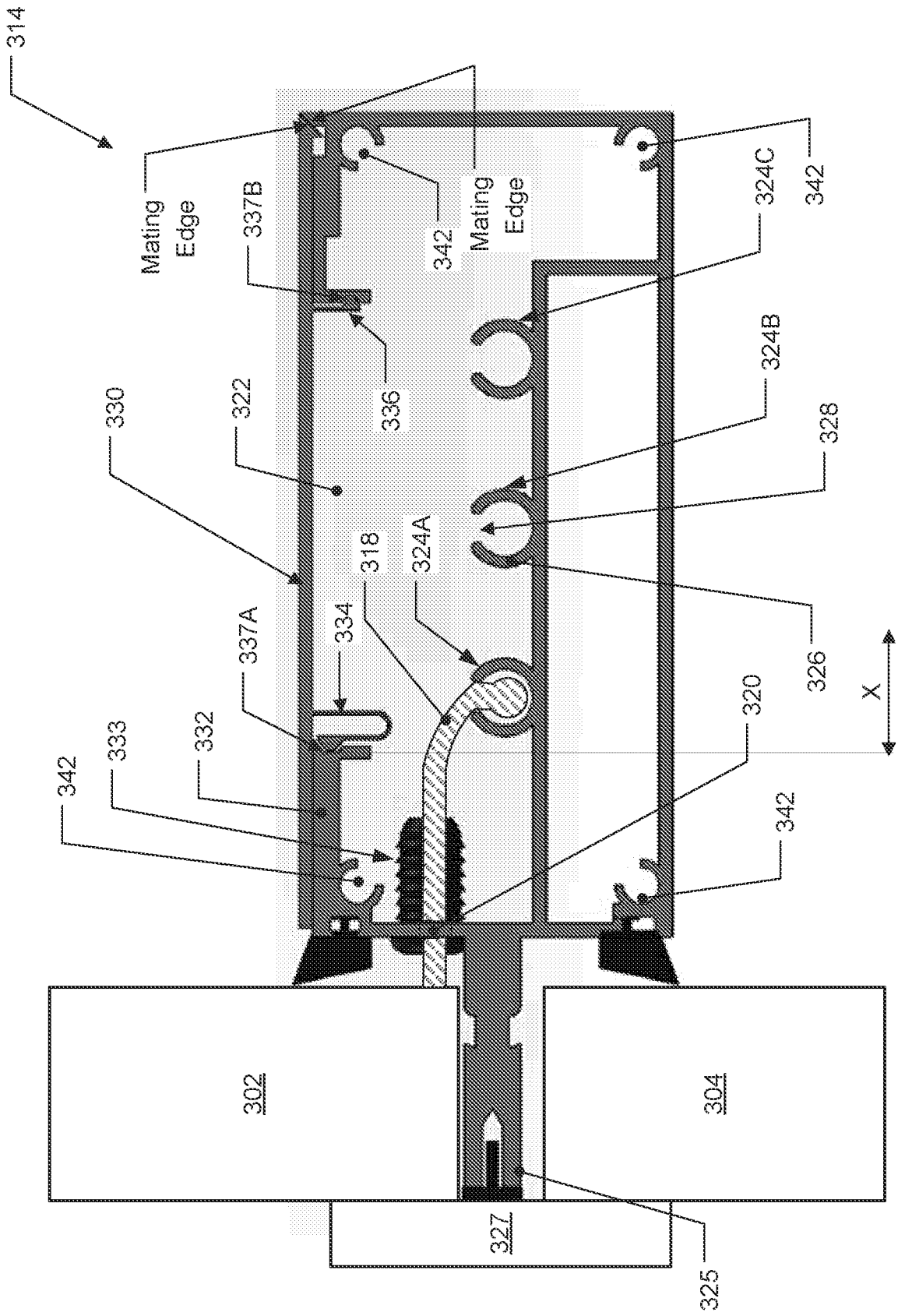

314
Mating Edge
337B
342
Mating Edge
342
324C
342
330
322
336
324B
328
318
324A
334
337A
326
320
X
333
332
342
342
302
304
327
325

FIG. 3

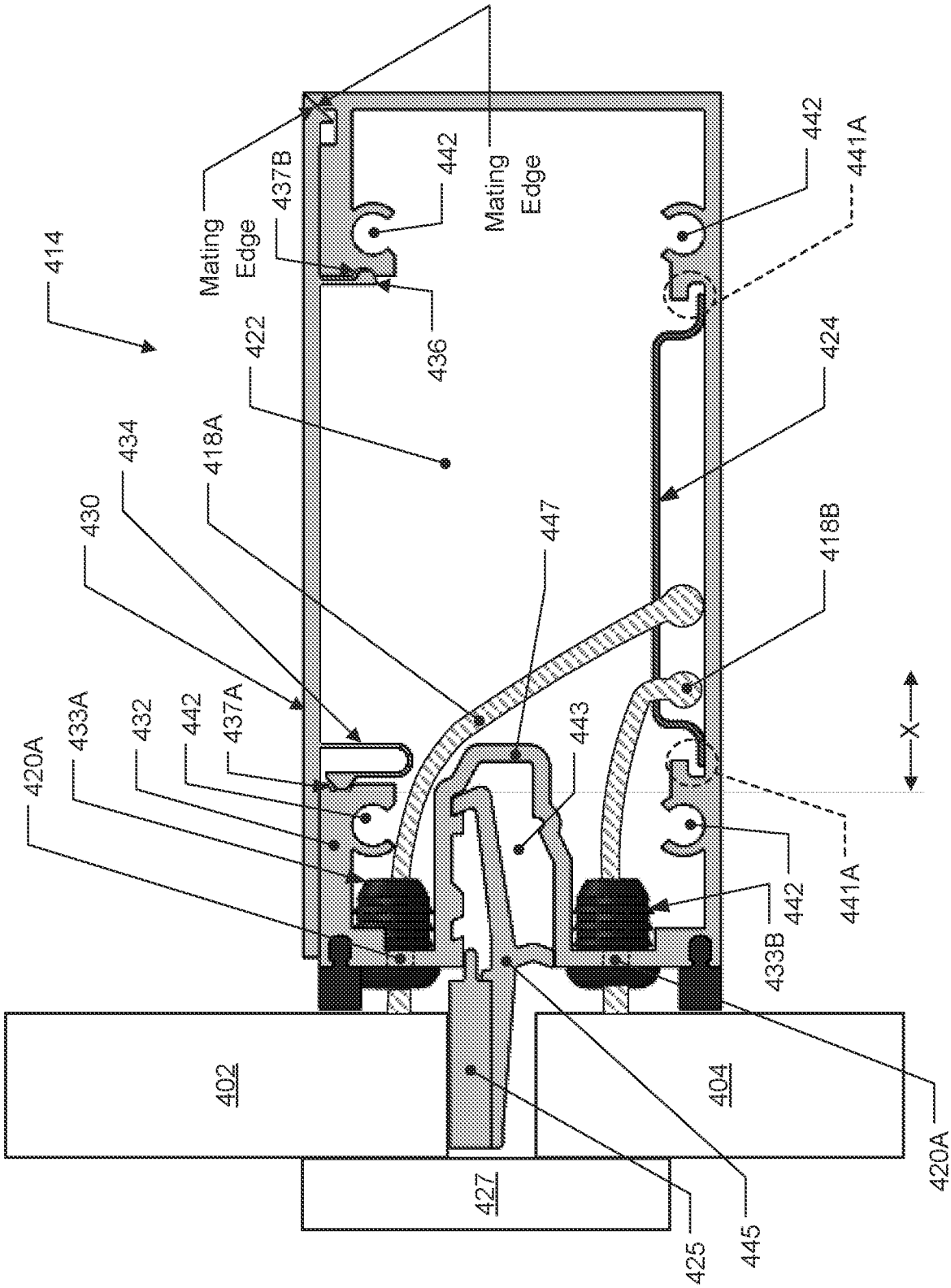

414
Mating Edge
437B
442
Mating Edge
442
441A
422
436
424
434
418A
430
447
418B
420A
433A
432
442
437A
443
X
441A
442
433B
402
404
420A
427
425
445

FIG. 4

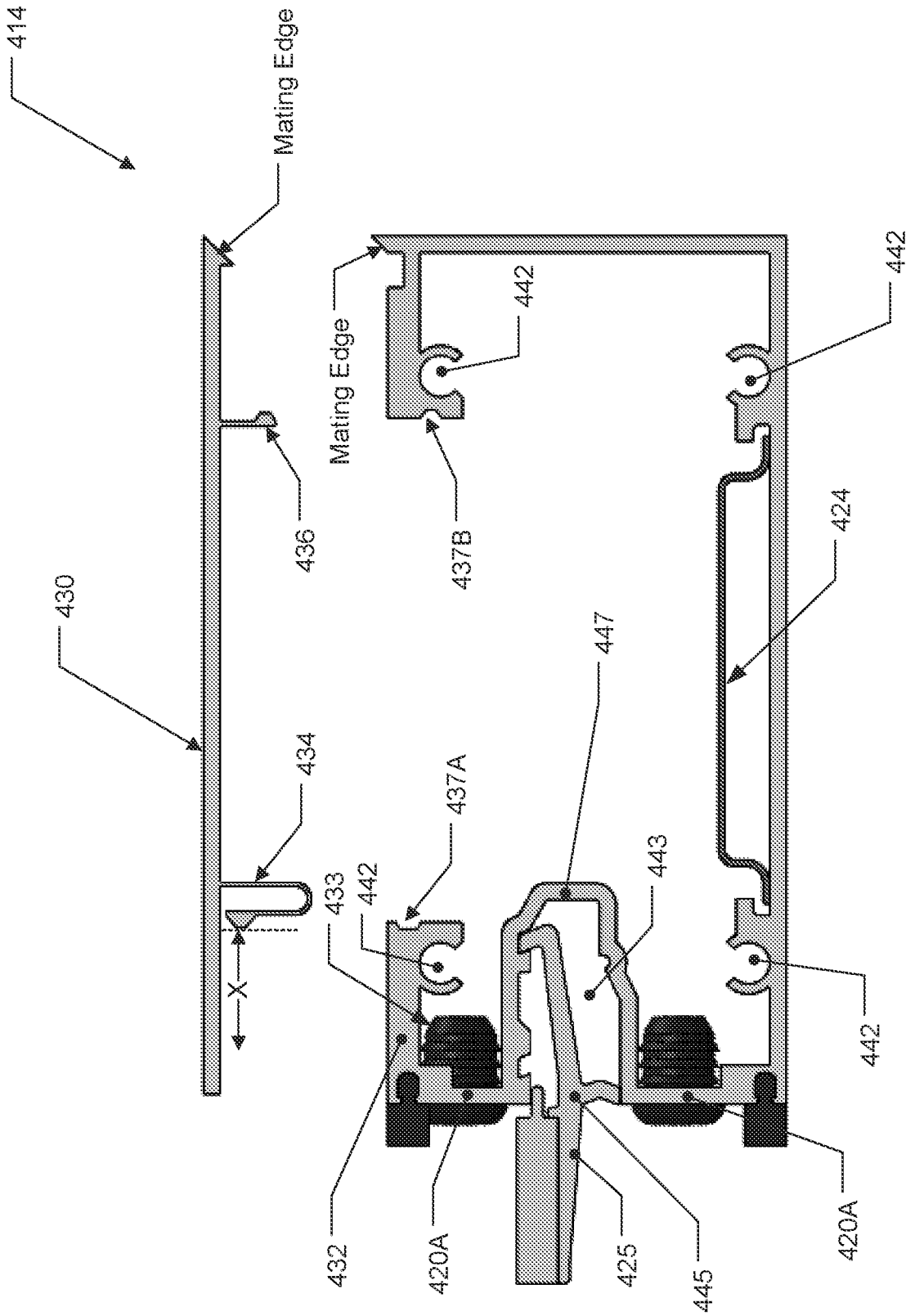

414
Mating Edge
Mating Edge
442
442
442
436
437B
424
430
447
434
437A
443
433
442
X
432
420A
425
445
420A

FIG. 5

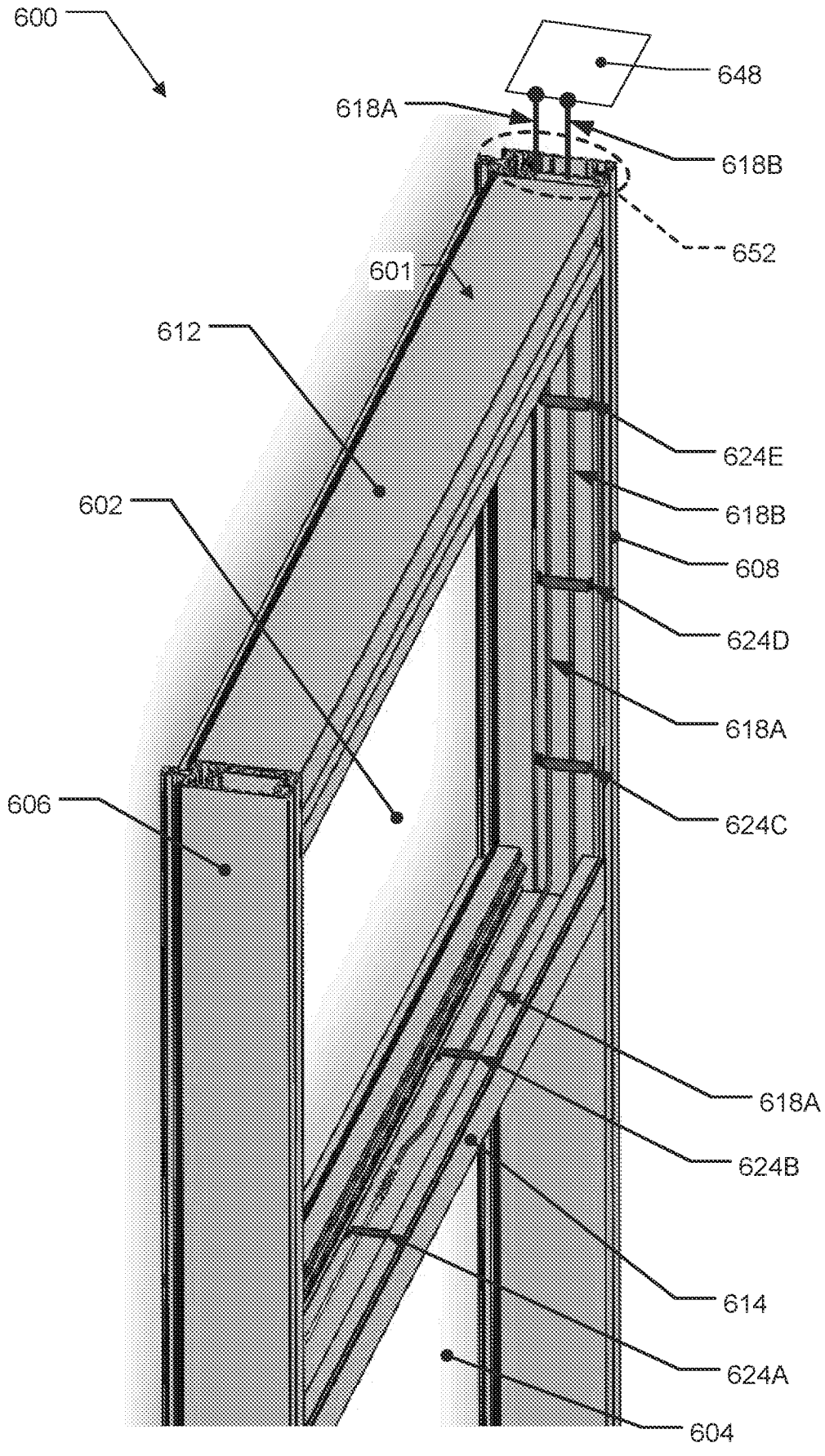

600
648
618A
618B
652
601
612
624E
602
618B
608
624D
618A
606
624C
618A
624B
614
624A
604

FIG. 6

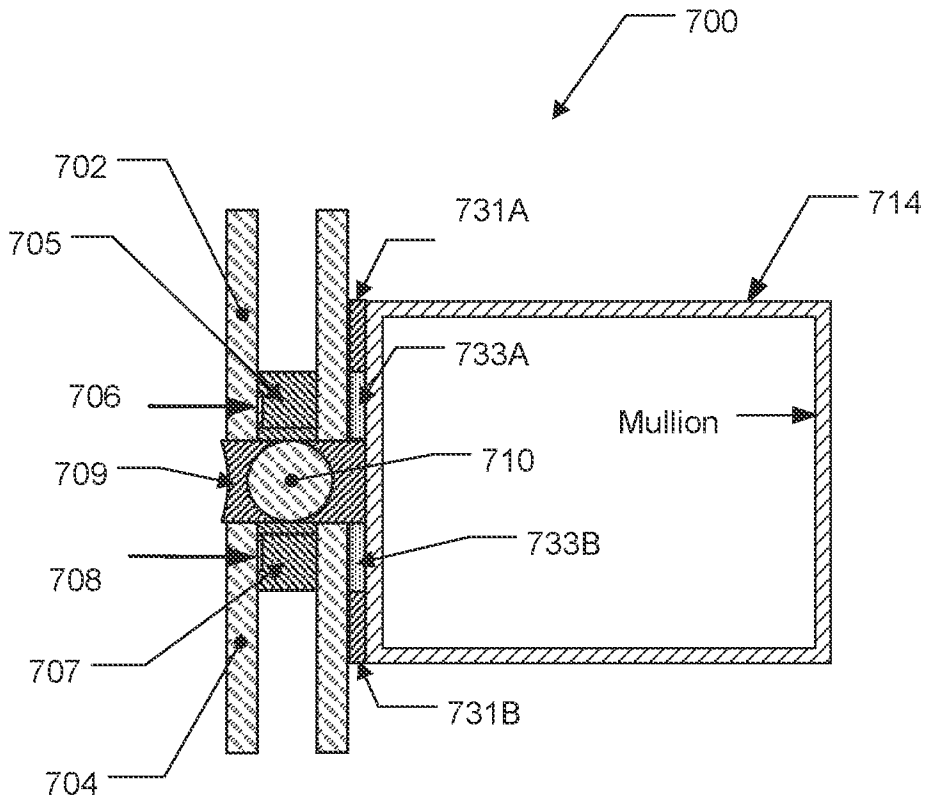

700
702
705
731A
714
733A
706
Mullion
709
710
733B
708
707
731B
704

FIG. 7A

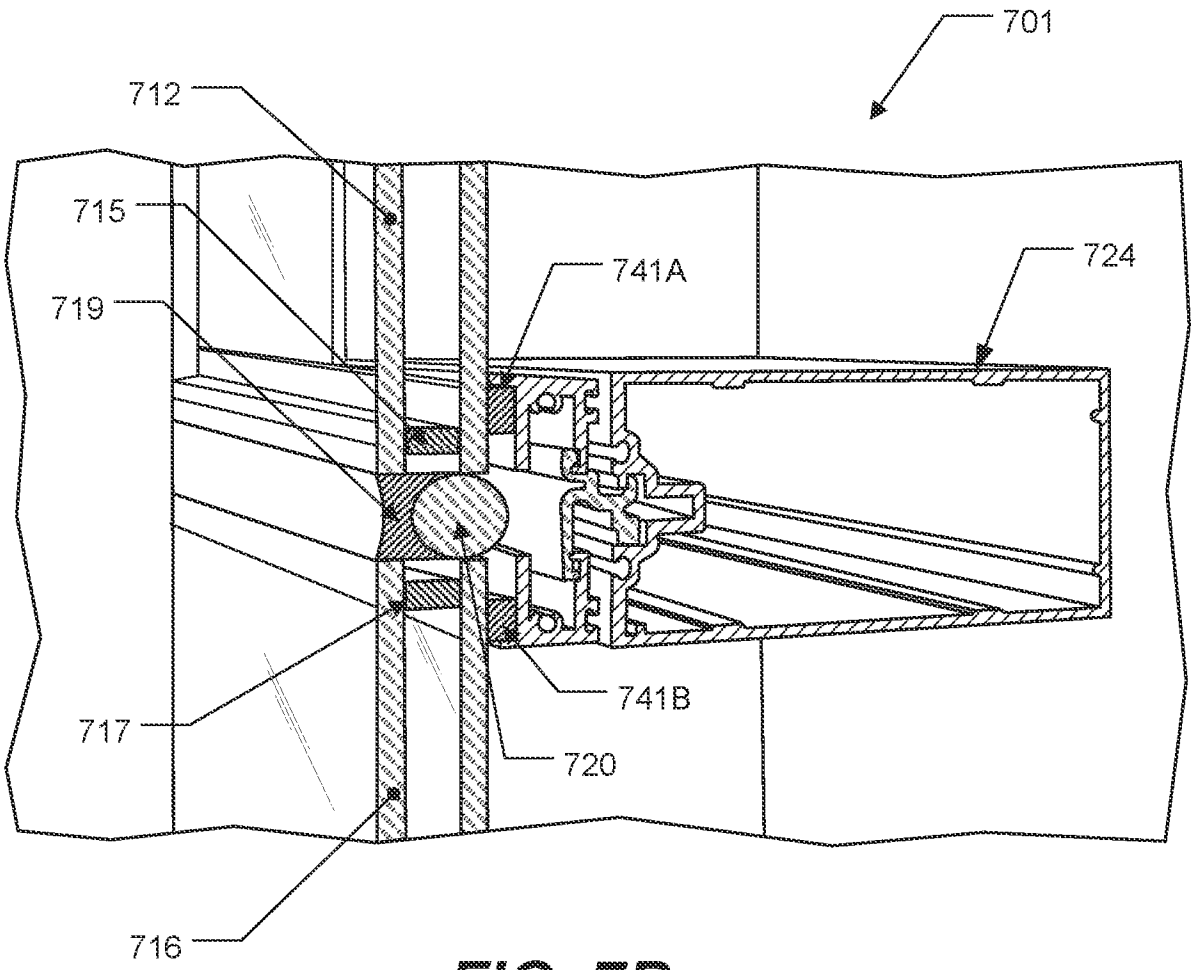

701
712
715
741A
724
719
741B
717
720
716

FIG. 7B

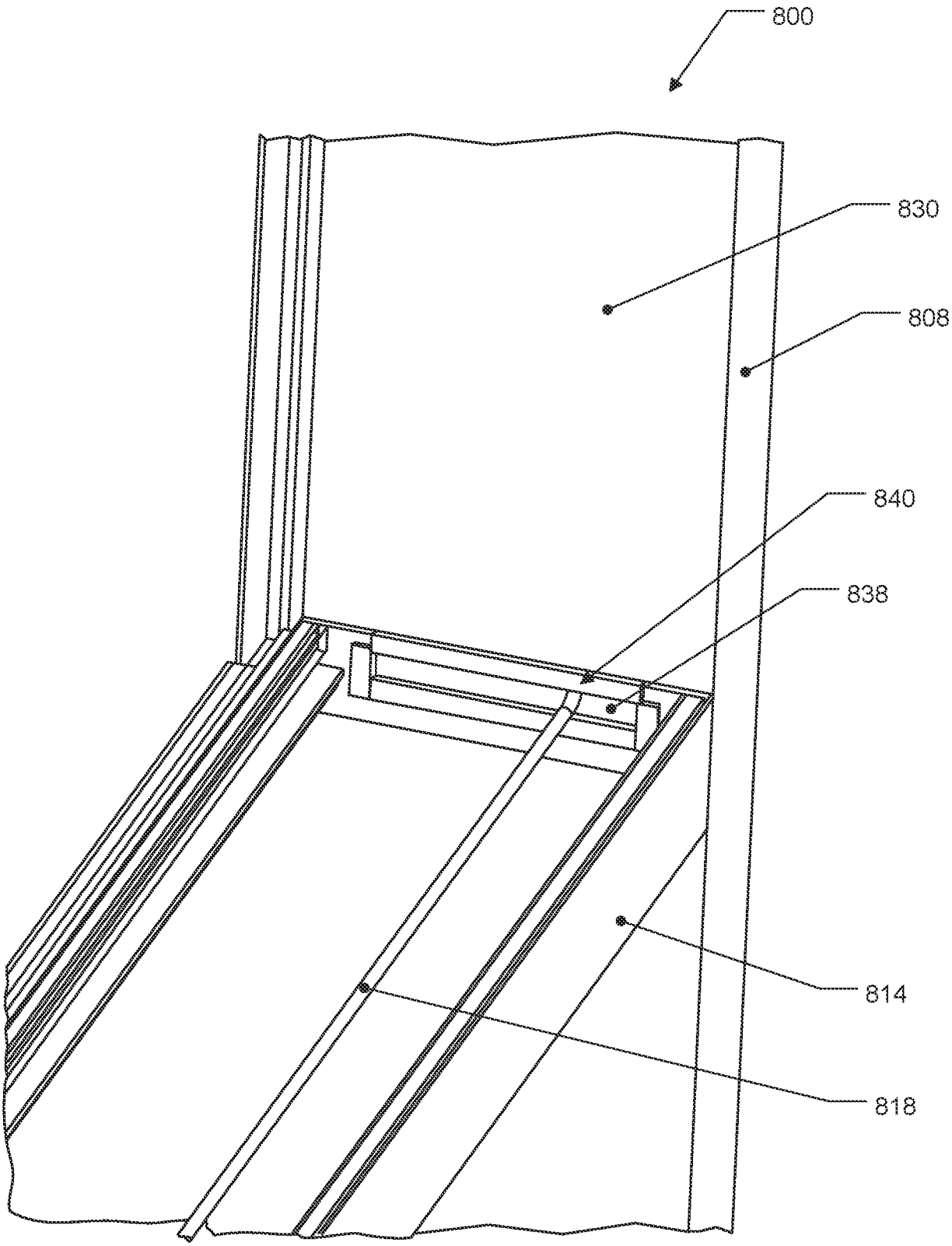


FIG. 8

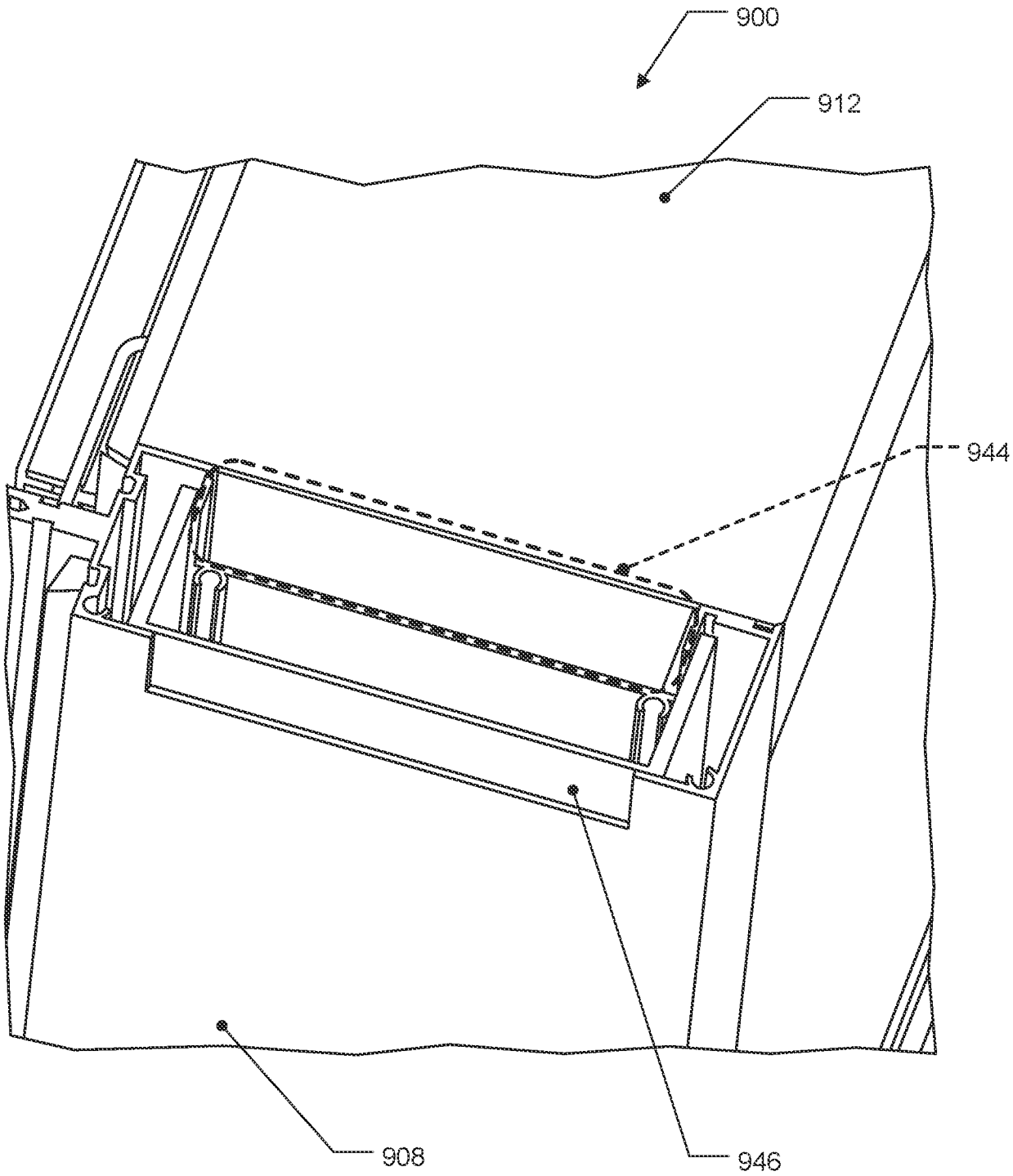


FIG. 9

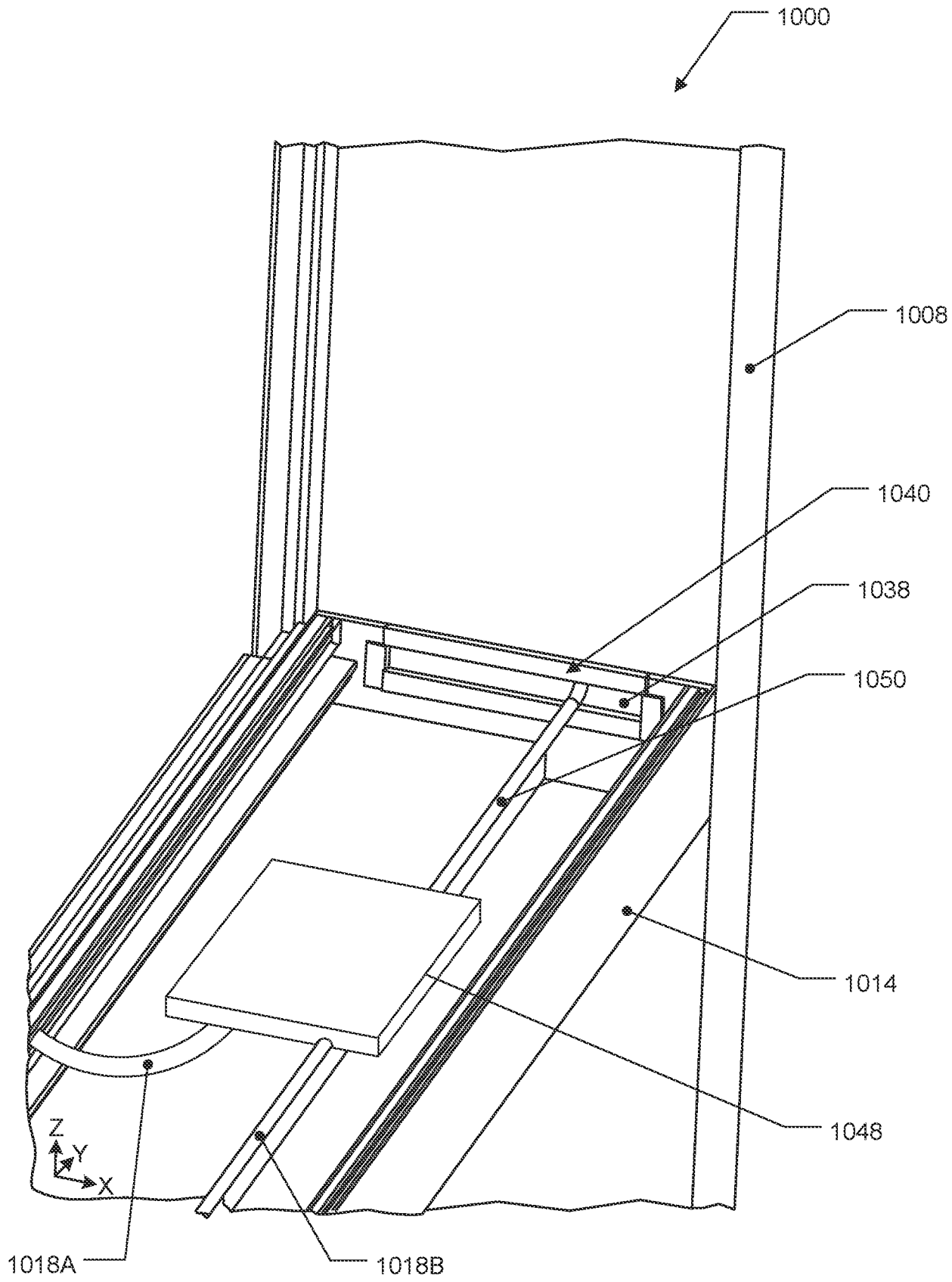


FIG. 10

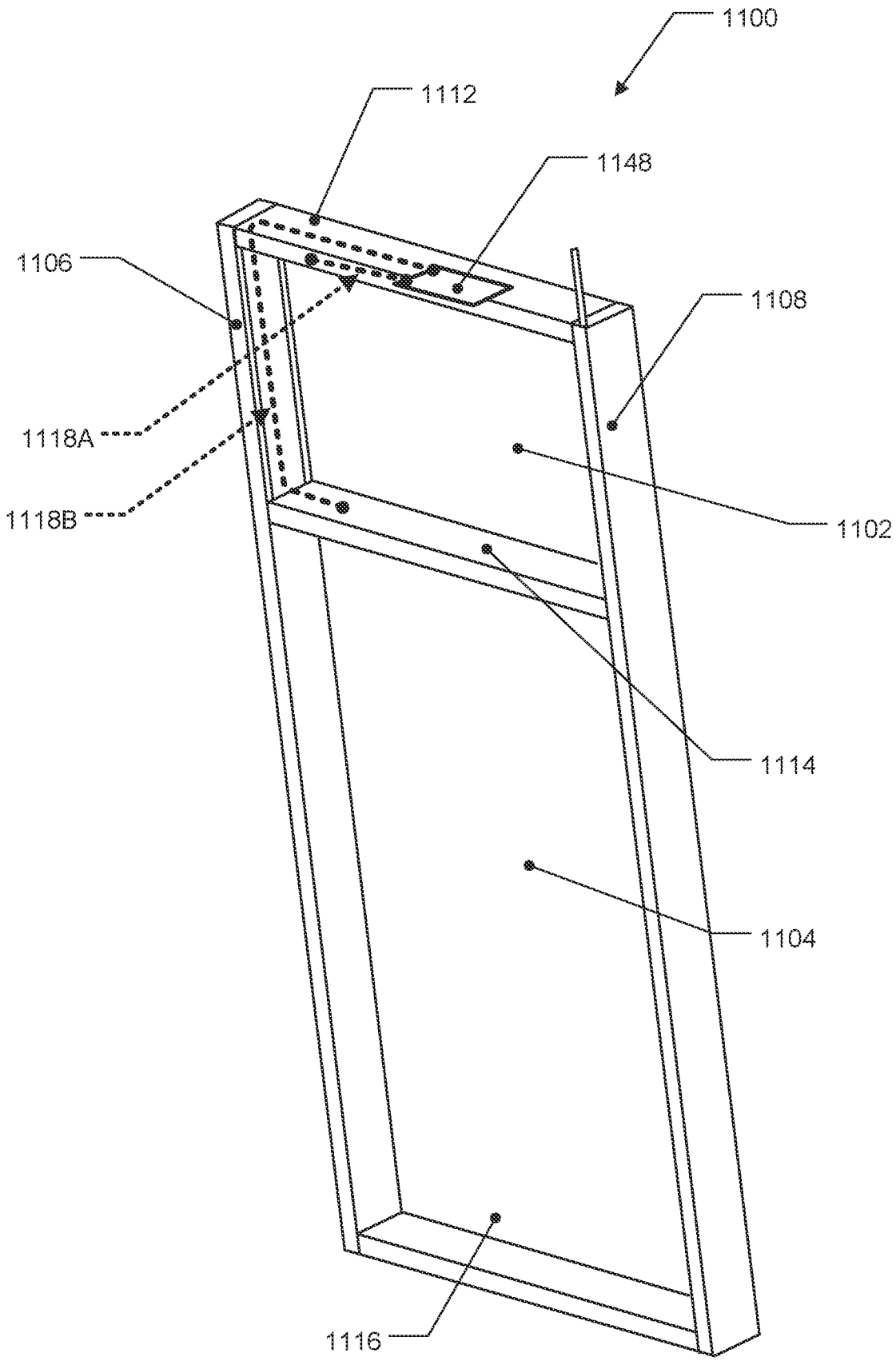


FIG. 11

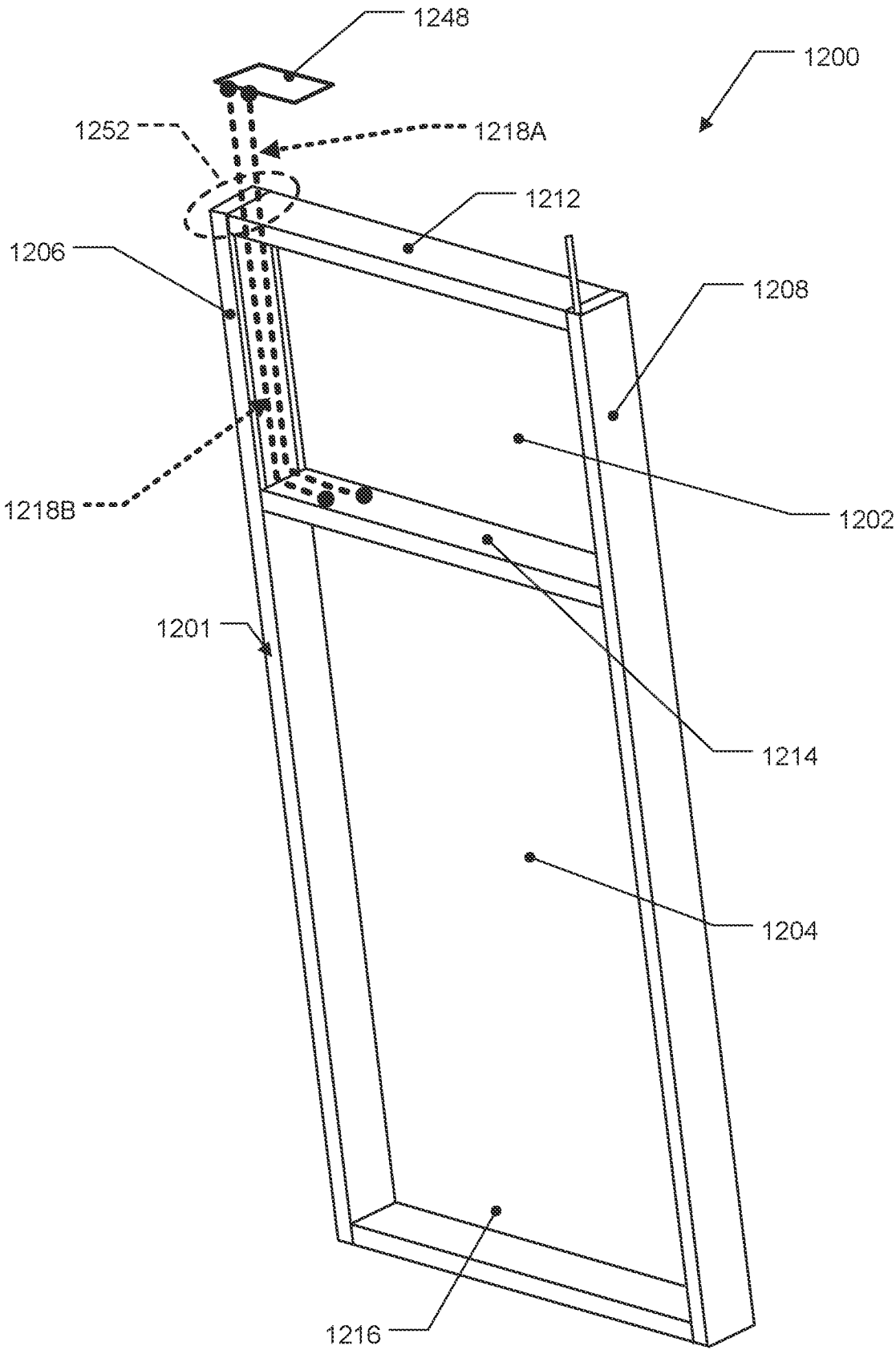

1248
1200
1252
1218A
1212
1206
1208
1218B
1202
1201
1214
1204
1216

FIG. 12

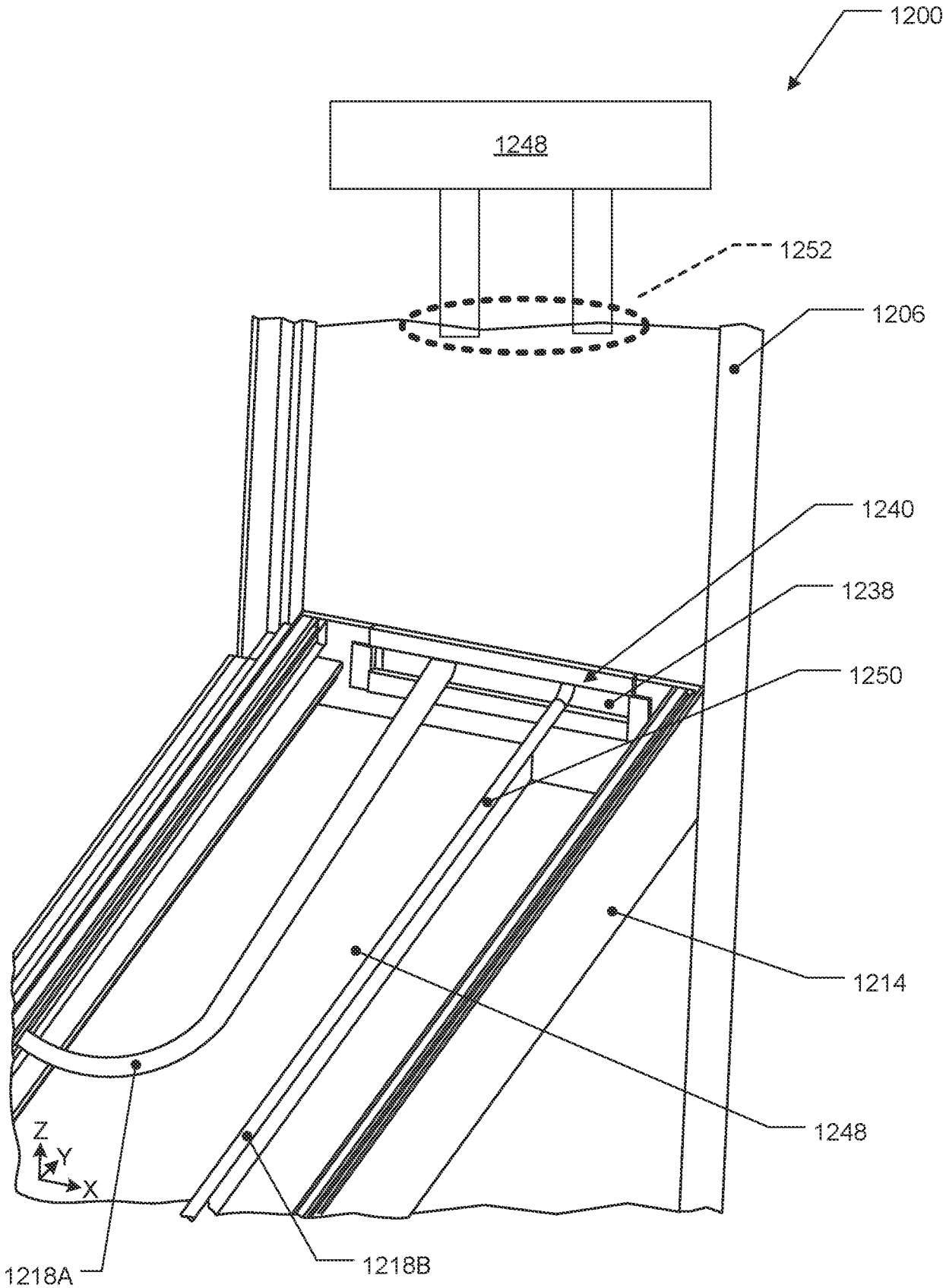


FIG. 13

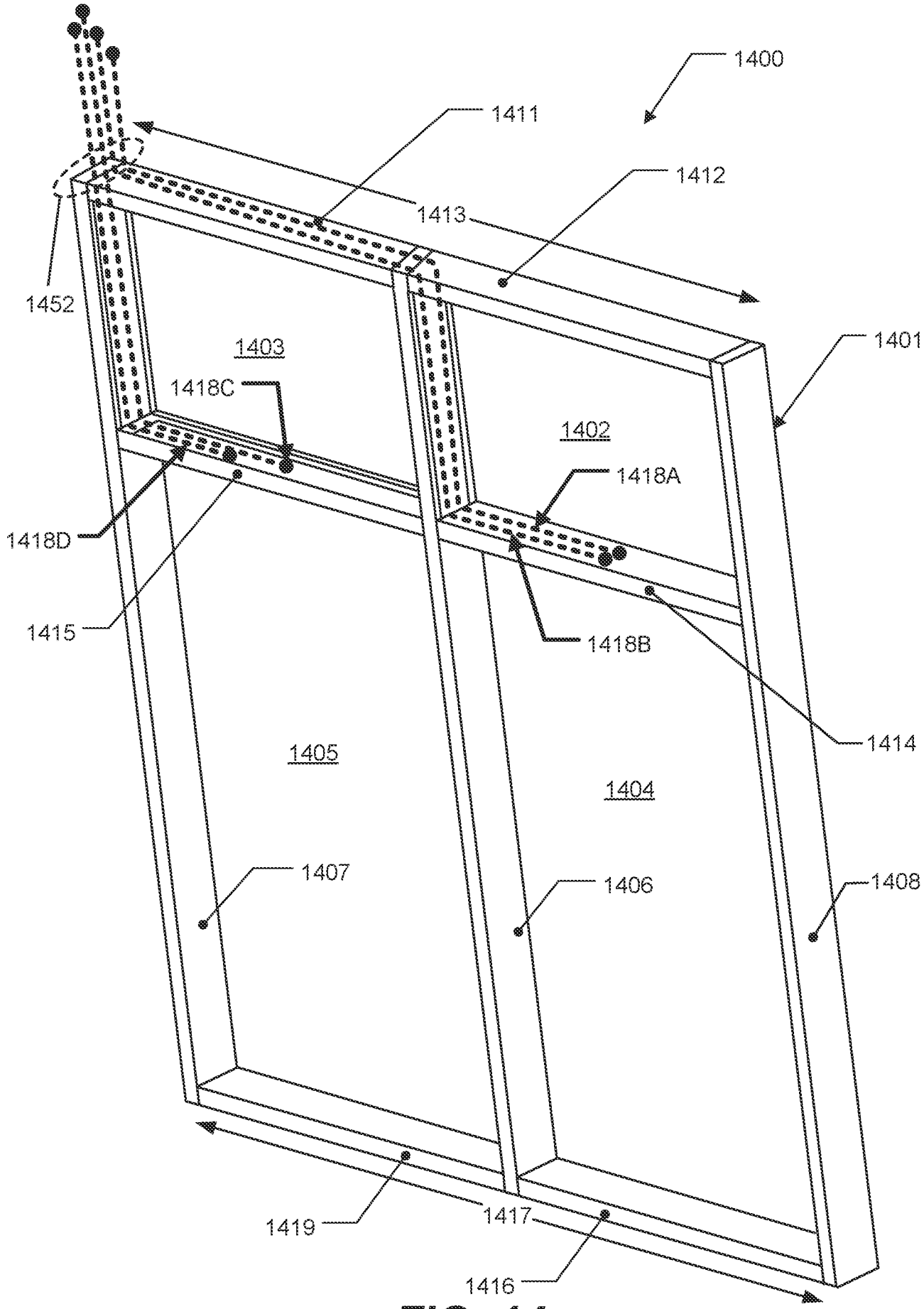

1400
1411
1412
1413
1452
1403
1418C
1401
1402
1418A
1418D
1415
1418B
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1405
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1407
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FIG. 14

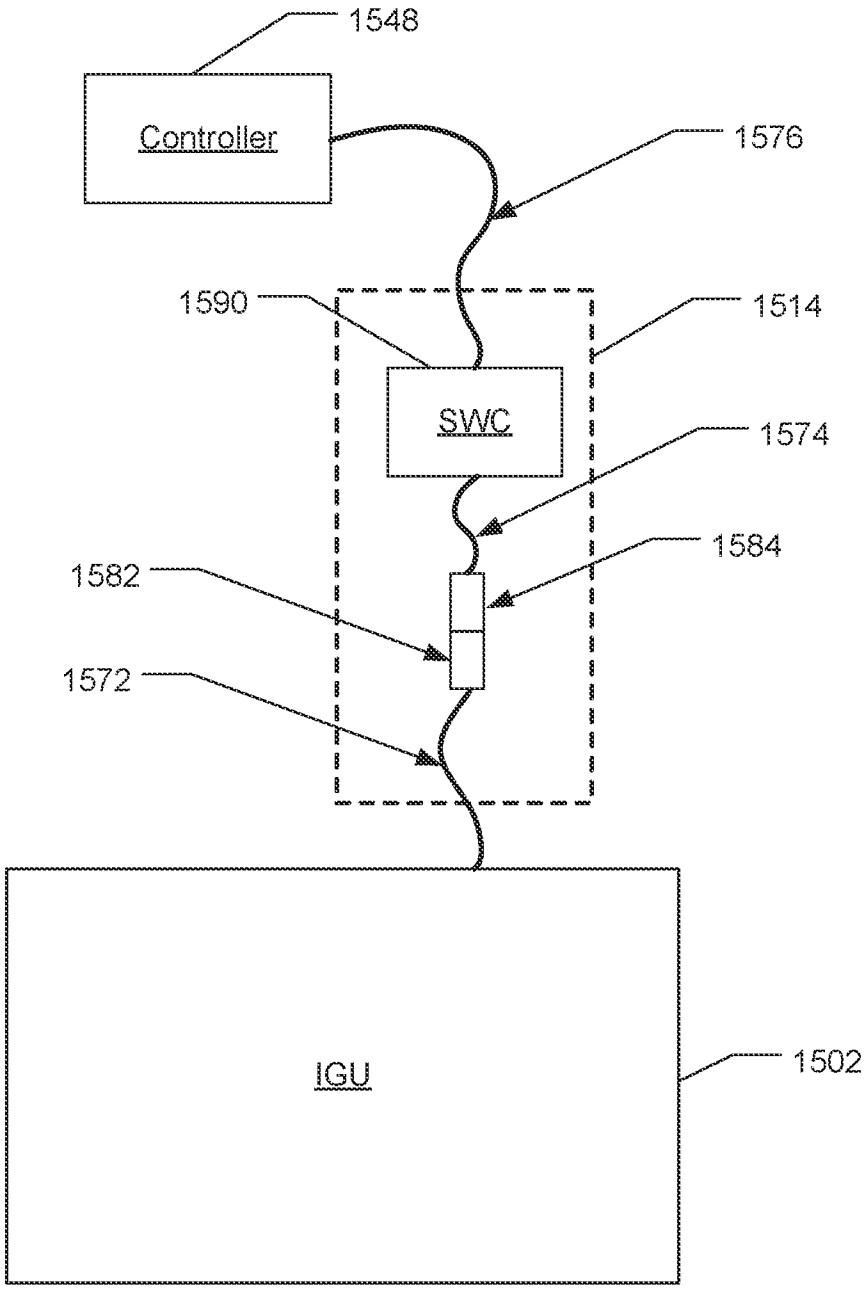

1548
Controller
1576
1590
1514
SWC
1574
1584
1582
1572
IGU
1502

FIG. 15

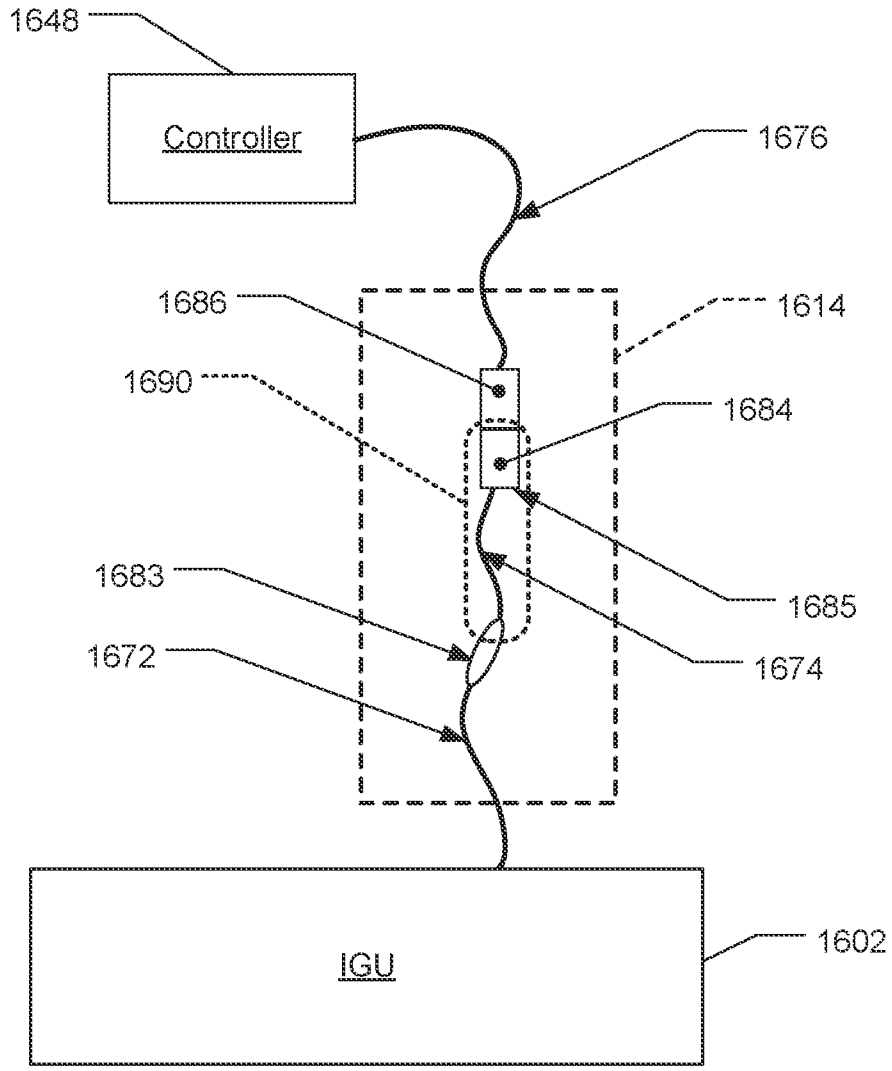


FIG. 16A

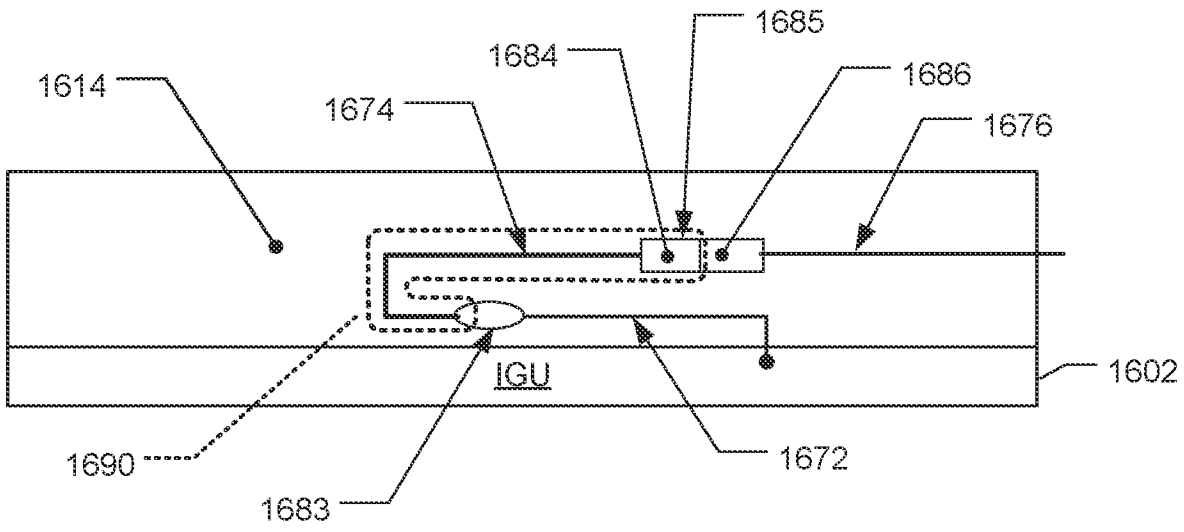


FIG. 16B

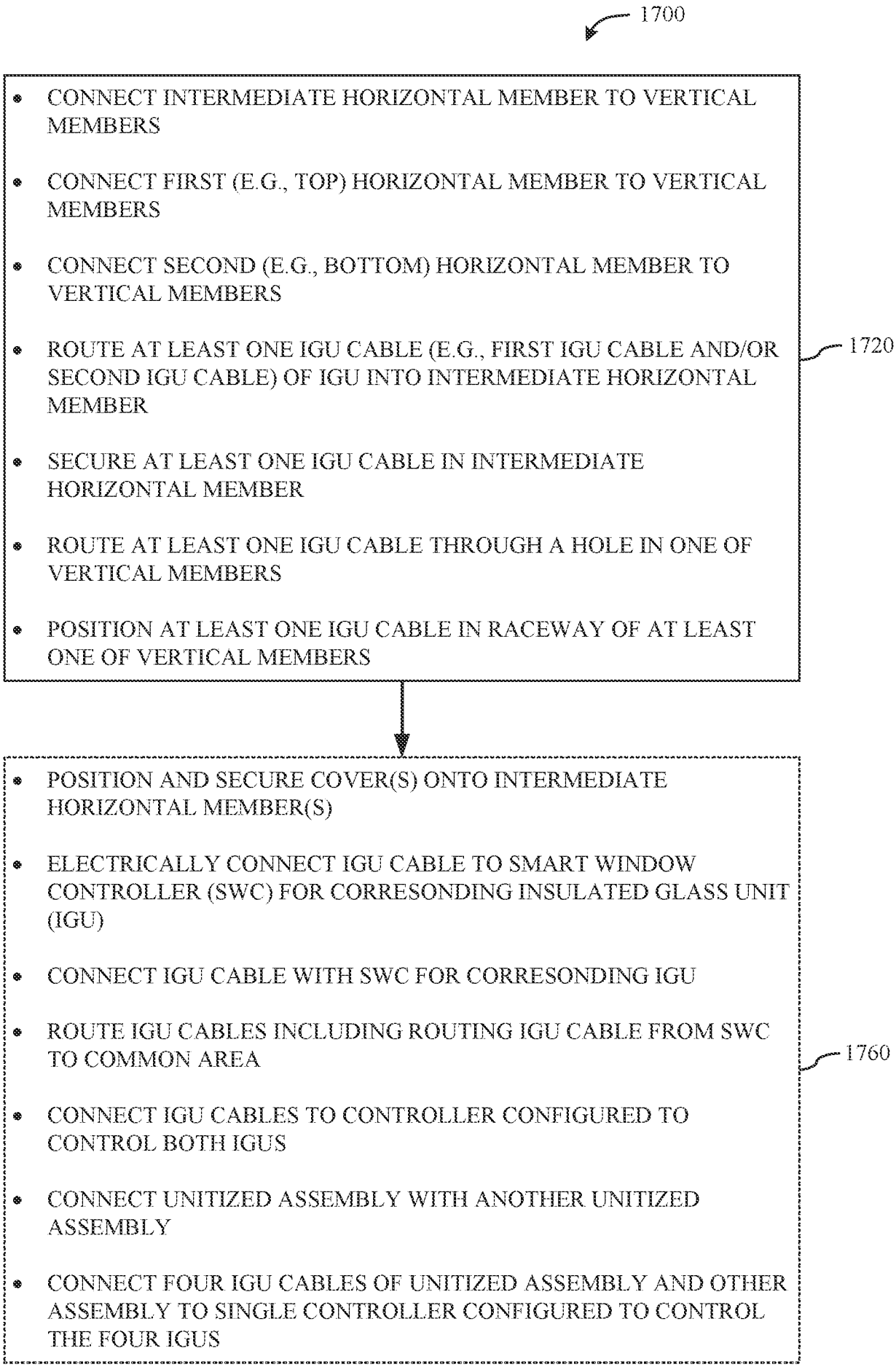

1700
CONNECT INTERMEDIATE HORIZONTAL MEMBER TO VERTICAL MEMBERS
CONNECT FIRST (E.G., TOP) HORIZONTAL MEMBER TO VERTICAL MEMBERS
CONNECT SECOND (E.G., BOTTOM) HORIZONTAL MEMBER TO VERTICAL MEMBERS
ROUTE AT LEAST ONE IGU CABLE (E.G., FIRST IGU CABLE AND/OR SECOND IGU CABLE) OF IGU INTO INTERMEDIATE HORIZONTAL MEMBER
SECURE AT LEAST ONE IGU CABLE IN INTERMEDIATE HORIZONTAL MEMBER
ROUTE AT LEAST ONE IGU CABLE THROUGH A HOLE IN ONE OF VERTICAL MEMBERS
POSITION AT LEAST ONE IGU CABLE IN RACEWAY OF AT LEAST ONE OF VERTICAL MEMBERS
1720
POSITION AND SECURE COVER(S) ONTO INTERMEDIATE HORIZONTAL MEMBER(S)
ELECTRICALLY CONNECT IGU CABLE TO SMART WINDOW CONTROLLER (SWC) FOR CORRESONDING INSULATED GLASS UNIT (IGU)
CONNECT IGU CABLE WITH SWC FOR CORRESONDING IGU
ROUTE IGU CABLES INCLUDING ROUTING IGU CABLE FROM SWC TO COMMON AREA
CONNECT IGU CABLES TO CONTROLLER CONFIGURED TO CONTROL BOTH IGUS
CONNECT UNITIZED ASSEMBLY WITH ANOTHER UNITIZED ASSEMBLY
CONNECT FOUR IGU CABLES OF UNITIZED ASSEMBLY AND OTHER ASSEMBLY TO SINGLE CONTROLLER CONFIGURED TO CONTROL THE FOUR IGUS
1760

FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2023/036098

A. CLASSIFICATION OF SUBJECT MATTER

E06B 9/24(2006.01)i; **G02F 1/15**(2006.01)i; **H04L 67/125**(2022.01)i; **G09G 3/19**(2006.01)i; **G02F 1/163**(2006.01)i

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)

E06B 9/24(2006.01); E04B 2/88(2006.01); E04B 2/96(2006.01); E04C 2/54(2006.01); E04D 13/18(2006.01); E06B 3/26(2006.01); G02F 1/163(2006.01); H05B 45/22(2020.01); H05B 47/11(2020.01)

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

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: insulated glass unit, frame, intermediate horizontal member, vertical member, IGU cable, controller

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2022-072454 A1 (VIEW, INC.) 07 April 2022 (2022-04-07) paragraphs [0177], [0224], [0229] and figures 9, 23	1-8,14-15,19,30-33
Y		9-13,16-18,20-29
Y	KR 10-0909893 B1 (KN WALLDEX CO., LTD.) 30 July 2009 (2009-07-30) paragraphs [0060], [0082] and figures 5-7, 10	9-12,16-18,20-22
Y	CN 102797310 A (SHEN, RONGHU) 28 November 2012 (2012-11-28) paragraph [0015] and figure 1	13
Y	KR 10-1930724 B1 (GURGWANG COMPANY) 19 December 2018 (2018-12-19) paragraphs [0030]-[0031] and figure 2	23-25
Y	CN 202157436 U (SHENYANG YUANDA AL. IND. ENG. CO.) 07 March 2012 (2012-03-07) paragraph [0016] and figures 1-2	26

☑ 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
"D" document cited by the applicant in the international application
"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
20 February 2024	**22 February 2024**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office **189 Cheongsa-ro, Seo-gu, Daejeon** **35208, Republic of Korea**	**PARK, Tae Wook**
Facsimile No. **+82-42-481-8578**	Telephone No. **+82-42-481-3405**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2023/036098

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2020-0260556 A1 (VIEW, INC.) 13 August 2020 (2020-08-13) paragraph [0164] and figure 20	27-29

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US2023/036098

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		CN 104234280 A	24 December 2014
		CN 104234280 B	14 July 2017
KR 10-1930724 B1	19 December 2018	None	
CN 202157436 U	07 March 2012	None	
US 2020-0260556 A1	13 August 2020	CA 2934349 A1	25 June 2015
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		EP 3757672 B1	10 May 2023
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		EP 4033297 A3	31 May 2023
		ES 2683188 T3	25 September 2018
		HK 1206109 A1	31 December 2015
		TW 202306919 A	16 February 2023
		TW I765975 B	01 June 2022
		US 2014-0177028 A1	26 June 2014
		US 9341912 B2	17 May 2016
		WO 2015-095615 A1	25 June 2015