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(54) A WINDOW FRAME ASSEMBLY

(57) An elongate connector section for connecting to a first window frame section of a window frame assembly, the connector section comprising: a body; and a first leg extending away from the body transversely to a longitudinal axis of the connector section, the first leg including a first male portion for interengagement with a corresponding first female portion of the first window frame section, the first male portion including a first undercut for receiving a wall of the first female portion, wherein a layer of flexible polymeric material is secured to the first male portion.

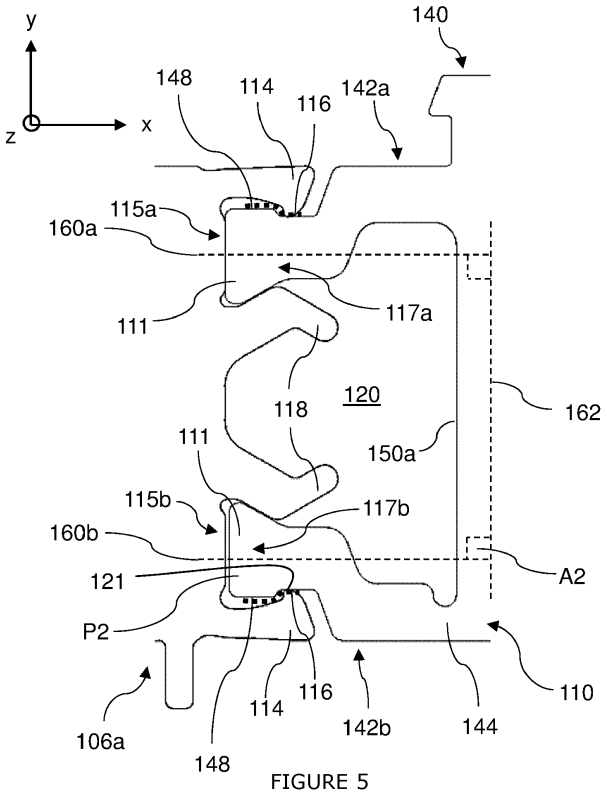

FIGURE 5

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Description

FIELD

[0001] The present teachings relate to a window frame assembly, and in particular to a connector section for a window frame assembly.

BACKGROUND

[0002] Typical fenestration units are assembled from a glazing unit comprising one or more panes of glass held around their periphery by frame members located along the borders of both faces of the glazing unit. In modern fenestration units, the frame members tend to be formed from plastics materials such as, for example, unplasticised polyvinyl chloride (uPVC) and/or metallic materials such as, for example, an aluminium alloy.

[0003] In units where the frame members are formed from a metallic material, it is typical for each frame member to comprise multiple interconnected sections. Commonly, these frame members are designed such that structural sections located adjacent a first face of the glazing unit are connected to structural sections located adjacent a second face of the glazing unit via two or more "dog-bone" shaped connector sections. It is preferable for the connector sections to be formed from a less thermally conductive material such as, for example, a plastics material. This allows the connector sections to act as thermal breaks between the structural sections adjacent a face of the glazing unit that may be external to a building and the structural sections adjacent a face of the glazing unit that may be internal to the building.

[0004] A problem with prior art window frame assemblies is that using two or more connector sections to connect two structural sections together tends to make the process of connecting the structural sections more complex and thus more time intensive. Moreover, when the two or more connector sections are required to act as thermal breaks, the connector sections are commonly required to be formed from high-strength, high melting point plastics materials, such as polyamides in order to ensure the connector sections do not distort causing misalignment of the two structural sections and can withstand the heat of a powder coating process after assembly. Such material can be costly.

[0005] The grip between an interconnected connector section and a structural section is required to be strong enough to resist typical forces acting to cause the two sections to slide axially relative to each other. In some jurisdictions, it must be demonstrated that frame members can resist at least a predetermined sliding force between a connector section and a structural section for certification purposes. For example, to be certified in the UK, the connection has to resist a load applied by a mass of 125kg/100mm of length.

[0006] In prior art frame members, it is typical for metallic structural frame sections to be knurled or roughened where they contact the connector section to improve the grip between the two sections. A problem with this method is that knurling or roughening the structural frame sections is time and labour intensive, and requires specialised tooling. This approach is typically used where the two structural sections are to be different colours (e.g. white on the section intended to be inside the building to which the fenestration unit is fitted and grey on the section intended to be on the exterior of the building)

[0007] It is also known to include a heat-curable epoxy within the joints between the metallic structural frame sections and the connector section. This is used where both structural frame sections are powder coated after they are connected to the connector and then heat cured as a complete frame member. The heat cures both the powder coating and the epoxy to adhesively bond the connector to the structural sections. However this prevents different colours being used for the internal and external structural sections.

[0008] The present teachings seek to overcome, or at least mitigate the problems of the prior art.

SUMMARY

[0009] According to a first aspect, there is provided an elongate connector section for connecting to a first window frame section of a window frame assembly. The connector section comprises:

a body; and

a first leg extending away from the body transversely to a longitudinal axis of the connector section, the first leg including a first male portion for interengagement with a corresponding first female portion of the first window frame section, the first male portion including a first undercut for receiving a wall of the first female portion,

wherein a layer of flexible polymeric material is secured to the first male portion.

[0010] Advantageously, it has been determined that the layer of flexible polymeric material has a high coefficient of friction which improves the grip between the first male portion and the first female portion, and thus between the connector section and the first window frame section, relative to if no layer of flexible polymeric material is present.

[0011] Moreover, the layer of flexible polymeric material may be quickly and easily secured to the connector section in order to improve the grip between the connector section and the first window frame section. Thus, the time-intensive processes for improving the grip between sections of a frame member known in the prior art can be avoided.

[0012] The layer of flexible polymeric material may be secured at the first undercut.

[0013] Each layer of flexible polymeric material may be proud of a surface of the connector section bordering

said layer.

[0014] Advantageously, this helps to maximise the surface area of the layer of material which is engageable by the first female portion and thus helps to provide superior frictional engagement between the wall of the first female portion and the layer of material.

[0015] Each layer of flexible polymeric material may be a membrane arranged to cover at least a portion of the respective undercut.

[0016] The membrane may have a thickness of 0.1 to 0.5mm, e.g. 0.2 to 0.3mm.

[0017] Providing the layer of flexible polymeric material as a membrane may improve the contact surface area between the first female portion and the membrane.

[0018] Each layer of flexible polymeric material may be an elongate strip arranged to extend longitudinally along the respective undercut.

[0019] The elongate strip may have a width of 1 to 5mm, e.g. 2 to 3mm.

[0020] Providing the layer of flexible polymeric material as an elongate strip may improve the contact surface area between the first female portion and the elongate strip.

[0021] Each elongate strip may extend along the majority or all of a length of the respective undercut.

[0022] Each layer of flexible polymeric material may be coextruded with the respective male portion.

[0023] Coextruding the layer of non-slip material with the respective male portion simplifies manufacture of the connector section, and ensures that the layer of non-slip material is securely attached to the respective male portion.

[0024] The flexible polymeric material may comprise polyvinyl chloride.

[0025] The first male portion may comprise a boss at least partially defined by the first undercut and an additional undercut, the additional undercut for receiving a portion of the first female portion in use. A layer of flexible polymeric material may be secured to the additional undercut.

[0026] This further improves the grip between the first male portion and the first female portion, and thus between the connector section and the first window frame section.

[0027] The connector section may be formed from a plastics material, preferably unplasticized polyvinyl chloride.

[0028] The connector section may have a constant cross-sectional profile along a longitudinal axis of the connector section.

[0029] The connector section may further comprise a second leg extending away from the body. The second leg may include a second male portion for interengagement with a corresponding second female portion of a second window frame section. The second male portion may include a second undercut. A layer of flexible polymeric material may be secured to the second undercut.

[0030] Advantageously, this allows the connector section to connect two window frame sections together. Moreover, this improves the grip between the second male portion and the second female portion, and thus between the connector section and the second window frame section, relative to if no layer of flexible polymeric material is present.

[0031] The connector section may further comprise a third leg extending away from the body. The third leg may include a third male portion for interengagement with a corresponding third female portion of the first window frame section in use. The third male portion may include a third undercut for receiving a wall of the third female portion in use. A layer of flexible polymeric material may be secured to the third undercut.

[0032] The connector section may further comprise a fourth leg extending away from the body. The fourth leg may include a fourth male portion for interengagement with a corresponding fourth female portion of the second window frame section in use. The fourth male portion may include a fourth undercut for receiving a wall of the fourth female portion in use. A layer of flexible polymeric material may be secured to the fourth undercut.

[0033] Providing a single connector section including four male portions may negate the need to use two separate connectors to connect two window frame sections together. Advantageously, this may simplify the assembly of a window frame.

[0034] The body may comprise two spaced apart transverse members joined via a first cross-member and a second cross-member. The first leg and the third leg may extend away from the first cross-member. The second leg and the fourth leg may extend away from the second cross-member.

[0035] The first cross-member and the second cross-member may provide a space therebetween to trap air. Advantageously, the trapped air may act as a thermal barrier which helps to increase the thermal insulation properties of the connector section.

[0036] According to a second aspect, there is provided a kit of parts for a window frame assembly comprising:

an elongate first window frame section comprising a first female portion including a first wall, wherein the first wall is movable between an open position and a closed position; and

the elongate connector section according to the first aspect,

wherein the first male portion is shaped to at least partially conform to the first female portion when the first wall is in the closed position.

[0037] The kit of parts may further comprise an elongate second window frame section comprising a second female portion including a second wall. The second wall may be movable between an open position and a closed position. The second male portion may be shaped to at least partially conform to the second female portion when the second wall is in the closed position.

[0038] The first window frame section may comprise a third female portion including a third wall. The third wall may be movable between an open position and a closed position. The third male portion may be shaped to at least partially conform to the third female portion when the third wall is in the closed position.

[0039] The second window frame section may comprise a fourth female portion including a fourth wall. The fourth wall may be movable between an open position and a closed position. The fourth male portion may be shaped to at least partially conform to the fourth female portion when the fourth wall is in the closed position.

[0040] The first window frame section may be a structural frame section. The connector section may be a thermal insulation section that is formed from a more thermally insulative material than the structural frame section.

[0041] The first window frame section may be formed from an aluminium alloy. The connector section may be formed from a plastics material, preferably unplasticized polyvinyl chloride.

[0042] According to a third aspect, there is provided a window frame assembly comprising:

the elongate connector section according to the first aspect; and

an elongate first window frame section comprising a first female portion including a first wall, wherein the first wall is movable between an open position and a closed position,

wherein the first male portion is interengaged with the first female portion, and wherein the first wall is in contact with the layer of flexible polymeric material secured to the first undercut.

[0043] The window frame assembly may further comprise an elongate second window frame section comprising a second female portion including a second wall. The second wall may be movable between an open position and a closed position. The second male portion may be interengaged with the second female portion. The second wall may be in contact with the layer of flexible polymeric material secured to the second undercut.

[0044] The first window frame section may comprise a third female portion including a third wall. The third wall may be movable between an open position and a closed position. The third male portion may be interengaged with the third female portion. The third wall may be in contact with the layer of flexible polymeric material secured to the third undercut.

[0045] The second window frame section may comprise a fourth female portion including a fourth wall. The fourth wall may be movable between an open position and a closed position. The fourth male portion may be interengaged with the fourth female portion. The fourth wall may be in contact with the layer of flexible polymeric material secured to the fourth undercut.

[0046] The first window frame section may be a structural frame section. The connector section may be a thermal insulation section that is formed from a more thermally insulative material than the structural frame section.

[0047] The first window frame section may be formed from an aluminium alloy. The connector section may be formed from a plastics material, preferably unplasticized polyvinyl chloride.

BRIEF DESCRIPTION OF THE DRAWINGS

[0048] Embodiments are now disclosed by way of example only with reference to the drawings, in which:

Figure 1a is a front view of a fenestration unit comprising a window frame assembly according to an embodiment;

Figure 1b is a cross-sectional view of the fenestration unit shown in figure 1a along section X-X shown in figure 1a;

Figure 2 is a cross-sectional view of window frame sections of a window frame assembly according to an embodiment;

Figure 3 is a cross-sectional view of a connector section according to an embodiment;

Figure 4 is a cross-sectional view of a step of a window frame assembly method; and

Figure 5 is a cross-sectional view of a step of the method illustrated in Figure 4.

DETAILED DESCRIPTION OF EMBODIMENT(S)

[0049] Figures 1a and 1b show a fenestration unit 100 comprising a window frame assembly 102 and a glazing unit 104. As shown in Figure 1b, the glazing unit 104 comprises two panes of glass 108 spaced apart and lying parallel to each other. However, it will be appreciated that the glazing unit 104 may comprise one or more than two panes of glass 108. Alternatively, the glazing unit 104 could be replaced with a panel of wood, aluminium or other suitable material. It shall be appreciated that although the glazing unit 104 in this embodiment is a double glazing unit, alternative glazing units, for example opaque panels, for example for doors, may be used.

[0050] Fenestration units 100 of this type are typically used in external walls of domestic and commercial buildings. It is therefore necessary that the fenestration unit meets requirements for thermal insulation, sealing against water ingress, draughts etc.

[0051] The glazing unit 104 is supported by the window frame assembly 102, which is in contact with two opposite faces of the glazing unit 104 along each border of the glazing unit 104. The window frame assembly 102 com-

prises four window frame members 103, each being made up of a plurality, in this case three, window frame sections, these being an elongate first structural section 106a, an elongate second structural section 106b and an elongate connector section 110. Each structural section 106a, 106b abuts an opposite face of the glazing unit 104 such that movement of the glazing unit 104 is restricted along the x-axis and along the y-axis in Figure 1b. The connector section 110 connects the first structural section 106a to the second structural section 106b and lies generally alongside but is spaced from an edge of the glazing unit 104.

[0052] It will be noted that in contrast to the prior art described above, the connector section 110 is a single unitary component instead of two or more discrete "dog bones". By utilising a single unitary component, this may reduce the complexity of assembling the window frame assembly 102.

[0053] In the embodiment illustrated in Figure 1b, the first structural section 106a comprises a glazing bead 101; shown schematically in Figure 1b. The glazing bead 101 may be formed as part of the second structural section 106b or may alternatively be releasably connected to the first structural section 106a.

[0054] Figure 2 shows the first and second structural sections 106a, 106b and the connector section 110 exclusively. Each of the sections 106a, 106b, 110 has a corresponding longitudinal axis 112a, 112b, 124, which are all shown as being parallel to each other and extending into the page in Figure 2; i.e. along the z-axis.

[0055] The first structural section 106a includes a first female portion 115a and a second female portion 115b along an edge of the first structural section 106a. Likewise, the second structural section 106b includes a third female portion 115c and a fourth female portion 115d along an edge of the second structural section 106b.

[0056] In the embodiment illustrated in Figure 2, the female portions 115a, 115b, 115c, 115d each comprise a wall 114, a protrusion 118, and a cavity 122 defined by the respective wall 114 and the respective protrusion 118. In this embodiment each wall 114 is located along a corner of the respective structural section 106a, 106b and is movable from an open position (illustrated in Figure 4) to a closed position (illustrated in Figures 1b, 2 and 5). An inner face of the wall 114 is provided with a tooth 121 that has a point or tip facing generally inwardly.

[0057] The connector section 110 includes a body 140 and four legs 142a, 142b, 142c, 142d extending away from the body 140.

[0058] The body 140 includes two spaced apart transverse members 152 which are joined via a first cross-member 150a and a second cross-member 150b. The number of cross members 150 may differ in other embodiments e.g. one may be provided or three or more. The cross members 150a, 150b may additionally improve the thermal performance of the connector section 110 by reducing thermal transfer via convection across the frame member 103.

[0059] A first leg 142a and a second leg 142b extend away the first cross-member 150a in a first direction substantially parallel to the x-axis in Figure 2. A third leg 142c and a fourth leg 142d extend away from the second cross-member 150b in a second direction substantially parallel to the x-axis in Figure 2 and opposite to the first direction. The first leg 142a and the third leg 142c are spaced from the second leg 142b and the fourth leg 142d respectively along the y-axis.

[0060] In Figure 2, the x-axis is perpendicular to the longitudinal axis 124 of the connector section 110. As such, the legs 142a, 142b, 142c, 142d all extend transversely to the longitudinal axis 124.

[0061] The first leg 142a includes a first male portion 117a, the second leg 142b includes a second male portion 117b, the third leg 142c includes a third male portion 117c and the fourth leg 142d includes a fourth male portion 117d. The first, second, third and fourth male portions 117a, 117b, 117c, 117d are all suitable for inter-engagement with the first, second, third and fourth female portions 115a, 115b, 115c, 115d respectively, as will be discussed more below.

[0062] In the illustrated embodiment, each male portion 117a, 117b, 117c, 117d comprises a boss 111, defining an outer undercut 116 and an inner undercut 119. An opening 120 is defined between the first male portion 117a and the second female portion 117b, and another opening 120 is defined between the third male portion 117c and the fourth male portion 117d.

[0063] Each boss 111 has a leading edge (i.e. the edge of the boss 111 facing the cavity 122 in Figure 2) that it is wider relative to a trailing edge, and each undercut 116, 119 and each opening 120 is shaped to define each boss 111.

[0064] In the illustrated embodiment, each protrusion 118 has an obliquely angled cross-sectional profile and each opening 120 has a truncated bell-shaped cross-sectional profile. The combined width of the two protrusions 118 on the first structural section 106a where the protrusions 118 join the remainder of the first structural section 106a, is substantially equal to the width of the entrance of the opening 120 between the first male portion 117a and the second male portion 117b (where the width is defined as being aligned with the y-axis in Figure 2).

[0065] Likewise, the combined width of the two protrusions 118 on the second structural section 106b where the protrusions 118 join the remainder of the second structural section 106b, is substantially equal to the width of the entrance of the opening 120 between the third male portion 117c and the fourth male portion 117d.

[0066] In alternative embodiments (not shown), the protrusions 118 and the corresponding openings 120 may have a different cross-sectional profile. For example, each protrusion 118 may have a rectangular, triangular or any other shaped cross-sectional profile, and the corresponding opening 120 may have a rectangular, triangular or any other shaped cross-sectional profile.

[0067] In the illustrated embodiment, each male portion 117a, 117b, 117c, 117d has an identical geometry relative to each other. Likewise, in the particular embodiment, each female portion 115a, 115b, 115c, 115d has an identical geometry relative to each other, and each are symmetrical about a horizontal axis that is parallel to the x-axis in Figure 2.

[0068] In alternative embodiments (not shown), one or more of the male portions 117a, 117b, 117c, 117d may not have an identical geometry relative to one or more of the others. Additionally or alternatively, one or more of the female portions 115a, 115b, 115c, 115d may not have an identical geometry relative to one or more of the others.

[0069] In the illustrated embodiment, the connector section 110 is a thermal insulation section that is formed from a more thermally insulative material than the first structural section 106a and the second structural section 106b. In particular, the first structural section 106a and the second structural section 106b are formed from an aluminium alloy and the connector section 110 is formed from a plastics material.

[0070] In this embodiment, the connector section 110 is formed from unplasticized polyvinyl chloride (uPVC). It has been determined that forming the connector section 110 from uPVC provides the connector section 110 with more than sufficient material strength and material thermal insulation properties. It is preferred to form the connector section 110 from uPVC relative to other plastics materials, since uPVC tends to be lower cost to produce relative to comparable plastics materials, such as polyamides for example. An example of a suitable uPVC based material is Thermavic^{RTM} manufactured by Benvic SAS of Chevigny-Saint-Sauveur, France.

[0071] In alternative embodiments (not shown), the structural sections 106a, 106b and the connector section 110 may be formed from any suitable materials. For example, the structural sections 106a, 106b may be formed from an alternative metallic material. The connector section 110 may be formed from an alternative plastics material such as a polyamide for example.

[0072] In the illustrated embodiment, the structural sections 106a, 106b and the connector section 110 all have a constant cross-sectional profile along their respective longitudinal axes 112a, 112b, 124. As such, the structural sections 106a, 106b and the connector section 110 may be formed via extrusion.

[0073] In alternative embodiments (not shown), one or more of the structural sections 106a, 106b and the connector section 110 may not have a constant cross-sectional profile along their respective longitudinal axes 112a, 112b, 124. For example, the body 140 of the connector section 110 may have a varying cross-sectional profile along the longitudinal axis 124.

[0074] Figure 3 shows the connector section 110 exclusively.

[0075] It can be more clearly seen in Figure 3 that the first leg 142a includes a first stem portion 146a interposed between the body 140 and the first male portion 117a. Likewise, the second leg 142b includes a second stem portion 146b interposed between the body 140 and the second male portion 117b. Likewise, the third leg 142c includes a third stem portion 146c interposed between the body 140 and the third male portion 117c. Likewise, the fourth leg 142d includes a fourth stem portion 146d interposed between the body 140 and the fourth male portion 117d.

[0076] Each stem portion 146a, 146b, 146c, 146d is secured to the body 140. In particular, the first stem portion 146a and the second stem portion 146b are secured to and extend from the first cross-member 150a. The third stem portion 146c and the fourth stem portion 146d are secured to and extend from the second cross-member 150b.

[0077] It can be seen in Figure 3 that the second leg 142b incudes a flexible portion 144. The flexible portion 144 is configured such that the second leg 142b is more flexible in bending relative to the first leg 142a. Likewise, the fourth leg 142d includes a flexible portion 144 is configured such that the fourth leg 142d is more flexible in bending relative to the third leg 142c.

[0078] In the illustrated embodiment, the flexible portion 144 of the second leg 142b is substantially identical to the flexible portion 144 of the fourth leg 142d. In the following, unless stated otherwise, only the flexible portion 144 of the second leg 142b will be discussed. This discussion will apply equally to the flexible portion 144 of the fourth leg 142.

[0079] The flexible portion 144 of the second leg 142b is configured such that the second male portion 117b is pivotable about the flexible portion 144. As shown in Figure 3, the second male portion 117b is pivotable about the flexible portion 144 relative to the body 140 between a first position P1 (shown in phantom) and a second position P2 (shown in solid lines).

[0080] The flexible portion 144 of the second leg 142b is configured such that it has a lower second moment of area relative to the remainder of the second leg 142b. As such, the flexible portion 144 of the second leg 142b has a lower flexural rigidity relative to the remainder of the second leg 142b.

[0081] In the illustrated embodiment, this is achieved by reducing the thickness of the flexible portion 144 relative to the remainder of the second leg 142b. As shown in Figure 3, the flexible portion 144 has a minimum thickness T1. The thickness T1 is smaller relative to the minimum thickness of the remainder of the second leg 142b. By remainder of the second leg 142b it is meant all of the second leg 142b except for the flexible portion 144.

[0082] In the illustrated embodiment, the second stem portion 146b of the second leg 142b includes the flexible portion 144. In particular, the flexible portion 144 is located at the end of the second stem portion 146b which joins the body 140, i.e. a root of the second leg 142b. As such, the second leg 142b is secured to the body 140 via the flexible portion 144. Advantageously, this may

maximise the range of movement of the second male portion 117b relative to the body 140.

[0083] In alternative embodiments (not shown), the flexible portion 144 may not be on or in the second stem portion 146b. In such embodiments, the second male portion 117b may include the flexible portion 144, or the flexible portion 144 may be interposed between the second stem portion 146b and the second male portion 117b.

[0084] In alternative embodiments (not shown), the second leg 142b may not be secured to the body 140 via the flexible portion. In such embodiments, the flexible portion 144 may be located in or on the second stem portion 146b and spaced from the end of the second stem portion 146b which joins the body 140, i.e. the root of the second leg 142b.

[0085] As shown in Figure 3, the first stem portion 146a has a substantially constant thickness T2 along its length between the body 140 and the first male portion 117a. It is clear that the minimum thickness T1 of the flexible portion 144 is smaller than the thickness T2 of the first stem portion 146a. Moreover, the minimum thickness T1 of the flexible portion 144 is smaller than the minimum thickness of the entire first leg 142a. As such, the second leg 142b is more flexible in bending than the first leg 142a.

[0086] In the illustrated embodiment, the thickness T1 is in is in the range of 0.5 mm to 2.5 mm, preferably in the range of 1 mm to 2 mm, and more preferably 1.5 mm. The thickness T2 is in the range of 1 mm to 4 mm, preferably in the range of 2 mm to 3 mm, more preferably 2.5 mm.

[0087] In alternative embodiments (not shown), the first stem portion 146a may not have a substantially constant thickness along its length between the body 140 and the first male portion 117a; i.e. the first stem portion 146a may have a variable thickness. In such embodiments, the minimum thickness T1 of the flexible portion 144 may be smaller than a minimum thickness of the first stem portion 146a. The minimum thickness of the first stem portion 146a may be in the range of 1 mm to 4 mm, preferably in the range of 2 mm to 3 mm, more preferably 2.5 mm.

[0088] In alternative embodiments (not shown), the flexural rigidity of the flexible portion 144 of the second leg 142b may be reduced relative to the remainder of the second leg 142b by additional or alternative means. For example, the flexible portion 144 of the second leg 142b may be perforated along a direction parallel to the longitudinal axis 124.

[0089] In alternative embodiments (not shown), the flexible portion 144 of the second leg 142b may be formed from a different material to the remainder of the second leg 142b, said different material being more flexible relative to the material of the remainder of the second leg 142b. In such embodiments, the material of the flexible portion 144 may or may not be weaker than the material of the remainder of the second leg 142b.

[0090] With reference to Figures 3 and 4, a layer of non-slip material 148 (represented schematically as a dashed line) is secured to the first male portion 117a. In particular, the layer of non-slip material 148 is secured to at least a portion of the outer undercut 116 of the first male portion 117a. Likewise, a layer of non-slip material 148 is secured to at least a portion of the outer undercut 116 of the third male portion 117c.

[0091] As shown in Figures 4 and 5, a layer of non-slip material 148 is also secured to at least a portion of the outer undercut 116 of the second male portion 117b. Although not shown, it will be appreciated that a layer of non-slip material 148 may also be secured to at least a portion of the outer undercut 116 of the fourth male portion 117d.

[0092] Each layer of non-slip material 148 is configured to increase the grip strength between the walls 114 (and in particular the teeth 121 thereof) and the respective outer undercuts 116 when the female portions 115a, 115b, 115c, 115d and the male portions 117a, 117b, 117c, 117d are interengaged, as will be discussed more below.

[0093] In the illustrated embodiment, each layer of non-slip material 148 is a layer of flexible polymeric material, such as a flexible polyvinyl chloride (PVC) or a thermoplastic elastomer (TPE), for example a thermoplastic rubber (TPR). This provides each layer of non-slip material 148 with a relatively high co-efficient of friction which acts to improve the grip between the walls 114 and the layers of non-slip material 148, and thus between the connector section 110 and the structural sections 106a, 106b, relative to if no layers of non-slip material 148 were present.

[0094] Moreover, the layers of flexible polymeric material can be compressed by and conform to the respective walls 114, which further improves the grip between the walls 114 and the layers of non-slip material 148, in particular in the z direction..

[0095] Each layer of non-slip material 148 is a membrane which is arranged to cover at least a portion of the respective outer undercut 116. Each membrane has a thickness, as measured normal to the surface of the respective outer undercut 116 to which it is secured, typically in the range of 0.1 to 0.5mm, preferably in the range of 0.2 to 0.3mm.

[0096] Providing each layer of non-slip material 148 as a membrane helps to maximise the contact surface area between each layer of non-slip material 148 and the respective wall 114, without the need to modify the geometry of the male portions 117 or the female portions 115 to accommodate the layers of non-slip material 148. By being relatively thin and with relatively rigid uPVC underlying it, the material 148 is effectively clamped and cannot readily resile away from the wall 114 and tooth 121, further enhancing the grip.

[0097] Each layer of non-slip material 148 is formed as an elongate strip which extends longitudinally (i.e. substantially parallel to the longitudinal axis 124) along the respective outer undercut 116. This helps to maximise the contact surface area between each layer of non-slip material 148 and the respective wall 114.

[0098] Each layer of non-slip material 148 may extend along a majority of or all of the longitudinal length of the respective outer undercut 116. It will be appreciated that the layers of non-slip material 148 secured to the outer undercuts 116 may be of different lengths.

[0099] Each layer of non-slip material 148 is an elongate strip having a width, as measured substantially transverse to the longitudinal axis 124, typically in the range of 1.0 to 5.0mm, preferably in the range of 2.0 to 3.0mm.

[0100] In the illustrated embodiment, each layer of non-slip material 148 is secured to the respective male portion 117a, 117b, 117c, 117d by coextruding the layer of non-slip material 148 with the respective male portion 117a, 117b, 117c, 117d.

[0101] In alternative embodiments (not shown), each layer of non-slip material 148 may be secured to the respective male portion 117a, 117b, 117c, 117d via any suitable means, such as via bonding or heat sealing for example.

[0102] Each layer of non-slip material 148 is arranged to be proud of a surface or surfaces of the connector section 110 bordering said layer of non-slip material 148; i.e. each layer of non-slip material 148 protrudes relative to the surface or surfaces of the connector section 110 (e.g. the surface or surfaces of the respective outer undercut 116) directly adjacent the edges of the layer of non-slip material 148.

[0103] Advantageously, this allows a greater surface area of each layer of non-slip material 148 to be compressed by the respective walls when the female portions 115a, 115b, 115c, 115d and the male portions 117a, 117b, 117c, 117d are interengaged, relative to if each layer of non-slip material 148 was flush with the surface or surfaces of the connector section 110 bordering said layer of non-slip material 148 for example. Thus, this results in a superior frictional engagement between the connector section 110 and the structural sections 106a, 106b.

[0104] In alternative embodiments (not shown), a layer of non-slip material 148 may be secured to only one of the male portions 117a, 117b, 117c, 117d, or any combination of two or three of the male portions 117a, 117b, 117c, 117d. Alternatively, no layer of non-slip material 148 may be secured to any of the male portions 117a, 117b, 117c, 117d.

[0105] In alternative embodiments (not shown) a layer of non-slip material 148 may be secured to one or more of the inner undercuts 119.

[0106] A method of connecting the first structural section 106a to the connector section 110 will now be described with reference to Figures 4 and 5.

[0107] In a first step of the method, the first male portion 117a of the connector section 110 is received within the first female portion 115a of the first structural section 106a. Likewise, the second male portion 117b is received within the second female portion 115b. Figure 4 shows both male portions 117a, 117b after they have been received within the respective female portions 115a, 115b.

[0108] As the second male portion 117b is received in the second female portion 115b, the second male portion 117b is in the first position P1. As shown in Figure 4, in the first position P1, a transverse axis 160b of the second male portion 117b is oriented at an obtuse angle A1 relative to a reference axis 162. In Figures 4 and 5, the reference axis 162 is parallel to the y-axis. A transverse axis 160a of the first male portion 117a is oriented perpendicular to the reference axis 162, i.e. the transverse axis 160a is parallel to the x-axis. As such, the transverse axis 160b of the second male portion 117b is oriented away from the transverse axis 160a of the first male portion 117a.

[0109] Moreover, as the second male portion 117b is received in the second female portion 115b, the walls 114 of the first female portion 115a and the second female portion 115b are in their open positions.

[0110] In the illustrated embodiment, the first and the second male portions 117a, 117b are received within the first and the second female portions 115a, 115b respectively by first arranging the first structural section 106a and the connector section 110 such that their respective longitudinal axes 112a, 124 are parallel to each other, and such that a free end of the first structural section 106a faces a free end of the connector section 110.

[0111] Subsequently, the first male portions 117a, 117b are received within the respective female portions 115a, 115b by translating/sliding the male portions 117a, 117b and the female portions 115a, 115b relative to each other along their respective longitudinal axes 112a, 124.

[0112] Each male portion 117a, 117b is shaped such that it can be received within the corresponding female portion 115a, 115b along the longitudinal directions 112a, 124 when each wall 114 is in the open position and when the second male portion 117b is in the first position P1. As can be seen in Figure 4, the bosses 111 are able to enter and be fully received within the corresponding cavities 122.

[0113] With the second male portion 117b in the first position P1 and the wall 114 of the second female portion 115b in the open position, there is sufficient clearance between the male portions 117a, 117b and the respective female portions 115a, 115b in order for the male portions 117a to be easily received within the female portions 115a, 115b by sliding the first structural section 106a and the connector section 110 relative to each other. Advantageously, this allows the male portions 117a, 117b to be quickly and easily received within the respective female portion 115a, 115b.

[0114] In alternative embodiments (not shown), the first and the second male portions 117a, 117b may be received within the first and the second female portions 115a, 115b respectively by first arranging the first structural section 106a and the connector section 110 such that their respective longitudinal axes 112a, 124 are parallel to each other and such that the first and the second male portions 117a, 117b are facing the first and the sec-

ond female portions 115a, 115b respectively. Subsequently, the first male portions 117a, 117b may be received within the respective female portions 115a, 115b by translating the male portions 117a, 117b and the female portions 115a, 115b towards each other along the x-axis in Figures 4 and 5, which is perpendicular to both of the longitudinal axes 112a, 124. In such embodiments, the openings to the cavities 122 of the female portion 115a, 115b would need to be sufficiently sized to allow the male portions 117a, 117b to enter said cavities along the transverse direction, i.e. along the x-axis.

[0115] Once the male portions 117a, 117b have been received within the respective female portions 115a, 115b, the wall 114 of the first female portion 115a is moved from the open position to the closed position. Once the wall 114 is in the closed position, the wall 114 engages the outer undercut 116 of the first male portion 117a as shown in Figure 5. This may be achieved, for example, by manually pressing the wall 114 until it engages the corresponding outer undercut 116. Alternatively or additionally, a tool or machine may be used to position the wall 114 until it engages the corresponding outer undercut 116.

[0116] Once engaged, the wall 114 of the first female portion 115a and the outer undercut 116 of the first male portion 117a are shaped such that the first male portion 117a and the first female portion 115a are interengaged; i.e. the first male portion 117a and the first female portion 115a are mutually engaged in order to provide a connection between the sections 106a, 110.

[0117] As shown in Figure 5, the wall 114 of the first female portion 115a abuts against the layer of non-slip material 116 as said wall 114 engages the outer undercut 116 of the first male portion 117a. As such, the layer of non-slip material 116 improves the grip strength between the wall 114 of the first female portion 115a and the first male portion 117a, in particular so as to inhibit relative sliding in a longitudinal direction.

[0118] The wall 114 of the first female portion 115a is configured to be mechanically retained in the outer undercut 116 of the first male portion 116a once positioned to engage said outer undercut 116. In the illustrated embodiment, this is achieved via a portion of the wall 114 being configured to plastically deform when positioned to engage the outer undercut 116.

[0119] Either prior to, at the same time as or subsequent to the wall 117 of the first female portion 115a being positioned until it engages the outer undercut 116 of the first male portion 117a, the wall 114 of the second female portion 115b is moved from the open position to the closed position. As the wall 114 of the second female portion 115b moves from the open position to the closed position, the wall 114 engages the outer undercut 116 of the second male portion 117b such that the second male portion 117b moves from the first position P1 shown in Figure 4 to the second position P2 shown in Figure 5. This may be achieved, for example, by manually pressing the wall 114 until it engages the corresponding outer undercut 116. Alternatively or additionally, a tool or machine may be used to position the wall 114 until it engages the corresponding outer undercut 116.

[0120] Once the second male portion 117b is in the second position P2, the wall 114 of the second female portion 115b and the outer undercut 116 of the second male portion 117b are shaped such that the second male portion 117b and the second female portion 115b are interengaged.

[0121] It can be seen in Figure 5, that in the second position P2, the transverse axis 160b of the second male portion 117b is oriented at an angle A2 relative to the reference axis 162, which is parallel to the y-axis. In the illustrated embodiment, the transverse axis 160b is perpendicular to the reference axis 162, i.e. the angle A2 is ninety degrees. As such, the transverse axis 160a of the first male portion 117a is parallel to the transverse axis 160b of the second male portion 117b, and is therefore parallel to the x-axis. As the second male portion 117b is moved from the first position P1 to the second position P2, the second male portion 117b is moved towards the first male portion 117a.

[0122] As shown in Figure 5, the wall 114 of the second female portion 115b abuts against the layer of non-slip material 116 as said wall 114 engages the outer undercut 116 of the second male portion 117b. As such, the layer of non-slip material 116 improves the grip strength between the wall 114 of the second female portion 115b and the second male portion 117b, in particular so as to inhibit relative sliding in a longitudinal direction.

[0123] The wall 114 of the second female portion 115b is configured to be mechanically retained in the outer undercut 116 of the second male portion 117b once positioned to engage said outer undercut 116. In the illustrated embodiment, this is achieved via a portion of the wall 114 being configured to plastically deform when positioned to engage the outer undercut 116.

[0124] It has been determined that the combination of the relatively stiff first leg 142a and the relatively flexible second leg 142b results in predictable positions for the first structural section 106a with respect to the connector section 110, which has been found to result in a finished profile of the interengaged sections 106a, 110 which is consistently free from unwanted distortions.

[0125] By "consistently free from unwanted distortions" it is meant that the sections 106a, 106b, 110 of the finished profile are generally level and the longitudinal axes 112a, 112b, 124 of the sections 106a, 106b, 110 are substantially parallel to each other. Unwanted distortions arise when portions of two or more of the sections 106a, 106b, 110 of the finished profile are not level with each other due to local divergence of the longitudinal axes 112a, 112b, 124 of those sections 106a, 106b, 110. It will be appreciated that such distortions may prevent proper fitting of the finished profile to the remainder of the fenestration unit 100. In particular, unwanted distortions may inhibit beads (for example the bead 101 in Figure 1b) and other components from being secured to the

finished profile, or sealing between components being adequate.

[0126] In alternative embodiments (not shown), the transverse axis 160a of the first male portion 117a may not be perpendicular to the reference axis 162. Additionally or alternatively, the transverse axis 160a of the first male portion 117a and the transverse axis 160b of the second male portion 117b may not be parallel when the second male portion 117b is in the second position P2.

[0127] In alternative embodiments (not shown), the positions of the wall 114 and the protrusion 118 on the second female portion 115b may be reversed, and the positions of the outer and the inner undercuts 116, 119 on the second male portion 117b may be reversed accordingly. In such embodiments, the transverse axis 160b of the second male portion 117b may move away from the transverse axis 160a of the first male portion 117a as the wall 114 of the second female portion 115b engages the outer undercut 116 of the second male portion 117b such that the second male portion 117b moves from the first position P1 to the second position P2. Alternatively or additionally, the positions of the wall 114 and the protrusion 118 on the first female portion 115a may be reversed, and the position of the outer and the inner undercuts 116, 119 on the first male portion 117a may be reversed accordingly. In such embodiments, a tool or machine may be inserted internally between the connector section 110 and the first structural section 106a to position the wall/walls 114 to engage the corresponding undercut/undercuts 116.

[0128] It will be appreciated that the foregoing method may be adapted to connect the second structural section 106b to the connector section 110 via the interengagement of the third male portion 117c and the third female portion 115c, and the interengagement of the fourth male portion 117d and the fourth female portion 115d. Figure 1b shows the window frame assembly 102 in which the connector section 110 has been connected to both the first structural section 106a and the second structural section 106b via the foregoing method.

[0129] In the foregoing disclosure, the second leg 142b is made to be more flexible in bending than the first leg 142b by providing the second leg 142b with the flexible portion 144. However, in alternative embodiments, the second leg 142b may not include the flexible portion 144. In such embodiments, the body 140 of the connector section 110 may be configured to such that the second leg 142b is more flexible in bending than the first leg 142a. For example, the portion of the body 140 to which the second leg 142b joins may be formed from a more flexible material relative to the portion of the body 140 to which the first leg 142a joins. Moreover, the means which allows the second leg 142b to be more flexible in bending relative to the first leg 142a, may be different to the means which allows the fourth leg 142d to be more flexible in bending relative to the third leg 142c.

[0130] In the foregoing disclosure, structural sections 106a, 106b each comprising two walls 114 and connector sections 110 comprising four corresponding undercuts 116 have been disclosed. However, it will be appreciated that in some embodiments, the structural sections 106a, 106b may each comprise one or more than two walls 114 and the connector section 110 may comprise one, two, three or more than four corresponding undercuts 116.

[0131] In the foregoing disclosure, structural sections 106a, 106b each comprising two protrusions 118 have been disclosed. However, it will be appreciated that in some embodiments, one or both of the structural sections 106a, 106b may comprise only one protrusion 118 which is suitably shaped to be receivable within one of the openings 120 of the connector section 110. In such embodiments, the single protrusion 118 on one or both of the structural section 106a, 106b may be shaped to at least partially define the female portions 115a, 115b, 115c, 115d of the corresponding structural section 106a, 106b.

[0132] In the foregoing disclosure, female portions 115a, 115b, 115c, 115d each comprising one cavity 122 and male portions 117a, 117b, 117c, 117d each comprising one boss 111 have been disclosed. However, it will be appreciated that the female portions 115a, 115b, 115c, 115d and the corresponding male portion 117a, 117b, 117c, 117d may be of any shape, so long as each male portion 117a, 117b, 117c, 117d is shaped to at least partially conform to the respective female portion 115a, 115b, 115c, 115d when each wall 114 is in the closed position, when the second and fourth male portions 117b, 117d are in the second position P2, and when the structural sections' 112a, 112b longitudinal axes 112a, 112b is parallel to the connector section's 110 longitudinal axis 124.

[0133] In the foregoing disclosure, the connector section 110 includes four legs 142a, 142b, 142c, 142d extending away from the body 140, each leg including the respective male portion 117a, 117b, 117c, 117d. However, in alternative embodiments (not shown), the connector section 110 may include only one, two or three legs extending away from a body, each leg including a male portion. For example, the connector section 110 may include only two legs and have a "dog-bone" shape. In such embodiments, all of the legs may have a similar flexural rigidity. In alternative embodiments (not shown), the connector section 110 may include more than four legs, each leg including a male portion.

Claims

1. An elongate connector section for connecting to a first window frame section of a window frame assembly, the connector section comprising:

   a body; and

   a first leg extending away from the body transversely to a longitudinal axis of the connector section, the first leg including a first male portion for interengagement with a corresponding first

female portion of the first window frame section, the first male portion including a first undercut for receiving a wall of the first female portion, wherein a layer of flexible polymeric material is secured to the first male portion.

2. The connector section of claim 1, wherein each layer of flexible polymeric material is proud of a surface of the connector section bordering said layer.

3. The connector section of claims 1 or 2, wherein each layer of flexible polymeric material is a membrane arranged to cover at least a portion of the respective undercut, optionally, a membrane having a thickness of 0.1 to 0.5mm, e.g. 0.2 to 0.3mm.

4. The connector section of any preceding claim, wherein the layer of flexible polymeric material is secured to the first undercut.

5. The connector section of any preceding claim, wherein each layer of flexible polymeric material is an elongate strip arranged to extend longitudinally along the respective undercut; optionally, an elongate strip having a width of 1 to 5mm, e.g. 2 to 3mm; optionally, wherein each elongate strip extends along the majority or all of a length of the respective undercut.

6. The connector section of any preceding claim, wherein each layer of flexible polymeric material is coextruded with the respective male portion, and/or wherein the flexible polymeric material comprises polyvinyl chloride.

7. The connector section of any preceding claim, wherein the first male portion comprises a boss at least partially defined by the first undercut and an additional undercut, the additional undercut for receiving a portion of the first female portion in use, wherein a layer of flexible polymeric material is secured to the additional undercut.

8. The connector section of any preceding claim, wherein the connector section is formed from a plastics material, preferably unplasticized polyvinyl chloride, and/or wherein the connector section has a constant cross-sectional profile along a longitudinal axis of the connector section.

9. The connector section of any preceding claim, further comprising a second leg extending away from the body, the second leg including a second male portion for interengagement with a corresponding second female portion of a second window frame section, the second male portion including a second undercut, wherein a layer of flexible polymeric material is secured to the second undercut.

10. The connector section of claim 9, further comprising a third leg extending away from the body, the third leg including a third male portion for interengagement with a corresponding third female portion of the first window frame section in use, the third male portion including a third undercut for receiving a wall of the third female portion in use, wherein a layer of flexible polymeric material is secured to the third undercut.

11. The connector section of claim 10, further comprising a fourth leg extending away from the body, the fourth leg including a fourth male portion for interengagement with a corresponding fourth female portion of the second window frame section in use, the fourth male portion including a fourth undercut for receiving a wall of the fourth female portion in use, wherein a layer of flexible polymeric material is secured to the fourth undercut; optionally,
wherein the body comprises two spaced apart transverse members joined via a first cross-member and a second cross-member, wherein the first leg and the third leg extend away from the first cross-member, and wherein the second leg and the fourth leg extend away from the second cross-member.

12. A kit of parts for a window frame assembly comprising:

an elongate first window frame section comprising a first female portion including a first wall, wherein the first wall is movable between an open position and a closed position; and
the elongate connector section of any preceding claim,
wherein the first male portion is shaped to at least partially conform to the first female portion when the first wall is in the closed position; optionally,
wherein the first window frame section is a structural frame section and the connector section is a thermal insulation section that is formed from a more thermally insulative material than the structural frame section, for example, wherein the first window frame section is formed from an aluminium alloy and the connector section is formed from a plastics material, preferably unplasticized polyvinyl chloride.

13. The kit of parts of claim 12 when dependent on any one of claims 9 to 11, further comprising an elongate second window frame section comprising a second female portion including a second wall, wherein the second wall is movable between an open position and a closed position, wherein the second male portion is shaped to at least partially conform to the second female portion when the second wall is in the closed position; optionally,

when dependent on claims 10 or 11, wherein the first window frame section comprises a third female portion including a third wall, wherein the third wall is movable between an open position and a closed position, wherein the third male portion is shaped to at least partially conform to the third female portion when the third wall is in the closed position; optionally,
when dependent on claim 11, wherein the second window frame section comprises a fourth female portion including a fourth wall, wherein the fourth wall is movable between an open position and a closed position, wherein the fourth male portion is shaped to at least partially conform to the fourth female portion when the fourth wall is in the closed position.

14. A window frame assembly comprising:

the elongate connector section of any one of claims 1 to 11; and
an elongate first window frame section comprising a first female portion including a first wall, wherein the first wall is movable between an open position and a closed position,
wherein the first male portion is interengaged with the first female portion, and wherein the first wall is in contact with the layer of flexible polymeric material secured to the first undercut; optionally,
wherein the first window frame section is a structural frame section and the connector section is a thermal insulation section that is formed from a more thermally insulative material than the structural frame section, for example, wherein the first window frame section is formed from an aluminium alloy and the connector section is formed from a plastics material, preferably unplasticized polyvinyl chloride.

15. The window frame assembly of claim 14 when dependent on any one of claims 9 to 11, further comprising an elongate second window frame section comprising a second female portion including a second wall, wherein the second wall is movable between an open position and a closed position, wherein the second male portion is interengaged with the second female portion, and wherein the second wall is in contact with the layer of flexible polymeric material secured to the second undercut; optionally,

when dependent on claims 10 or 11, wherein the first window frame section comprises a third female portion including a third wall, wherein the third wall is movable between an open position and a closed position, wherein the third male portion is interengaged with the third female portion, and wherein the third wall is in contact with the layer of flexible polymeric material secured to the third undercut; optionally,
when dependent on claim 11, wherein the second window frame section comprises a fourth female portion including a fourth wall, wherein the fourth wall is movable between an open position and a closed position, wherein the fourth male portion is interengaged with the fourth female portion, and wherein the fourth wall is in contact with the layer of flexible polymeric material secured to the fourth undercut.

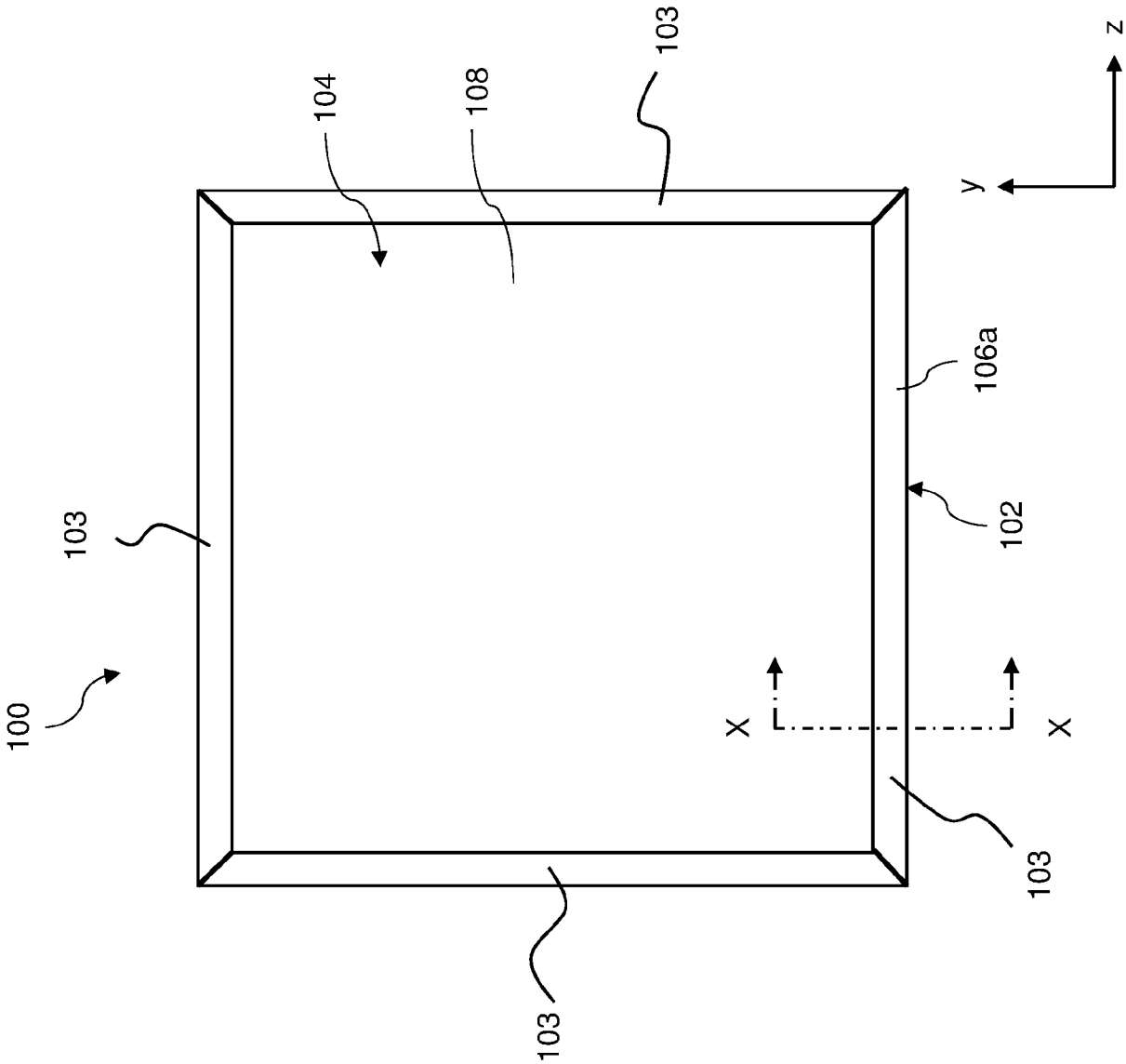


FIGURE 1a

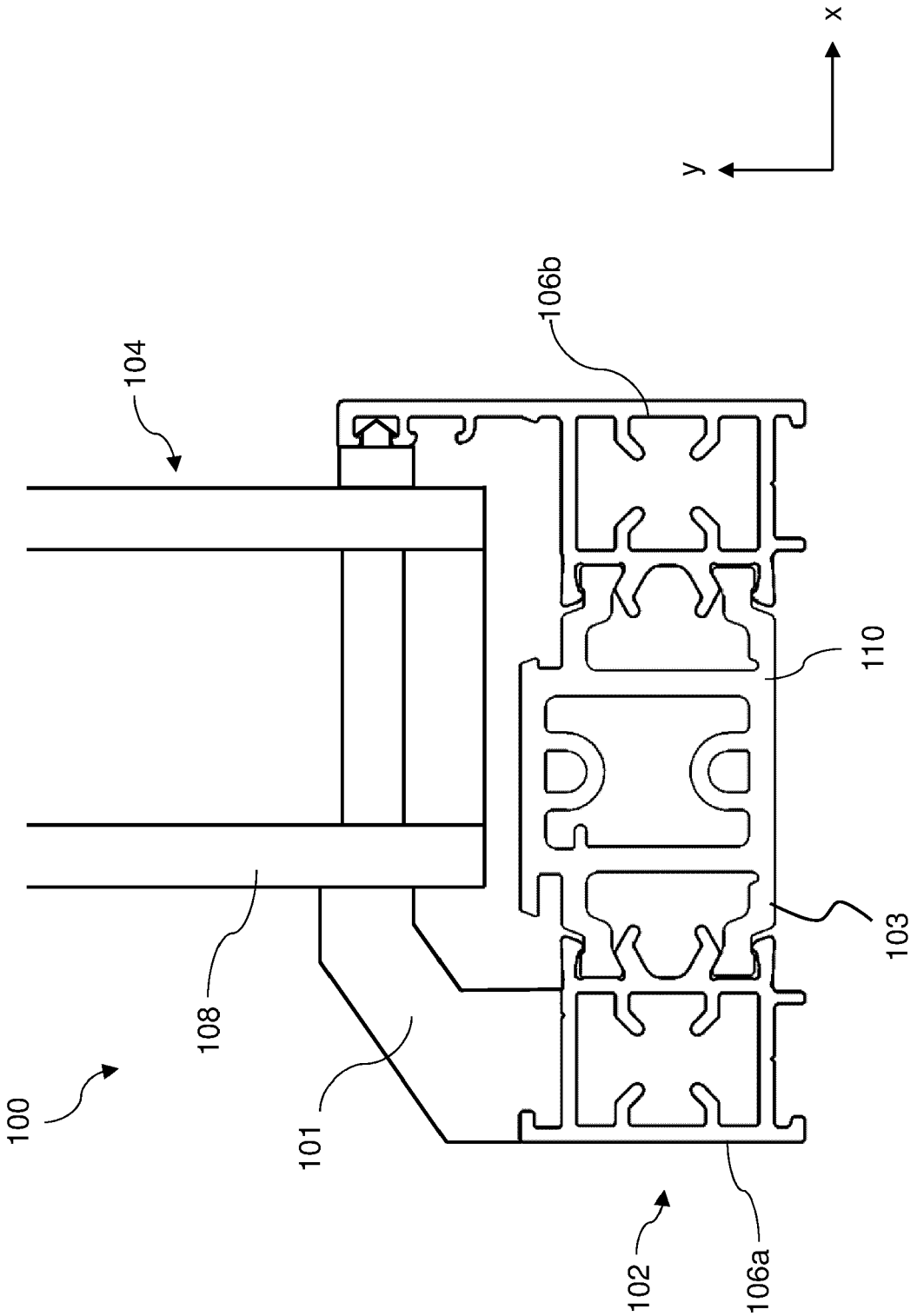
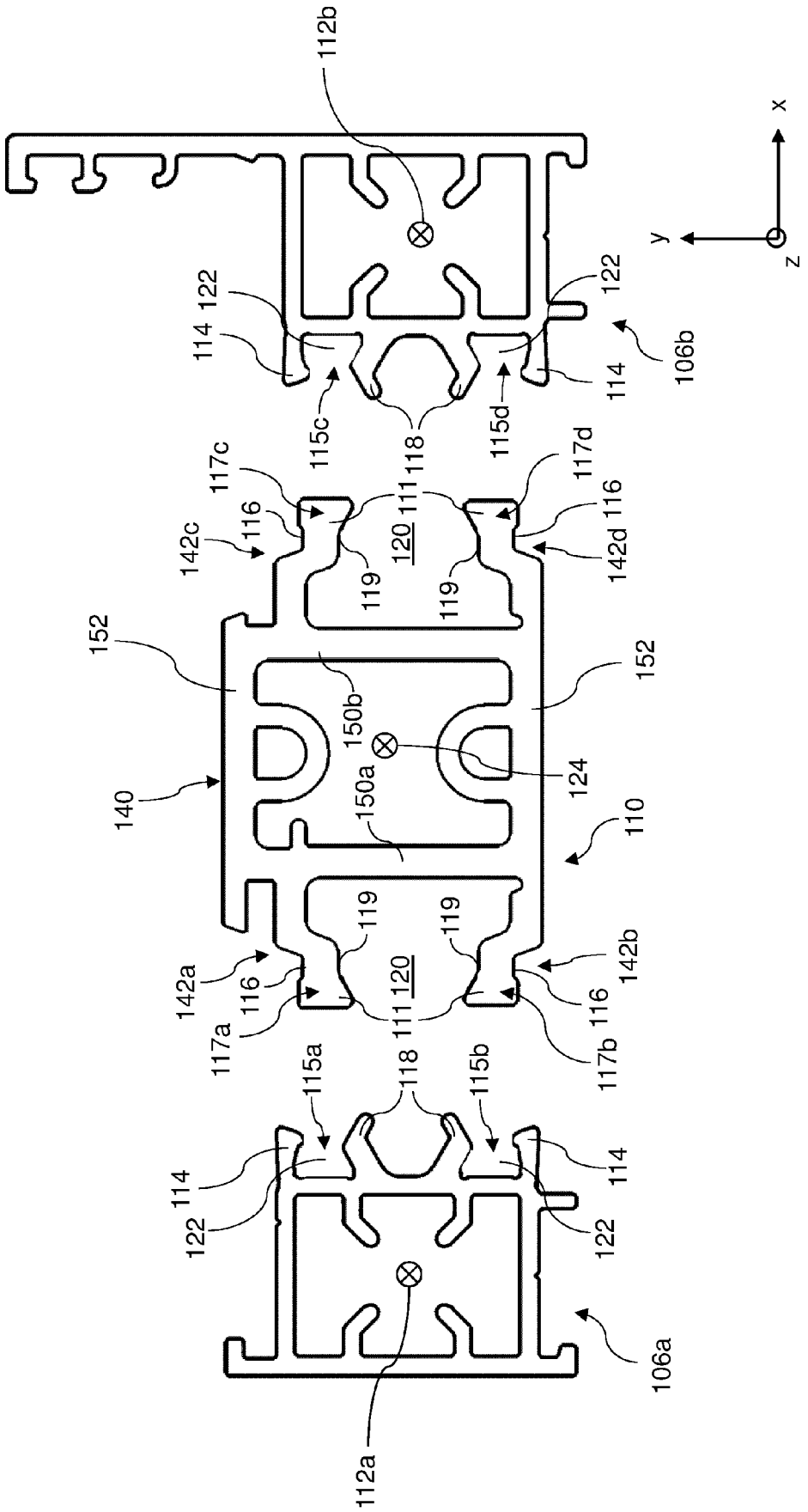


FIGURE 1b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115a
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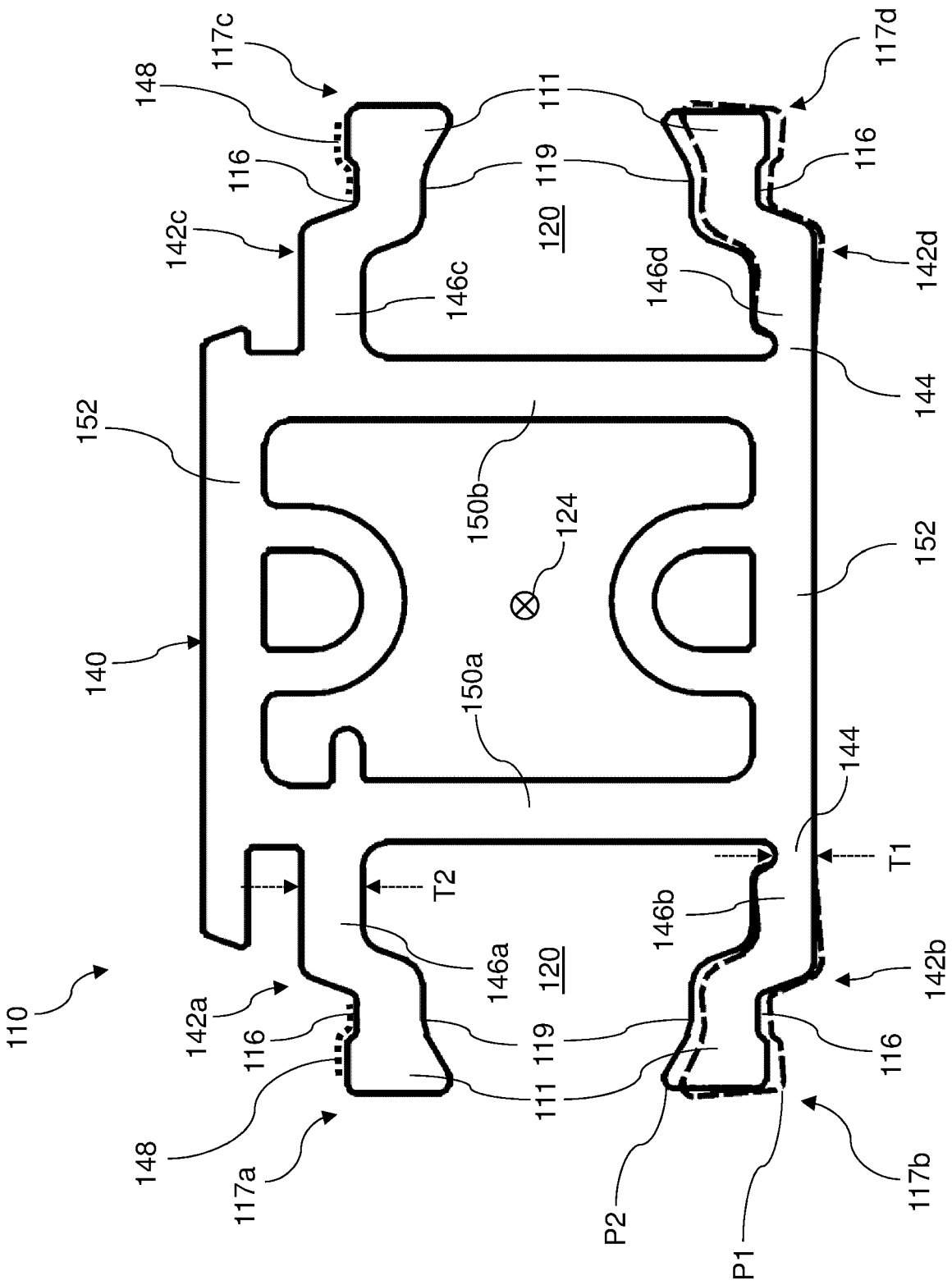
106a
112a

FIGURE 2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119
120
117d
116
142d
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146b
142a
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117a
117b
P2
P1

FIGURE 3

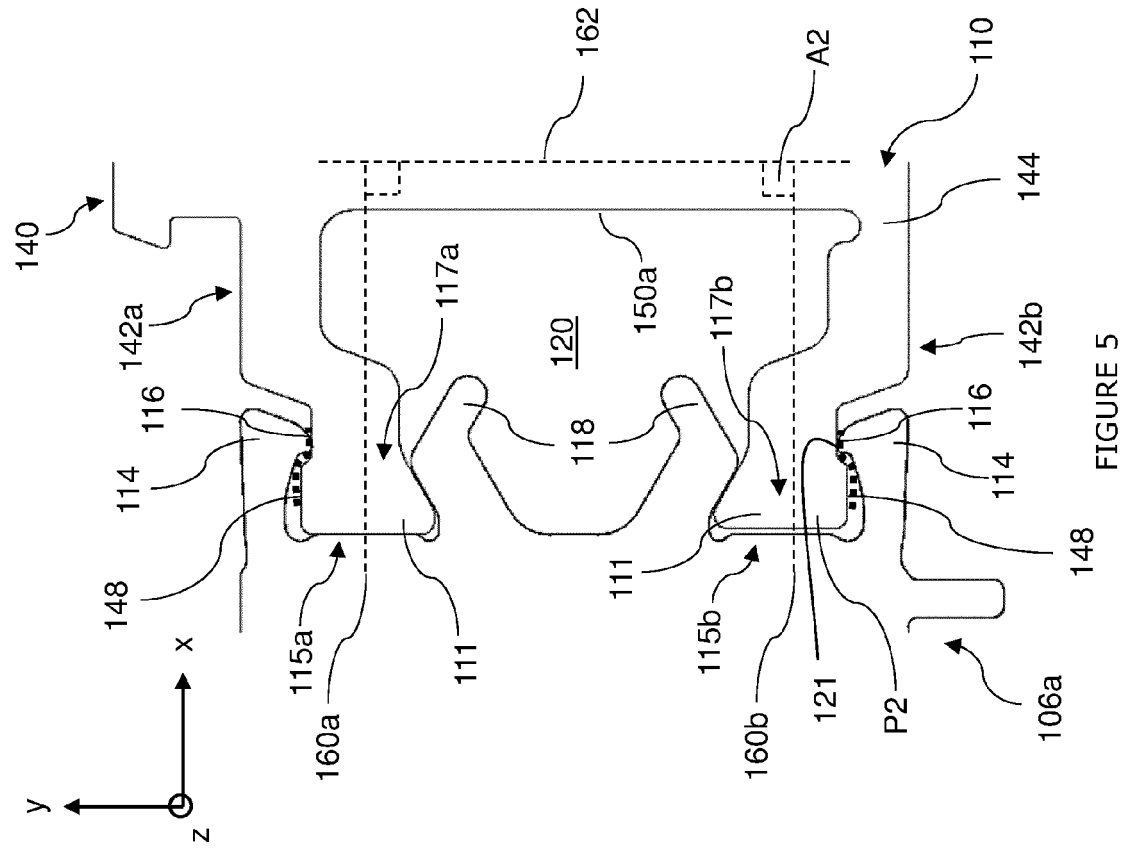

FIGURE 5

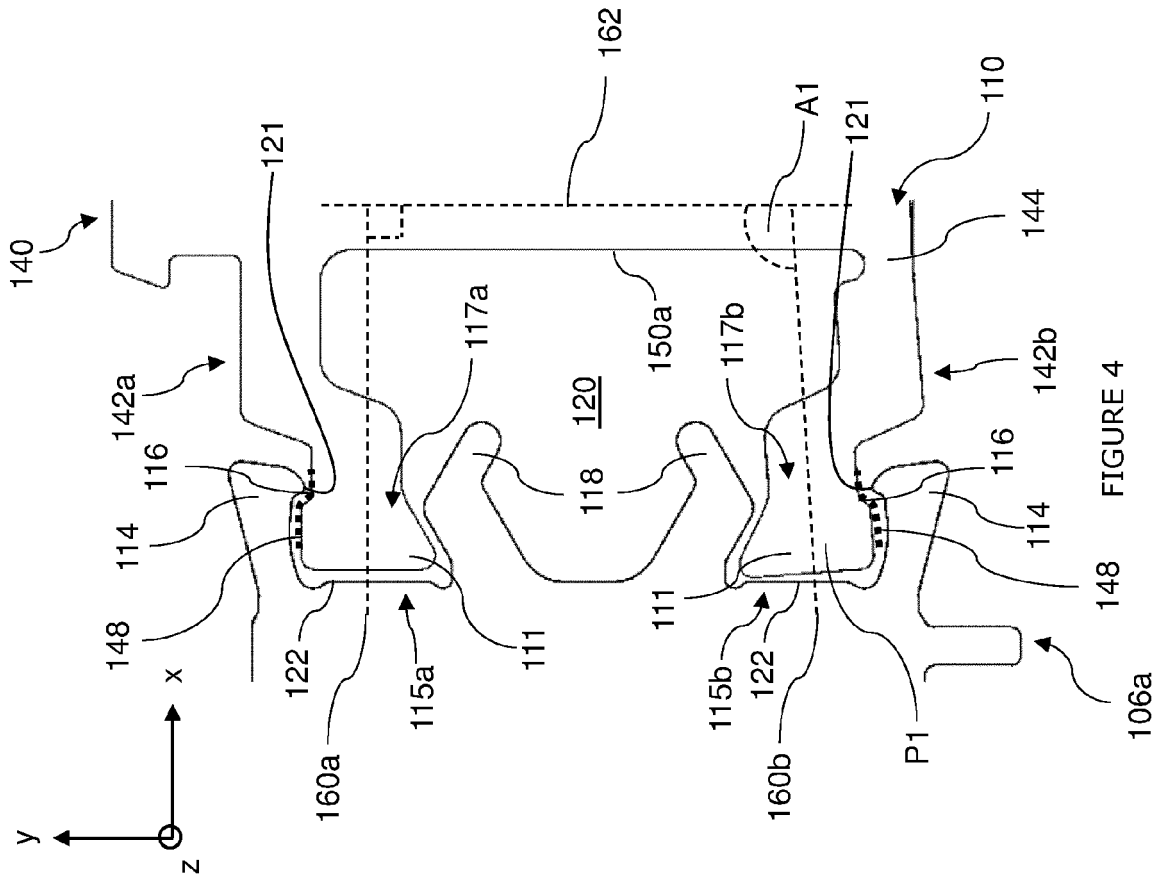

FIGURE 4

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 3749

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 June 2022	Verdonck, Benoit

CATEGORY OF CITED DOCUMENTS

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