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(54) A FRAME MEMBER, A METHOD FOR MAKING A FRAME MEMBER, A FRAME STRUCTURE AND USE OF A FRAME MEMBER

(57) A frame member for a sash or frame structure for a window or door, said frame member comprising: a core substantially made from a foamed material having a thermal conductivity below 0.037 W/m K, wherein at least one strength imparting layer, preferably made of metal, covering at least a part of the core and the strength imparting layer has a thickness of or below 0.1 mm, preferably below 0.06 mm.

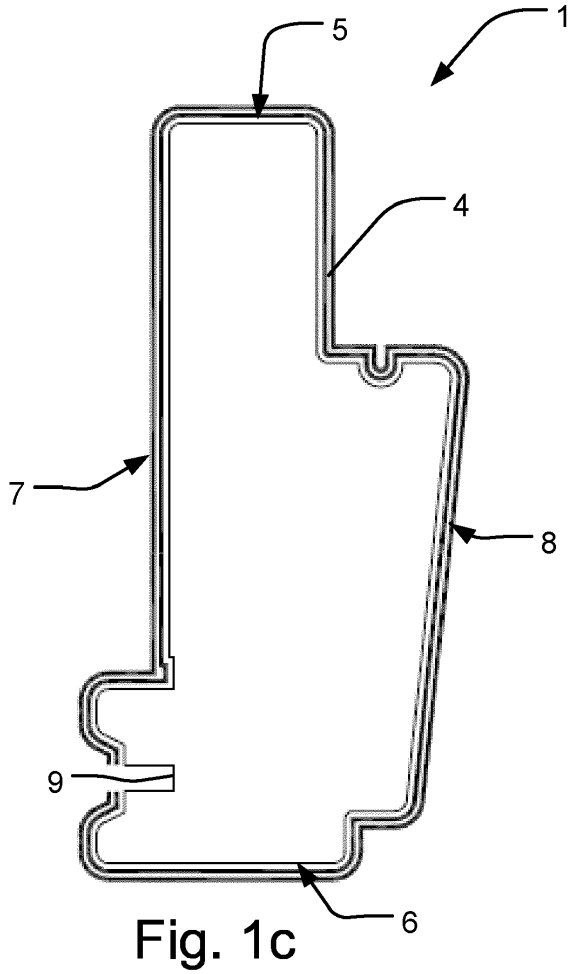

Fig. 1c

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Description

[0001] The present invention relates to a frame member, such as a side, a top and a bottom piece for a sash or frame structure for a window or door, said frame member comprising:

> a core substantially made from a foamed material having a thermal conductivity below 0.037 W/m K, wherein at least one strength imparting layer, preferably made of metal, covering at least a part of the core.

[0002] The invention further relates to a frame structure comprising a frame member, a method of providing a frame member and use of a frame member.

[0003] Traditional wooden frame or sash structures are considered aesthetically pleasing but are not very robust, particularly not when exposed to moisture, and they lack the insulating properties wanted in modern buildings.

[0004] The robustness issues have previously been solved with window frames made from polyvinylchloride (PVC), which is very widely used, while other window makers, including the applicant, have chosen to make the frames from profiles with a wooden core, typically of ply-wood, and a polyurethane (PUR) shell. Other plastic materials have also been used for the shell, but PUR is by far the most widely used, since it has suitable properties with regard to weather resistance, insulation, mouldability etc.

[0005] These frames, however, still lack sufficient insulating properties to live up to the still stricter building regulations, which are being adopted in many countries, and it has therefore been attempted to include insulating materials in the frame member.

[0006] From US2015/0096257 a frame member is described, wherein the core has one or more core members made from expanded polystyrene (EPS) and a shell of polyurethane (PUR) encasing the core.

[0007] In US 5,833,796 a thick skin or sheet is provided on an structural article such as a window frame. The core may be made of EPS. The strength imparting layer is preferably amorpheus polyester.

[0008] It is the object of the invention to provide an alternative and cheaper frame member still having good thermal insulating properties and acceptable rigidity and strength properties.

[0009] This is achieved with a strength imparting layer having a thickness of or below 0.1 mm, preferably below 0.06 mm. This provides a frame member with sufficient structural strength and insulation properties approximately 4-5 times better than the insulation properties of wood. Furthermore, it is a lighter construction compared to structures having a thicker and often rollformed strength imparting layer.

[0010] Preferably the core is thermostable up to 90 degrees C, but thermostability up to 70 degrees C will be sufficient for most applications.

[0011] The core may have a density above 60 kg/m^3, preferably above 80 kg/m^3 and/or between 60-200 kg/m^3, preferably between 80-200 kg/m^3.

[0012] The strength imparting layer may be provided only on selected parts of the surface, for example only covering 4/5 or ½ or 1/3 of the surface, or only selected edges of the frame member. The top and the bottom of the frame member should preferably be covered due the stress imparted on these edges. The sides do not necessarily have to be completely covered. The strength imparting layer may also enclose the core completely or having only the ends free from any strength imparting layer(s). Furthermore, as the frame member is likely a profiled member with projections and grooves, the strength imparting layer does not necessarily have to cover the (narrow) grooves. Often will these grooves be used for receiving gaskets or other elements and the core will therefore not be exposed to the surroundings.

[0013] Likewise, in the production process it is not possible to get the strength imparting layer or strength imparting cover layer attached to the core in the narrower grooves.

[0014] Without wishing to be bound by theory, the invention is based on the recognition that the contribution of strength of the individual components of the frame member renders it possible to provide a frame member with properties corresponding to the local load and hence demand for bending, compressive and torsional strength.

[0015] The cross-sectional configuration of the frame member is bound by certain requirements. In the top section of the frame member, adapted to face the exterior, the local load will primarily be compressive stress, whereas at the bottom section, adapted to face the interior of the building, the tensile stress is predominant. The further into the core element towards the center, the tensile and the compressive stress equalizes and consequently the stress diminishes. According to the laws of statics, the moment of inertia and hence the bending stiffness increases by the power of three of the height of the element in question. Therefore, by strengthening a frame member at its periphery, by partly or completely wrapping a frame member in a strength imparting layer, a proportionally greater contribution of the strengthening material is provided to the member, than if the same material were provided in the center of the frame member.

[0016] The frame member may further comprise at least one strength imparting cover layer in a different material from the strength imparting layer. This adds to the strength of the frame member.

[0017] The strength imparting cover layer may be provided only on selected parts of the surface, for example only covering 4/5 or ½ or 1/3 of the surface, or only selected edges of the frame member. The top and the bottom of the frame member should preferably be covered due the stress imparted on these edges. The sides do not necessarily have to be completely covered. The strength imparting cover layer may also enclose the core completely or having only the ends free from any strength

imparting cover layer. Furthermore, as the frame member is likely a profiled member with projections and grooves, the strength imparting layer does not necessarily have to cover the (narrow) grooves. Often will these grooves be used for receiving gaskets or other elements and the core will therefore not be exposed to the surroundings.

[0018] The frame member may have a maximum deflection of 5 mm at a load of 300 Newton, preferably a maximum deflection of 5 mm at a load of 800 Newton. Further information/circumstances may be found in the description of fig. 4.

[0019] According to a preferred embodiment the material of the core comprises a material selected from the group consisting of thermostable expanded polystyrene (EPS), graphite containing expanded polystyrene, polyphenylene oxide, polyurethane (PUR), hybrid foam and biobased polymer.

[0020] These materials provide the frame with good insulation properties. The thermostable EPS offers a thermostability up to 90 degrees C and PUR offers a thermostability up to 120 degrees C. A biobased polymer such as polylactide acid (PLA) looks and behaves like polyethylene and polypropylene and has a thermostability up to 70 degrees C. Generally, polymers have good shock absorption properties due to being long chained. The core may comprise nanostructures as well in order to increase the strength of the core.

[0021] According to another embodiment the strength imparting layer may be attached to the core by means of an attachment means, such as welding, rivets, and/or an adhesive. Preferably an adhesive such as glue is used but mechanical attachment means may also be used.

[0022] The adhesive may advantageously be selected from the group consisting of a reactive hot melt adhesive, preferably a polyurethane reactive hot melt adhesive. The reactive hot melt adhesive is pressure sensitive, reactive when heated and thereby able to absorb moisture. The reactive hot melt adhesive is cross-binding and thereby elastic, providing the connection between the layers with greater strength. At the top of the frame member, the frame member is subjected to a compressive stress, the adhesion of the layer with the core is important, otherwise the strength imparting layer will begin to crease.

[0023] To increase the adhesive force at least a part of the surface of the core may be a bit rough, but not uneven, when the layers have been attached to each other by means of adhesion such as an reactive hot melt adhesive.

[0024] Preferably the strength imparting layer may be selected from a group consisting of aluminium, copper, stainless steel, such as austenitic stainless steel and/or AISI Type 304 Stainless Steel. Aluminium is generally easy to work with and is available in a number of different thicknesses. Austenitic stainless steel and/or AISI Type 304 Stainless Steel has/have a considerable smaller thermal conductivity than aluminium. Where the thermal conductivity for aluminium is approximately 240 W/m K it is only 16.2 W/m K for AISI Type 304 stainless steel and thereby considerably lower. This is particularly important when it is being used for window or door frame members, where hot and cold air meet at the frame, and thereby water vapour may accumulate on the warm side of the window or door frame, which is undesirable. To compare the thermal conductivity for wood is approximately 1.2 W/m K. The strength imparting layer may comprise several layers and/or the different strength imparting layers may be made of the same and/or different materials. The strength imparting layer is preferably a film or a foil with weatherproof qualities. The strength imparting layer may also be made of other types of steel or alloys.

[0025] The strength imparting cover layer may be selected from a group consisting of: a biobased veneer, such as bamboo veneer, hemp veneer, basically any kind of wood veneer. Other materials such as fiberglass, polypropylene, polyvinylchloride or carbon fiber may also be used. The strength imparting cover layer should both act as a strengthening layer and a decorative layer, as this will be the outer most layer of the window or door frame. The strength imparting cover layer prevents the strength imparting layer from collapsing or creasing when forces are applied to the frame member. Bamboo veneer is preferred due to its chock absorption properties and it is an environmentally friendly material. The remaining biobased veneers may preferably be stretched prior to application on to the strength imparting layer, in order to reduce their elasticity and thereby their tendency to bend when pressure is applied for example perpendicular to a length direction of the frame member. Polymers are less preferred as they are thermoplastic. The strength imparting cover layer preferably has a thickness between 0.1 and 1 mm, more preferably between 0.4 and 0.7 mm.

[0026] In some embodiments the core may be provided with a primer and/or backing layer, prior to or after application of the strength imparting layer. The primer may be sprayed on or applied with a brush to increase adhesiveness to the subsequent layer, and the backing layer may be glued on or in other ways be attached to the core or strength imparting layer in order to increase adhesiveness. The backing layer may be a non woven material. In particular when the core is made of PUR, it may be advantageous to provide the core with a primer, due to its uneven surface, where maybe only a 30% contact area between the core and strength imparting layer is obtained if no primer and/or backing layer is used. If the primer and/or backing layer is used, an intimate connection between the core and the strength imparting layer is obtainable. The strength imparting layer may be provided directly on top of the primer or an intermediate backing layer may be provided on top of the primer. The backing layer is preferably a nonwoven material used for distribution of forces.

[0027] The frame member is provided with an additional receiving element, preferably embedded in the core. The receiving elements may be individual receiving ele-

ments for receiving attachment means in the form of screws or dovels placed directly where the attachment are meant to be positioned. The receiving element is preferably a polymer, such as PE, PP, PVC, ABS or nylon, preferably made by casting. Alternatively, or additionally a plate like element, for example a laminated plate, may be sandwiched post production of the core or embedded in the core during moulding thereof.

[0028] The frame member may comprise two or more strength imparting layers depending on the choice of material for the strength imparting layers and of the strength requirement. A larger window will for example require a frame member having a greater strength.

[0029] The strength imparting layer and the strength imparting cover layer is preferably made of different materials.

[0030] The strength imparting layer may only cover segments of the core, the strength imparting layer having no more than one bend. In this way the strength imparting layer becomes independent of the size of the core, so if there are any production tolerances of the core and/or the strength imparting layer, this does not affect the fit of the strength imparting layer in relation to the core.

[0031] For example, strips may be applied to one or more plane or curving sides of the core. Alternatively, the strength imparting layer may cover two sides of the core such that it extends around a corner of the core. Thereby the strength imparting layer has only one bend. The bend may form a straight, acute or an obtuse angle. Alternatively, the strength imparting layer is curve shaped. This of course depends on the shape of the core. By applying the strength imparting layer in segments or strips, the wrapping becomes independent of slight tolerances that may be in the size and shape of the core. Thereby a perfect fit between the core and the strength imparting layer is provided also when there are small size tolerances in the core. The strength imparting layer is preferably wrapped partly around the core or applied in strips. Furthermore, interruptions between the segments may break a possible thermal bridge, such that humidity doesn't accumulate on the inside of the frame or sash member.

[0032] The frame members may be wrapped in a wrapping device for wrapping profiles in laminates and foils, preferably provided with rolls for the different layers and divided into wrapping zones. Ideally the zones and/or rolls are easily exchangeable for an adaptable production line. This production process allows for a differentiated wrapping, because the rollers with the different layers are easily exchangeable, for example if different kinds of wrapping are required or if first a batch of small frame members requiring one strength imparting layer are run succeeded by larger frames requiring for example two strength imparting layers or a strength imparting layer of a different material.

[0033] It may also be possible to semi wrap the core. For example a layer may be provided on the side of the core adapted to face the interior side of a building, while the side of the core adapted to face the exterior side of the building may be provided with a different layer.

[0034] The frame members are preferably joined with a dove tail connection in the corners.

[0035] The hybrid foam may be a combination of metal and/or ceramic and/or fabric and/or polymer.

[0036] The foamed material is preferably a rigid material so that not only the strength imparting cover layer contributes to the rigidity of the frame member.

[0037] The frame member is preferably a profiled and/or prism shaped frame member.

[0038] Substantially made from a foamed material, should be construed as meaning that separate elements of other materials, such as receiving elements may be incorporated into the core material, for receiving screws, dovels or other attachment means.

[0039] The frame member would as such replace the traditional wooden frame members and would thus constitute the supporting structure of the window or door. The frame member may thus be forming part of a frame or sash structure for a door or a window.

[0040] In another aspect the invention relates to a method of producing a frame member, comprising the steps of conveying the core through an adhesive application device, conveying the core through a wrapping device comprising a number of wrapping zones and thereby providing the core with a strength imparting layer.

[0041] In yet another aspect the invention relates to use of a frame member according to the invention, for the production of a window or a door.

[0042] In the following, the invention will be described in further detail with reference to the drawings in which:

Fig. 1a-c is a cross section of an embodiment of a sash member at different production stages according to the invention,

fig. 2a-c is a cross section of an embodiment of a frame member at different production stages according to the invention,

fig. 3 is a perspective view of an embodiment of a frame structure,

fig. 4 is a diagram over deflection of seven different embodiments of frame members in relation to the load exerted upon it,

fig. 5a-b is a cross section of an embodiment of a frame member and a sash member respectively, where the strength imparting layer has been applied in segments.

[0043] Fig. 1 a shows a core 2 of a side frame member 1 before wrapping is applied. Fig. 1b shows an embodiment of a frame member 1, where a strength imparting layer 3 has been applied onto the core 2. Fig. 1c shows an embodiment of a frame member 1 where a strength imparting cover layer 4 has been applied. The frame member 1 in a figs. 1a-c have a top 5, a bottom 6 and sides 7,8. The frame member 1 comprises an EPS core 2 and a strength imparting layer 3 in the form of 0.05 mm

of stainless steel. The strength imparting layer 3 is attached to the core by means of a reactive hot melt adhesive (not shown). On top of the strength imparting layer 3 a strength imparting cover layer 4 is provided, and likewise attached with a reactive hot melt adhesive. The strength imparting cover layer 4 consist of a layer of bamboo veneer. The core may also be made of PLA and/or the strength imparting layer made of stainless steel may also be thinner, such as 0.03 mm.

[0044] The strength imparting layer 3 may also be made of two layers of 0.1 mm aluminum or other materials mentioned in the application.

[0045] The different layers are all attached in the same way, i.e. with a reactive hot melt adhesive. Other types of adhesives may be used, but may not provide the same advantages. Furthermore, the core 2 has a groove 9 adapted to receive a gasket or a liner. As can be seen on the figure the strength imparting layer 3 and strength imparting cover layer 4, does not connect to the core in the groove 9. This is due to the production process where the layers are applied with rollers which are wider than the groove 9.

[0046] This embodiment may also be provided with a nonwoven backing layer (not shown) before application of the strength imparting layer 3.

[0047] The frame member 1 may be provided with one or more receiving elements for receiving attachment means.

[0048] In figs. 2a-c a sash member of a frame member 1 is shown. The description of the embodiments in figs 1a-c applies to figs. 2a-c mutatis mutantis.

[0049] In figure 3 a whole frame structure 11 can be seen comprising top, bottom and side frame members 1 of a frame, each attached to each other by means of a reactive hot melt adhesive and dove tail joints. (not shown). The frame members may be attached to each other by other means for example by gluing beveled edges together.

[0050] Fig. 4 show a diagram over tests for deflection of a six different embodiments of frame members in relation to a load exerted upon it. One graph shows an interpolation based on test results and of physical properties of the material.

[0051] In the test the frame members were supported at a distance of 100 cm. The members should thus be able to hold themselves in this position without additional support.

[0052] The members were pressed 15 mm down at a speed of 10 mm/minute and 50 mm/minute in the middle between the support points. This was done on all four sides/directions. All members were bent to a deflection of 15 mm.

[0053] The different graphs are marked A-G.

[0054] A-F are the test results and G is the interpolated result, in which the result for A has been multiplied by 2.5, due to the mechanical properties of aluminum in relation to stainless steel.

A represents an EPS core provided with a primer foil, two strength imparting layers in the form of 0.1 mm aluminum foil and a strength imparting cover layer in the form of ash veneer.

B is an EPS core provided with a primer foil.

C is an EPS core only.

D is an EPS core provided with an ash veneer.

E is an EPS core provided with a primer foil, one strength imparting layer in the form of 0.1 mm aluminum foil and a strength imparting cover layer in the form of ash veneer.

F is a wooden core.

G is the interpolated result presumably corresponding to an EPS core provided with a strength imparting layer of 0.05 mm stainless steel and a strength imparting cover layer of ash veneer.

[0055] It is clear that both the core with two layers of aluminum (A) and the core with one layer of stainless steel (G) are preferred in relation to strength of option B-D. In terms of insulation properties option A-E and G are to be preferred over F.

[0056] This indicates that it would be preferable to use a metal as a strength imparting layer, and a strength imparting cover layer preferably made of plant/bio material.

[0057] Fig. 5a-b is a cross section of an embodiment of a frame member 1 and a sash member respectively, where the strength imparting layer 3 has been applied in segments onto the core 2. It can be seen that the segments of the strength imparting layer 3 only has one bend 32 such that interruptions 31 are present between the different segments. The bend 32 may form a straight, acute or an obtuse angle. Alternatively, the strength imparting layer 3 is curve shaped. The strength imparting layer 3 may be stainless steel having a thickness of 0.04 mm or less. The frame member 1 is provided with a receiving element 12 for receiving attachment means such as screws. The receiving element 12 may be positioned somewhere else and more than one may be present. A strength imparting cover layer (not shown) may be applied on top of the strength imparting layer 3, however the strength imparting cover layer preferably covers most of the frame/sash member as can be seen in figs. 1c and 2c, and not only the segments.

[0058] The same reference numbers apply to the same features throughout the application. The scope of the present invention is set out by the accompanying claim set. In the context of the claims, the terms "comprising" or "comprises" do not exclude other possible elements or steps. Also, the mentioning of references such as "a" or "an" etc. should not be construed as excluding a plurality. When referring to a frame member, it is to be construed as a sash member and/or a frame member. In general, the features of the embodiments shown and described may be combined freely and no feature should be seen as essential unless stated in the independent claims.

Claims

1. A frame member (1), such as a side, a top or a bottom piece for a sash or frame structure for a window or door, said frame member (1) comprising:

   a core (2) substantially made from a foamed material having a thermal conductivity below 0.037 W/m K,
   wherein at least one strength imparting layer (3), preferably made of metal, covering at least a part of the core (2) **characterized in that** the strength imparting layer (3) has a thickness of or below 0.1 mm, preferably below 0.06 mm.

2. The frame member according to claim 1, wherein the frame member (1) further comprises at least one strength imparting cover layer (4) in a different material from the strength imparting layer (3).

3. The frame member according to claim 1 or 2, wherein the frame member (1) has a maximum deflection of 5 mm at a load of 300 Newton, preferably a maximum deflection of 5 mm at a load of 800 Newton.

4. The frame member (1) according to any one of the preceding claims, wherein the material of the core (2) comprises a material selected from the group consisting of thermostable expanded polystyrene (EPS), graphite containing expanded polystyrene, polyphenylene oxide, polyurethane, hybrid foam and biobased polymer.

5. The frame member (1) according to any one of the preceding claims, wherein the strength imparting layer (3) is attached to the core (2) by means of an attachment means, such as welding, rivets, and/or an adhesive.

6. The frame member (1) according to claim 5, wherein the attachment means comprises a layer of adhesive selected from the group consisting of a reactive hot melt, preferably a polyurethane reactive hot melt.

7. The frame member (1) according to any one of the preceding claims, wherein the core (2) is thermostable up to 70 degrees C, preferably up to or above 90 degrees C.

8. The frame member (1) according to any one of the preceding claims, wherein the strength imparting layer (3) is selected from a group consisting of aluminum, copper, stainless steel, such as austenitic stainless steel and/or AISI Type 304 Stainless Steel.

9. The frame member (1) according to any one of the preceding claims, wherein the strength imparting cover layer (4) is selected from a group consisting of: a biobased veneer, such as bamboo veneer, hemp veneer, wood veneer; fiberglass, polypropylene, polyvinylchloride and carbon fiber.

10. The frame member (1) according to any one of the preceding claims, wherein the core (2) is provided with a primer and/or backing layer, prior to application of the strength imparting layer (3).

11. The frame member (1) according to any one of the preceding claims, wherein the frame member (1) is provided with an additional receiving element (12), preferably embedded in the core (2).

12. The frame member (1) according to any one of the preceding claims, wherein the strength imparting layer (3) covers segments of the core (2), such as a side or a corner, the strength imparting layer (3) having no more than one bend (32).

13. A frame structure (11) for a door or a window comprising at least one frame member (1) according to any one of the preceding claims.

14. A method of producing a frame member (1) according to any one of claims 1-12,
    comprising the steps of:

    -conveying the core (2) through an adhesive application device
    conveying the core (2) through a wrapping device comprising a number of wrapping zones, thereby providing the core (2) with a strength imparting layer (3).

15. Use of a frame member (1) according to any one of claims 1-12, for the production of a window or a door.

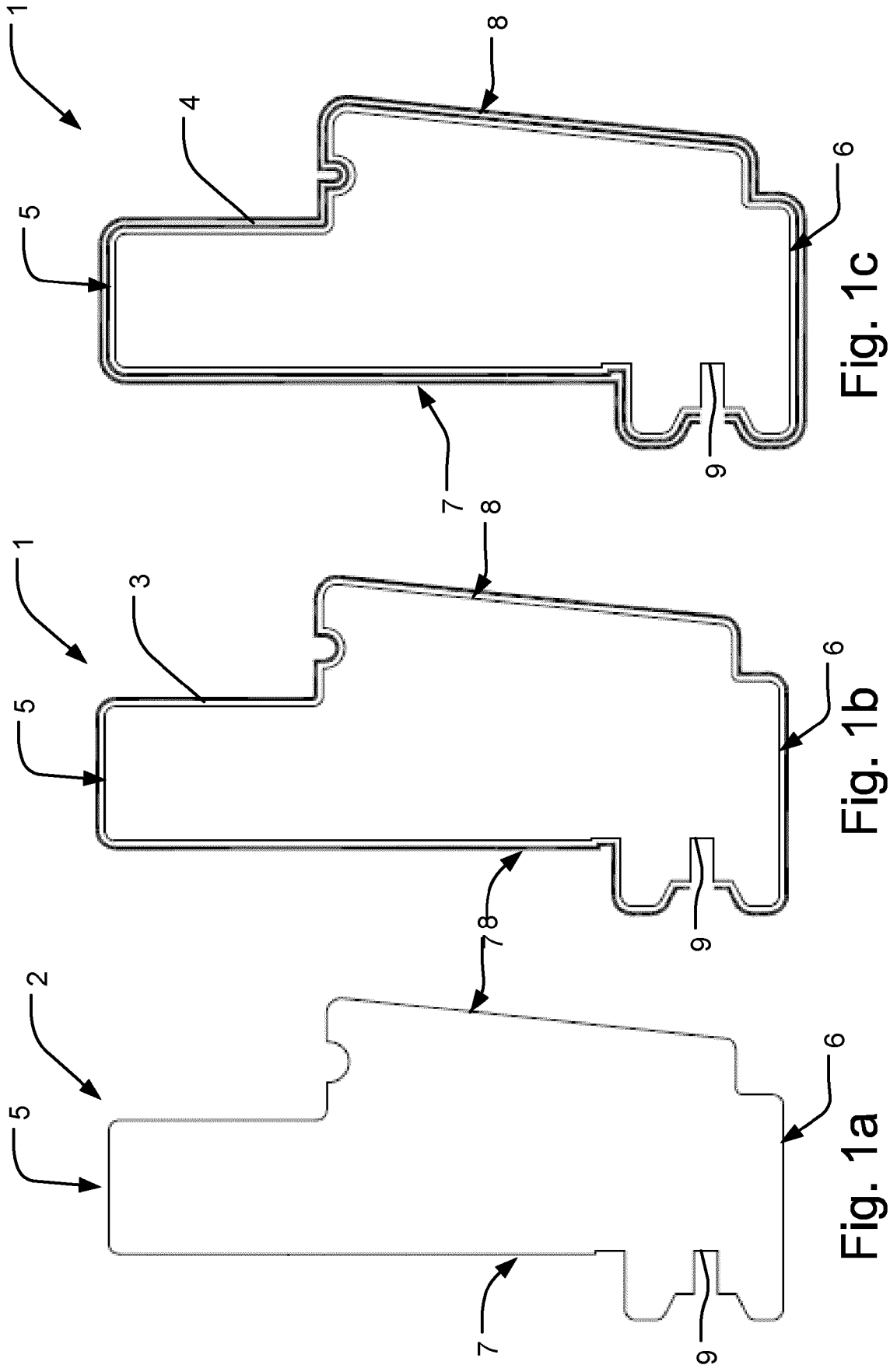

Fig. 1c

Fig. 1b

Fig. 1a

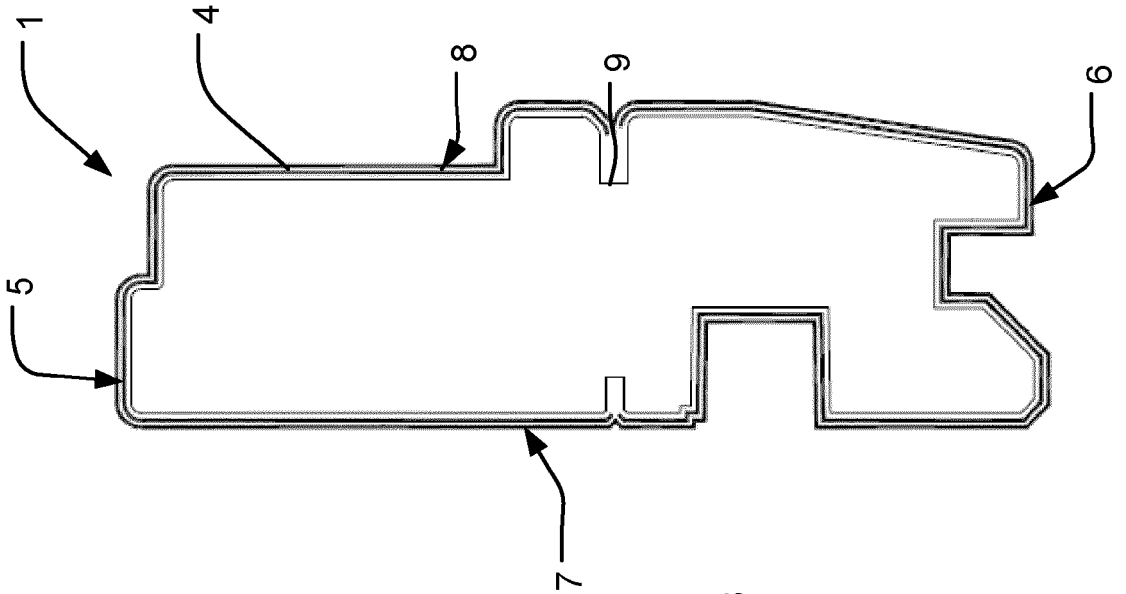

Fig. 2c

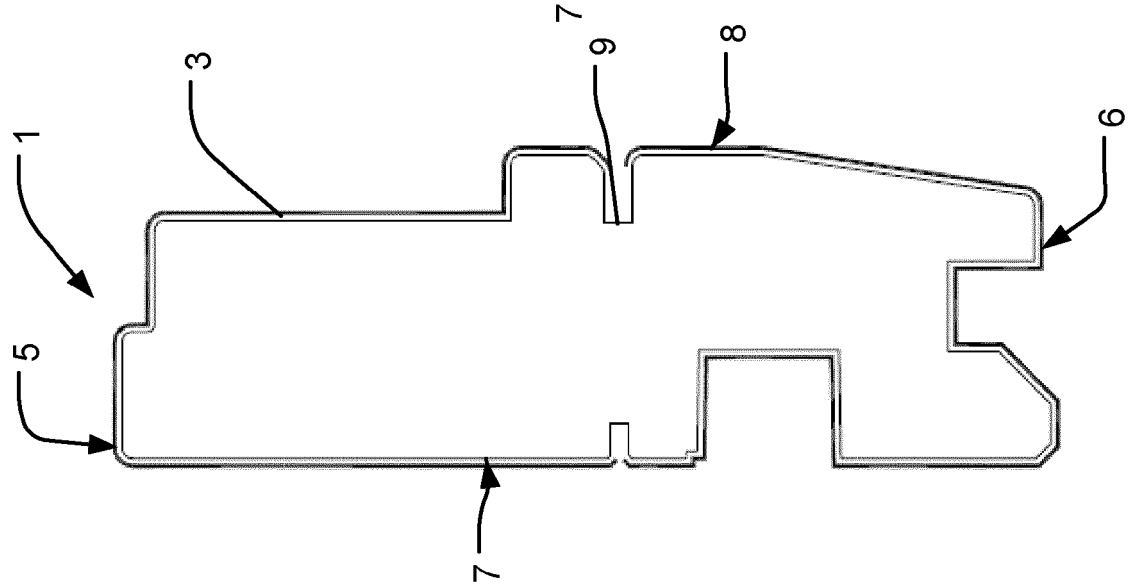

Fig. 2b

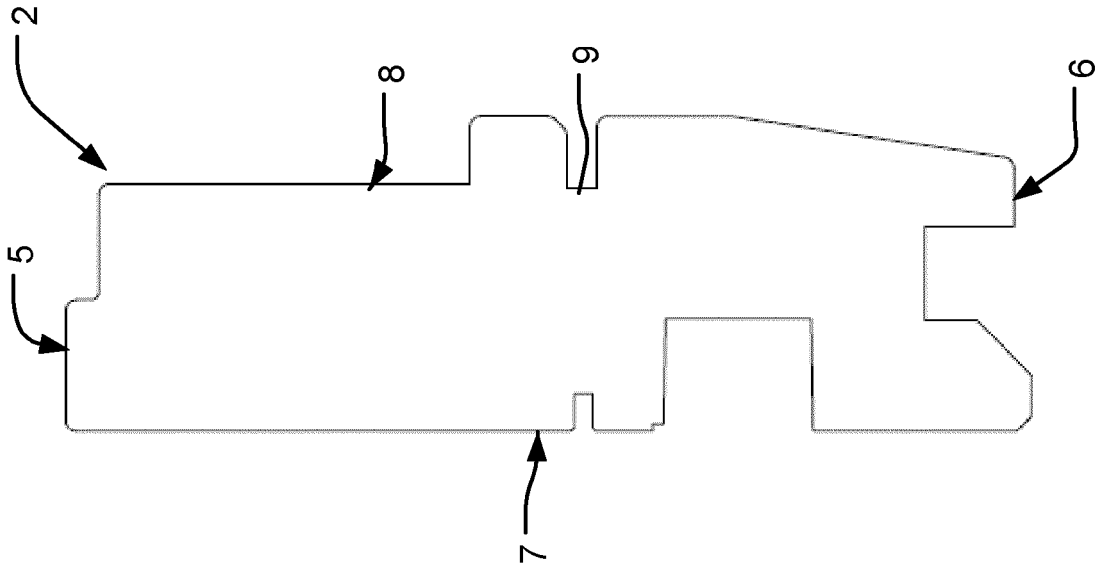

Fig. 2a

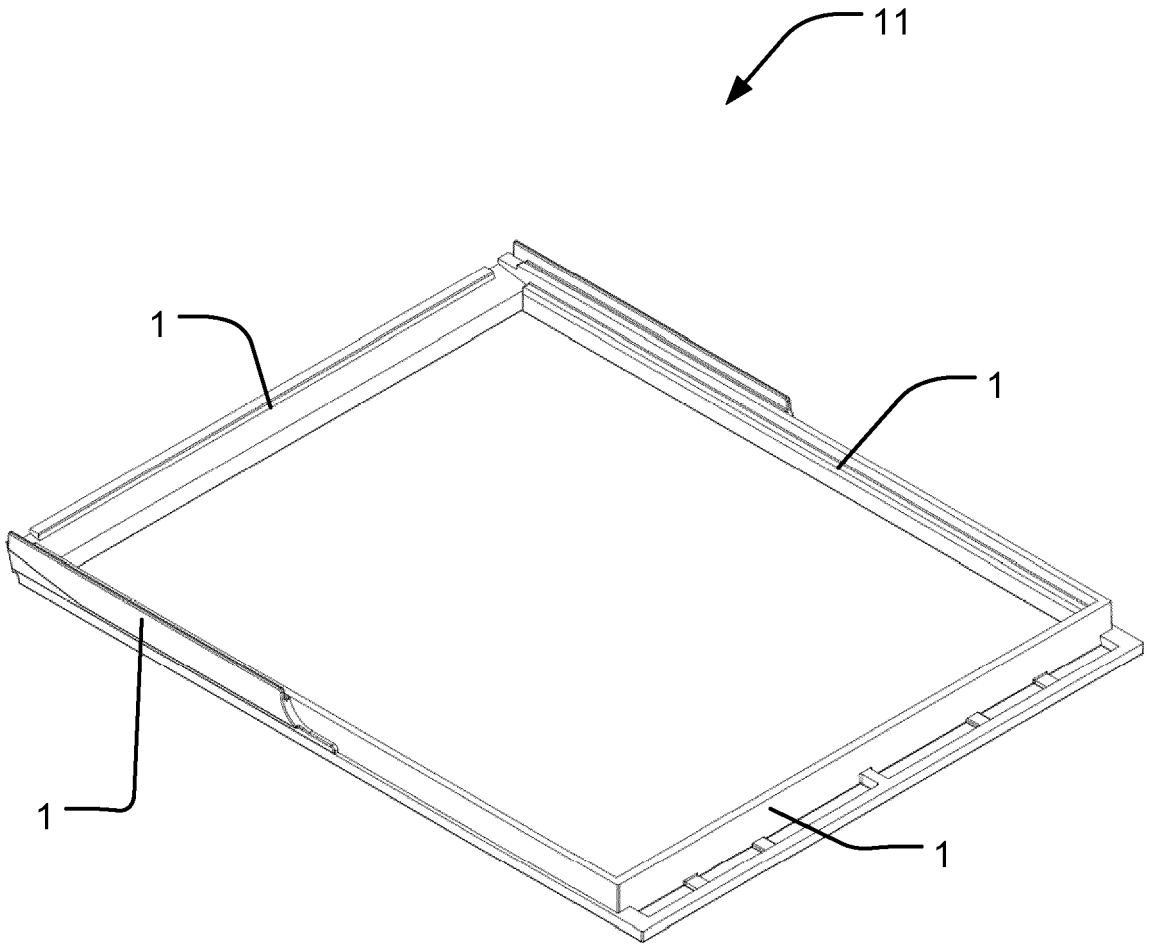

Fig. 3

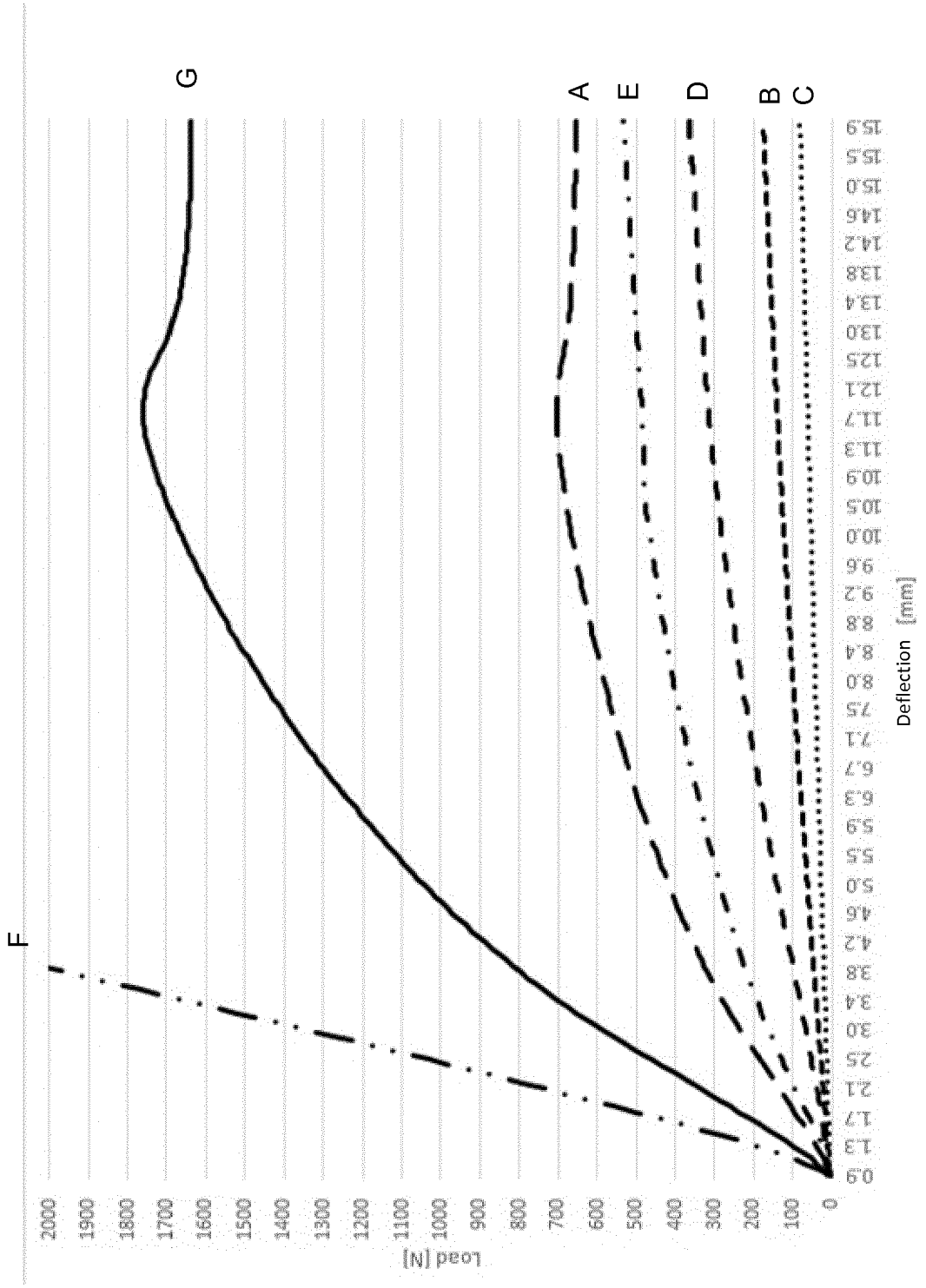

Fig. 4

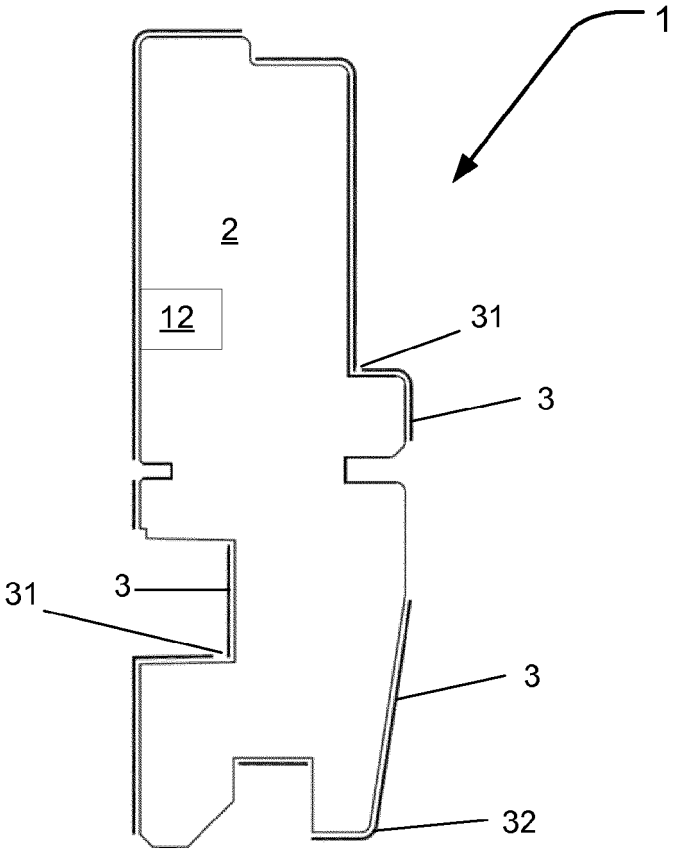

Fig. 5a

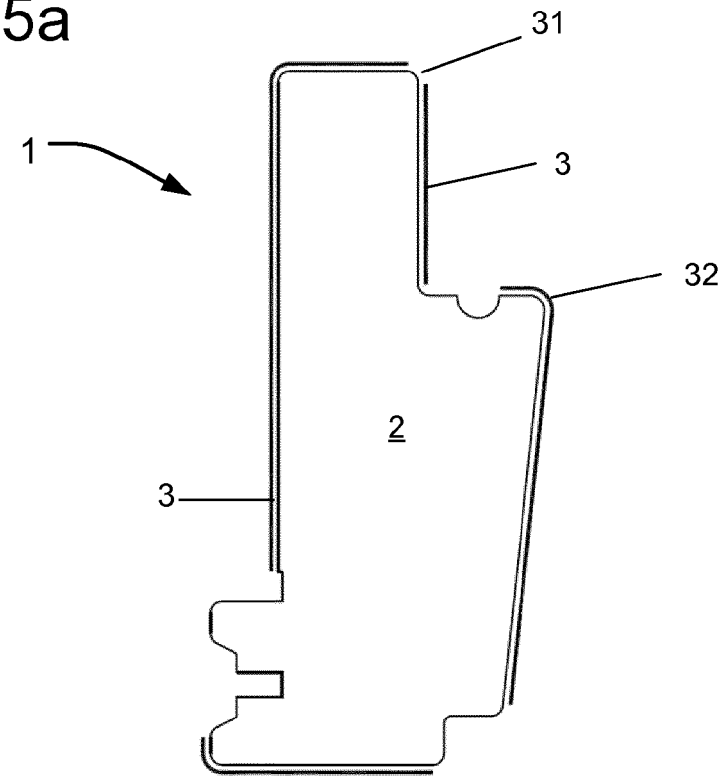

Fig. 5b

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European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 19 6144

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	DE 199 53 133 A1 (RAICO BAUTECHNIK GMBH [DE]) 10 May 2001 (2001-05-10) * figure 2 *	1-7,10, 11,13-15 12	INV. E06B3/20 E06B3/30 E06B3/263
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X A	US 6 047 514 A (VERCH JOHN T [US]) 11 April 2000 (2000-04-11) * figure 9 *	1-4,7-9, 11,13,15 5,6,10, 12,14	
X A	DE 26 30 573 A1 (HAINZ FRANZ) 12 January 1978 (1978-01-12) * page 4, paragraph 2 - page 6, paragraph 2; figure 1 *	1-4,7-9, 11,13,15 5,6,10, 12,14	
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X A	CN 104 847 217 A (ZHEJIANG HONGBO NEW BUILDING MATERIALS CO LTD) 19 August 2015 (2015-08-19) * figure 1 *	1,3-7, 10,13-15 12	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 February 2018	Jülich, Saskia

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