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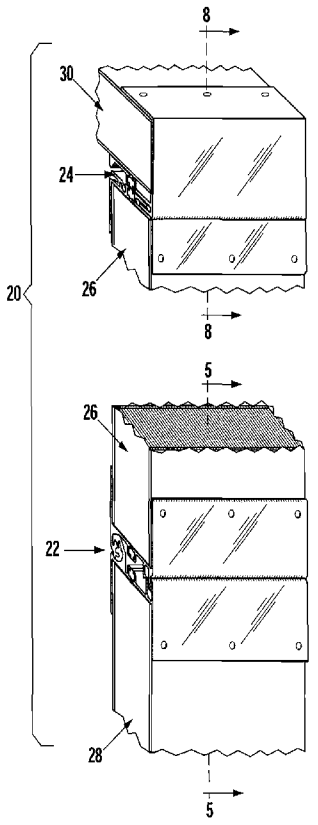
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[Continued on next page]

(54) Title: INTERCONNECTION SYSTEM FOR PANEL ASSEMBLIES

Fig. 1



(57) Abstract: A system for interconnecting multiple panel assemblies comprising a first bracketing body having a first bearing member and at least one planar member; a second bracketing body having a second bearing member pivotally engaged with the first bearing member and at least one planar member; a third bracketing body having at least one planar member; a fourth bracketing body having at least one planar member; a first panel receiving volume at least partially defined by the at least one planar member of the first and third bracketing bodies; a second panel receiving volume at least partially defined by the at least one planar members of the second and fourth bracketing bodies; and wherein the at least one planar members of the second and fourth bracketing bodies at least partially define a second panel receiving volume. According to another aspect of the present invention, a first thermal insulating body is positioned between and separates the first and third bracketing bodies, and a second thermal insulating body positioned between and separates the second and fourth bracketing bodies. According to yet another aspect of the present invention, a fastenerless connection is provided between surfaces of the system and the panel assemblies.

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TITLE OF THE INVENTION

[0001] Interconnection System for Panel Assemblies

CROSS REFERENCE TO RELATED APPLICATIONS

[0002] Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0003] Not applicable.

BACKGROUND OF THE INVENTION

1. Field of the Invention.

[0004] The present invention relates to foldable, connectable panel assemblies for use in building structures and other structures where the panel assemblies may be utilized. More specifically, the present invention relates to a system for interconnecting panel assemblies, providing for rotatability of one panel assembly relative to another around an axis of rotation, and providing for securing the interconnection of one panel assembly with respect to another panel assembly in a fixed, lockable relationship. Additionally, this invention provides with a fastenerless connection between the construction panel its perimeter trims.

2. Description of the Related Art.

[0005] Pre-fabricated, foldable, portable building structures have been developed to enable shipment of structures in a collapsed form while facilitating the erection of those buildings at their installation site. One objective in developing pre-fabricated, foldable, portable buildings is to provide for maximum square footage of erected structure while retaining a minimum volume and weight of the structure in its collapsed form for shipping purposes. This avoids the unnecessary transportation of air volume within the structure, resulting in more economical transportation of such structures. At the same time, hingedly joining components of the structure to fold when collapsed facilitates erection of these structures at the erection site by unskilled labor at considerable cost and time saving.

[0006] The successful development and introduction of containerized transportation, involving the loading of fixed-dimension containers aboard land, sea, and air modes of transportation specially adapted for standard container sizes, has provided considerable cost benefit and generally provides safer and quicker worldwide freight transportation. The I.S.O. freight containers have been universally adopted by most modern modes of transportation, and

practically every country in the world is now capable of handling and delivering such containers, making it possible to economically ship I.S.O. freight containers to practically any destination in the world.

[0007] Given the benefits associated with containerized transportation, the development of a pre-fabricated, foldable, portable building that is collapsible to fit within the outside dimensions of shipping containers meeting I.S.O standards is desirable. One problem associated with the development of a pre-fabricated, foldable, portable building is a sufficiently robust and maneuverable interconnection system for interconnection of panel assemblies that compose the foldable building.

[0008] Current designs for interconnection systems are not maximally efficient in terms of use of the available space, do not interconnect panel assemblies with adequate fixation, resulting in weak connections, create unwanted heat transfer at the connections of adjacent panel assemblies, and inadequately seal the space between sides of the panel assembly to prevent fluid flow therebetween. Accordingly, there exists a need for an optimized panel assembly that addresses such deficiencies.

BRIEF SUMMARY OF THE INVENTION

[0009] The present invention system for interconnection multiple panel assemblies comprises a first bracketing body having a first bearing member and at least one planar member; a second bracketing body having a second bearing member pivotally engaged with the first bearing member and at least one planar member; a third bracketing body having at least one planar member; a fourth bracketing body having at least one planar member; a first panel receiving volume at least partially defined by the at least one planar member of the first and third bracketing bodies; a second panel receiving volume at least partially defined by the at least one planar members of the second and fourth bracketing bodies; and wherein the at least one planar members of the second and fourth bracketing bodies at least partially define a second panel receiving volume. According to another aspect of the present invention, a first thermal insulating body is positioned between and separates the first and third bracketing bodies, and a second thermal insulating body positioned between and separates the second and fourth bracketing bodies. According to yet another aspect of the present invention, a fastenerless connection is provided between surfaces of the system and the panel assemblies.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0010] FIG. 1 is a perspective view of the preferred embodiment of the present invention.

[0011] FIG. 2 is a sectional elevation of a bracketing body of the preferred invention.

[0012] FIG. 2A is a sectional elevation of an alternative embodiment of the bracketing body shown in FIG. 2.

[0013] FIG. 2B shows the relationship between the bearing surfaces of the bracketing body shown in FIG. 2.

[0014] FIG. 3 is a sectional elevation of a second bracketing body of the preferred invention.

[0015] FIG. 3A is a sectional elevation of an alternative embodiment of the bracketing body shown in FIG. 3.

[0016] FIG. 3B shows the relationship between the bearing surfaces of the bracketing body shown in FIG. 3.

[0017] FIGS. 4–5 are sectional views of third and fourth bracketing bodies of the hinge assembly of the present invention.

[0018] FIG. 6 is a sectional view of the hinge assembly shown in FIG. 1 from line 5–5 thereof in a first configuration wherein the interconnected panel assemblies are in coplanar alignment.

[0019] FIG. 6A is a sectional view of an alternative embodiment to the embodiment shown in FIG. 6 comprising planar engaging members extending into the panel receiving volumes.

[0020] FIG. 6B and FIG. 6C shows the sectional view and an isometric view, respectively of the embodiment shown in FIG. 6A, and further depicts individualized extruded teeth engaging the panel engaging members to inhibit removal of the panel assemblies from the panel receiving slots.

[0021] FIG. 7 is a sectional view of the hinge assembly shown in FIG. 6 in a second configuration wherein the interconnected panel assemblies are in a perpendicular relationship.

[0022] FIGS. 8–9 are sectional views of the elements of the preferred embodiment of the connection assembly shown in FIG. 1 from line 8–8 thereof.

[0023] FIG. 8A and FIG. 8B are section views of an alternative embodiment of the FIGS. 8–9, which further comprise panel engaging members extending into the respective panel receiving volumes.

[0024] FIG. 10 is a sectional view of the connection assembly shown in FIG. 1 along line 10–10 thereof.

[0025] FIG. 10A is a section view shown in FIG. 10 with the locking member engaged with the lock engaging edges.

[0026] FIG. 11 is a sectional view of an alternative embodiment of FIG. 10 further comprising panel engaging members extending into the panel receiving volumes.

DETAILED DESCRIPTION OF THE INVENTION

[0027] FIG. 1 depicts a preferred embodiment 20 of the present invention, which comprises a hinge assembly 22 and a connection assembly 24 interconnecting a first panel assembly 26, a second panel assembly 28, and a third panel assembly 30. The hinge assembly 22 interconnects the first and second panel assemblies 26, 28 and provides rotational movement of the first panel assembly 26 relative to the second panel assembly 28 between the first relative position shown in FIG. 1 and a second relative position. The connection assembly 24 interconnects the first panel assembly 26 and the third panel assembly 30 in a fixed relative position in which the first panel assembly 26 is orientated at a right angle relative to the third panel assembly 30, such as, for example, would be found at the intersection of a sidewall and a ceiling of a building.

[0028] FIGS. 2–7 depict the basic structure and operation of the preferred hinge assembly 22 in greater detail. While FIGS. 2–7 are sectional views of a specific profile of the hinge assembly 22, it should be understood that any profile through the hinge assembly 22 is identical. As shown in FIG. 2, the hinge assembly 22 comprises a first bracketing body 32 having first and second planar members 34, 36 intersecting at a first junction 38 in a perpendicular relationship. As used herein, "bracketing body" means a body for attachment to one or more sides of the member to be bracketed in order to fix the relationship so that the attached member securely moves with the bracketing body as the bracketing body is moved, or alternatively so that the bracketing body securely moves with the attached member is moved. First and second planar members 34, 36 have first and second free ends 40, 42, respectively, distal from the first junction 38 and also comprise first and second planar engaging surfaces 44, 46 intersecting in a right angle at the first junction 38. As used herein, "planar member" means a member having at least one planar surface, and "engaging surface" means a surface having a profile with a shape at least generally corresponding to the shape of the surface of an object member to which the engagement surface is to be proximally positioned for the purpose of fixing the body with the "engagement surface" to the object member. The terms "engaging surface" and "planar surface" are not intended, however, to exclude the incorporation of additional panel engaging members proximal

to or extending from the surface, such as the use of teeth or ridges as described elsewhere herein, to provide further fixation functionality between the body and the object member.

[0029] The first bracketing 32 body is preferably fixed to a panel assembly with fasteners, such as rivets 47. Alternative embodiments contemplate panel engaging members, in conjunction with or instead of fasteners, extending from the engaging surfaces. In one alternative embodiment of the first bracketing body 32, shown in FIG. 2A, a first set of normal ridges extends from the first engaging surface 44 and a first set of angled ridges 48 extends from the second engaging surface 46 toward the first engaging surface 44. Each of the ridges 48, 50 extends along the length of the engaging surface 44, 46. In another alternative embodiment, a plurality of individualized extruded teeth extends normally or at an angle from the first and second engaging surfaces 44, 46.

[0030] A first channel beam 51 having a generally C-shaped cross section is formed integrally with and extends from the free end 40 to the first planar member 34. A non-engaging surface 45 of the first planar member 34 opposite its engaging surface 44 and the channel beam 51 has a concave interior curved surface 52 which defines a first insulating volume 54.Still referring to FIG. 2, the first bracketing body 32 has a first bearing member 56 which extends from the first junction 38 opposite of the second planar member 36 and comprises a curved first bearing arm 57 partially surrounding and spaced from a generally cylindrical hinge pin 59. The first bearing arm 57 is connected to the hinge pin 59 by a bridging member 61.

[0031] The hinge pin 59 has a convex first bearing surface 58 having a first radius R1 from a first axis 60. The bearing arm 57 has interior second bearing surfaces 62 having a second radius R2 from the first axis 60 and a convex exterior third bearing surface 64 having a third radius R3 from the first axis 60. The bearing arm 57 terminates at an end surface 76 extending between the second and third bearing surfaces 62, 64.

[0032] A stop member 65 extends from the exterior third bearing surface 64. This stop member 65 comprises two preferably parallel opposite side stopping surfaces 68, 70 extending between the third bearing surface 64 and a convex fourth bearing surface 66 having a fourth radius R4 from the first axis 60.

[0033] As shown jointly in FIG. 2 and FIG. 2A, all of the bearing surfaces 58, 62, 64, 66 are partially-cylindrical and concentric around the first axis 60. The magnitude of the first radius R1 is less than the magnitude of the second radius R2, which is less than the magnitude of the third radius R3, which is less than the magnitude of the fourth radius R4.

[0034] First and second inner stopping surfaces 72, 74 comprise the sides of the bridging member 61 and extend between the first and second bearing surfaces 58, 62. Each of the first and second inner stopping surfaces 72, 74 are coplanar with reference planes P1, P2 extending through the first axis 60. A first partially-toroidal slot 78 is defined by the first inner stopping surface 72 and the first and second bearing surfaces 58, 62. A second partially-toroidal slot 80 is defined by the second inner stopping surface 74 and the first and second bearing surfaces 58, 62. A planar first support surface 82 is positioned adjacent to the second bearing surface 62 and extends between the non-engaging surface 45 of the first planar member 34 and the second bearing surface 62.

[0035] Referring to FIG. 3, the hinge assembly 22 further comprises a second bracketing body 84 having third and fourth planar members 86, 88 intersecting at a second junction 90 in a perpendicular relationship. The third and fourth planar members 86, 88 have free ends 92, 94 distal from the second junction 90 and also comprise a third and fourth planar engaging surfaces 96, 98 intersecting in a right angle at the second junction 90.

[0036] The second bracketing body 84 is preferably fixed to a panel assembly with fasteners, such as a row of rivets 99. Alternative embodiments contemplate panel engaging members, in conjunction with or instead of fasteners, extending from the engaging surfaces. In one alternative embodiment of the second bracketing body 84, shown in FIG. 3A, a second set of normal ridges 102 extends from the third engaging surface 96 and a second set of angled ridges 100 extends from the fourth engaging surface 98 toward the third engaging surface 96. Each of the ridges 100, 102 extend along the length of the corresponding engaging surface 96, 98. In another alternative embodiment, a plurality of individualized extruded teeth extends normally or at an angle from the first and second engaging surfaces 96, 98.

[0037] A second channel beam 91 having a generally C-shaped cross section is formed integrally with and extends from a non-engaging surface 97 of the third planar member 86 adjacent its free end 92. The second channel beam 91 has a concave interior curved surface 104 which defines a second insulating volume 106.

[0038] Still referring to FIG. 3, a second bearing member 108 which extends from the non-engaging surface 97 of the third member 86 comprises a curved second bearing arm 107 which terminates in a hinge barrel 109 having a generally semicircular, C-shape cross section and an interior concave fifth bearing surface 110 having a fifth radius R5 from a second axis 112. The hinge barrel 109 has a convex sixth bearing surface 114 having a sixth radius R6 from the second axis 112 and a convex seventh bearing surface 116 having a seventh radius R7 from the

axis 112. The second bearing arm 107 has an interior, concave eighth bearing surface 118 having an eighth radius R8 from the axis 112 and an interior, concave ninth bearing surface 120 having a ninth radius R9 from the axis 112. The ninth bearing surface 120 extends between two stopping surfaces 124, 126 positioned on the second bearing arm 108.

[0039] As shown in FIG. 3 and FIG. 3A, all of the bearing surfaces 110, 114, 116, 118, 120 are partially-cylindrical and concentric around the second axis 112. The magnitude of the fifth radius R5 is less than the magnitude of the sixth radius R6, which is equal to the magnitude of the seventh radius R7. The magnitude of the seventh radius R7 is less than the magnitude of the eighth radius R8, which is less than the magnitude of the ninth radius R9.

[0040] A first stopping surface 122 extends between the seventh and eighth bearing surfaces 116, 118 and is co-planar with a reference plane P3 extending radially through the second axis 112. The second stopping surface 124 extends between the eighth and ninth bearing surfaces 118, 120 and is co-planar with a reference plane P4 extending radially through the second axis 112. The third stopping surfaces 126 extends from the ninth bearing surface 120 and is positioned adjacent the second junction 90 of the third and fourth planar members 86, 88. The hinge barrel 129 has an outer end surface 128 which extends between the fifth and sixth bearing surfaces 110, 114, and an inner end surface 130 extends between the fifth and seventh bearing surfaces 110, 116. A planar second support surface 132 is positioned adjacent to the sixth bearing surface 114 forming a portion of the exterior surface of the second bearing arm 108.

[0041] FIG. 4 shows a third bracketing body 134 having fifth and sixth planar members 136, 138 intersecting at a third junction 140 in a perpendicular relationship. The fifth planar member 136 has a first planar engaging surface 146, a non-engaging surface 147 and a free end 142 distal from the third junction 140. Likewise, the sixth planar member 138 has a sixth planar engaging surface 148, non-engaging surface 149 and free end 144 distal from the third junction 140.

[0042] The third bracketing body 134 is preferably fixed to a panel assembly with fasteners, such as a row of rivets 145. Alternative embodiments contemplate panel engaging members (i.e., ridges or individualized extruded teeth), in conjunction with or instead of fasteners, extending from the engaging surfaces, as shown and described with reference to the first and second bracketing bodies 32, 84 and FIG. 2A and FIG. 3A.

[0043] A third channel beam 153 having a generally C-shaped cross section is continuous and extends from and is formed integrally with the non-engaging surface 147 of the

fifth planar member 136 proximal its free end 142. The third channel beam 153 has a concave interior curved surface 154 defining a third insulating volume 156.

[0044] First and second engagement fins 158, 160 extend generally perpendicular from the non-engaging surface 147 of the fifth planar member 136 to partially define therebetween a first sealing volume 162 proximal to the junction 140. Retaining members 161 are angle toward the fifth planar member 136 extend from the planar surfaces of the first and second engagement fins 158, 160 that define the sealing volume 162. In the preferred embodiment, the retaining members 161 are ridges. In alternative embodiments the retaining members 161 are a plurality of individualized extruded teeth.

[0045] FIG. 5 depicts a fourth bracketing body 164 having seventh and eighth planar members 166, 168 intersecting at a fourth junction 170 in a perpendicular relationship. The seventh planar member 166 has a seventh planar engaging surface 176, a non-engaging surface 177, and a free end 172 distal from the fourth junction 170. Likewise, the eighth planar surface 168 has an eighth planar engaging surface 178, a non-engaging surface 179 and a free end 174 distal from the fourth junction 170. The seventh and eighth planar engaging surfaces 176, 178 intersect at a right angle.

[0046] The fourth bracketing body 164 is preferably fixed to a panel assembly with fasteners, such as a row of rivets 175. Alternative embodiments contemplate panel engaging members (i.e., ridges or individualized extruded teeth), in conjunction with or instead of fasteners, extending from the engaging surfaces, as shown and described with reference to the first and second bracketing bodies 32, 84 and FIG. 2A and FIG. 3A.

[0047] A fourth channel beam 183, having a C-shaped cross section, is continuous with and extends from the non-engaging surface 177 of the seventh planar member 166 proximal its free end 172. The fourth channel beam member 183 has a concave interior curved surface 184 defining a fourth insulation volume 186.

[0048] Third and fourth engaging fins 188, 190 extend generally perpendicular from the non-engaging surface 177 of the seventh planar member 166 to define a second sealing volume 192 therebetween. The third engaging fin 188 is coplanar with the eighth planar member 168 and has a free end 194 that curves toward the fourth engagement fin 190. Retaining members 196 angled toward the seventh member 166 extend from the planar surfaces of the third and fourth engagement fins 188, 190 that define the sealing volume 192. In the preferred embodiment, the retaining members 196 are ridges extending along the length of the planar surfaces. In alternative embodiments the retaining members 196 are a plurality of individualized extruded teeth.

[0049] FIG. 6 shows the hinge assembly 22 of the present invention in its entirety, including the elements described previously with reference to FIGS. 2–5, in use with the first and second panel assemblies 26, 28. The first planar member 34 of the first bracketing body 32 is positioned adjacent the fifth planar member 136 of the third body 134 in coplanar alignment with a space 35 therebetween. The first and third bracketing bodies 32, 134 are oriented such that the second and sixth planar members 36, 138 extend from the first and third bodies 32, 134, respectively, in the same direction.

[0050] The first and third channel beams 51, 153 of the first and third bodies 32, 134, respectively, are mechanically connected with a first insulating body 198 positioned in a space between the first and third channel beams 51, 153. The first insulating body 198 is rigid, made of an insulative material such as a thermally nonconductive resin, portions of which are shaped to fit within the first and third insulating volumes 54, 156. Preferably, such a resin is poured into the insulating volumes 54, 156 and the space therebetween in a liquid state and allowed to harden. The interior curved surface 52, 154 of the first and third channel beam members 51, 153, respectively, secure the first and third bracketing bodies 32, 134 to the first insulating body 198.

[0051] The planar engaging surfaces 44, 46, 146, 148 of the first bracketing body 32 and the third bracketing body 134 form an assembly having a square U-shaped cross section which defines a first panel receiving volume 200. As shown in FIGS. 1 and 6, the first panel assembly 26 is positioned within the panel receiving volume 200 such that the sides of the first panel assembly 26 engage the planar engaging surfaces 44, 46, 146, 148 and are fastened with rows of rivets 47, 145

[0052] The first panel assembly 26 itself comprises a layer of insulative core material (e.g., polystyrene) 202 positioned between two reinforcing layers 204, 206 that provide structural rigidity to the intermediate layer 202. In the preferred embodiment, the first and second reinforcing layers are metallic.

[0053] In the same manner as described with regard to the first and third bracketing bodies 32, 134, the second and fourth bracketing bodies 84, 164 are mechanically connected with a thermally non-conductive second insulating body 207 wherein the second insulating body 207 is positioned between the second and fourth channel beams 91, 183 and secured with the second and fourth insulating volumes 106, 186. In this position, the third planar member 86 of the second body 84 is in co-planar alignment with the seventh planar member 166 with a space 37 between the respective free ends 92, 172. Also in this position, the fourth and eighth planar members 88, 168 of the second and fourth bracketing bodies 84, 164, respectively, extend in the

same direction wherein the planar engaging surfaces 146, 148, 176, 178 of the second and fourth bracketing bodies 84, 164 form an assembly with a square U-shaped cross section defining a second panel receiving volume 208. One end of the second panel assembly 28, also comprising a layer of insulative core material 210 positioned between two preferably metallic reinforcing layers 212, 214, is positioned within the second panel receiving volume 208.

[0054] FIG. 6 shows the hinge assembly 22 in a first configuration wherein the first bearing member 56 and second bearing member 108 are interconnected and the first and second panel assemblies 26, 28 are in coplanar alignment. In this configuration, the first axis 60 described with reference to the first through fourth bearing surfaces 58, 62, 64, 66 (see FIG. 2) is coaxial with the second axis 112 described with reference to the fifth through ninth bearing surfaces 110, 114, 116, 118 (see FIG. 3) to form an axis of rotation 216. To prevent further rotation of the second bearing member 108 with respect to the first bearing member 56, the outer end surface 128 of the hinge barrel 129 is in contact with the second stopping surface 74 and the side stopping surface 70 of the stop member 65 is in contact with the third stopping 126.

[0055] Still referring to FIG. 6, the rubber sealing elements 218, 220 are positioned in the first and second sealing volumes 162, 192, respectively, to prevent fluid flow into an interior space 222 of the hinge assembly 22. The sealing element 220 is compressed and held within the second sealing volume 192 by the first engagement fin 158. The other sealing element 218 is compressed and held within the first sealing volume 162 by the fourth engagement fin 190. Retaining members 161, 196 inhibit movement of the sealing elements 218, 220 within the sealing volumes 162, 192.

[0056] FIG. 7 shows the hinge assembly 22 in a second configuration wherein the first bearing member 56 and the second bearing member 108 are still interconnected and the second panel assembly 28 is at a right angle with respect to the first panel assembly 26. In this position, to prevent further rotational movement of the second bearing member 108 with respect to the first bearing member 56, the inner end surface 130 of the hinge barrel 129 contacts the first stopping surface 72 of the bearing member 56; the side stopping surface 68 of the stop member 65 is in contact with the second stopping surface 124; and end surface 76 of the first bearing member 56 is in contact with the stopping surface 122 of the second bearing member 108.

[0057] Use of the preferred embodiment of the hinge assembly 22 is initially described with reference to FIG. 6. First and second panel assemblies 26, 28 are positioned in the first and second panel receiving volumes 200, 208 respectively. Rows of rivets 47, 145 engage with the

first panel assembly 26 to inhibit movement thereof. Likewise, rows of rivets 99, 175 engage the second structural member 28 to inhibit removal thereof.

[0058] As shown in FIG. 6A, in an alternative embodiment, angled ridges 48, 150 and normal ridges 50, 152 within the first panel receiving volume 200 (described with reference to FIG. 2A and FIG. 3A) engage with the first panel assembly 26 to inhibit movement thereof, either in conjunction with or in place of rivets described with reference to FIG. 6. Likewise, the angled ridges 100, 180 and isometric ridges 102, 182 within the second panel receiving volume 208 engage the second structural member 28 to inhibit removal thereof.

[0059] As shown in FIGS. 6B–6C, in other alternative embodiments, the panel assemblies 26, 28 may include similarly-shaped but oppositely-orientated individualized extruded teeth 215 formed in the metallic reinforcing layers 204, 206, 212, 214 that engage with the angled ridges 48, 100, 150, 180 to provide additional engagement functionality. In still other embodiments, individualized extruded teeth extending normally or at an angle into the panel receiving volumes from the engaging surfaces, the panel assemblies 26, 28 to engage teeth or ridges formed in the reinforcing layers 204, 206, 212, 214.

[0060] Referring back to any of FIG. 6, the first and second bearing members 56, 108 are rotatable with respect to one another so that the first and second panel assemblies 26, 28 may be rotated between the first relative position shown in FIG. 6 wherein the panel assemblies 26, 28 are aligned and the second relative position shown in FIG. 7 wherein the panel assemblies 26, 28 are in a perpendicular relationship.

[0061] When the panel assemblies 26, 28 are in the aligned position as shown in FIG. 6, the first and second insulating bodies 198, 207 and the first and second spaces 35, 37, create a thermal barrier across the hinge assembly 22. Thermal energy is inhibited from passing from the first and second bodies 32, 84 on one side of the hinge assembly 22 to the third and fourth bodies 134, 164 on the other side of the hinge assembly. The interior space 222 defined by the hinge assembly 22, is normally filled with air and also provides thermal insulation. Although the preferred embodiment is described as including the first and second insulating bodies 198, 207, alternative embodiments contemplate manufacture of the present invention without these thermal bodies 198, 207 when the intended installation site is at a temperate area.

[0062] FIG. 8 shows a sectional view of the first bracketing body 230 and second bracketing body 254 of the preferred embodiment of the connection assembly 24. The first bracketing body 230 and the second bracketing body 254 define a third panel receiving volume 328 have a square U-shaped cross section. The third panel assembly 30 is positioned within the

third panel receiving volume 328. The third panel assembly 30 is preferably comprised of a layer of insulative core material 224 positioned between metallic reinforcing layers 226, 228.

[0063] The first bracketing body 230 comprises a base planar member 232 with a first end 234 and a second end 236. A first engagement fin 238 extends at a right angle from the first end 234 of the base planar member 232. A side planar member 240 extends at a right angle from the second end 236 of the base planar member 232. A second engagement fin 246 extends from the base member 232 at a position between the side planar member 240 and first engagement fin 238 at a right angle. The base planar member 232 and the side planar member 240 both have planar engaging surfaces 233, 241 and non-engaging surfaces 235, 243.

[0064] The first bracketing body 230 is preferably fixed to the panel assembly 328 with fasteners, such as a row of rivets 245. A first channel beam 247, having a generally C-shaped cross section, is positioned at and formed integrally with the free end of the second engagement fin 246. The first channel beam 247 has a curved concave interior surface 248 which defines a first insulating volume 250. The first engagement fin 238, the second engagement fin 246, and the base member 232 define a first sealing volume 252 having a generally square U-shaped cross section. Retaining members 226 are located within the first seal forming volume 252. In the preferred embodiment, the retaining members 196 are ridges. In alternative embodiments the retaining members 226 are a plurality of individualized extruded teeth.

[0065] As shown in FIG. 8, the second bracketing body 254 comprises a base planar member 256 with a first end 258 and a second end 260, a planar engaging surface 255 and a non-engaging surface 257. A second channel beam 261 having a generally C-shaped cross section is formed integrally with and positioned at the first end 258 of the base planar member 256. The second channel beam 261 has a curved concave interior surface 262 defining a second insulating volume 264. A locking engagement surface 266 extends from the non-engaging surface 257 at an angle proximal to the second end 260 of the base planar member 256. The locking engagement surface 266 has ridges 265 extending therefrom.

[0066] The second engagement fin 246 and the second bracketing body 254 are positioned with respect to each other such that the open ends of the first and second channel beams 247, 261 face each other with a space 267 between. The channel beams 247, 261 are mechanically connected by a rigid first insulating body 268 (i.e., a thermally-nonconductive, hardened resin) shaped to fit within the first and second insulating volumes 250, 264 and a portion of the space 267 between the channel beams 247, 261. In this manner, the second

bracketing body 254 is fixed relative to, but not in direct contact with, the first bracketing body 230.

[0067] FIG. 9 discloses a sectional view of a third bracketing body 270 and a fourth bracketing body 290 of the preferred embodiment of the connection assembly 24. The third bracketing body 270 and fourth bracketing body 290 define a fourth panel receiving volume 330 having a square U-shaped cross section. A second end of the first panel assembly 26 is positioned in the fourth panel receiving volume 330. The third bracketing body 270 having base planar member 272 with a first end 274, a second end 276, a planar engaging surface 273 and a non-engaging surface 275. A side planar member 278 extends at a right angle from the first end 274 of the base member 272 and also has an engaging surface 279 and a non-engaging surface 283.

[0068] A third channel beam 281 having a generally C-shaped cross section is formed integrally with and positioned at the free end of the side planar member 278. The third channel beam 281 has a concave curved interior surface 282 which defines a third insulating volume 284.

[0069] A third engagement fin 280 is formed integrally with and extends from the third channel beam 281 in a direction generally toward the base planar member 272. The third engagement fin 280 is spaced from and generally parallel with the side planar member 278 forming a second sealing volume 289 defined by the third engagement fin 280, the third channel beam 281 and the side planar member 278.

[0070] As shown in FIG. 9, the preferred embodiment of the connection assembly 24 includes a fourth bracketing body 290 with a base planar member 291 and side planar member 293 extending from one end 285 of the base planar member 291. The base planar member 291 has a planar engaging surface 295 and a non-engaging surface 297. The side planar member 293 also has a planar engaging surface 299 and non-engaging surface 301.

[0071] The fourth bracketing body 290 is preferably fixed to the panel assembly 330 with fasteners, such as a row of rivets 287. A fourth channel beam 292, having a generally C-shaped cross section, is formed integrally with and positioned at the free end of the side planar member 293. The fourth channel beam 292 has a concave curved interior surface 294 forming a fourth insulating volume 296. A partially-cylindrical bearing surface 300 is formed in the exterior surface 295 of the fourth channel beam 292, the non-engaging surface 301 of the side planar member 293 and a curved surface 203 of a bearing fin 298 extending from the non-engaging surface 301. The side planar member 278 of the third bracketing body 270 is positioned with respect to the side planar member 293 of the fourth bracketing body 290 such

that the open ends of the third and fourth channel beams 281, 292 face each other with a space 303 therebetween. The channel beams 281, 292 are mechanically connected by a second insulating body 322 (i.e., a thermally-nonconductive, hardened resin) shaped to fit within the third and fourth insulating volumes 284, 296 and a portion of the space 303 between the channel beams 281, 292. In this manner, the third bracketing body 270 is fixed relative to, but not in direct contract with, the fourth bracketing body 290.

[0072] A locking member 308 having a hinge pin 310 at one end is rotatably connected to the third bracketing body 290 with the hinge pin 310 pivoting within the partially-cylindrical bearing surface 300 and occupying the corresponding partially-cylindrical volume 302 defined by the bearing surface 300. The locking member 308 includes a planar strut member 312 extending from the hinge pin 310 at one end and having a free second end 314. Ridges 316 are formed in the free second end 314 to correspond with the locking engagement surface 266 of the lock-engaging member 254 (see FIG. 8). A spacing fin 318 having an L-shaped cross-section extends from the planar strut member 312. The spacing fin 318 is positioned with respect to the hinge pin 310 such that the hinge pin 310 occupies the space between spacing fin 318 and the bearing fin 298 when the locking member 308 is in the unlocked position as shown in FIG. 9.

[0073] FIG. 10 depicts the connection assembly in a configuration where the first panel assembly 26 is connected to a third panel assembly 30 in a perpendicular alignment. This could occur in a building construction, for example, when a wall panel is mated with a ceiling panel. In this configuration, the first and second insulating bodies 268, 322 and the first and second spaces 267, 303 create a thermal barrier across the connection assembly 24. Thermal energy is inhibited from passing from the first and second bracketing bodies 230, 254 on one side of the connection assembly 24 to the third and fourth bracketing bodies 270, 290 on the other side.

[0074] In the configuration shown in FIG. 10, the first, second and third engagement fins 238, 246, 280 are arranged in a generally parallel, overlapping configuration with the third engagement fin 280 positioned in the first sealing volume 252 between the first and second engagement fins 238, 246 and the first engagement fin 238 positioned in the second sealing volume 289 between the side panel member 278 and the third engagement fin 280.

[0075] A rubber sealing element 324 is positioned in the first sealing volume and compressed therein by the third engagement fin 280. Sealing element 326 occupies the second sealing volume 289 and is compressed therein by the first engagement fin 238. In this manner, the sealing elements 324, 326 inhibit fluid flow into the interior space 330.

[0076] To use the connection assembly 24, the first and third panel assemblies 26, 30 are inserted into the fourth and third panel receiving volumes 330, 328, respectively, and fixed thereto with fasteners, such as rows of rivets 245, 277, 287.

[0077] As shown in FIG. 10, the locking member 308 is rotatable between a first position (shown in FIG. 9) and second position. In the first position, the ridges 316 of the locking member 308 are not engaged with the ridges 265 of the locking engagement surface 266 of the second bracketing body 254. In the second position, the ridges 316 are engaged with the ridges 265 of the locking engagement surface 266.

[0078] As described above, the sealing elements 324, 326 inhibit moisture and other fluids from passing through the connection assembly 24 between first and third panel assemblies 26, 30. In addition, the sealing elements 324, 326 create a biasing force that urges the first bracketing body 230 and the third bracketing body 270 apart and at the same time urges the ridges 316 of the locking member 308 into the ridges 365 of the locking engagement surface 266 of the second bracketing body 254. This inhibits inadvertent disengagement of the locking member 308 from the locking engagement surface 266. Retaining members 332 in the first and second sealing volumes 252, 289, respectively, inhibit egress of the sealing elements 324, 326 from those volumes.

[0079] As shown in FIG. 11, in alternative embodiments, in addition to or instead of the rivets described with reference to FIG. 10, the engaging surfaces 233, 241 of the base planar member 232 and the side planar member 240 of the first bracketing body 230 have isometric ridges 242 and angled ridges 244, respectively, that engage the third panel assembly 30. Likewise, the engaging surfaces 295, 299 of the base planar members 291 and side planar members 293 of the fourth bracketing body 290 have angled ridges 304 and isometric ridges 306 that engage the first panel assembly 26, with the angled ridges 304 angled to resist movement of the first panel assembly 26 from the bracketing volume 330. The engaging surfaces 273, 279 of the base planar member 272 and the side planar member 278 of the third bracketing body 270 have angled ridges 286 and isometric ridges 288, respectively, that engage the first panel assembly 26, with the angled ridges 286 angled toward the side planar member 278. Other alternative embodiments of the invention contemplate a plurality of individualized extruded members extending normally or at an angle from the planar members, as described with reference to FIGS. 6B–6C.

The present invention is described above in terms of preferred illustrative embodiments of a specifically described interconnection system. Those skilled in the art will recognize that

alternative constructions of such a system can be used in carrying out the present invention. Other aspects, features, and advantages of the present invention may be obtained from a study of this disclosure and the drawings, along with the appended claims.

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CLAIMS

I claim:

1. A hinge assembly for interconnecting first and second panels and providing for rotation said first panel with respect to said second panel around an axis of rotation between a first relative position and a second relative position, the hinge assembly comprising:

a first bracketing body having a first bearing member and at least one planar member;

a second bracketing body having a second bearing member pivotally engaged with the first bearing member and at least one planar member;

a third bracketing body having at least one planar member;

a fourth bracketing body having at least one planar member;

a first thermal insulating body positioned between and separating said first and third bracketing bodies;

a second thermal insulating body positioned between and separating said second and fourth bracketing bodies;

a first panel receiving volume at least partially defined by said at least one planar member, of said first and third bracketing bodies;

a second panel receiving volume at least partially defined by said at least one planar members of said second and fourth bracketing bodies; and

wherein said at least one planar members of said second and fourth bracketing bodies at least partially define a second panel receiving volume.

2. The hinge assembly of Claim 1 further comprising at least one sealing element positioned between said third bracketing body and said fourth bracketing body.

3. The hinge assembly of Claim 1 wherein:

said at least one planar member of said first bracketing body comprises first and second planar members intersecting at a first junction in a perpendicular relationship and having first and second planar surfaces that, at least partially, define the first panel receiving volume;

said at least one planar member of said second bracketing body comprises third and fourth planar members intersecting at a second junction in a perpendicular relationship and having third and fourth planar surfaces that, at least partially, define the second panel receiving volume;

said at least one planar member of said third bracketing body comprises fifth and sixth planar members intersecting at a third junction in a perpendicular relationship and

having fifth and sixth planar surfaces that, at least partially, define the first panel receiving volume; and

said at least one planar member of said fourth bracketing body comprises seventh and eighth planar members intersecting at a fourth junction in a perpendicular relationship and having seventh and eighth planar surfaces that, at least partially, define the second panel receiving volume.

4. The hinge assembly of Claim 1 wherein:

said first bearing member comprises a curved first bearing arm partially surrounding but spaced from said hinge pin; and

said second bearing member comprises a curved second bearing arm that terminates in a hinge barrel partially encircling and engaging said hinge pin.

5. The hinge assembly of Claim 4 wherein the first bearing member further comprises:

a convex first bearing surface of said hinge pin having a first radius R1 from the axis of rotation;

at least one concave second bearing surface of said first bearing arm having a second radius R2 from the axis of rotation, wherein R2 is greater than R1;

a convex exterior third bearing surface of said first bearing arm having a third radius R3 from the axis of rotation, wherein R3 is greater than R2; and

an end surface of said bearing arm extending between the second and third bearing surfaces.

6. The hinge assembly of Claim 5 wherein said first bearing member further comprises:

a first stopping surface extending between first bearing surface and said second bearing surface.

7. The hinge assembly of Claim 6 wherein said first stopping surface forms a first side of a bridging member connecting said hinge pin to said first bearing arm and wherein said bridging member having a second side extending between said first bearing surface and said second bearing surface forming a second stopping surface.

8. The hinge assembly of Claim 7 wherein said first bearing member further comprises:

a stop member extending from the exterior third bearing surface of said first bearing arm;

said stop member comprising third and fourth stopping surfaces extending between the third bearing surface and a convex fourth bearing surface; and

said fourth bearing surface having a fourth radius R4 from the axis of rotation, wherein R4 is greater than R3.

9. The hinge assembly of Claim 5 wherein the second bearing member comprises:

an concave fifth bearing surface of said hinge barrel having a fifth radius R5 from the axis of rotation, equal to R1;

a convex sixth bearing surface of said hinge barrel having a sixth radius R6 from the axis of rotation, wherein R6 is greater than R5;

a convex seventh bearing surface of said hinge barrel having a seventh radius R7 from the axis of rotation, wherein R7 is greater than R5; and

a concave eighth bearing surface of said second bearing arm having an eighth radius R8 from the axis of rotation, wherein R8 is greater than R7;

an outer end surface of said hinge barrel extending between the fifth and sixth bearing surfaces.

10. The hinge assembly of Claim 9 wherein said second bearing member further comprises a stopping surface extending between the seventh and eighth bearing surfaces.

11. The hinge assembly of Claim 8 wherein said second bearing member further comprises:

a concave fifth bearing surface of said hinge barrel having a fifth radius R5 from the axis of rotation, equal to R1;

a convex sixth bearing surface of said hinge barrel having a sixth radius R6 from the axis of rotation, wherein R6 is greater than R5;

a convex seventh bearing surface of said hinge barrel having a seventh radius R7 from the axis of rotation, wherein R7 is greater than R5; and

a concave eighth bearing surface of said bearing arm having an eighth radius R8 from the axis of rotation, wherein R8 is greater than R7;

a concave ninth bearing surface having a ninth radius R9 from the axis of rotation, wherein R9 is greater than R8; and

an outer end surface of said hinge barrel extending between the fifth and sixth bearing surfaces.

12. The hinge assembly of Claim 11 further comprising second and third stopping surfaces extending from the ninth bearing surface and positioned to contact the third and fourth stopping surfaces, respectively, of the stop member.

13. The hinge assembly of Claim 2 further comprising:

first and second fins extending from the second bracketing body and partially defining a first sealing volume therebetween;

third and fourth fins extending from the fourth bracketing body and partially defining a second sealing volume therethrough;

wherein said at least one sealing element is first and second sealing element;

said first sealing element occupying the first sealing volume; and

said second sealing element occupying the second sealing volume.

14. The hinge assembly of Claim 3 further comprising a plurality of teeth extending into said first and second panel receiving volumes from at least one of said panel surfaces.

15. The hinge assembly of Claim 3 further comprising a plurality of ridges extending into said first and second panel receiving volumes from at least one of said panel surfaces.

16. The hinge assembly of Claim 13 wherein in the first relative position:

the first and second panel receiving volumes are aligned;

the second sealing element is compressed between the first or second engagement fins and the fourth bracketing body; and

the first sealing element is compressed between one of the third or fourth engaging fins and the third bracketing body.

17. The hinge assembly of Claim 1 wherein:

the first thermal insulating body is positioned between and connected with the first and third bracketing bodies; and

the second thermal insulating body is positioned between and connected with the second and fourth bracketing bodies.

18. The hinge assembly of Claim 17 further comprising:

a first channel beam connected to said first bracketing body;

a second channel beam connected to said second bracketing body;

a third channel beam connected to said third bracketing body;

a fourth channel beam connected to said fourth bracketing body;

wherein the first thermal insulating body is positioned between and connected to said first and third channel beam; and

wherein the first thermal insulating body is positioned between and connected to said second and fourth channel beam.

19. A connection assembly for connecting two panel assemblies in a fixed relative position, the connection assembly comprising:

a first bracketing body having at least one planar member;

a second bracketing body having at least one planar member;

a first thermal insulating body positioned between and connected to said first and second bracketing bodies;

wherein the first bracketing body and the second bracketing body define a first panel receiving volume;

a third bracketing body having at least one planar member;

a fourth bracketing body having at least one planar member;

a second thermal insulating body positioned between and connected to the third and fourth bracketing bodies;

wherein the third and fourth bracketing bodies define a second panel receiving volume; and

at least one fluid sealing element positioned between the first and second bracketing bodies.

20. The connection assembly of Claim 19 further comprising a locking member pivotally connected to the connection assembly.

21. The connection assembly of Claim 20 further comprising:

a hinge pin positioned at a first end of said locking member;

a planar strut member of said locking member extending from said hinge pin; and

a locking engagement surface positioned for engagement with said strut member to lock the bracketing bodies in a fixed relative position.

22. The connection assembly of Claim 21 further comprising:

ridges formed in the free end of said planar strut member for engagement with ridges formed on said locking engagement surface of said connection assembly.

23. The connection assembly of Claim 22 wherein:

said hinge pin of the locking member is positioned adjacent a bearing surface of the fourth bracketing body; and

said engagement surface is positioned on said second bracketing body.

24. The connection assembly of Claim 19 further comprising:

a first channel beam connected to said first bracketing body;

a second channel beam connected to said second bracketing body;

a third channel beam connected to said third bracketing body;

a fourth channel beam connected to said fourth bracketing body;

wherein said first thermal insulating body is positioned between and connected to said first and third channel beams; and

wherein said second thermal insulating body is positioned between and connected to said second and fourth channel beams.

25. The connection assembly of Claim 19 further comprising:

a first fin extending from a first planar member of said first bracketing body;

a second fin extending said first planar member of said first bracketing bodies;

a sealing volume positioned between said first and second fins;

a first sealing element of said at least one sealing element positioned in said first sealing volume.

26. The connection assembly of Claim 25 further comprising:

a third fin connected to said fourth bracketing body;

said third fin forming a sealing volume between said fin and a second sealing volume;

a second sealing element of said at least one sealing element is positioned in said second sealing volume.

27. The connection assembly of Claim 26 wherein said bracketing bodies are locked in a fixed relative position

said first fixed sealing element is compressed between said third fin and said first bracketing body; and

said second sealing element is compressed between said first fin and said third bracketing body.

28. The connection assembly of Claim 19 further comprising a plurality of teeth extending into said panel receiving volumes from at least one of said panel surfaces.

29. The connection assembly of Claim 19 further comprising a plurality of ridges extending into said panel receiving volumes from at least one of said panel surfaces.

30. A connection assembly for connecting two panels, the assembly comprising:

a first plurality of bracketing bodies having a first set of planar surfaces defining a first volume for receiving a first panel;

a second plurality of bracketing bodies members having a second set of planar surfaces defining a second volume for receiving a second panel;

a first thermal insulating body positioned between two of the first plurality of bracketing bodies;

a second thermal insulating body positioned between two of the second plurality of bracketing bodies; and

at least one sealing element positioned in a sealing volume, wherein said sealing volume

is positioned between the first and second panel receiving volumes.

31. The connection assembly of Claim 30 wherein the thermal insulating bodies are a hardened resin.

32. The connection assembly of Claim 30 wherein:

the first thermal insulating body is connected to but separates two of the first plurality of bracketing bodies; and

the second thermal insulating body is connected to but separates two of the second plurality of bracketing bodies.

33. The connection assembly of Claim 30 further comprising:

a first panel having a portion thereof occupying the first panel receiving volume and in engagement with the first set of planar surfaces;

a second panel having a portion thereof occupying the second panel receiving volume and in engagement with the second set of planar surfaces.

34. The connection assembly of Claim 33 wherein each of the first and second panels comprise:

a layer of insulating material;

a first layer of structural reinforcing material adjacent a first surface of said layer of insulating material;

a second layer of structural reinforcing material adjacent a second opposing surface of said layer of insulating material.

35. The connection assembly of Claim 33 further comprising;

panel engaging members extending from the first set of planar surfaces into the first panel receiving volume; and

panel engaging members extending from the second set of planar surfaces into the second panel receiving volume.

36. The connection assembly of Claim 34 wherein said panel engaging members are a plurality of teeth.

37. The connection assembly of Claim 34 wherein said panel engaging members are a plurality of ridges.

38. The connection assembly of Claim 30 wherein the first plurality of bracketing bodies is pivotally coupled to the second plurality of bracketing bodies.

39. The connection assembly of Claim 38 further comprising stopping surfaces on first and second plurality of bracket bodies positioned to prevent rotation of the first plurality of bracketing bodies relative to the second plurality of bracketing bodies beyond ninety degrees.

40. The connection assembly of Claim 30 wherein:

said first plurality of bracketing and the second plurality of bodies can be positioned to at least partially define an interior space positioned between the first and second panel receiving volumes; and

said at least one sealing element inhibits fluid flow into and from the interior space.

41. The connection assembly of Claim 40 wherein said at least one sealing elements is two sealing elements.

42. The connection assembly of Claim 30 further comprising a locking member pivotally coupled to the first plurality of bracketing bodies and rotatable to and from a locking position wherein the locking member is engaged with a lock engaging surface of the second plurality of bracketing bodies.

43. The connection assembly of Claim 42 wherein the locking member and the lock engaging surface have corresponding ridges positioned to interlock when the locking member is rotated into a locking position.

44. A connection assembly for connecting three panels, the assembly comprising:

a first plurality of bracketing bodies having a first set of planar surfaces defining a first volume for receiving a first panel;

a second plurality of bracketing bodies having a second set of planar surfaces defining a second volume for receiving a second panel;

a first thermal insulating body positioned between two of the first plurality of bracketing bodies;

a second thermal insulating body positioned between two of the second plurality of bracketing bodies;

at least one sealing element positioned in a first sealing volume, wherein said first sealing volume is positioned between the first and second panel receiving volumes;

a third plurality of bracketing bodies having a third set of planar surfaces defining a third volume for receiving said first panel;

a fourth plurality of bracketing bodies having a fourth set of planar surfaces defining a fourth volume for receiving a third panel;

a third thermal insulating body positioned between two of the third plurality of bracketing bodies;

a fourth thermal insulating body positioned between two of the fourth plurality of bracketing bodies; and

at least one sealing element positioned in a second sealing volume, wherein said second sealing volume is positioned between the third and fourth panel receiving volumes.

45. The connection assembly of Claim 44 wherein the thermal insulating bodies are a hardened resin.

46. The connection assembly of Claim 44 wherein:

the first thermal insulating body is connected to but separates two of the first plurality of bracketing bodies;

the second thermal insulating body is connected to but separates two of the second plurality of bracketing bodies;

the third thermal insulating body is connected to but separates two of the third plurality of bracketing bodies; and

the fourth thermal insulating body is connected to but separates two of the fourth plurality of bracketing bodies.

47. The connection assembly of Claim 44 further comprising:

a first panel having a first portion thereof occupying the first panel receiving volume and in engagement with the first set of planar surfaces, said first panel having a second portion thereof occupying the fourth panel receiving volume and in engagement with the fourth set of planar surfaces;

a second panel having a portion thereof occupying the second panel receiving volume and in engagement with the second set of planar surfaces; and

a third panel having a portion thereof occupying the third panel receiving volume and in engagement with the third set of planar surfaces.

48. The connection assembly of Claim 47 wherein each of the first, second, and third panels comprise:

a layer of insulating material;

a first layer of structural reinforcing material adjacent a first surface of said layer of insulating material;

a second layer of structural reinforcing material adjacent a second opposing surface of said layer of insulating material.

49. The connection assembly of Claim 47 further comprising;

panel engaging members extending from the first set of planar surfaces into the first panel receiving volume;

panel engaging members extending from the second set of planar surfaces into the second panel receiving volume;

panel engaging members extending from the third set of planar surfaces into the third panel receiving volume; and

panel engaging members extending from the fourth set of planar surfaces into the fourth panel receiving volume.

50. The connection assembly of Claim 49 wherein said panel engaging members are a plurality of teeth.

51. The connection assembly of Claim 49 wherein said panel engaging members are a plurality of ridges.

52. The connection assembly of Claim 44 wherein the first plurality of bracketing bodies is pivotally coupled to the second plurality of bracketing bodies.

53. The connection assembly of Claim 52 further comprising stopping surfaces on first and second plurality of bracketing bodies positioned to prevent rotation of the first plurality of bracketing bodies relative to the second plurality of bracketing bodies beyond ninety degrees.

54. The connection assembly of Claim 44 wherein:

said first plurality of bracketing bodies and said second plurality of bodies can be positioned to at least partially define an interior space positioned between the first and second panel receiving volumes; and

said at least one sealing element inhibits fluid flow into and from the interior space

55. The connection assembly of Claim 54 wherein said at least one sealing element is two sealing elements.

56. The connection assembly of Claim 44 further comprising a locking member pivotally coupled to the fourth plurality of bracketing bodies and rotatable to and from a locking position wherein the locking member is engaged with a lock engaging surface of the third plurality of bracketing bodies.

57. The connection assembly of Claim 56 wherein the locking member and the lock engaging surface have corresponding ridges positioned to interlock when the locking member is rotated into a locking position.

58. A connection assembly for connecting three panels, the assembly comprising:

a first set of planar surfaces defining a first volume for receiving a first panel;

a second set of planar surfaces defining a second volume for receiving a second panel;

a first sealing volume positioned between the first and second panel receiving volumes;

a third set of planar surfaces defining a third volume for receiving said first panel;

a fourth set of planar surfaces defining a fourth volume for receiving a third panel;

a second sealing volume is positioned between the third and fourth panel receiving volumes;

panel engaging members extending from the first set of planar surfaces into the first panel receiving volume;

panel engaging members extending from the second set of planar surfaces into the second panel receiving volume;

panel engaging members extending from the third set of planar surfaces into the third panel receiving volume; and

panel engaging members extending from the fourth set of planar surfaces into the fourth panel receiving volume.

59. The connection assembly of Claim 58 wherein the first set of planar surfaces is pivotally coupled to the second set of planar surfaces.

60. The connection assembly of Claim 58 wherein the third set of planar surfaces is in a fixed relationship to the fourth set of planar surfaces;

61. The connection assembly of Claim 58 wherein said panel engaging members are a plurality of teeth.

62. The connection assembly of Claim 58 wherein said panel engaging members are a plurality of ridges.

63. The connection assembly of Claim 58 further comprising a locking member pivotally coupled between the third and fourth sets of planar surfaces and rotatable to and from a locking position wherein the locking member is engaged with a lock engaging surface positioned between said third and fourth volumes, wherein the locking member and the lock engaging surface have corresponding ridges positioned to interlock when the locking member is rotated into a locking position.

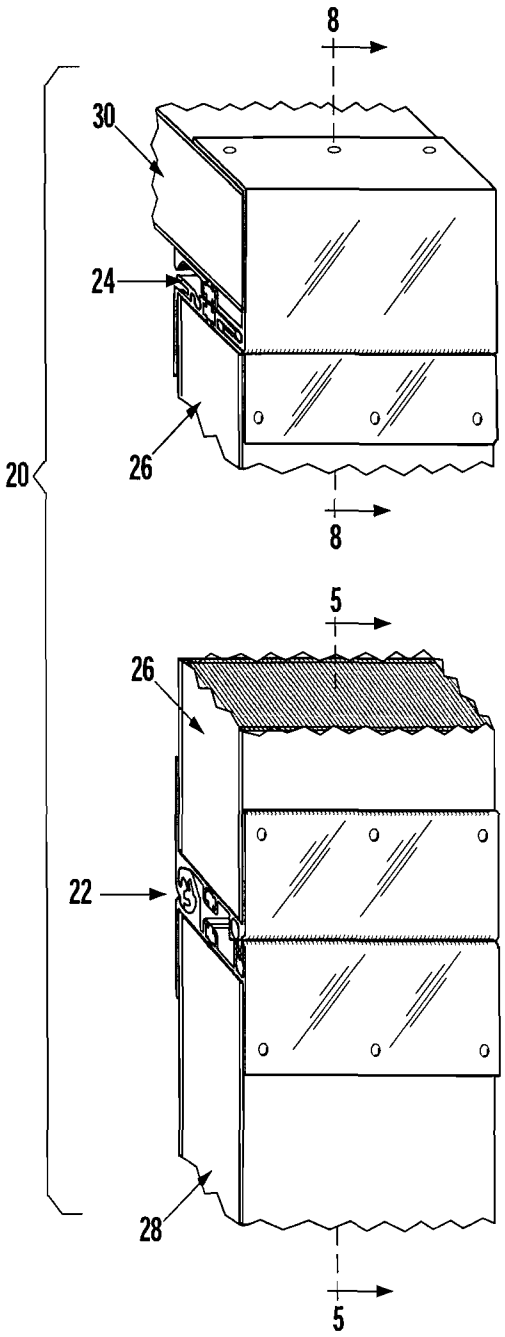


Fig. 1

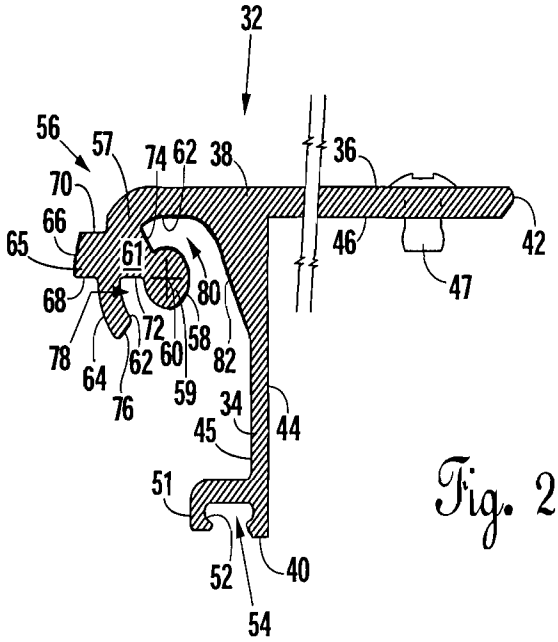

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Fig. 2

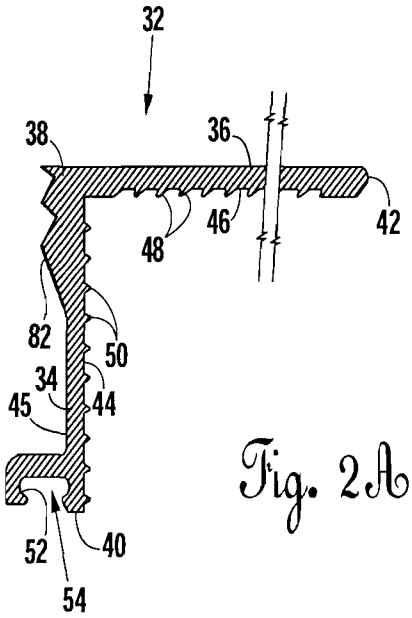

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Fig. 2A

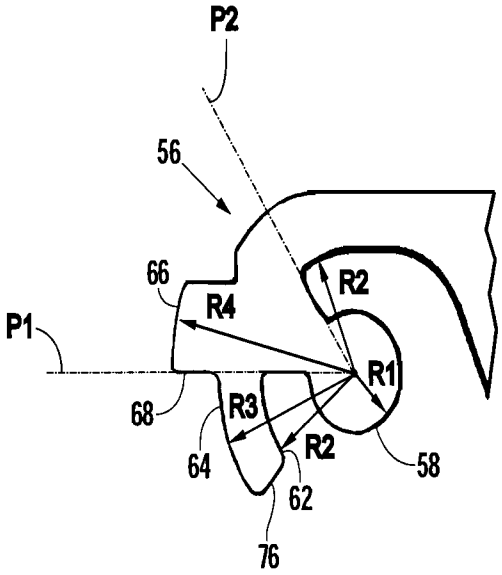


Fig. 2B

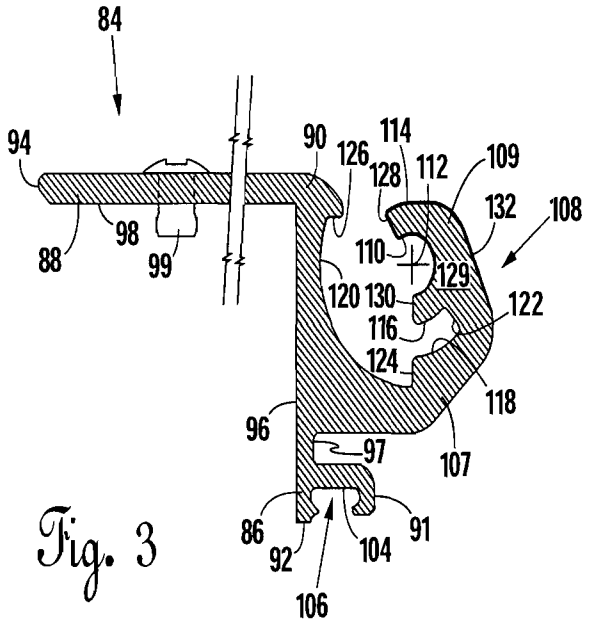

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Fig. 3

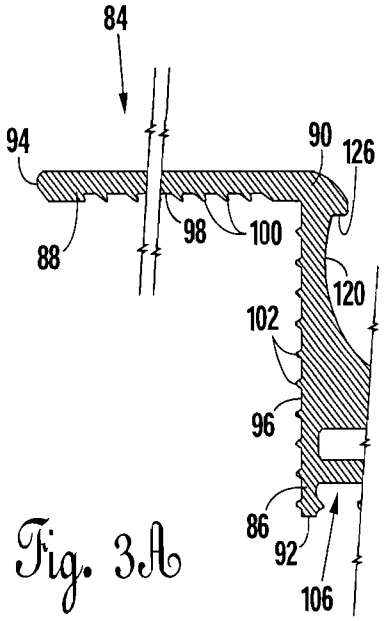

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Fig. 3A

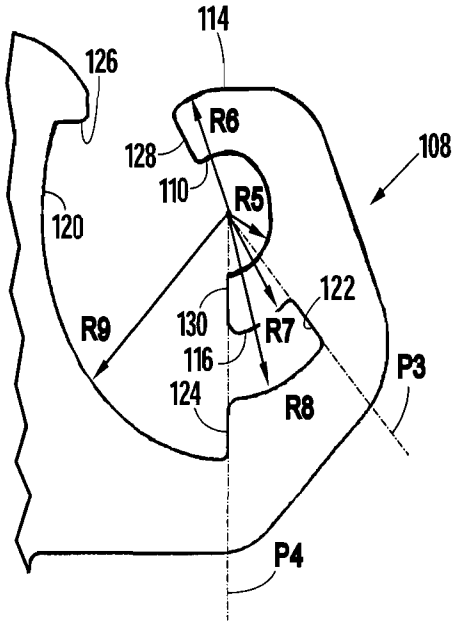


Fig. 3B

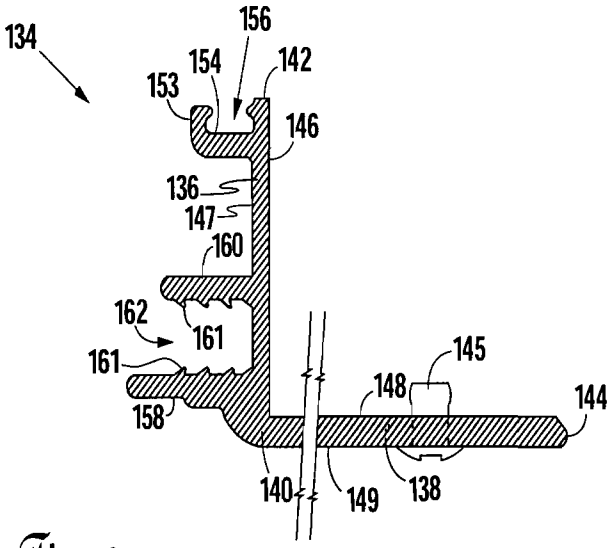

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Fig. 4

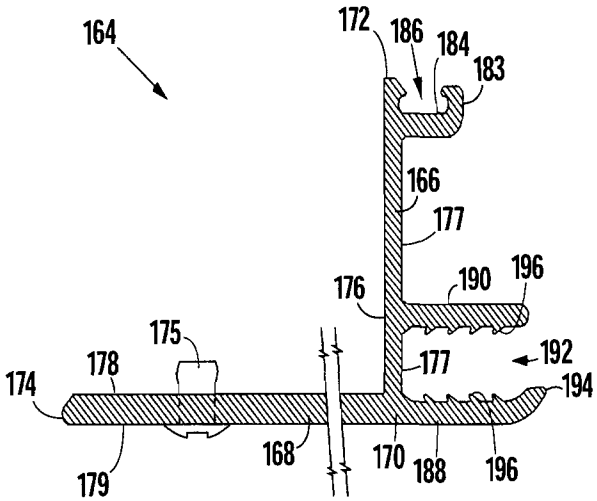

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Fig. 5

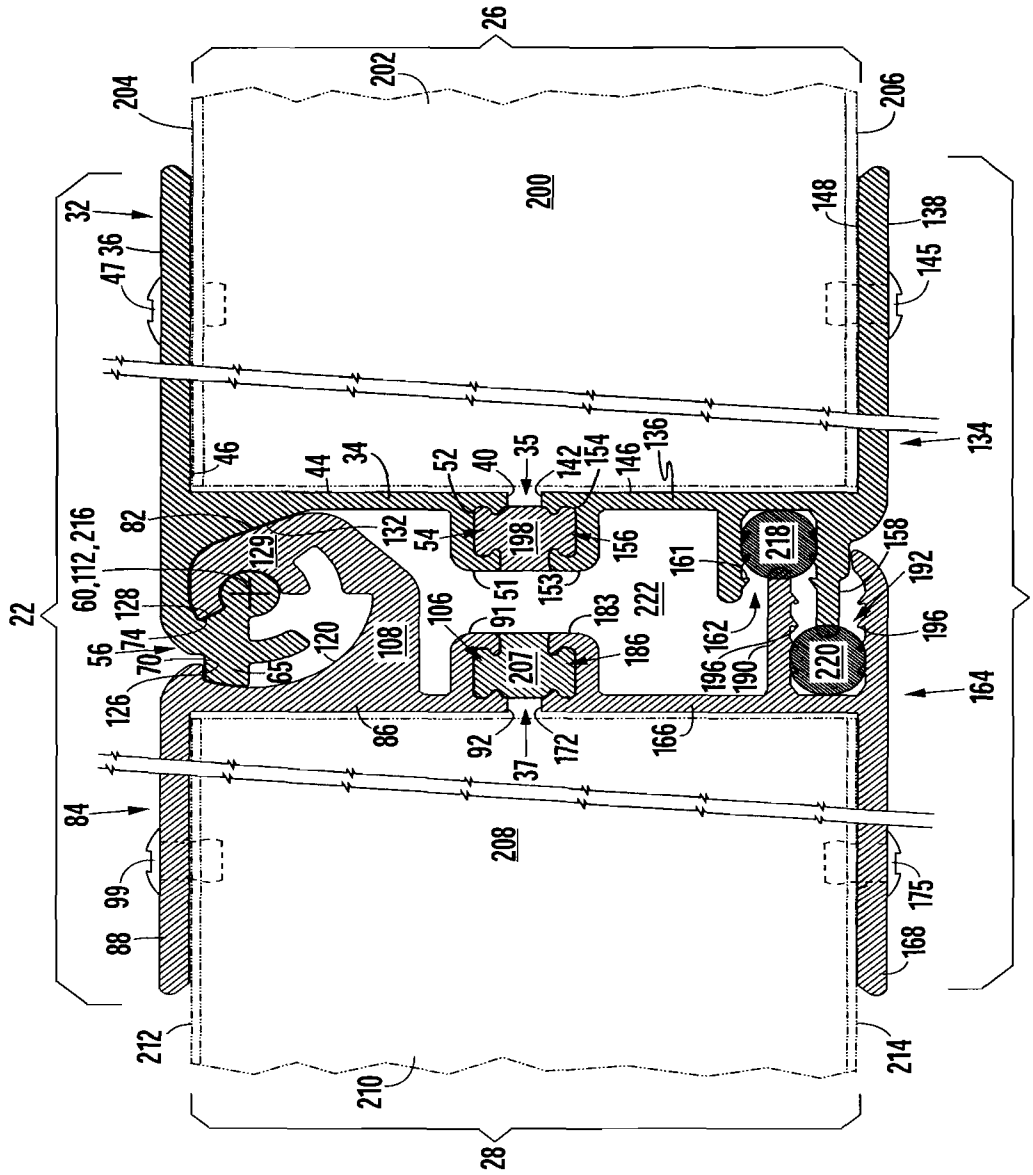

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Fig. 6

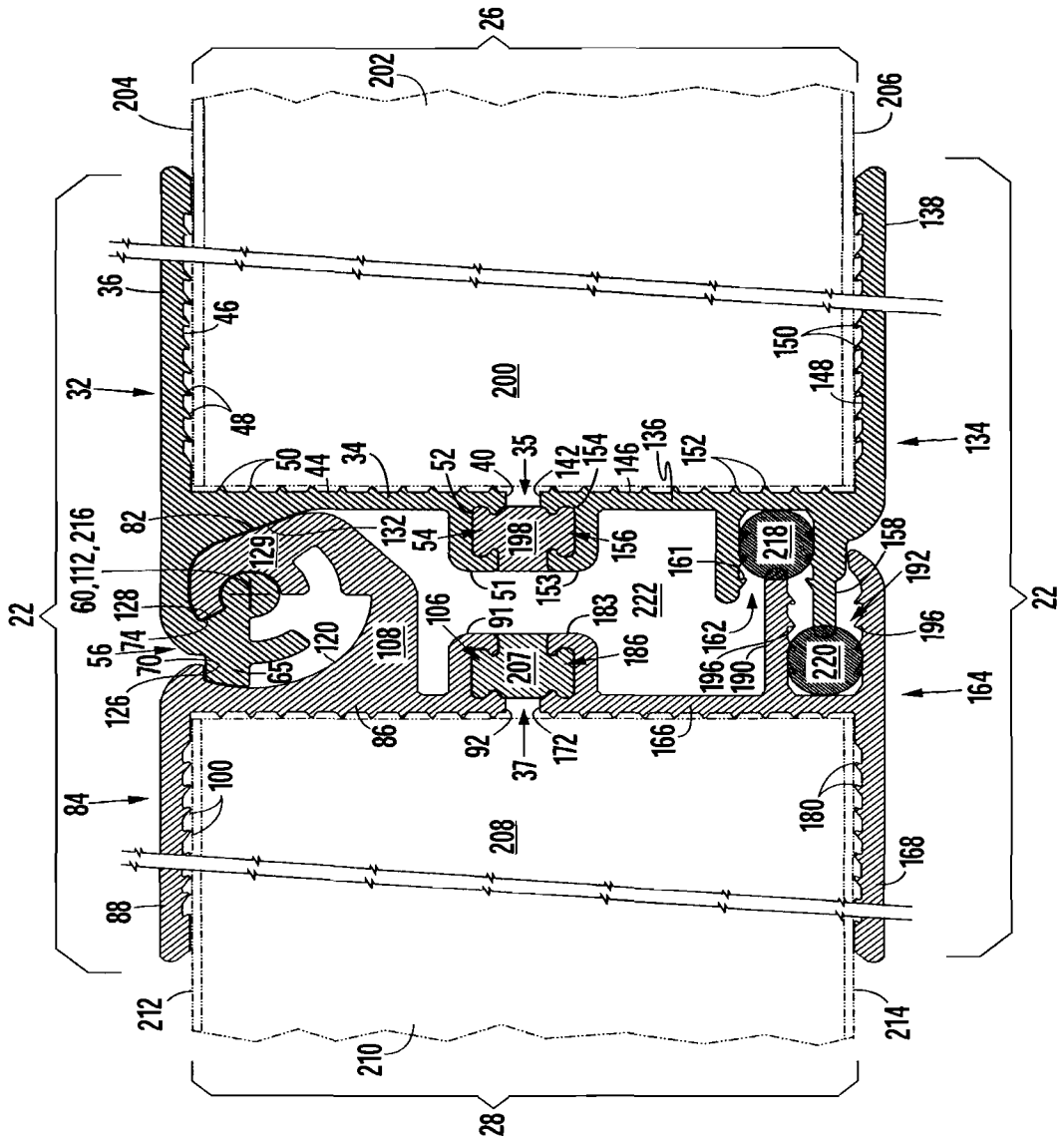

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Fig. 6A

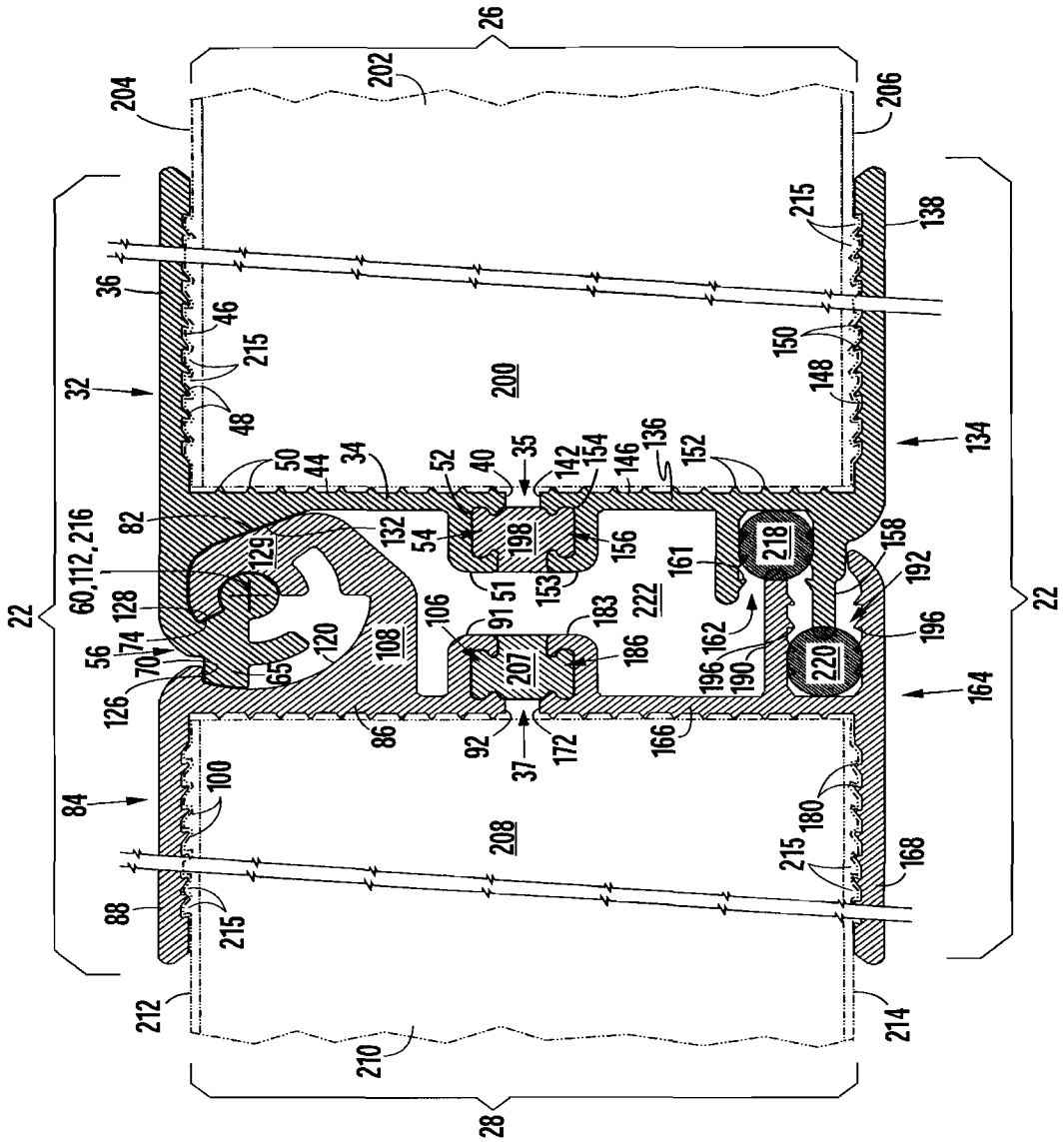

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Fig. 6B

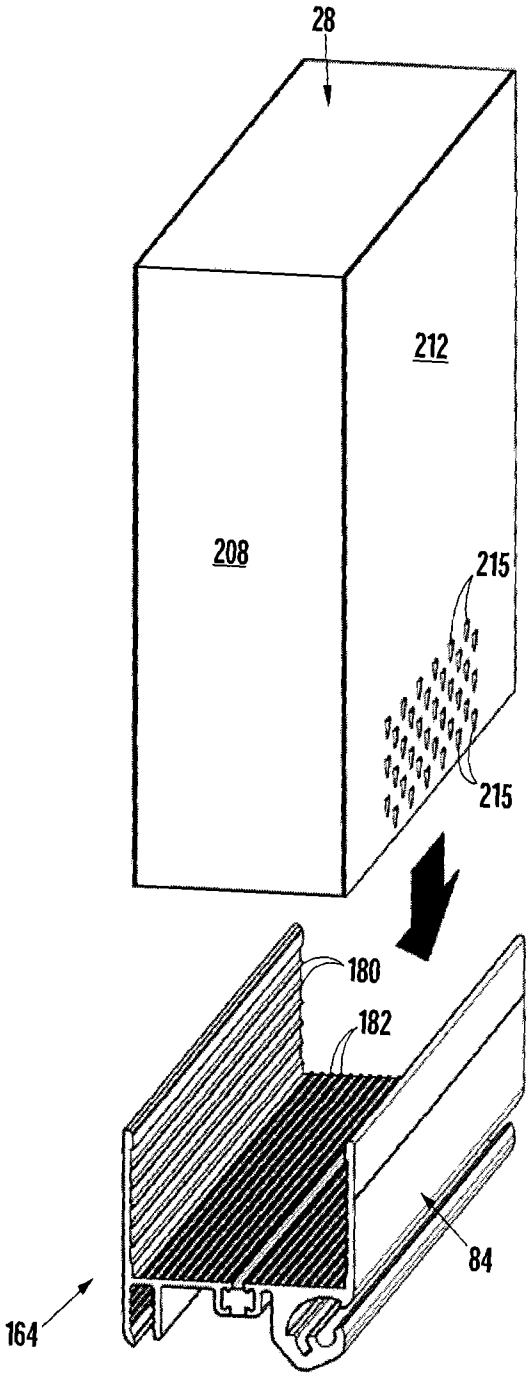


Fig. 6C

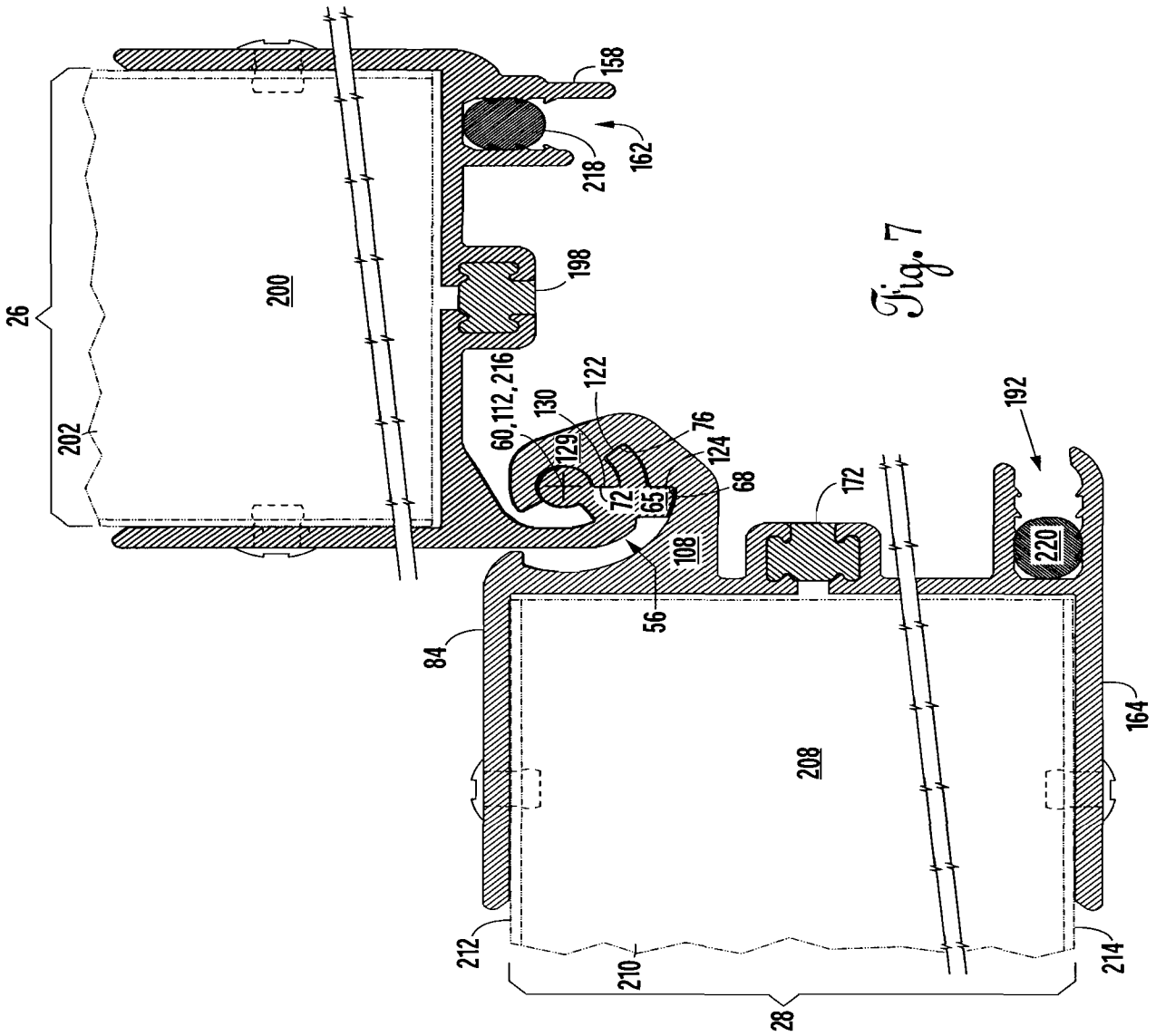

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Fig. 7

Fig. 8

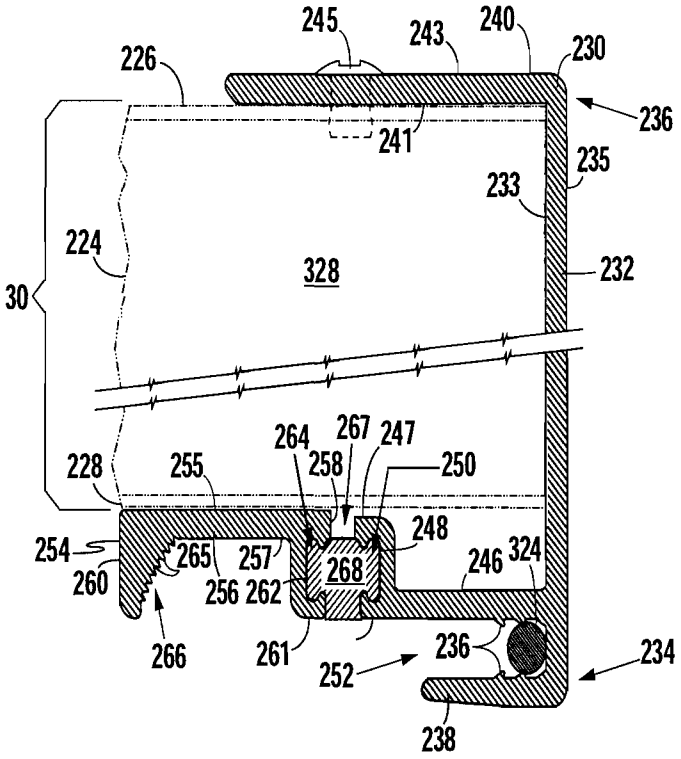
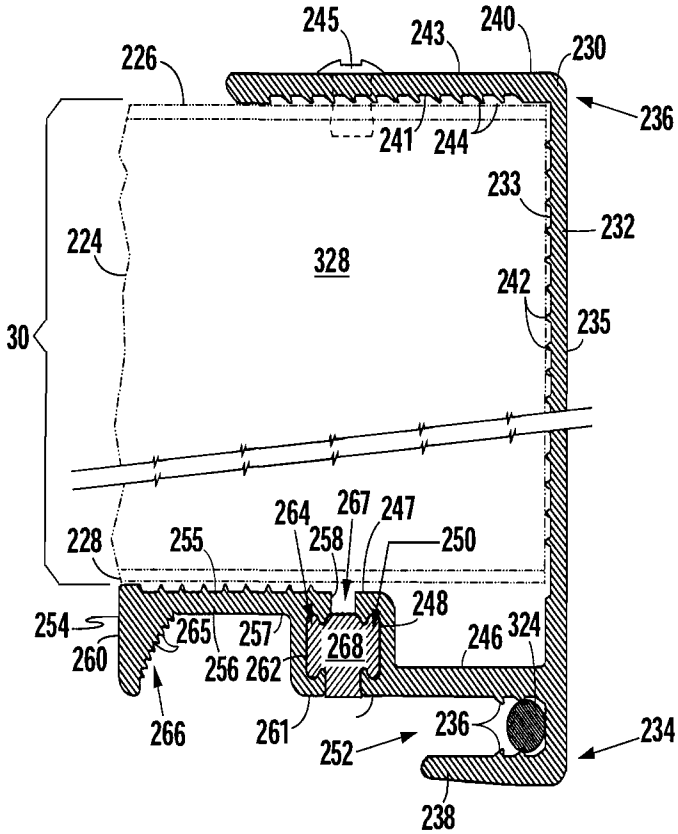

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Fig. 8A


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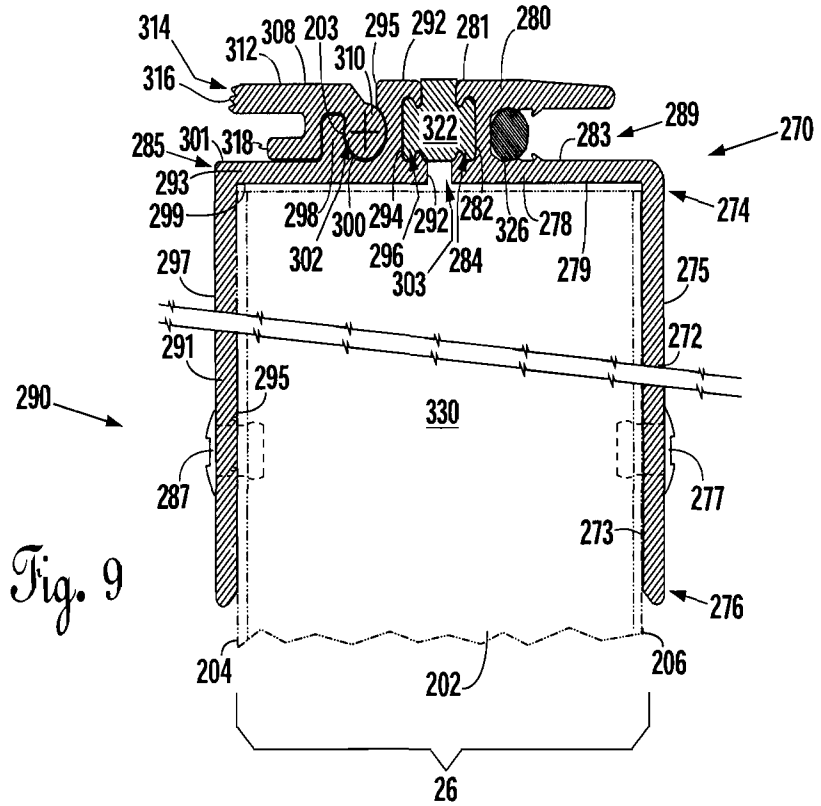

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Fig. 9

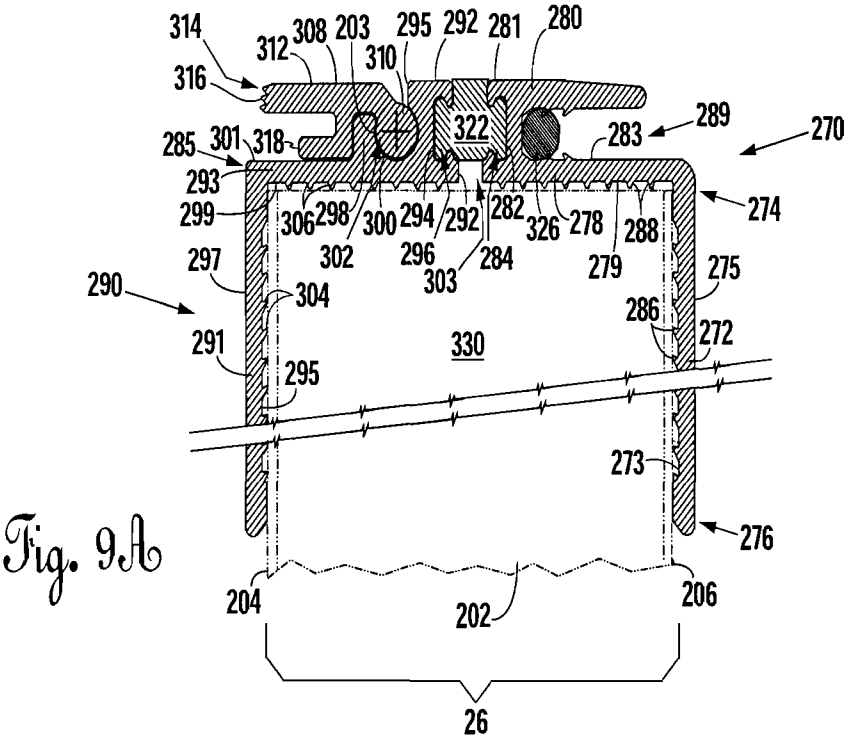

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Fig. 9A

Fig. 10

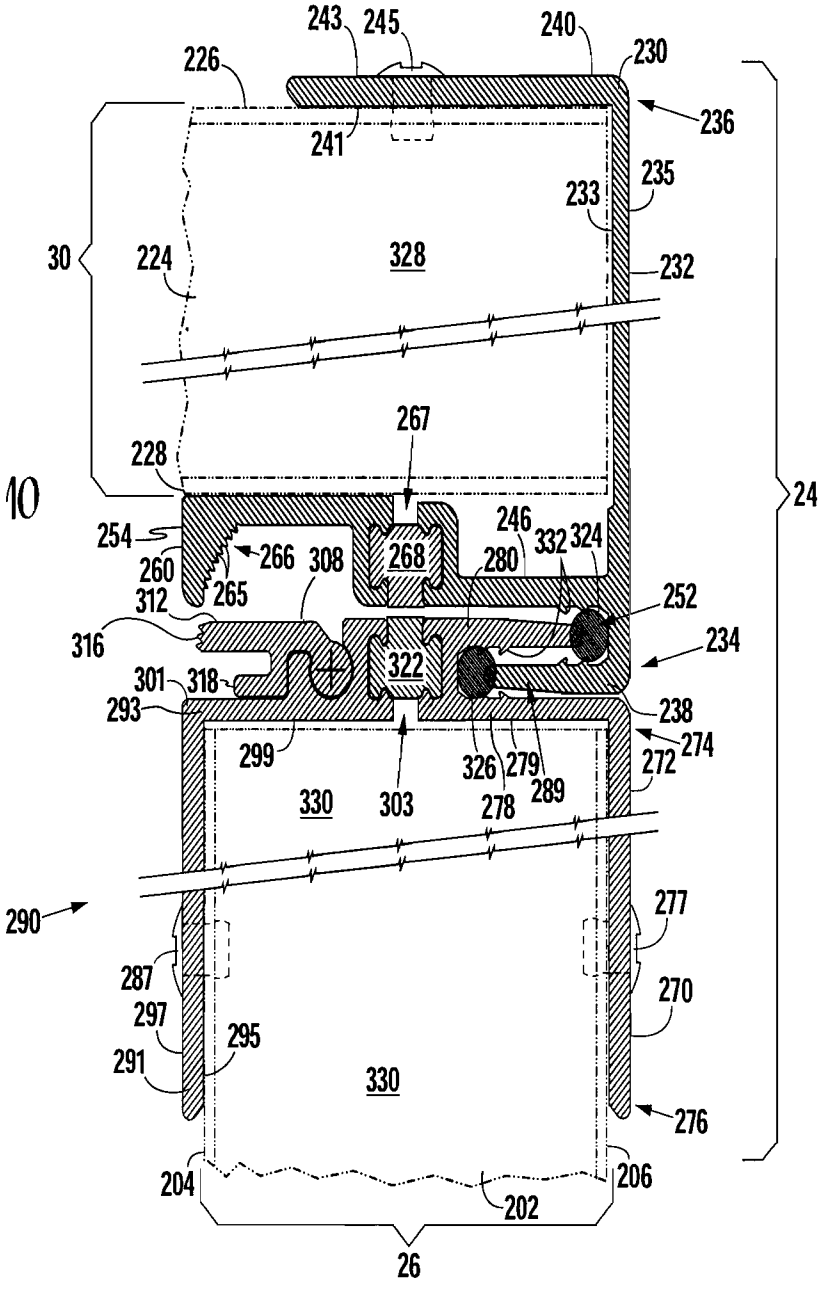
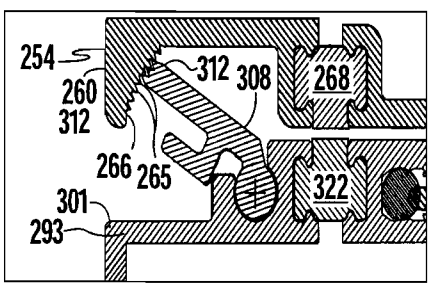


Fig. 10A



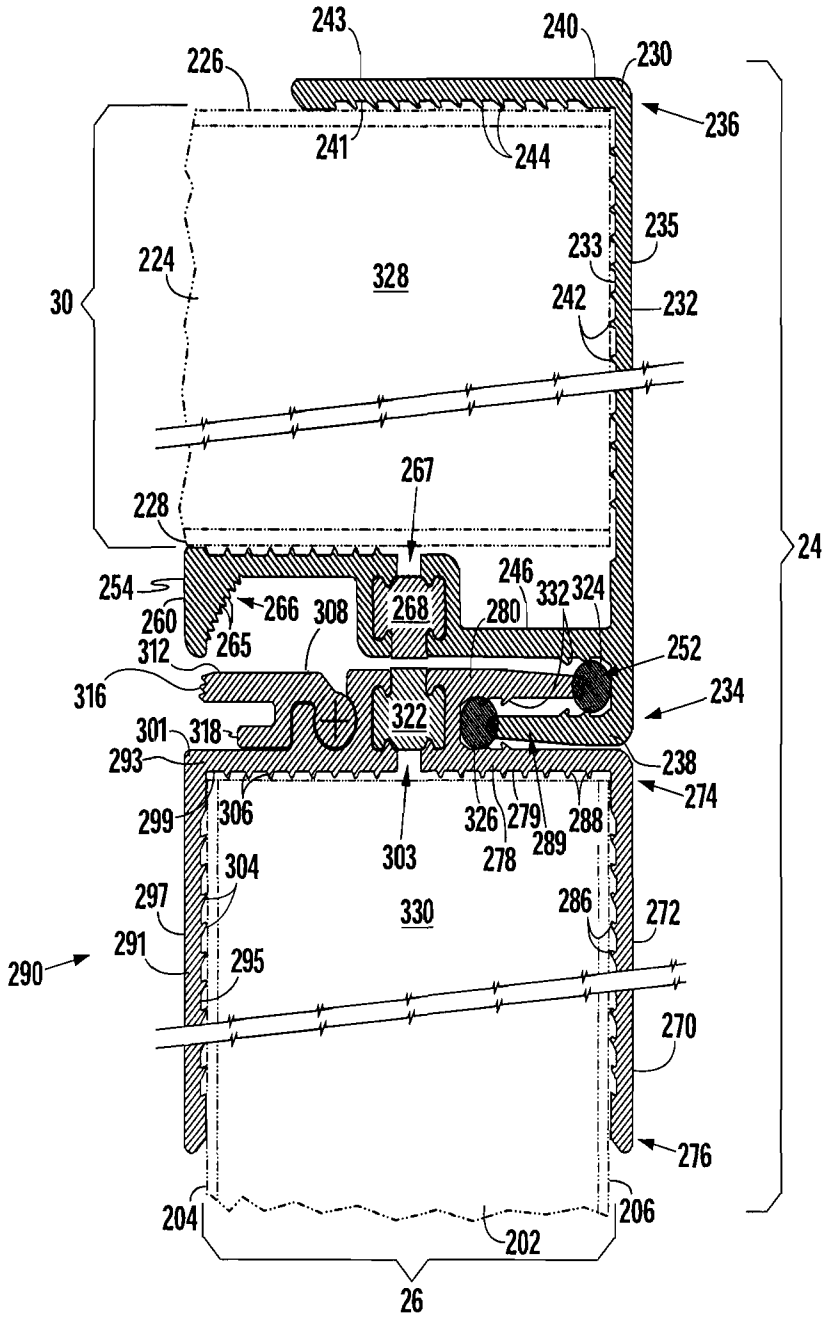

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Fig. 11