

(19)



(11)

EP 4 534 787 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
09.04.2025 Bulletin 2025/15

(51) International Patent Classification (IPC):
E05D 3/02 (2006.01) **E05D 5/06** (2006.01)
E05D 7/081 (2006.01) **E05D 7/12** (2006.01)
E05D 15/48 (2006.01)

(21) Application number: **24204131.7**

(22) Date of filing: **02.10.2024**

(52) Cooperative Patent Classification (CPC):
E05D 15/48; E04D 13/0354; E05D 3/02; E05D 5/06;
E05D 7/081; E05D 7/12; E05Y 2600/528;
E05Y 2600/53; E05Y 2900/152; E05Y 2900/154

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
 Designated Extension States:
BA
 Designated Validation States:
GE KH MA MD TN

(30) Priority: **02.10.2023 DK PA202370504**

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(54) A ROOF WINDOW COMPRISING A HINGE AND AN OPERATING ASSEMBLY

(57) In the roof window (1), a hinge assembly (9) provides connection between the frame (2) and the sash (3). The hinge assembly (9) is located within an outer circumference of the frame (2) and sash (3) to provide a hinge axis at the top frame and sash members (21, 31). Each sash member (31) comprises an exterior sash profile element (31p1) and each frame member (21) comprises an interior frame profile element (21p1) formed by a continuous moulding process. The exterior sash profile element (31p1) overlaps the associated interior frame profile element (21p1) in the closed and open positions of the sash (3). The hinge assembly (9) comprises locking means (990) to prevent unintentional release of the connection between the sash (3) and the frame (2).

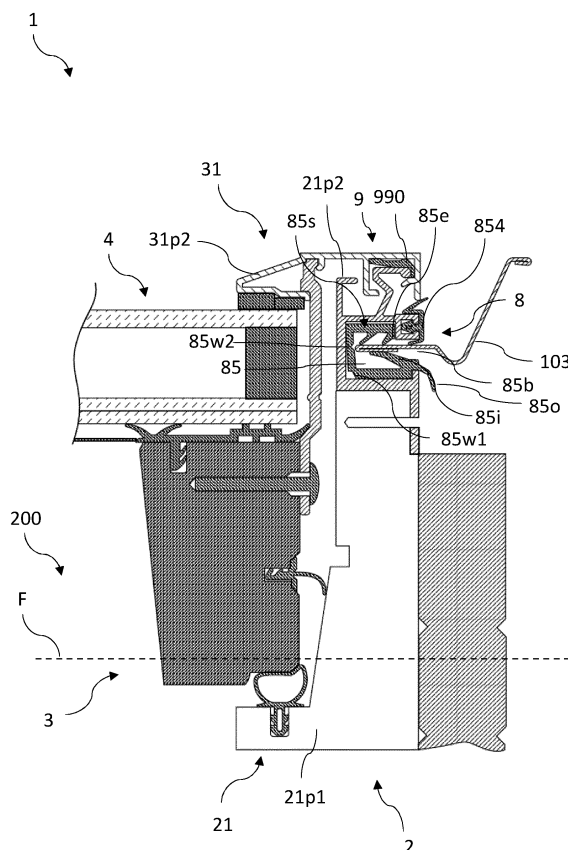


Fig. 9

Description

Technical Field

[0001] The present invention relates to a roof window comprising a frame, a sash, and a pane, in which the frame comprises a set of frame members including a top frame member, two side frame members and a bottom frame member and the sash comprises a set of sash members including a top sash member, two side sash members and a bottom sash member, in which the sash is connected to the frame by means of a hinge assembly, and in which an exterior pane surface defines a sash plane, said sash plane being positioned in parallel with a frame plane defined by the frame in a mounted condition of the roof window corresponding to a closed position of the sash, the sash being openable relative to the frame by means of a hinge assembly to allow rotation about at least a first hinge axis to an open position in which the sash plane forms an angle with the frame plane.

Background Art

[0002] Roof windows to be installed in inclined roof surfaces come in a variety of types. When selecting a roof window type for a specific installation location in a building, parameters such as operability, thermal properties, weather-tightness, and suitable finishing to the interior of the building are typically given substantial weight; however, it is also often desired and in some areas in fact necessary to factor in the external appearance as well. This applies in particular when installing roof windows in conservation areas, in which building regulations may demand that the roof windows meet standard or local requirements. Thus, certain requirements apply depending on whether the installation concerns a newly fitted roof window, or to replace an existing window or rooflight as part of a renovation or refurbishment project.

[0003] The windows or rooflights of past times were typically made of cast iron with single glass pane pieces, separated by one or more cast iron glazing bars, and the thermal efficiency of these roof windows or rooflights left room for improvement. To fulfil the energy performance required by modern day building regulations, conservation roof windows are typically provided with an insulating pane, while at the same time setting out to mimic the look of traditional rooflights.

[0004] In many installation situations it is a further requirement that the conservation roof window is able to be installed with a "low profile", i.e. that the height of the parts of the roof window protruding above the surrounding roofing is as small as possible. This is particularly pronounced in buildings with substantially flat roofing materials, such as slate or shingle. To meet this requirement, most major roof window manufacturers allow installation in at least two levels, thus accommodating the height of various roofing profiles and installation conditions.

[0005] With an ever-increasing awareness of environmental considerations and the wish to reduce or even eliminate the climate footprint of products, there is furthermore a need for providing products which are more environmentally friendly in terms of manufacturing, supply, installation, and use.

[0006] Taking all of the above requirements into account, it is an ongoing quest to improve a roof window for conservation purposes.

Summary of Invention

[0007] With this background, it is an object of the invention to provide a roof window by which it is possible to at least maintain the energy performance of standard roof windows while at the same time providing an appearance resembling traditional rooflights more closely.

[0008] This and further objects are achieved with a roof window of the kind mentioned in the introduction, which is furthermore characterised in that each sash member comprises at least one exterior sash profile element and each frame member comprises at least one interior frame profile element formed by a continuous moulding process, the exterior sash profile element of the sash members overlapping the associated interior frame profile element of the frame members in the closed position and in the open position of the sash, that the hinge assembly is located within an outer circumference of the frame and sash, that the first hinge axis is provided at the top frame and sash members, and that the hinge assembly comprises a hinge unit and a coupling unit, the coupling unit being connected the hinge unit in the mounted condition and comprising locking means to prevent unintentional release of the connection between the sash and the frame.

[0009] By this design, it has proven possible to provide the roof window with satisfactory thermal properties, due to a large extent to the presence of the interior frame profile element formed by a continuous moulding process. Thanks to the presence of exterior sash profile elements, the interior parts of the sash are adequately protected, and the sash may be given the desired appearance of a traditional cast-iron conservation rooflight, not least by obviating the need for a fixed top casing fastened to the top frame member, which is a characteristic shared by most standard roof windows, whether top-hung or pivoting. The sash thus rests on the frame as a lid-shaped structure in line with the appearance of traditionally styled rooflights. By providing the hinge assembly within the outer circumference of the frame and sash and with the first hinge axis provided at the top frame and sash members, improved thermal performance is achieved, while the division of the hinge assembly into a hinge unit and a coupling unit opens up for the possibility of facilitating installation and at the same time the locking means ensure that the connection between the sash and the frame is not inadvertently released.

[0010] In order to improve the thermal performance

even further, each sash member may comprise a first sash profile element and a second sash profile element, and each frame member may comprise a first frame profile element and a second frame profile element, each first sash profile element and first frame profile element being formed by a continuous moulding process.

[0011] Other presently preferred embodiments and further advantages will be apparent from the subsequent detailed description and drawings.

[0012] A feature described in relation to one of the aspects may also be incorporated in other aspects, and the advantage of the feature is applicable to all aspects in which it is incorporated.

Brief Description of Drawings

[0013] In the following description embodiments of the invention will be described with reference to the drawings, in which

Fig. 1 is a perspective view of a roof window in an embodiment of the invention;

Fig. 2 is a perspective view of a roof window in another embodiment of the invention;

Fig. 3 is a cross-sectional view of a side of a roof window in a further embodiment of the invention, corresponding to a cross-section along the line III-III in Fig. 2;

Fig. 4 is a view corresponding to Fig. 3, of an alternative embodiment of the invention;

Fig. 5 is a view corresponding to Fig. 3, of a still further embodiment of the invention;

Fig. 6 is a perspective view of a roof window in a still further embodiment of the invention;

Fig. 7 is a cross-sectional view of a side of a roof window in yet another embodiment of the invention, corresponding to a cross-section along the line VII-VII in Fig. 1;

Fig. 8 is a perspective cross-sectional view of a side of a roof window in yet another embodiment of the invention, corresponding to a cross-section along the line VII-VII in Fig. 1;

Fig. 9 is a cross-sectional view of a top of a roof window in yet another embodiment of the invention, corresponding to a cross-section along the line IX-IX in Fig. 1;

Fig. 10 is a cross-sectional view on a larger scale of details of Fig. 9;

Fig. 11 is a cross-sectional view on a larger scale of details of Fig. 9;

Fig. 12 is an exploded perspective view of a sash and a frame of a roof window in an embodiment incorporating a hinge assembly;

Fig. 13 is a partial perspective view of a top of a roof window in another embodiment incorporating a hinge assembly;

Fig. 14 is a partial perspective view of a top of a roof window in a further embodiment incorporating a

hinge assembly;

Fig. 15A is an exploded perspective view of details of a hinge assembly of a roof window in a still further embodiment incorporating a hinge assembly;

Fig. 15B is a perspective view of the details of the hinge assembly of Fig. 15A;

Fig. 16A is a plan view of a detail of a hinge assembly of a roof window in yet another further embodiment incorporating a hinge assembly;

Fig. 16B is a cross-sectional view showing the detail of Fig. 16A;

Fig. 17 is a partial perspective view of a hinge assembly of a still further embodiment of the roof window according to the invention;

Figs. 18A and 18B are perspective views from different angles, of a hinge assembly in an embodiment of the roof window according to the invention;

Figs. 19A and 19B, 20A and 20B, 21A and 21B are views from different angles, of a hinge assembly in different embodiments of the roof window according to the invention; and

Fig. 22 is a cross-sectional view of the bottom of a roof window in a still further embodiment of the invention.

Description of Embodiments

[0014] In the following detailed description, a preferred embodiment of the present invention will be described. However, it is to be understood that features of the different embodiments are exchangeable between the embodiments and may be combined in different ways, unless anything else is specifically indicated. It may also be noted that, for the sake of clarity, the dimensions of certain components illustrated in the drawings may differ from the corresponding dimensions in real-life implementations.

[0015] It is noted that terms such as "up", "down", "left-hand", "right-hand", "exterior", "interior", "outer", "inner" are relative and refers to the viewpoint in question. In general, when referred to an exterior side, this relates to a side of a roof window in a mounted condition facing the outdoors or external side of the building. Conversely, an interior side refers to a side facing the internal side of the building, i.e. typically a subjacent room including any light shaft. Terms such as "outwards" and "inwards" are directions generally perpendicular to an interior-exterior direction, taking as its base point a centre of the roof window.

General description of a roof window - Figs 1 and 2

[0016] Referring initially to Figs 1 and 2, a roof window 1 is shown. The roof window 1 is intended to be installed in an inclined roof surface (not shown).

[0017] The roof window 1 comprises a frame 2, a sash 3, and a pane 4. The frame 2 comprises a set of frame members including a top frame member 21, two side frame members 22, 23 and a bottom frame member 24.

Correspondingly, the sash 3 comprises a set of sash members including a top sash member 31, two side sash members 32, 33 and a bottom sash member 34. While the frame 2 and sash 3 are described as rectangular structures, some principles of the presented concepts may be applicable to other geometrical shapes as well.

[0018] The pane 4 comprises a number of edge portions generally associated to members of the sash 3 as will be described in further detail below. When in a closed position, an exterior pane surface defines a plane of the roof window 1 in an assembled condition of the roof window 1, corresponding to a sash plane. The assembled condition of the roof window 1 is achieved when main components of the frame 2 and sash 3 have been assembled and the frame 2 and sash 3 are connected to each other, for instance in an installed position when the roof window 1 is ready for use in the mounted condition. Correspondingly, an assembled condition of the sash 3 is achieved once main components of the sash 3 have been assembled, and an assembled condition of the frame 2 when main components of the frame 2 are assembled.

[0019] An interior pane surface faces the interior, typically a room of a building subjacent the roof surface in which the roof window 1 is installed. A glazing bar 45 is fitted to the exterior surface of the pane. It is conceivable to fit a counterpart glazing bar cover on the interior pane surface. Although less practical, it would also be possible to have a two-part pane with two pane halves divided by a throughgoing glazing bar. In wide roof windows, it is also possible to have more than one glazing bar, for instance two glazing bars dividing the surface of the pane visible from the exterior into three sections etc.

[0020] The pane 4 is in the embodiment shown as a two-layer insulating glazing unit, but may comprise three layer, or be a single-sheet glazing unit, or a vacuum insulated glass. The pane 4 may be stepped, i.e. an exterior sheet comprises an extended portion extending beyond a bottom edge portion of an interior sheet.

[0021] In the embodiments shown, the sash 3 is openable relative to the frame 2, to obtain one or more open positions. In such open positions, the sash 3 and pane 4 are moved out of the plane of the roof window 1 as defined by the frame 2 such that the sash plane forms an angle with the frame plane. As will be described in the following, the sash 3 is shown as being tophung, i.e. during normal use, the sash 3 is rotated about a substantially horizontal hinge axis at or near the top frame member 21 and top sash member 31. It is however conceivable to apply some principles of the presented concepts for roof windows on different types of windows having other opening patterns or being provided as fixed skylights.

[0022] Further details shown in Figs 1 and 2 include an operating assembly 5, here shown as a manual hand-winder or screwjack. Other operating assemblies may be present as well.

[0023] Also shown is a representative mounting bracket 6 forming part of a plurality of mounting brackets forming a load-transferring connection between the roof

window 1 and a surrounding roof structure (not shown). Such a roof structure may include rafters and battens, plywood, or other construction materials. Other mounting devices are conceivable.

[0024] Finally, an insulating frame 7 is shown. Insulation by an insulating frame is optional and may be provided along only some of the frame members or as shown surrounding all four frame members 21, 22, 23, 24.

[0025] In the following description of various embodiments, elements having the same or analogous function carry the same reference numerals throughout. Suitable variations and modifications will be apparent to the person skilled in the art.

15 Sash and frame structure - Figs 3 to 7

[0026] Referring now first to the cross-sectional view of Fig. 3, the configuration of the members of the frame 2 and sash 3 will be described by the representative side frame member 22 and side sash member 32. It is to be understood that the other frame and sash members have a corresponding configuration; differences will be emphasised and described in further detail as appropriate.

[0027] Thus, in the embodiment of Fig. 3, the side sash member 32 comprises a first sash profile element 32p1 and the side frame member 22 comprises a first frame profile element 22p1 and a second frame profile element 22p2.

[0028] Each first sash profile element 32p1 and first frame profile element 22p1 is formed by a continuous moulding process. In the embodiment shown, the first sash profile element 32p1 and the first frame profile element 22p1 are formed by extrusion of a thermoplastic material, here polyvinyl chloride (PVC). Other manufacturing methods and polymer materials may be suitable as well.

[0029] The second frame profile element 22p2 comprises an interface section 8 configured to interact with one or more external components. In the embodiment of Fig. 3, the second frame profile element 22p2 is a substantially L-shaped metal component with an outer end comprising the interface section 8.

[0030] In the embodiment of Fig. 3, the side sash member 32 comprises a second sash profile element 32p2 in addition to the first sash profile element 32p1.

[0031] Turning now briefly to Fig. 4, which shows an alternative embodiment of the invention, the side sash member 32 is composed by only the first sash profile element 32p1.

[0032] In order for the parts of the roof window 1 which are mainly visible from the exterior to be afforded a desired appearance, the exterior or outwards facing profile elements of the sash 3 in the embodiments shown have a metal or metal-like appearance so as to resemble a traditionally styled cast iron window. The outwards facing profile elements are represented by the first sash profile element 32p1 in the embodiment of Fig. 4 and the second sash profile elements 32p2 in the embodiment of

Fig. 3, respectively.

[0033] In the embodiment of Fig. 3, the second sash profile element 32p2 is provided as a longitudinal profile of a metal material, here aluminium but could also be steel or another metal.

[0034] In the embodiment of Fig. 4, the first sash profile element 32p1, which is here the only constituent main component of the sash member 32, is provided with a metal colouring on the surfaces visible to the exterior. Alternatively, the metallic look could be achieved by a metal coating or film and be present on all surfaces facing the exterior.

[0035] Whether the first or second sash profile elements are provided by a metal material, or by a plastic or composite material, it is also possible to combine materials in a continuous manufacturing process such as co-extrusion, co-moulding etc. by the addition of heat or light reflective or absorbing elements.

[0036] While extruded PVC profiles generally offer satisfactory strength and deformation properties, in particular when as shown provided with suitably positioned dividing walls 22w, 32w as is customary in the field, one or more reinforcement elements are advantageously provided in at least some of the first sash and frame profile elements. Thus, as indicated in Figs. 3 and 4, the first sash profile element 32p1 and the first frame profile elements 22p1 each comprises a reinforcement element 22r, 32r in the embodiments shown. Such reinforcement elements are suitable for offering reinforced fastening support but may also be used as strengthening elements to increase the stiffness and resistance to bending.

[0037] In Figs. 3 to 5, circumferential walls of the extruded profiles are indicated as being of a larger thickness compared to dividing walls of a mutually uniform thickness; however, such dividing walls may have varying thickness and also be provided with larger thickness than the circumferential walls. The thickness of the walls also depends on the material used and the manufacturing process; in for instance pultrusion and co-extrusion of composite materials, the thickness is typically larger.

[0038] As to the choice of materials in the embodiments shown in Figs. 3 to 5, it is possible to utilise recycled PVC on internal elements such as dividing walls and reinforcement elements of the frame and sash member. As such internal elements are not visible in the finished product, the appearance of the recycled PVC is of less or no significance. Outer surfaces may be comprised by virgin PVC, or by recycled PVC which has been provided with the desired appearance.

[0039] The reinforcement element 22r in the frame side member 22 is accommodated in the space formed between one of the dividing walls 22w and the outer circumferential wall of the first frame profile element 22p1 and primarily functions as a fastening support of the second frame profile element 22p2. The reinforcement element 22r may be an elongate element extending substantially throughout the length of the frame side member 22 or be in the form of intermittently positioned

pieces.

[0040] In the embodiment of Fig. 3, the reinforcement element 32r of the sash side member 32 functions primarily as a fastening support for the second sash profile element 32p2.

[0041] In the embodiment of Fig. 4, the reinforcement element 32r has a larger extension in the height direction compared to the Fig. 3 counterpart and thus adds to the stiffness and integrity of the side sash member 32 to provide additional support to portions of the side sash member 32 encasing the pane 4.

[0042] Further details indicated in Fig. 3 include tracks in the circumferential walls of the first frame and sash profile elements 22p1 and 32p1 of the side frame member 22 and side sash member 32, respectively. In the embodiment shown, the first sash profile element 32p1 and first frame profile element 22p1 comprise tracks 32t1, 32t1, 32t2 configured to accommodate sealing profiles.

[0043] The relationship between the interface section 8 of the second frame profile element 22p2 of the side frame member 22 will be described in more detail below.

[0044] Turning now to the embodiment of Fig. 5, it is seen how the interface section 8 of the second frame profile element 22p2 of the side frame member 22 comprises an upstanding flange configured to cooperate with the covering assembly 10, namely with a side flashing member 1012 forming part of an external flashing assembly. Forming the interface section 8 with an upstanding flange of the second frame profile element 22p2 itself allows for flexible options for the user, since for instance a traditional flashing by a material such as lead is easily folded over the flange of the interface section 8.

[0045] One example of an embodiment, in which such interface units are incorporated at the top and sides of the roof window 1 is shown in Fig. 6. Here, the second frame profile element 21p2 of the frame top member 21 and the second frame profile element 23p2 of the other frame side member 23 are indicated as well. The interface sections at the top and sides are configured to cooperate with external flashing assembly, in a way corresponding to the side flashing member 1012 shown in Fig. 5.

[0046] A further detail of the embodiment shown in Fig. 6 includes that the interface section 8 of the second frame profile element 24p2 of the bottom frame member 24 forms part of the covering assembly 10 itself, namely by constituting a bottom flashing member 1014.

[0047] Turning now to Fig. 7, an embodiment is shown in which the second sash profile element 32p2 of the side sash member 3 is formed by an extruded metal material which is connected to the first sash profile element 32p1 which is here formed by pultrusion, i.e. another continuous moulding process than the extruded PVC profiles of the embodiments shown in Figs. 3 to 5. Specifically, the first sash profile element 32p1 is formed by pultrusion of a composite material incorporating resin and glass fibre.

[0048] To form the interior facing surfaces of the sash with a harmonic appearance, an inner element 32c of for instance wood is provided and connected to the first sash

profile element 32p1 which thereby acts as an intermediate element.

[0049] In this embodiment, the first frame profile element 22p1 may be provided substantially as in the embodiments shown in Figs. 3 to 5. The second frame profile elements 22p2 is here provided as an extruded profile of a metal or composite material and comprises a track 22t2 comprised in the interface section 8. The interaction with the side flashing member 1012 of the covering assembly 10 will be described in further detail in the following.

Flashings and interfaces - Figs 7 to 10

[0050] Turning now to Fig. 7 which shows a cross-section of a roof window 1 where the frame 2 comprises a flashing socket 85 which houses a separate sealing member 85s which forms a sealing groove in which a flange 1017 of a side flashing member 1012 is arranged. Fig. 8 shows details of a similar roof window. Figs 9 and 10 show similar views but of the top of the roof window 1 corresponding to view IX in Figs 1 and 2. These figures are described collectively. The flashing socket 85 is provided in an interface section 8 of the frame 2, which interfaces with second sash profile elements 31p2, 32p2 covering the frame member which forms part of the frame 2. The interface section 8 here forms a separate frame profile element 22p2 joined to the frame 2, but the interface section could also be integrally formed with the remaining part of the associated frame member. The flashing socket 85 is seen to be formed by the track 22t2 of the frame, but in this context will be referred to as the flashing socket 85 to denote its purpose. The flashing socket 85 has socket opening 85b which faces away from the frame opening 200 whereby the flange 1017 of the flashing member 1012 can be inserted into the flashing socket 85 in a direction parallel to a frame plane F as shown in Figs. 7 and 8. The frame members 21, 22, 23, 24 define the frame plane F and a frame opening 200 between the frame members, which is best seen in Fig. 2. In Figs 9 and 10 a diverter rail 103 for diverting water and water coming down from the roof, is inserted into the flashing socket 85, but in the installed state of the window a flashing member is also inserted in the flashing socket alongside the diverter rail 103. The flashing socket 85 has an interior face 851 facing away from the roof structure (not shown), an exterior face 853 facing toward the roof structure and an end face 852 which connects the interior face 851 and exterior face 852. The end face 852 is provided opposite to the opening 85b. The interior face 851, end face 852 and exterior face 853 delimit the flashing socket 85 and they engage the sealing member 85s. One or more of the interior face 851, end face 852 and exterior face 853 may be provided with ribs 851r, 852r that protrude into the flashing socket 85 and engage the sealing member 85s as show in Figs. 7 and 8. The ribs extend along the flashing socket 85 in the length direction. Providing these ribs provide a drainage channels in between the ribs for draining away water, such as con-

densate. The ribs may also facilitate mounting the sealing member 85s in the flashing socket 85.

[0051] The sealing member 85s in the flashing socket 85 also has an opening (also at 85b) facing away from the frame opening 200 allowing the flashing member to be inserted in a sealing groove defined by the sealing member. The position of the sealing groove is also at reference 85. The sealing member 85s has an interior leg 85s1 which is associated with the interior face 851 of the flashing socket 85, i.e. it engages the interior face 851. Similarly, an end leg 85s2 is associated with the end face 852 and an exterior leg 85s3 is associated with the exterior face 853. The sealing member 85s is provided a plurality of the sealing protrusions which engage the flashing member 1012 or diverter rail 103 received in the sealing member 85s. An outwards sealing protrusion 85o is provided on the interior leg 85s1 and projects away from the frame opening 200 out of the flashing socket 85. The outwards sealing protrusion 85o engages a first leg 10121 of the flashing member 1012 when the flange 1017 is inserted into the flashing socket. Fig. 8 shows a view at an overlap between two side flashing members 1012. Typically these two flashing members 1012 are fit snugly, hindering water ingress, but these flashing members may inadvertently become deformed during installation, thereby creating a gap through which water can enter, e.g. because of wind. The outwards sealing protrusion 85o provides a seal against water which may enter through such a gap.

[0052] As shown in Fig 10 the outwards sealing protrusion 85o forms an angle α_1 with the frame plane F, which in this embodiment is about 30 degrees. The angle α_1 is measured in a state wherein the outwards sealings protrusion is not deformed by the flashing member 1012. The interior leg 85s1 of the sealing member 85s further comprise an interior inwards sealing protrusion 85i which protrudes into the sealing groove toward the frame opening 200. The interior inwards sealing protrusion 85i engages the flange 1017 received by the sealing member 85s from below. In the embodiments shown, the interior inwards sealing protrusion 85i extends at an angle to the frame plane F which angle is equal to the angle α_1 of the outwards sealing protrusion 85o, as the interior inwards sealing protrusion 85i extends in continuation of the outwards sealing protrusion 85o. It has been found that providing a single sealing protrusion on the interior leg which protrudes into the sealing groove offers the desired sealing. The interior inwards sealing protrusion 85i is in these embodiment a major sealing protrusion as a projection of the interior inwards sealing protrusion 85i onto the height direction constitutes more than 50 % of the height of the sealing groove. The height h_{85s2} of the sealing groove is indicated in Fig. 10 and is the height of the part of the end leg 85s2 which delimits the sealing groove. References to dimensions, incl. height and length, of sealing protrusions herein refer to an undeformed state of the sealing member and its protrusions, i.e. when the flashing members are not inserted in the

sealing groove.

[0053] The exterior leg 85s3 of the sealing member is provided with two exterior inwards sealing protrusions 85e which form the remaining sealing protrusions of the sealing member 85s. The exterior inwards sealing protrusions 85e protrude into the sealing groove toward the frame opening 200 and at an angle α_2 to the frame plane F. The angle α_2 is these embodiments about 60 degrees as shown in Fig. 10. It is advantageous that the number of sealing protrusions on the exterior leg 85s3 which protrude into the sealing groove exceeds the number of sealing protrusions on the interior leg 85s1 which protrude into the sealing groove, as the top of the flashing is more exposed. This arrangement of sealing protrusions is referred to as asymmetric, and in preferred embodiments, the interior leg is provided with the single interior inwards sealing protrusion 85i and the exterior leg 85s3 is provided with at least two exterior inwards sealing protrusions 85e. The exterior inwards sealing members 85e are here minor sealing protrusion, the length of which, when projected on to the height direction, extends less than 50 % of the height H85s2 of the sealing groove. As is best seen in Fig. 8, the sealing protrusions of the sealing member 85 are arranged to overlap in the space where the flange 1017 of the flashing member 1012 is received.

[0054] The sealing member 85s is provided with structures to facilitate fitting the sealing member 85s into the flashing socket 85. Indentation 85w2 is provided in the end leg 85s2 and extends along the length of the sealing member 85s. The indentation is a weakening of the sealing member, which allows the sealing member 85s to collapse when inserting the sealing member 85s into the flashing socket 85. The indentation 85w2 may also form a track to receive the part of the flashing member which is inserted into the sealing member 85s, increasing the sealing effect of the sealing member 85s. Hence, the indentation 85w2 is preferably arranged at a position in the height direction, at which the flange 1017 of the flashing member 1012 is received by the sealing member 85s. Another indentation 85w1 is provided in a surface of the sealing member 85s which faces the flashing socket 85. In the embodiment shown, the indentation 85w1 is provided at junction of the interior leg 85s1 and end leg 85s2 of the sealing member. This indentation 85w1 facilitates fitting the sealing member, provided a track for air displacement during fitting of the sealing member, which is especially helpful for embodiments of the flashing socket 85 without ribs 851r1, 852r as in Fig. 9.

[0055] The interface section 8, which is here embodied by profile elements 22p2, also has a supplemental socket 854 above the opening 85b of the flashing socket 85 as seen in the height direction. In the embodiments shown, the supplemental socket 854 is positioned to overlap with the flashing socket 85, thereby reducing a height H85b of the opening 85b of flashing socket 85 compared the height of the end face 852 of the flashing socket 85. This helps retaining the sealing member 85s in the flashing socket 85. The supplemental socket 854 is fitted with a

supplemental sealing member 854s which has an anchor section 854a extending into the supplemental socket 854 to retain it therein. The supplemental socket 854 further has an interior section 85i which extends toward the roof structure (not shown) to engage the flange 1017 of the flashing member 1012. The interior section 854i can deform such that it extends into the flashing socket 85 along the flange 1017 as shown in Fig. 7. This is enabled by an indentation positioned between the interior section 854 and anchor section 854a as shown in Fig. 8. The supplemental sealing socket 854s further has an exterior section 854e which extends away from the roof structure (not shown) and engages the profile element 31p2, 32p2 to seal a gap between the frame 2 and the profile element 31p2, 32p2. In the embodiment shown, the exterior section 854e is formed by two segments extending at angle to each other to achieve the desired point of contact to the second sash profile elements 31p2, 32p2. The point of contact is here the part of the profile elements 31p2, 32p2 which is proximal to the frame 2 and forms an outer side of the profile elements 31p2, 32p2 and is most interior (i.e. proximal to the frame 2).

Fittings and operators - Figs 9 to 22

[0056] In the following, the connection between the sash 3 and the frame 2 by means of a hinge assembly 9 will be described in detail.

[0057] The term "connected to" implies that the component in question is in a condition, state or position in which the component in question is in fact connected to a part, whereas "connectable to" is intended to encompass such conditions, states and positions in which the component in question may be connected to the relevant part but is not necessarily in connection with the part.

[0058] During opening of the sash 3, the sash 3 is rotated by means of the hinge assembly 9 at least a first hinge axis α at the top frame and sash members 21, 31 to an open position in which the sash plane forms an angle with the frame plane.

[0059] Furthermore, the hinge assembly 9 comprises a hinge unit and a coupling unit as will be described in the following, in which the coupling unit is connected the hinge unit in the mounted condition and comprises locking means to prevent unintentional release of the connection between the sash 3 and the frame 2.

[0060] The hinge assembly 9 is located within an outer circumference of the frame 2 and sash 3, meaning that no parts of the hinge assembly 9 protrude beyond the periphery of the roof window 1 in the mounted condition.

[0061] Referring now to Figs. 9 and 11, in which the structure of the frame 2 and the sash 3 substantially correspond to the one described for the frame side member 22 and side sash member 32 in connection with Fig. 7. Thus, the top sash member 31 comprises an exterior or second sash profile element 31p2 and an interior or first sash profile element 31p1, and the top frame member 21 comprises an interior or first frame

profile element 22p1 formed by a continuous moulding process, and an exterior or second frame profile element 22p2. The exterior sash profile element 31p2 of the top sash member 31 overlaps the associated interior frame profile element 22p1 of the top frame member 21 in the closed position and in the open position of the sash 3.

[0062] In the embodiment shown, the hinge unit of the hinge assembly 9 comprises a frame hinge part 21hp formed in the second frame profile element 21p2 of the frame top member 21 and a sash hinge part 31hp formed in the second sash profile element 31p2 of the sash top member 31.

[0063] The coupling unit of the hinge assembly 9 here comprises locking means in the form of a hinge inlay 990 configured to be accommodated between the frame hinge part 21hp and the sash hinge part 31hp in the assembled condition so as to hold the sash hinge part 31hp in engagement with the frame hinge part 21hp. The hinge inlay 990 is formed as an elongate component of an elastic material and extends from a first end to a second end such that the first hinge axis is located between the first end and the second end.

[0064] Referring now to Fig. 12, the general concept of providing the hinge assembly 9 with a hinge unit 91 which in an installation position is connected to the sash 3 and a coupling unit 95 which is connected to the frame 2 is illustrated. During installation, the hinge unit 91 is brought into engagement with the coupling unit 95, thereby ensuring the connection between the sash 3 and the frame 2.

[0065] The hinge unit 91 thus comprises a frame hinge part 92 connected to or connectable to the top frame member 21 and/or the side frame member 22, 23 and a sash hinge part 93 connected to the top sash member 31 and/or the side sash member 32, 33. The coupling unit 95 of the hinge assembly 9 is connected to or connectable to the frame 2 and configured to be connected to the hinge unit 91 in the mounted condition of the roof window 1.

[0066] In this way, it is possible to start from an installation condition of the roof window 1, in which the hinge unit 91 is connected to the sash 3 and the coupling unit 95 is connected to the frame 2, to a mounted condition in that the coupling unit 95 and the hinge unit 91 being configured to assume the following positions relative to each other:

- i) at least one intermediate position; and
- ii) a final position, corresponding to the mounted condition of the roof window 1.

[0067] In the below embodiments, the coupling unit 95 comprises a top frame coupling plate 96 connected to the frame 2 at a top corner of the top frame member 21 and one side frame member 23.

[0068] Furthermore, the frame hinge part 92 and the sash hinge part 93 are connected to each other by means of a hinge pin 94 defining the first hinge axis α in the mounted condition of the roof window 1.

[0069] In the embodiment of Fig. 13, the frame hinge part 92 and the sash hinge part 93 each comprises an angled plate section 928, 929 at the hinge pin 94. The top frame coupling plate 96 comprises a first coupling plate receiving structure 968a and a second coupling plate receiving structure 968b to receive a frame hinge part guide pin 928a and a frame hinge part engagement means 928b, respectively, to provide the locking means preventing unintentional release of the connection between the sash 3 and the frame 2 in the mounted condition. The top frame coupling plate 96 is shown in broken lines to illustrate the engagement between the coupling unit 95 and the hinge unit 91 more clearly.

[0070] During installation, the sash 3 with the hinge unit 91 is brought into a suitable position to allow the frame hinge part guide pin 927a to enter into engagement with the first coupling plate receiving structure 968a and the frame hinge part engagement means 928b into engagement with the second coupling plate receiving structure 968b. As indicated, the frame hinge part engagement means 928b comprises a locking tongue to provide the locking engagement, which may be released by for instance inserting a tool to depress the locking tongue.

[0071] In the alternative embodiment of Fig. 14, the top frame coupling plate 96 of the coupling unit 95 comprises a first and a second coupling plate pin 969a1, 969a2 configured to receive a first and second hinge unit recess 919a, 919b, respectively. The hinge unit 91 here comprises locking means in the form of a locking arm 911 configured to interact with at least one of the first and second coupling plate pins 969a1, 969a2 in the mounted condition, the top frame coupling plate 96 preferably comprising a coupling plate receiver 969b to guide the hinge unit 91 during installation.

[0072] In the embodiment of Figs. 15A and 15B, the coupling unit 95 instead of a top coupling plate comprises a side frame coupling plate 97 connected to a side frame member of the frame 2 and comprising a base section 971 configured to interact with a frame hinge base plate 921, wherein the base section 971 of the side frame coupling plate 97 comprises a first and a second pin 971x, 971y to engage with a first and second slit 921x, 921y, respectively, in the frame hinge base plate 921. Locking means are provided in the form of a locking device 98 connectable to the side frame coupling plate 97 or the frame hinge base plate 921 to lock the engagement between the first pin 971x and the first slit 921x and/or between the second pin 971y and the second slit 921y.

[0073] An example of an embodiment of such a locking device 98 is shown in Figs. 16A and 16B, in which the locking device 98 comprises a locking split 980 cooperating with the first pin 971x.

[0074] Referring now to the embodiments shown in Figs. 17 to 21B, it will be described how the coupling unit 95 and the hinge unit 91 are configured to assume at least two intermediate positions by means of at least a first intermediate engagement portion and a second inter-

mediate engagement portion, even up to five intermediate positions.

[0075] For the general configuration of such a hinge assembly 9, reference is made to Applicant's published international application WO 2023/186246 A1.

[0076] In these embodiments, the top frame coupling plate 96 is provided with coupling plate engagement means in the form of a hook element 964 comprising an arm 964a with a hook 964b and connected to a base section 961 of the top frame coupling plate 96 in a rotational joint 964c.

[0077] Two engagement pins 962, 963 are provided on the base section 961 to interact with respective recesses 926b, 926a in the frame hinge base plate 921. The frame hinge base plate 921 is connected to a frame hinge side flange 924 connected to an inner side of the side frame member 22. At the free end of the frame hinge side flange 924, a secondary hinge pin 927 is provided. In this way, the hinge assembly 9 provides for means to allow the sash 3 to be rotated about a substantially horizontal second hinge axis at a distance from the top frame member 21 and the top sash member 31.

[0078] The sash hinge part 93 comprises a sash hinge base plate 931 connected to an outer side of the top sash member 31. The sash hinge base plate 931 is connected to a sash hinge side flange 934 connected to an inner side of the side sash member 32.

[0079] Further details shown but not described in detail include an opening restrictor 925 provided by an arm rotatably connected to a sash or frame member, the arm comprising a track engaging with a pin on a frame or sash member, or on the hinge unit itself. The arm 9251 is rotatably connected to the sash hinge side flange 934 in a rotatable joint 9252, and wherein the pin 9254 interacting with the track 9253 is provided on the frame hinge side flange 924.

[0080] The hook element 964 comprises a plurality of intermediate engagement portions configured to cooperate with a protrusion 926e on the frame hinge base plate 921 constituting the counterpart frame hinge part engagement means.

[0081] In the embodiment shown, the hook element 964 is biased towards its locking position in that a spring (not shown), received in a spring-receiving opening 964d in the arm 964a. A final engagement portion 964g is provided, in which the roof window 1 is in a fully assembled condition and ready for use.

[0082] The intermediate engagement portions 964h, 964i, 964j, 964k, 964l are provided as a plurality of indentations in the side of the hook element 964 facing the frame hinge part engagement means 926. The plurality of indentations thus constitute sequential engagement portions. One or more of the indentations are formed by a curve prompting the hook element 964 to move in one direction, namely towards the final engagement position, assisted by the bias from the spring. However, the hook element 964 is at the same time not allowed to move backwards. In this way, the plurality

of indentations function as a ratchet.

[0083] As indicated in Fig. 21A, the first intermediate engagement portion 964h comprises an indentation larger than an indentation comprised in the second intermediate engagement portion 964i in the embodiment shown.

[0084] Referring finally to Fig. 22, the sash 3 is in this embodiment openable relative to the frame 2 within a predefined opening angle by means of operating assembly 5 connected to the sash 3 and the frame 2, here at the bottom sash and frame members. In the embodiment shown, the operating assembly 5 comprises a manual operator in the form of a lever handle 58 and an electric operator 59, which may for instance be solar powered. The electric operator 59 is not shown in detail but may include a chain operator or a pantograph operator. The electric operator 59 is provided as auxiliary equipment. During daily use, either the lever handle 58 or the electric operator 59 is in use. In order to allow switching between the operators, the connection between the manual operator 58 of the operating assembly 5 and the sash 3 and/or frame 2 is releasable and the connection between the electrical operator 59 and the sash 3 and/or frame 2 is releasable.

List of reference numerals

[0085]

1	roof	window
2	frame	
21	top frame member	
21hp	frame hinge part	
21p2	second frame profile element	
22	side frame member	
22p1	first frame profile element	
22p2	second frame profile element	
22t1	track	
22t2	track	
23	side frame member	
24	bottom frame member	
24p2	second frame profile element	
3	sash	
31	top sash member	
31hp	sash hinge part	
32	side sash member	
32c	inner element	
32p1	first sash profile element	
32p2	second sash profile element	
32r	reinforcement element	
32t1	track	
32t2	track	
32w	dividing wall	
33	side sash member	
34	bottom sash member	
4	pane	
45	glazing bar	
5	operating assembly	

58 manual operator
 59 electric operator
 6 mounting bracket
 7 insulating frame
 8 interface section
 85 flashing socket
 85b opening of the flashing socket
 85e exterior inwards sealings protrusion
 85i interior inwards sealing protrusion
 85o outwards sealing protrusion
 85s separate sealing member
 85s1 interior leg
 85s2 end leg
 85s3 exterior leg
 85w1 indentation
 85w2 weakening/indentation
 851 interior face
 851r rib
 852 end face
 852r rib
 853 exterior face
 854 supplemental socket
 854s supplemental sealing member
 854a anchor section
 854e exterior section
 854i interior section
 a1 angle of outwards sealing protrusion
 a2 angle of interior inwards sealing protrusion
 H85 height flashing socket opening
 H85s2 height of sealing groove
 9 hinge assembly
 91 hinge unit
 911 locking arm
 919a1 first hinge unit recess
 919a2 second hinge unit recess
 92 frame hinge part
 921 frame hinge base plate
 925 opening restrictor
 926 engagement means of frame hinge part
 927 secondary hinge pin
 928a frame hinge part engagement means
 928 frame hinge part engagement means
 929 angled plate section
 93 sash hinge part
 931 sash hinge base plate
 934 sash hinge side flange
 939 angled plate section
 94 hinge pin
 95 coupling unit
 96 top frame coupling plate
 961 base section
 962 bolt
 963 bolt
 964 hook element
 964a arm
 964b hook
 965c rotational joint
 965d spring-receiving opening

965g final engagement portion
 964h first intermediate engagement portion
 964i second intermediate engagement portion
 964j final engagement portion
 5 964k second intermediate engagement portion
 964l second intermediate engagement portion
 968a first coupling plate receiving structure
 968b second coupling plate receiving structure
 969a1 first coupling plate pin
 10 969a2 second coupling plate pin
 969b coupling plate receiver
 97 side frame coupling plate
 971 base section
 971x first pin
 15 971y second pin
 98 locking device
 980 locking split
 10 covering assembly
 1012 side flashing member
 20 1012l first leg
 1014 bottom flashing member
 α first hinge axis

Claims

- 25 1. A roof window (1) comprising a frame (2), a sash (3), and a pane (4), in which the frame (2) comprises a set of frame members including a top frame member (21), two side frame members (22, 23) and a bottom frame member (24) and the sash (3) comprises a set of sash members including a top sash member (31), two side sash members (32, 33) and a bottom sash member (34), in which the sash (3) is connected to the frame (2) by means of a hinge assembly (9), and in which an exterior pane surface defines a sash plane, said sash plane being positioned in parallel with a frame plane defined by the frame (2) in a mounted condition of the roof window (1) corresponding to a closed position of the sash (3), the sash (3) being openable relative to the frame (2) by means of a hinge assembly (9) to allow rotation about at least a first hinge axis (α) to an open position in which the sash plane forms an angle with the frame plane,
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- 45 **characterised in that**
- each sash member (31, 32, 33, 34) comprises at least one exterior sash profile element (32p1, 31p2, 32p2) and each frame member (21, 22, 23, 24) comprises at least one interior frame profile element (21p1, 22p1) formed by a continuous moulding process, the exterior sash profile element (32p1, 31p2, 32p2) of the sash members (31, 32, 33, 34) overlapping the associated interior frame profile element (21p1, 22p1) of the frame members (21, 22, 23, 24) in the closed position and in the open position of the sash (3),
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that the hinge assembly (9) is located within an outer circumference of the frame (2) and sash (3),

that the first hinge axis (α) is provided at the top frame and sash members (21, 31), and that the hinge assembly (9) comprises a hinge unit (91) and a coupling unit (900; 95), the coupling unit (900; 95) being connected the hinge unit (91) in the mounted condition and comprising locking means to prevent unintentional release of the connection between the sash (3) and the frame (2).

2. A roof window (1) according to claim 1, wherein each sash member (31, 32, 33, 34) comprises a first sash profile element (32p1) and a second sash profile element (31p2, 32p2), wherein each frame member (21, 22, 23, 24) comprises a first frame profile element (22p1) and a second frame profile element (21p2, 22p2), each first sash profile element (32p1) and first frame profile element (22p1) being formed by a continuous moulding process.
3. A roof window (1) according to claim 2, wherein each sash member (31, 32, 33, 34) comprises a second sash profile element (31p2, 32p2), the hinge unit of the hinge assembly (9) comprises a frame hinge part (21hp) formed in the second frame profile element (21p2) of the frame top member (21) and a sash hinge part (31hp) formed in the second sash profile element (31p2) of the sash top member (31).
4. A roof window (1) according to claim 3, wherein the coupling unit of the hinge assembly (9) comprises locking means in the form of a hinge inlay (990) configured to be accommodated between the frame hinge part (21hp) and the sash hinge part (31hp) in the assembled condition so as to hold the sash hinge part (31hp) in engagement with the frame hinge part (21hp), the hinge inlay (990) being preferably formed as an elongate component of an elastic material and extending from a first end to a second end such that the first hinge axis (α) is located between the first end and the second end.
5. A roof window (1) according to claim 1 or 2, wherein the hinge unit (91) comprises a frame hinge part (92) connected to or connectable to the top frame member (21) and/or the side frame member (22, 23) and a sash hinge part (93) connected to the top sash member (31) and/or the side sash member (32, 33), and wherein the coupling unit (95) of the hinge assembly (9) is connected to or connectable to the frame (2) and configured to be connected to the hinge unit (91) in the mounted condition of the roof window (1), and wherein in an installation condition of the roof window (1), the hinge unit (91) is connected to the sash (3) and the

coupling unit (95) is connected to the frame (2), the coupling unit (95) and the hinge unit (91) being configured to assume the following positions relative to each other:

- i) at least one intermediate position; and
- ii) a final position, corresponding to the mounted condition of the roof window (1).

6. A roof window according to claim 6, wherein the coupling unit (95) comprises a top frame coupling plate (96) connected to the frame (2) at a top corner of the top frame member (21) and one side frame member (23).
7. A roof window (1) according to claim 5 or 6, wherein the frame hinge part (92) and the sash hinge part (93) are connected to each other by means of a hinge pin (94) defining the first hinge axis (α) in the mounted condition of the roof window (1).
8. A roof window (1) according to claim 7, wherein the frame hinge part (92) and the sash hinge part (93) each comprises an angled plate section (928, 929) at the hinge pin (94), wherein the top frame coupling plate (96) comprises a first coupling plate receiving structure (968a) and a second coupling plate receiving structure (968b) to receive a frame hinge part guide pin (928a) and a frame hinge part engagement means (928b), respectively, to provide the locking means preventing unintentional release of the connection between the sash (3) and the frame (2) in the mounted condition.
9. A roof window (1) according to claim 6, wherein the top frame coupling plate (96) of the coupling unit (95) comprises a first and a second coupling plate pin (969a1, 969a2) configured to receive a first and second hinge unit recess (919a, 919b), respectively, and wherein the hinge unit (91) comprises locking means in the form of a locking arm (911) configured to interact with at least one of the first and second coupling plate pins (969a1, 969a2) in the mounted condition, the top frame coupling plate (96) preferably comprising a coupling plate receiver (969b) to guide the hinge unit (91) during installation.
10. A roof window (1) according to any one of claim 5 to 7, wherein the coupling unit (95) comprises a side frame coupling plate (97) connected to a side frame member of the frame (2) and comprising a base section (971) configured to interact with a frame hinge base plate (921), wherein the base section (971) of the side frame coupling plate (97) comprises a first and a second pin (971x, 971y) to engage with a first and second slit (921x, 921y), respectively, in the frame hinge base plate (921), and wherein locking means are provided in the form of a locking device

(98) connectable to the side frame coupling plate (97) or the frame hinge base plate (921) to lock the engagement between the first pin (971x) and the first slit (921x) and/or between the second pin (971y) and the second slit (921y).

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11. A roof window according to claim 10, wherein the locking device (98) comprises a locking split (980) cooperating with the first pin (971x).

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12. A roof window (1) according to claim any one of claims 5 to 11, wherein the coupling unit (95) and the hinge unit (91) are configured to assume at least two intermediate positions by means of at least a first intermediate engagement portion (964h) and a second intermediate engagement portion (964i), preferably at least five intermediate positions (964h, 964i, 964j, 964k, 964l).

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13. A roof window (1) according to claim 12, wherein the coupling unit (95) comprises a top frame coupling plate (96) provided with coupling plate engagement means in the form of a hook element (964) comprising an arm (964a) with a hook (964b) and connected to a base section (961) of the top frame coupling plate (96) in a rotational joint (964c), said hook element (964) comprising said intermediate engagement portions configured to cooperate with a protrusion (926e) on a frame hinge base plate (921) constituting the counterpart frame hinge part engagement means, the first intermediate engagement portion (964h) preferably comprising an indentation larger than an indentation comprised in the second intermediate engagement portion (964i).

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14. A roof window (1) according to any one of the preceding claims, wherein the sash (3) is openable relative to the frame (2) within a predefined opening angle by means of at least one operating assembly (5) connected to the sash (3) and the frame (2) and comprising a manual operator (58) such as a hand-winder or a lever handle, and wherein an electric operator (59), preferably solar powered, such as a chain operator or a pantograph operator is provided as auxiliary equipment.

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15. A roof window (1) according to claim 14, wherein the connection between the manual operator of the operating assembly (5) and the sash (3) and/or frame (2) is releasable and the connection between the electrical operator (59) and the sash (3) and/or frame (2) is releasable.

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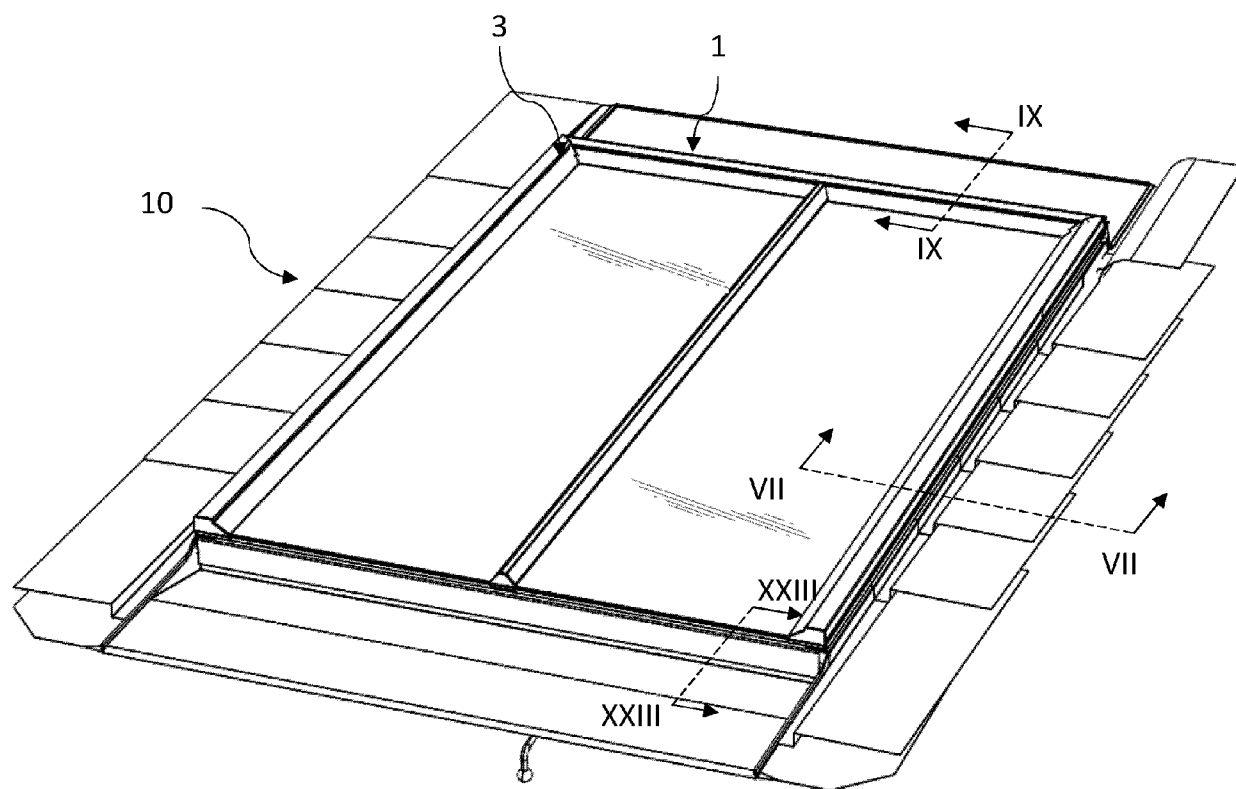


Fig. 1

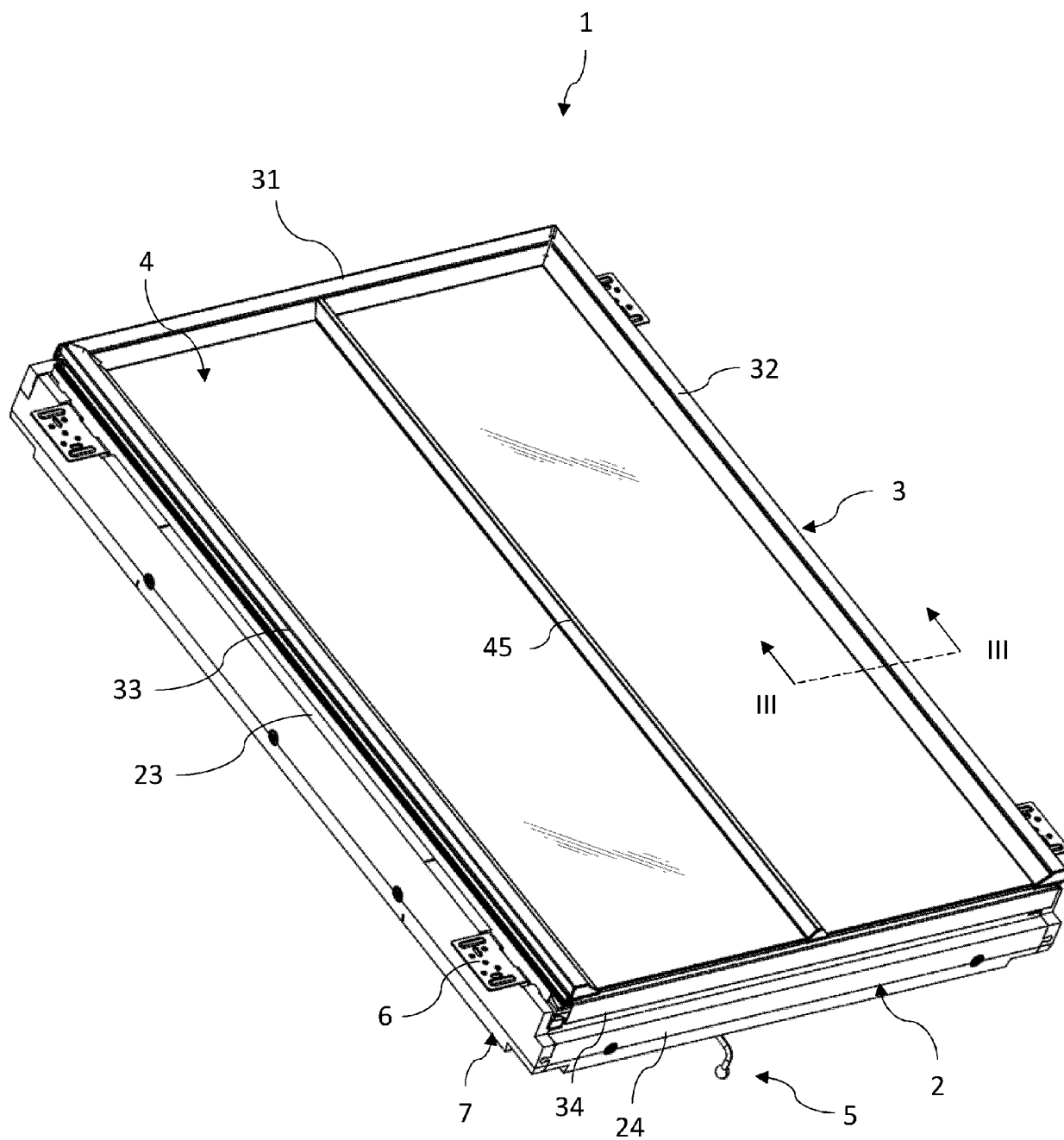


Fig. 2

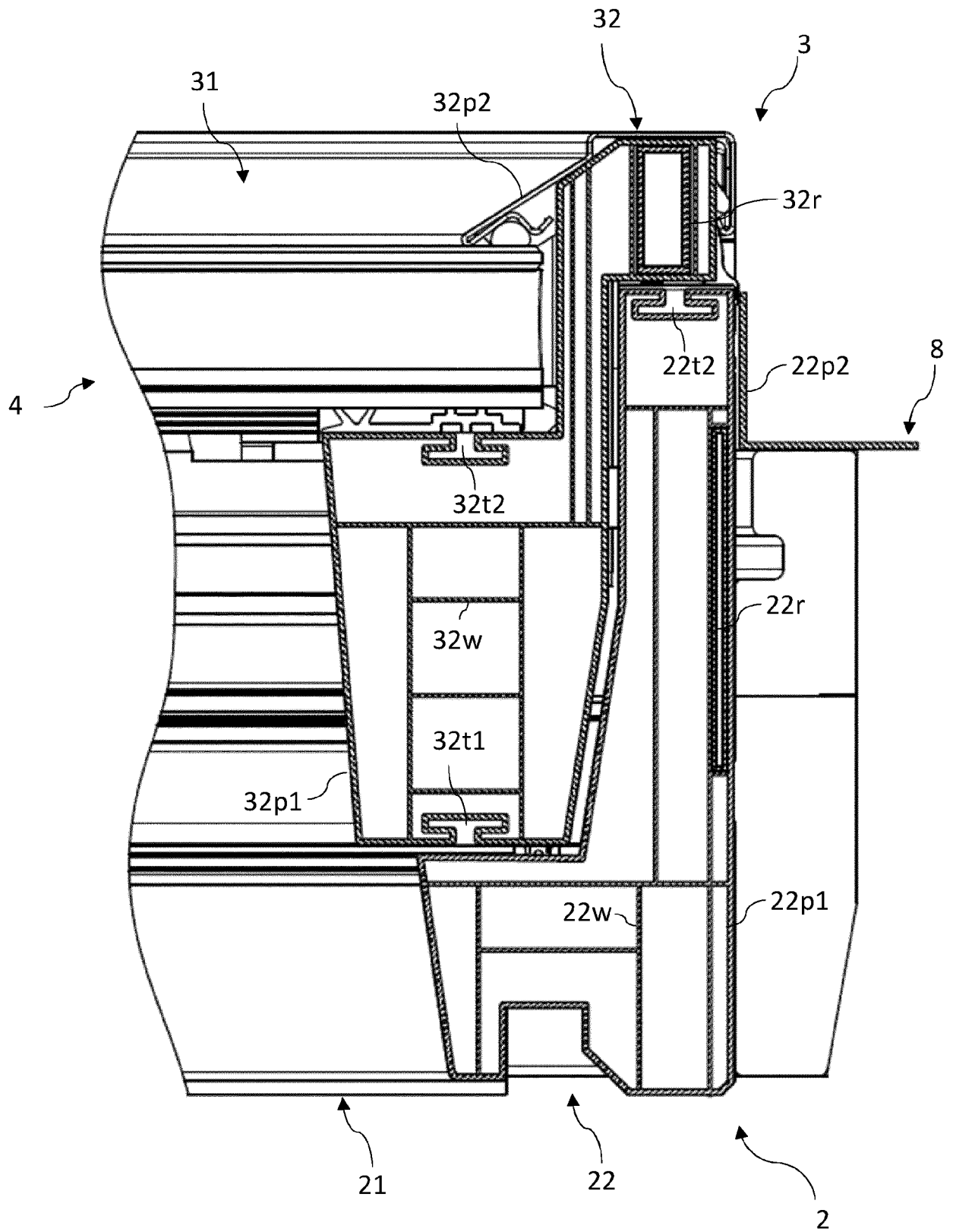


Fig. 3

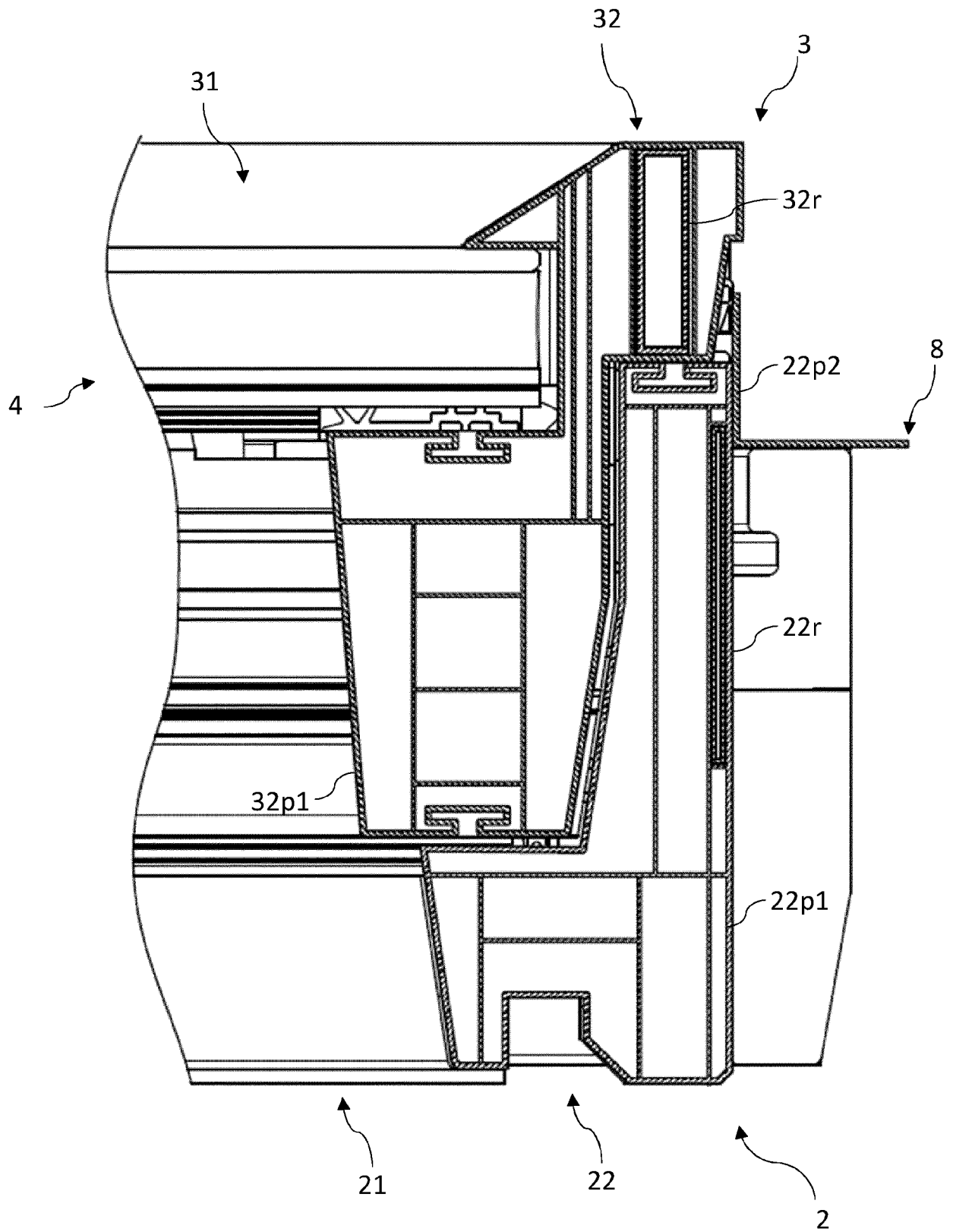


Fig. 4

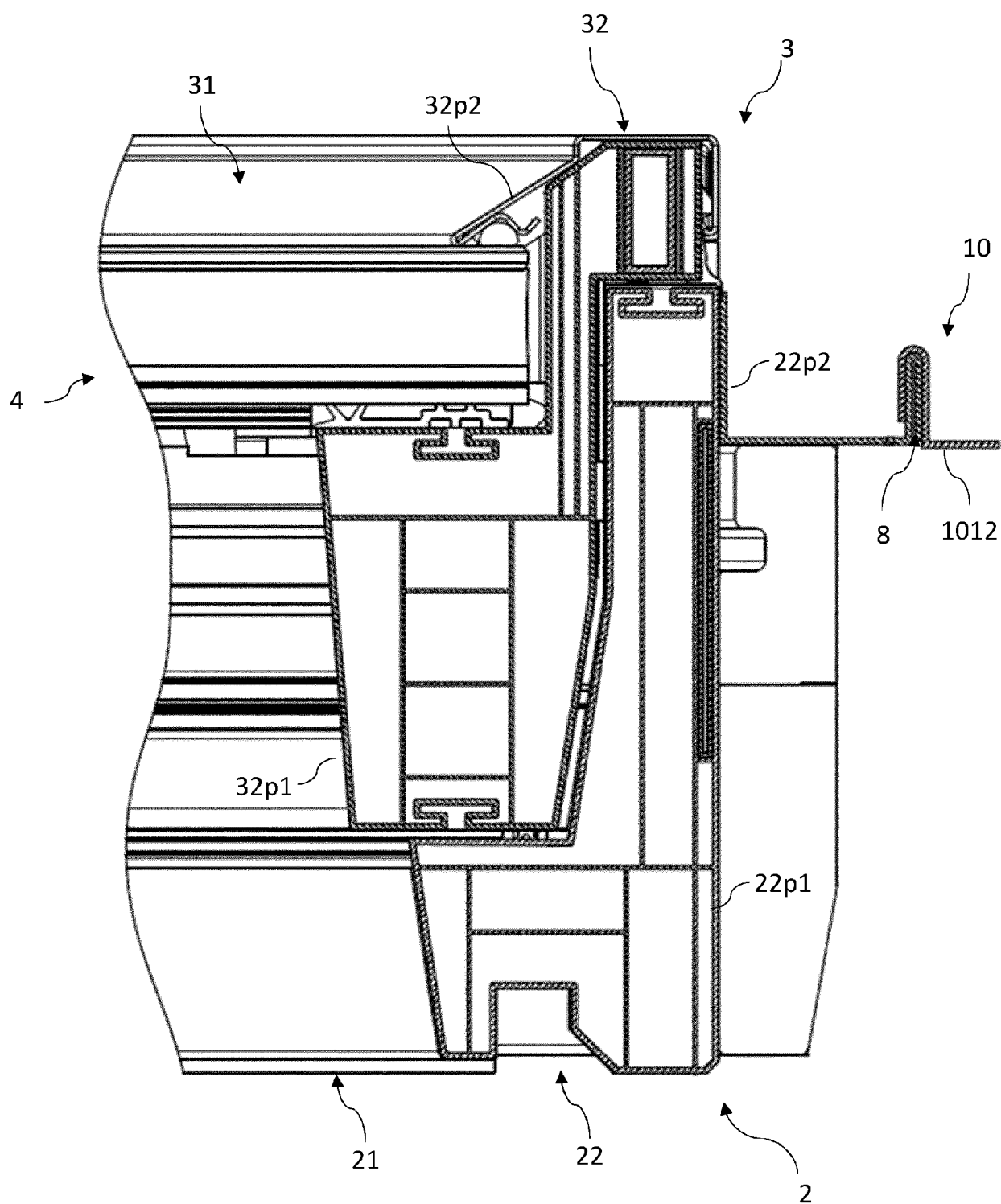


Fig. 5

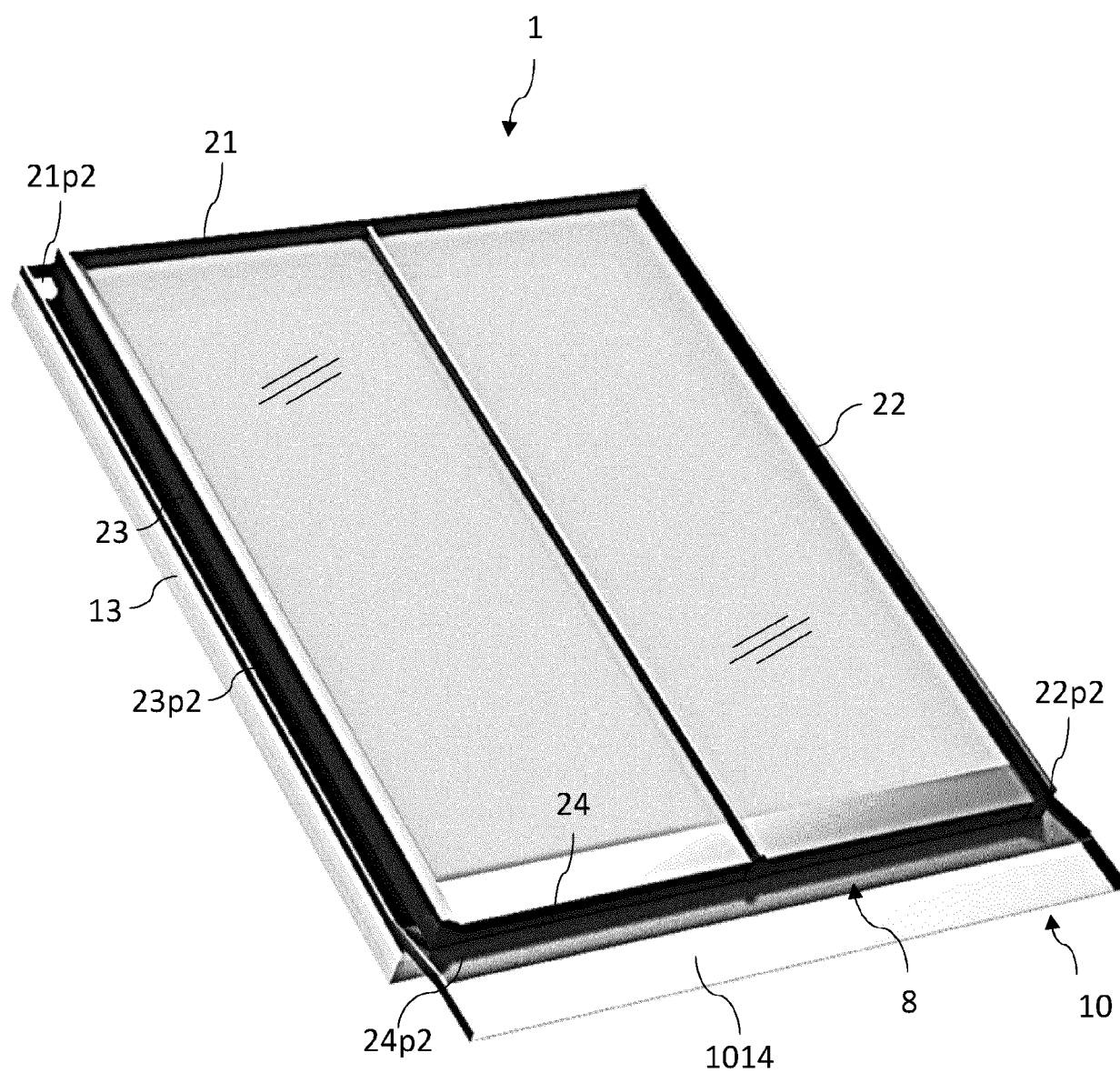


Fig. 6

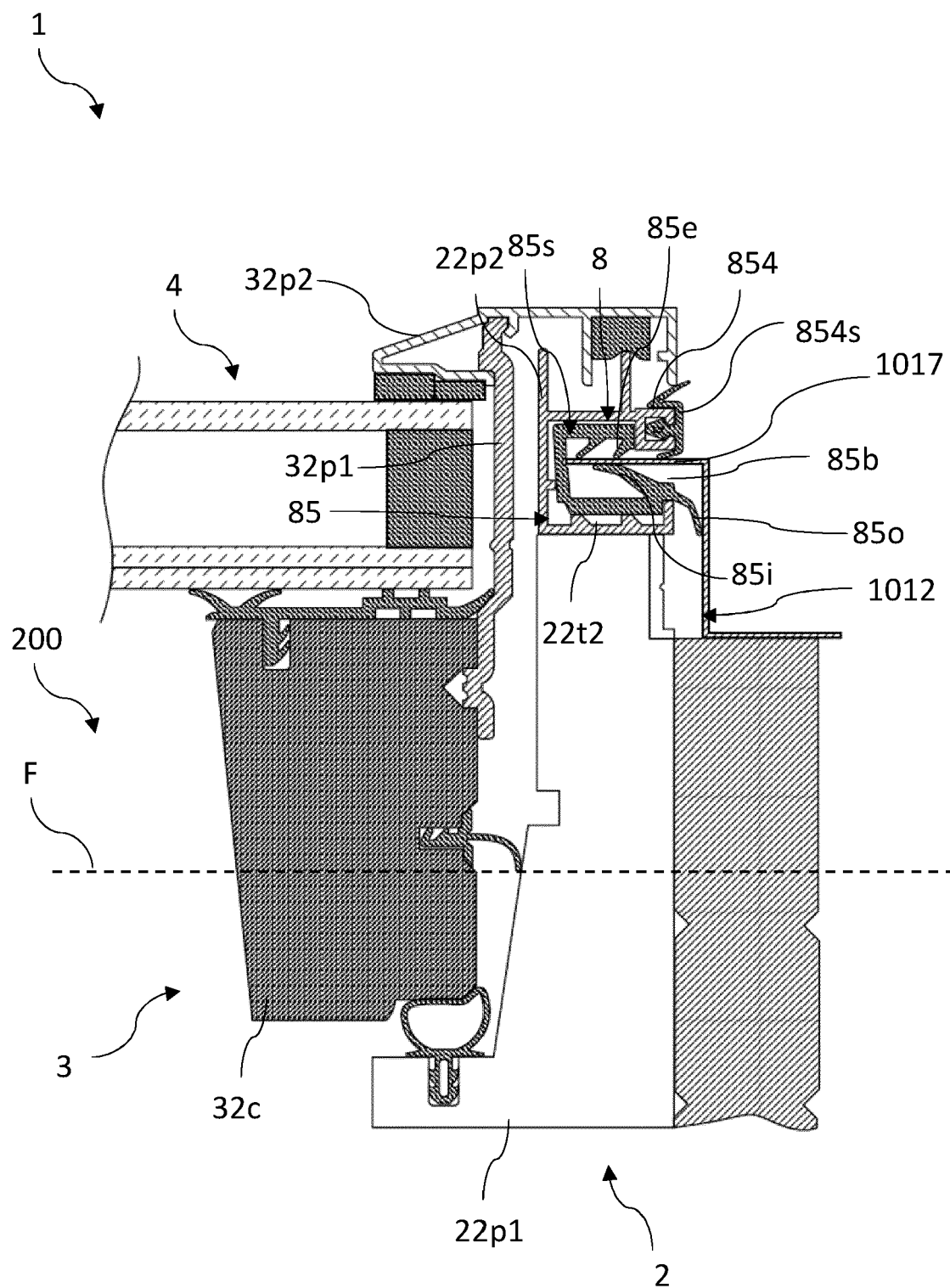


Fig. 7

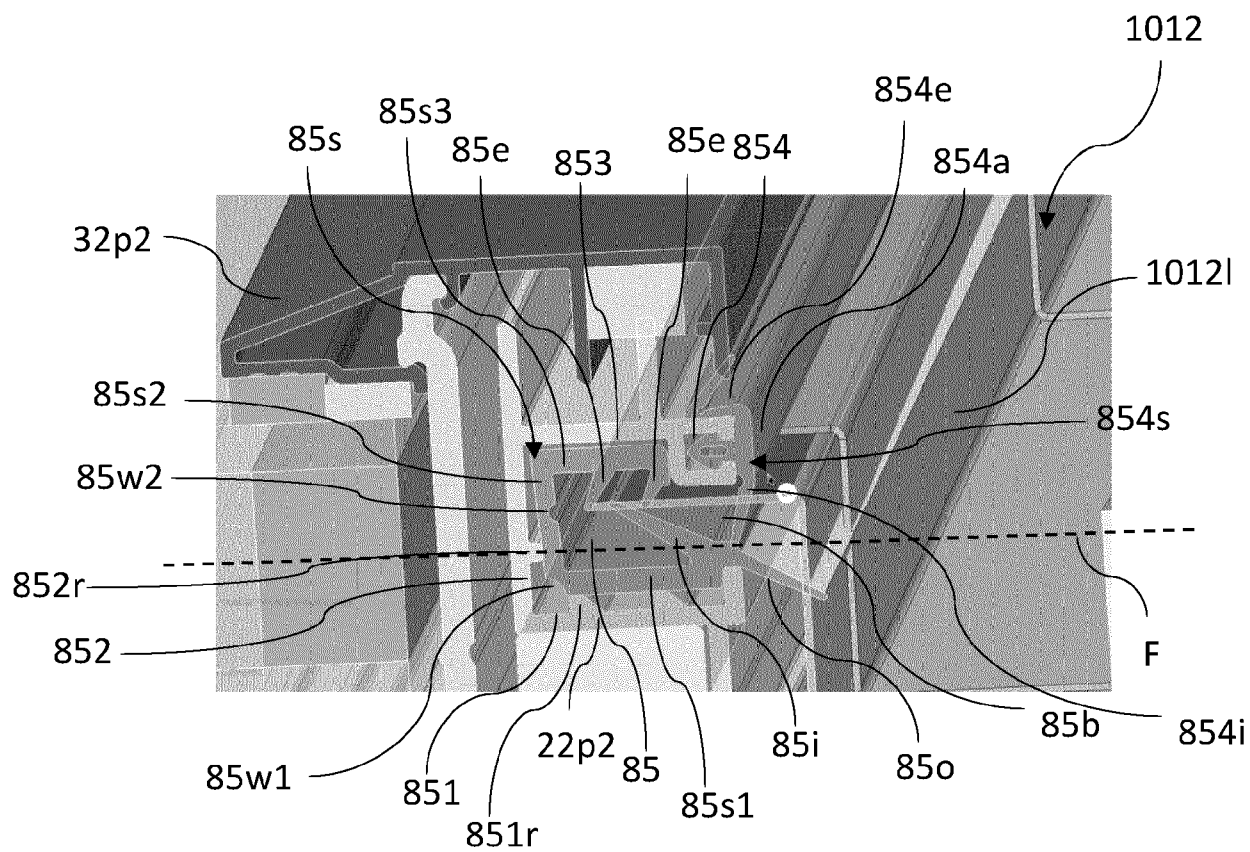


Fig. 8

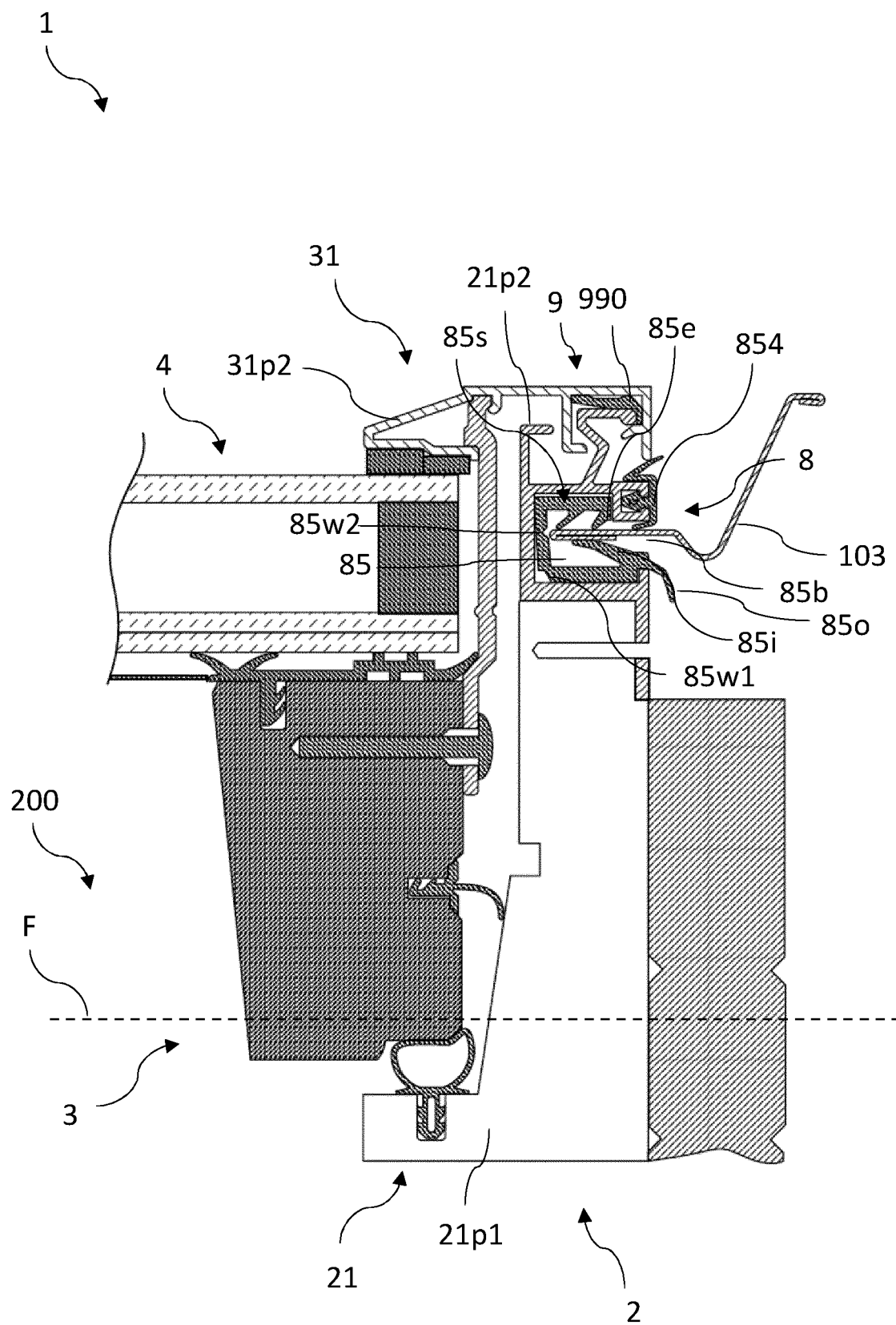


Fig. 9

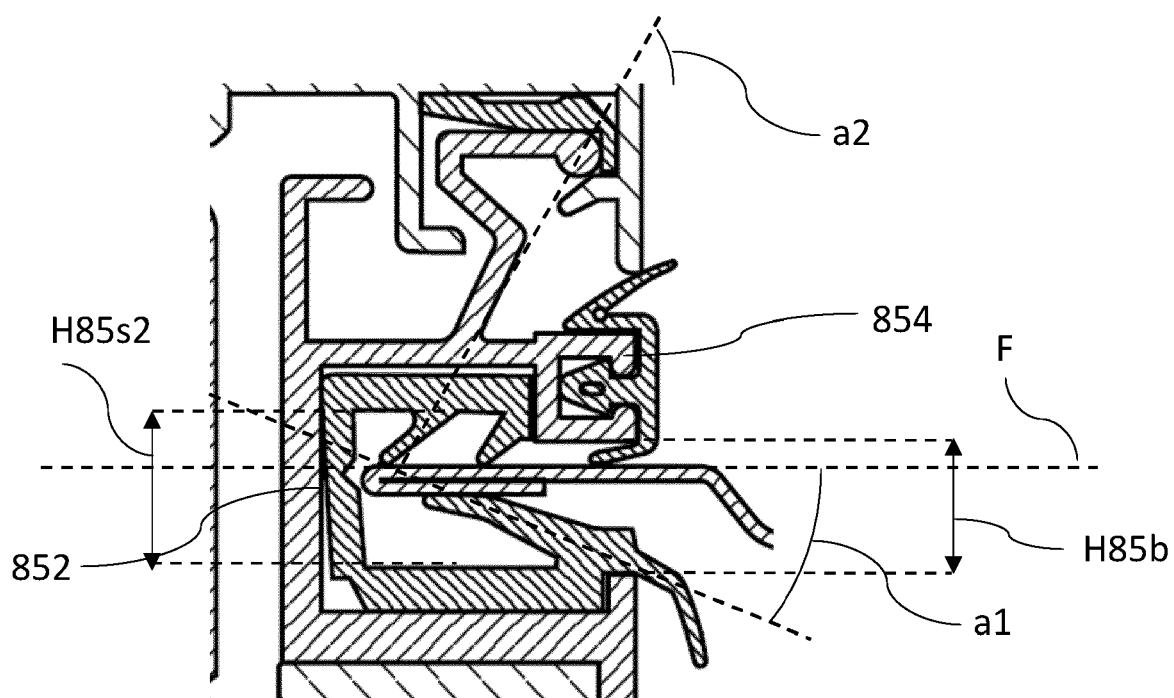


Fig. 10

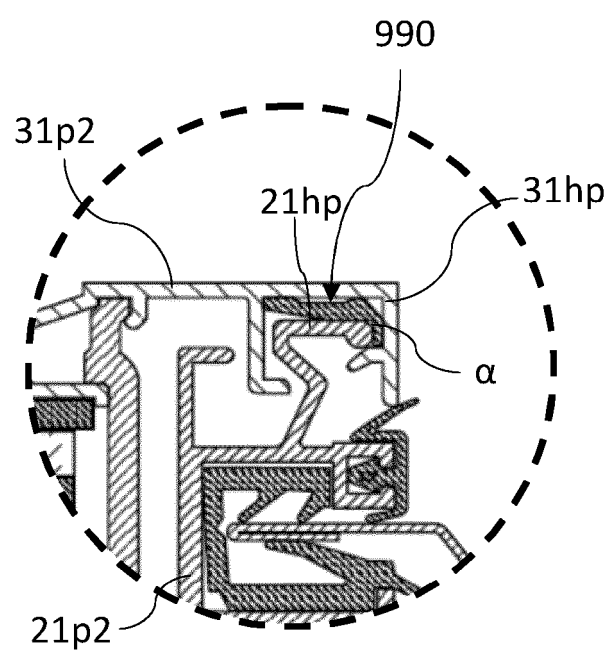


Fig. 11

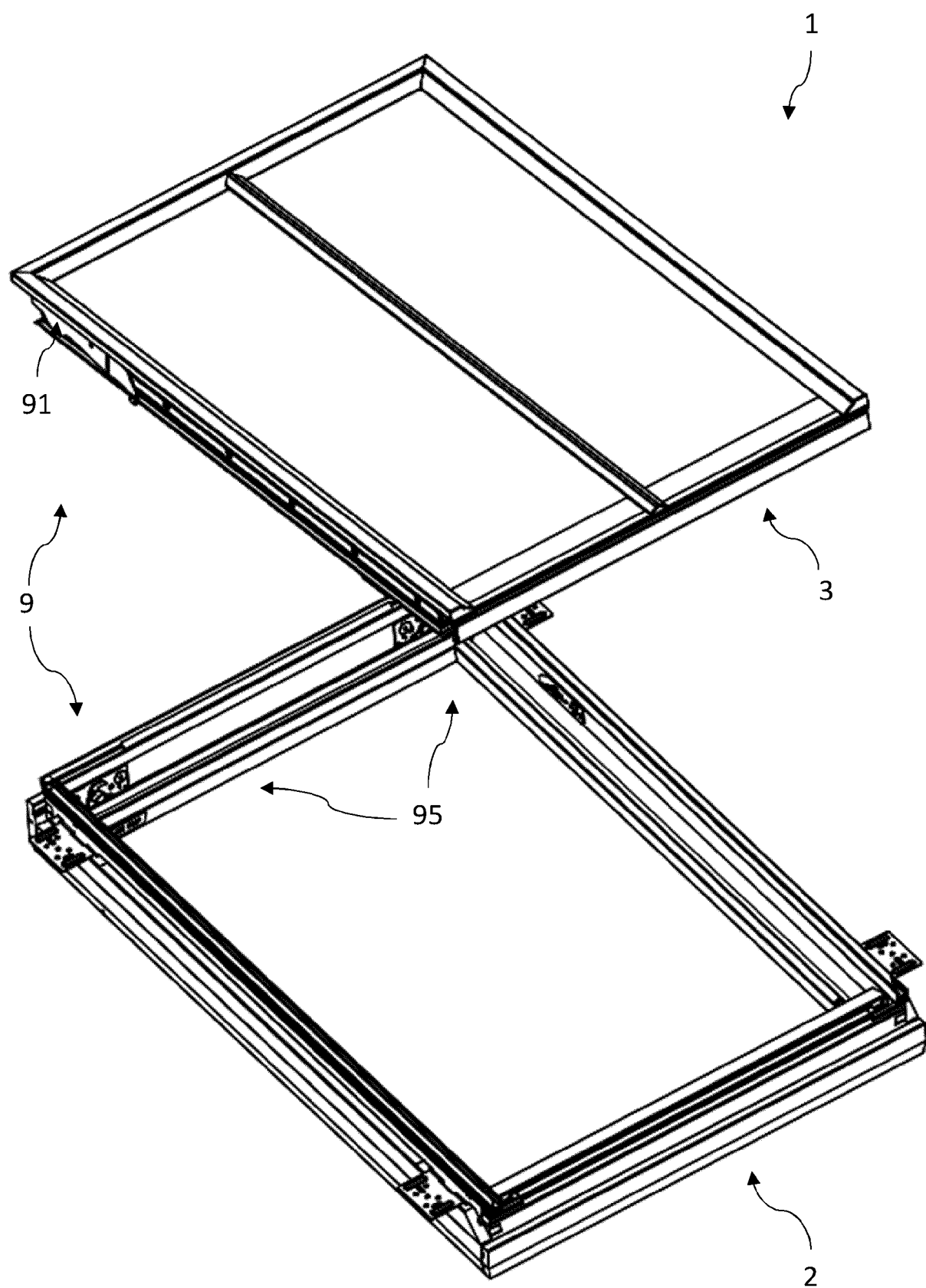


Fig. 12

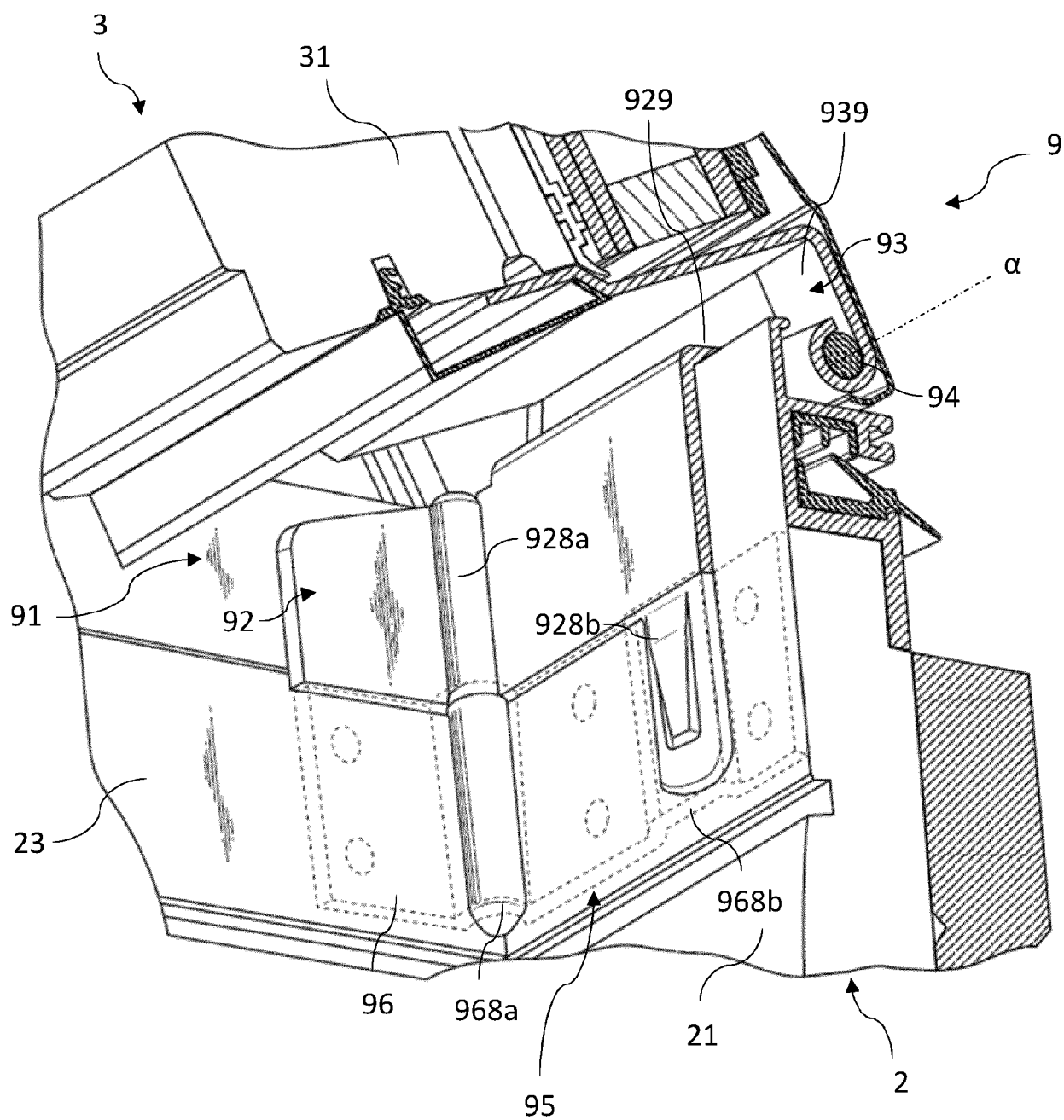


Fig. 13

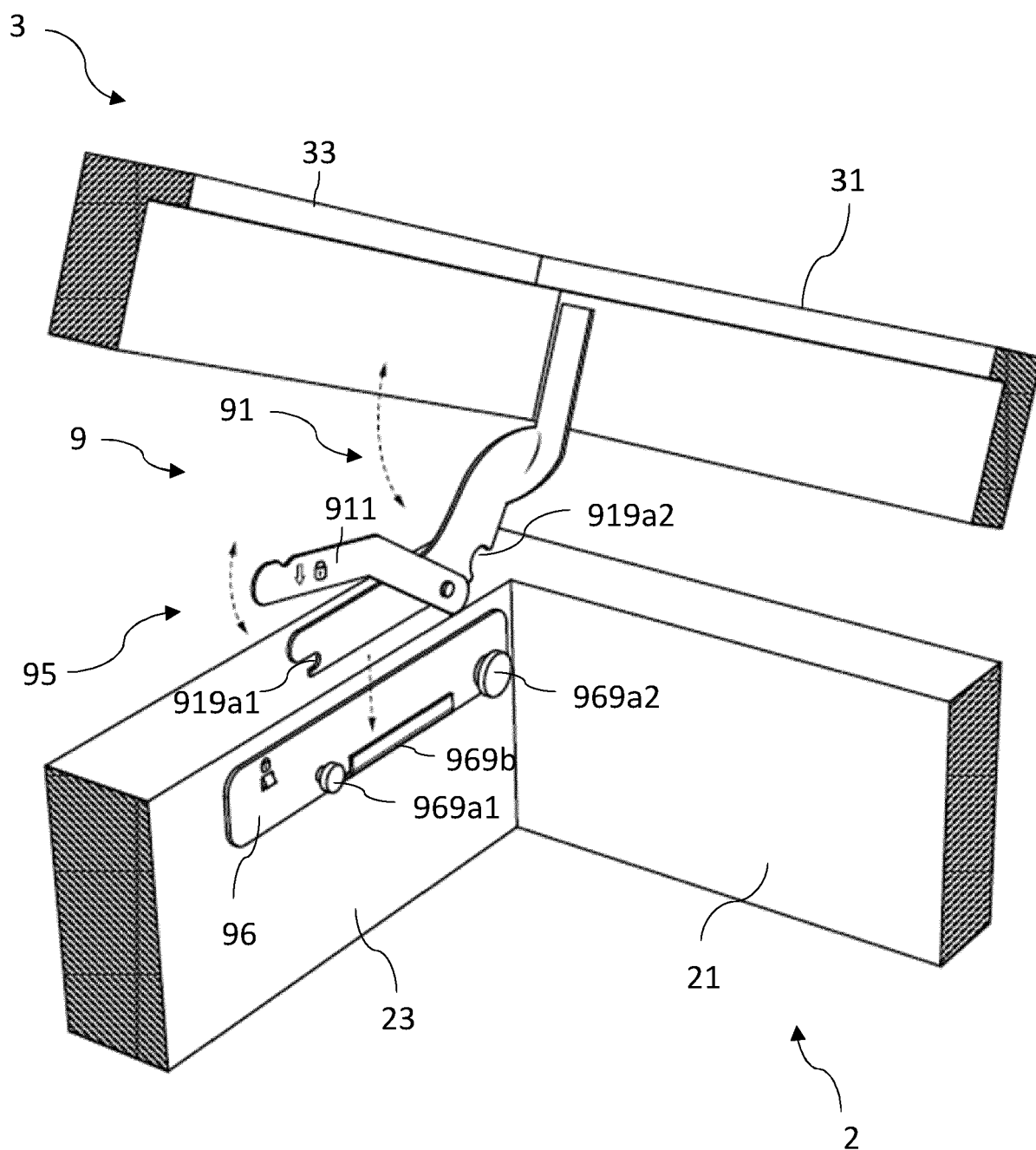


Fig. 14

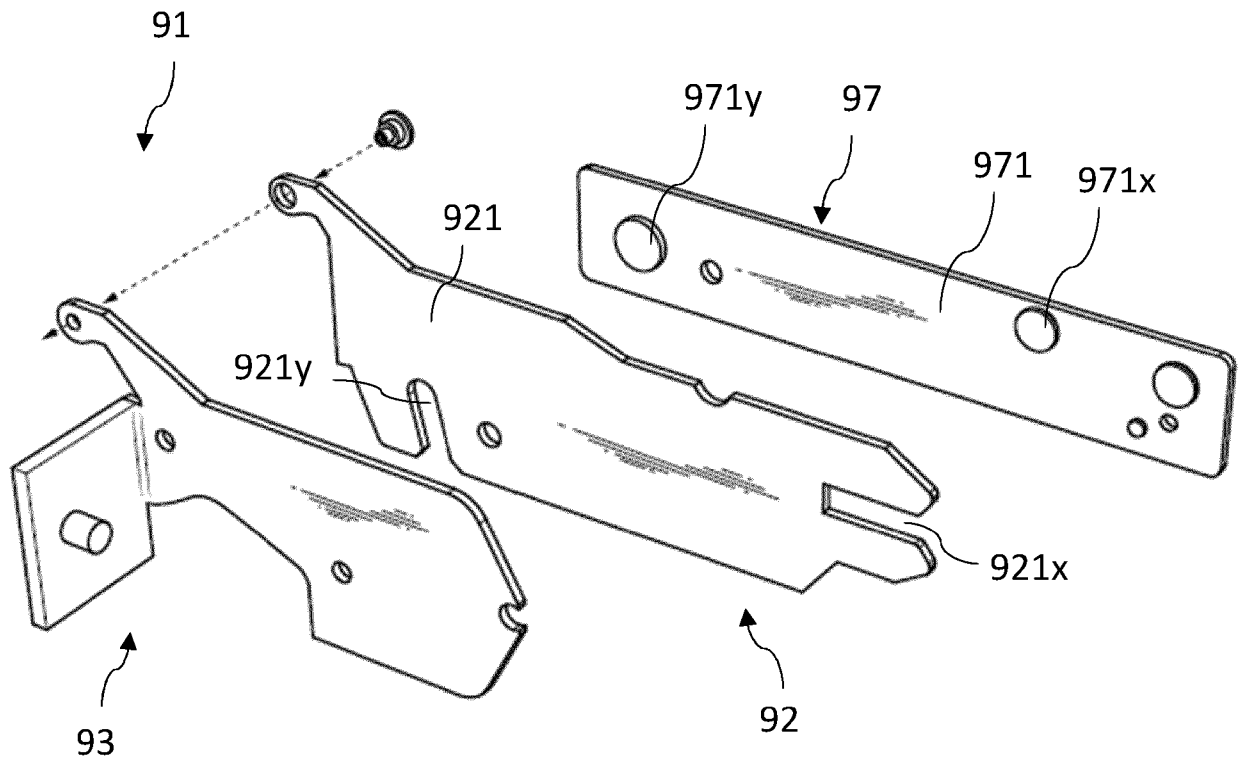


Fig. 15A

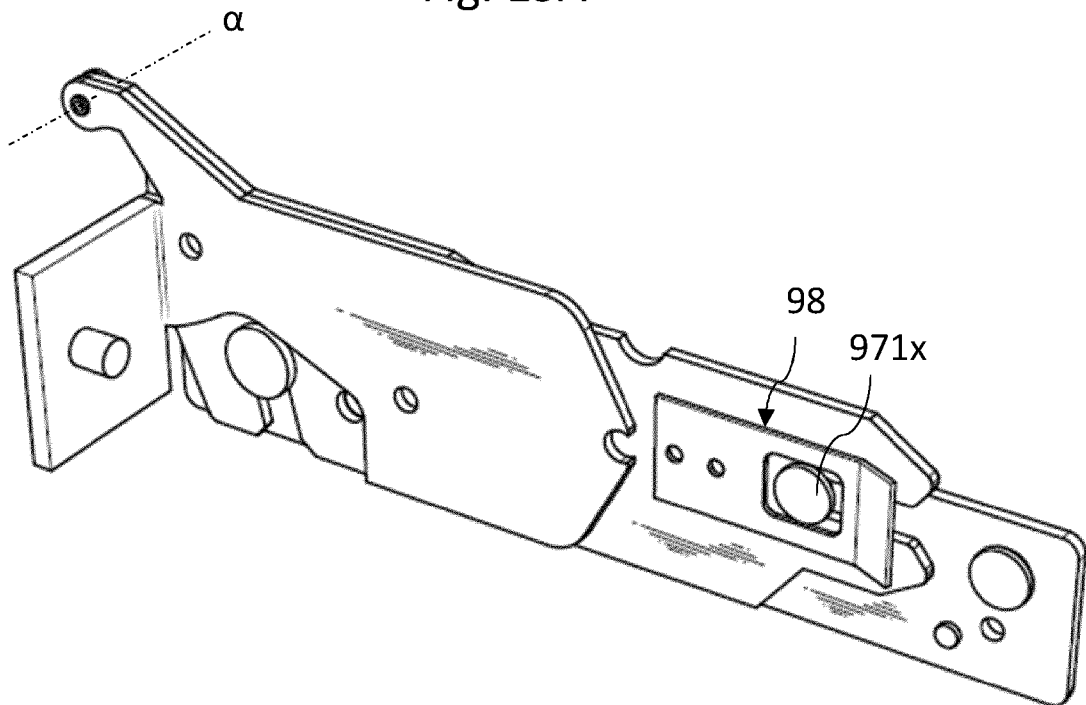


Fig. 15B

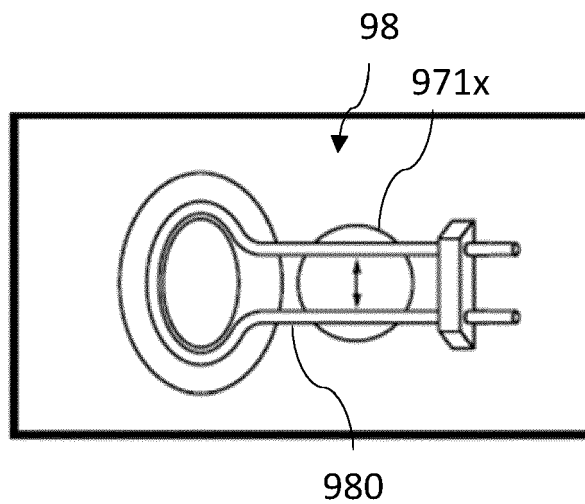


Fig. 16A

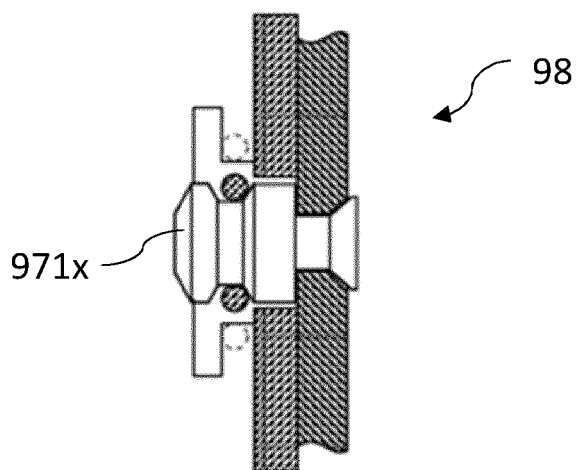


Fig. 16B

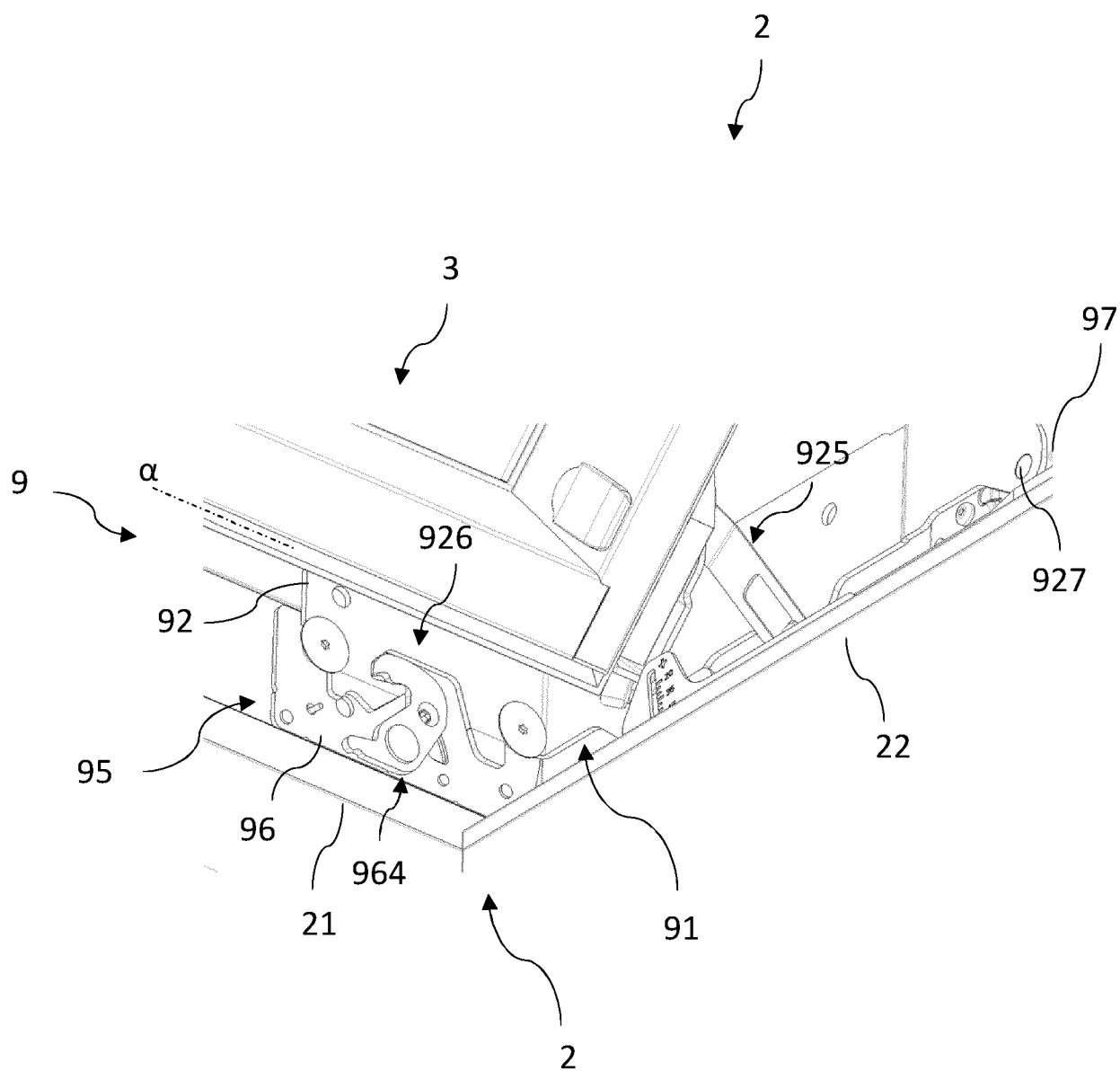


Fig. 17

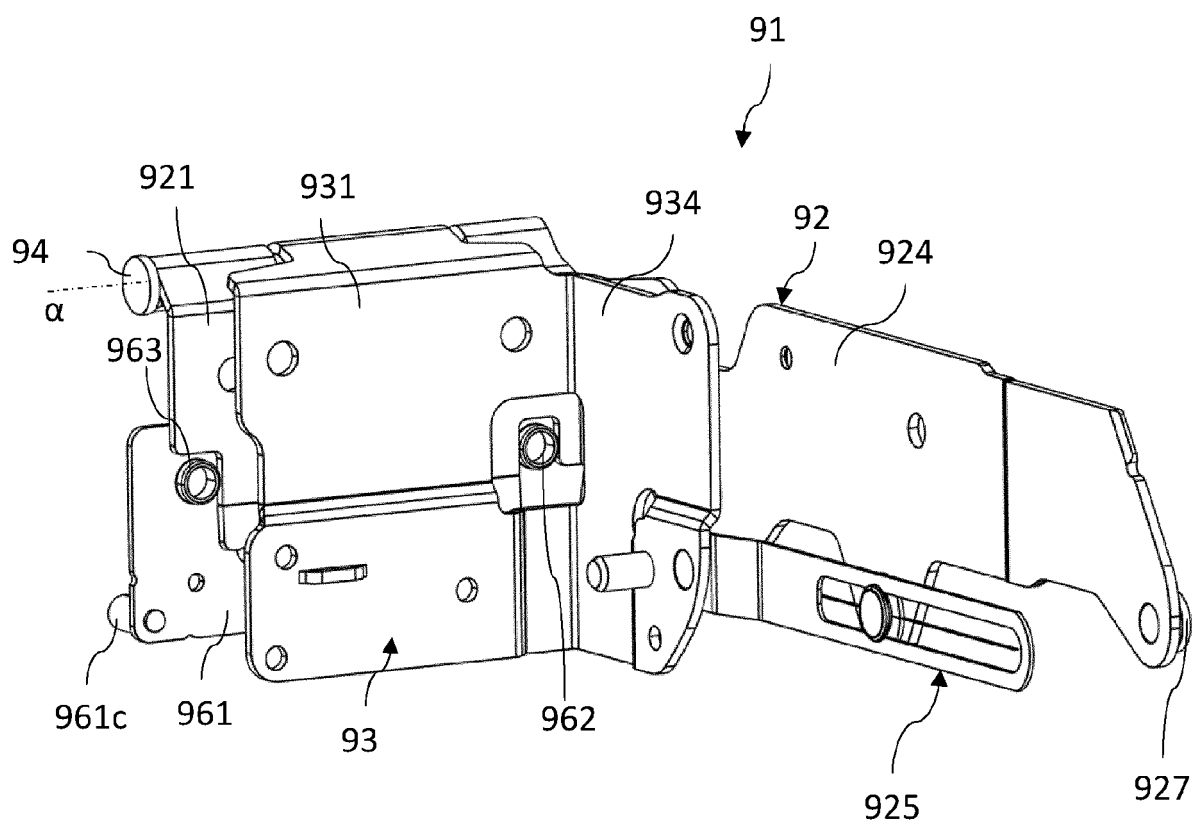


Fig. 18A

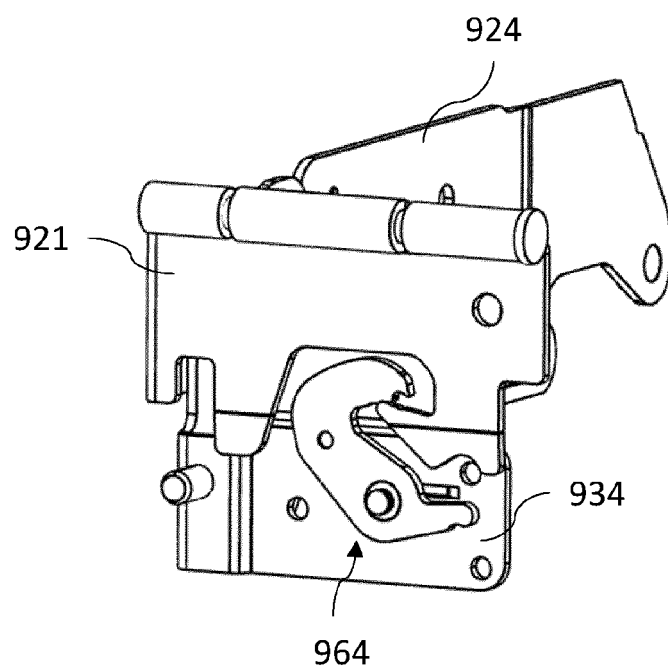


Fig. 18B

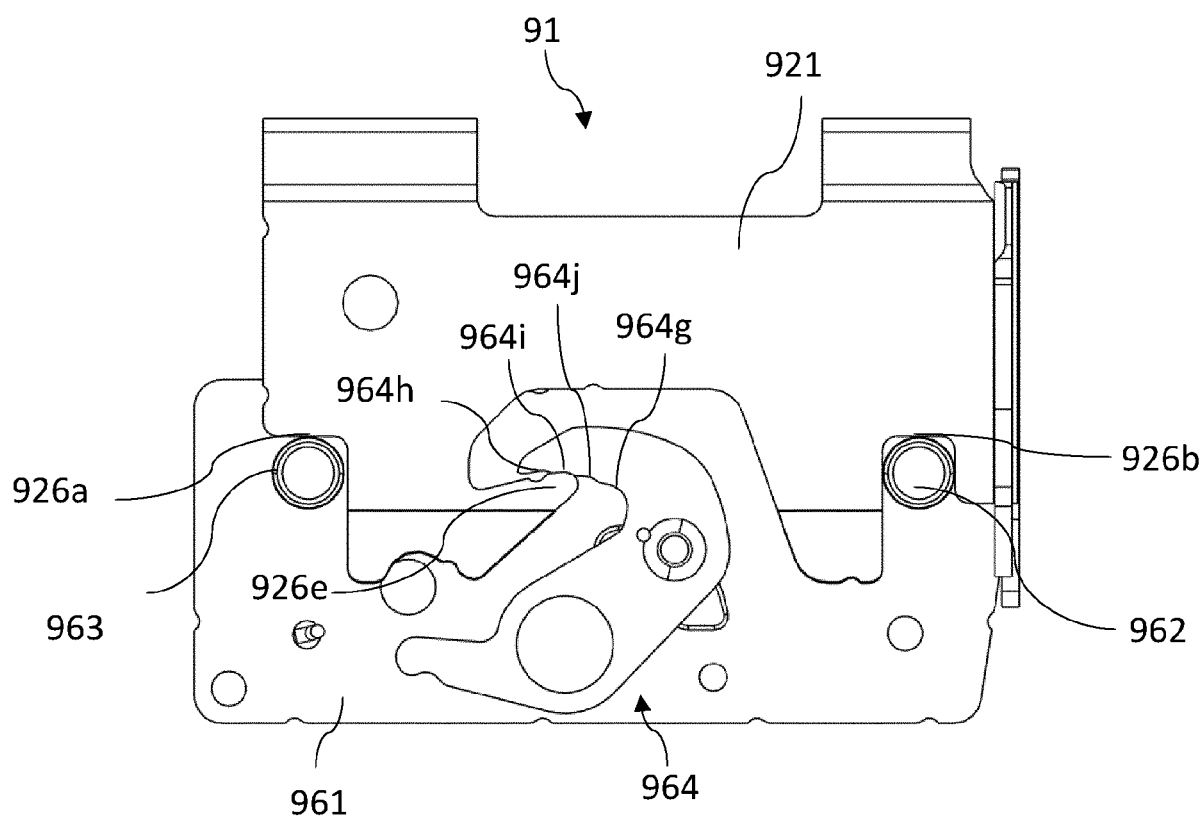


Fig. 19A

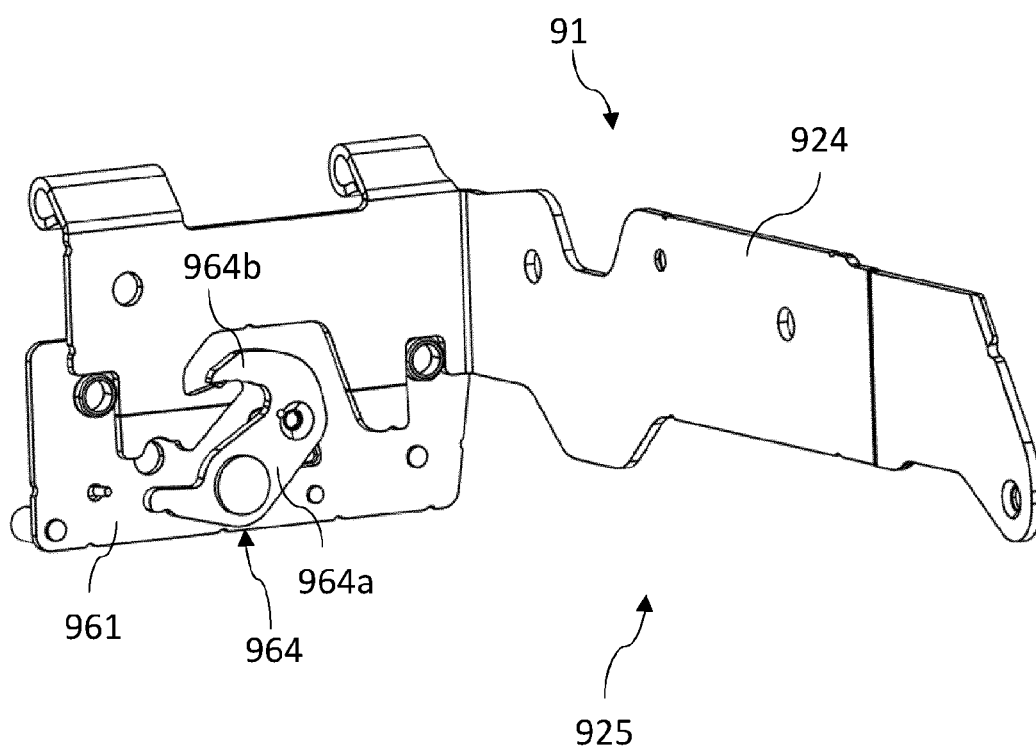


Fig. 19B

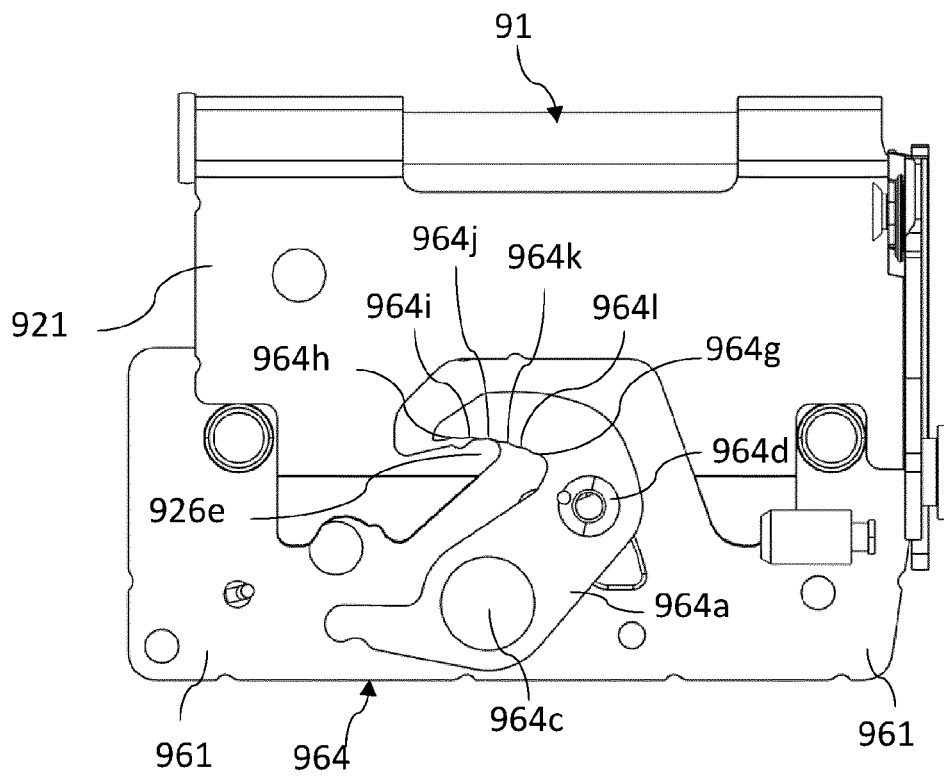


Fig. 20A

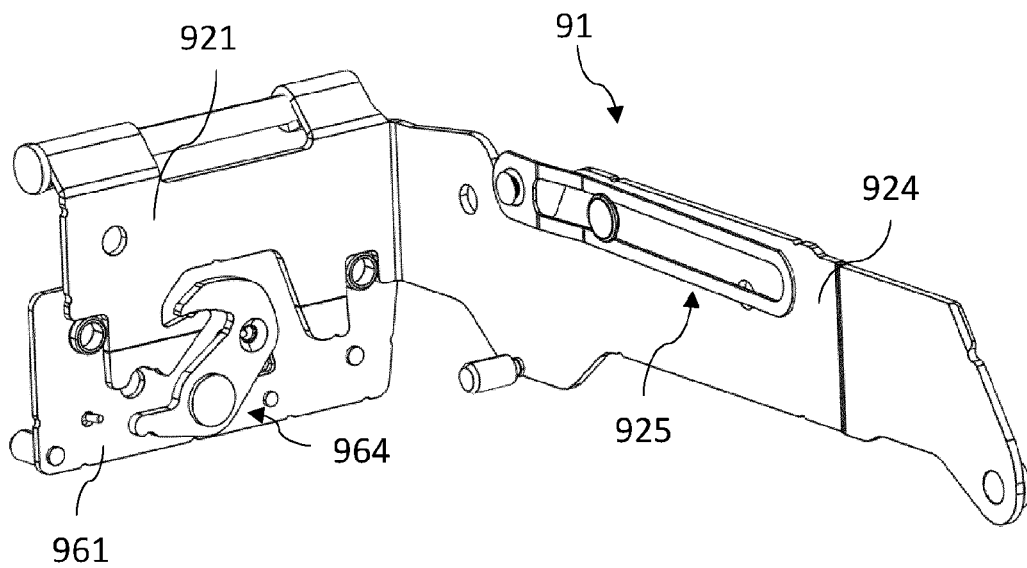


Fig. 20B

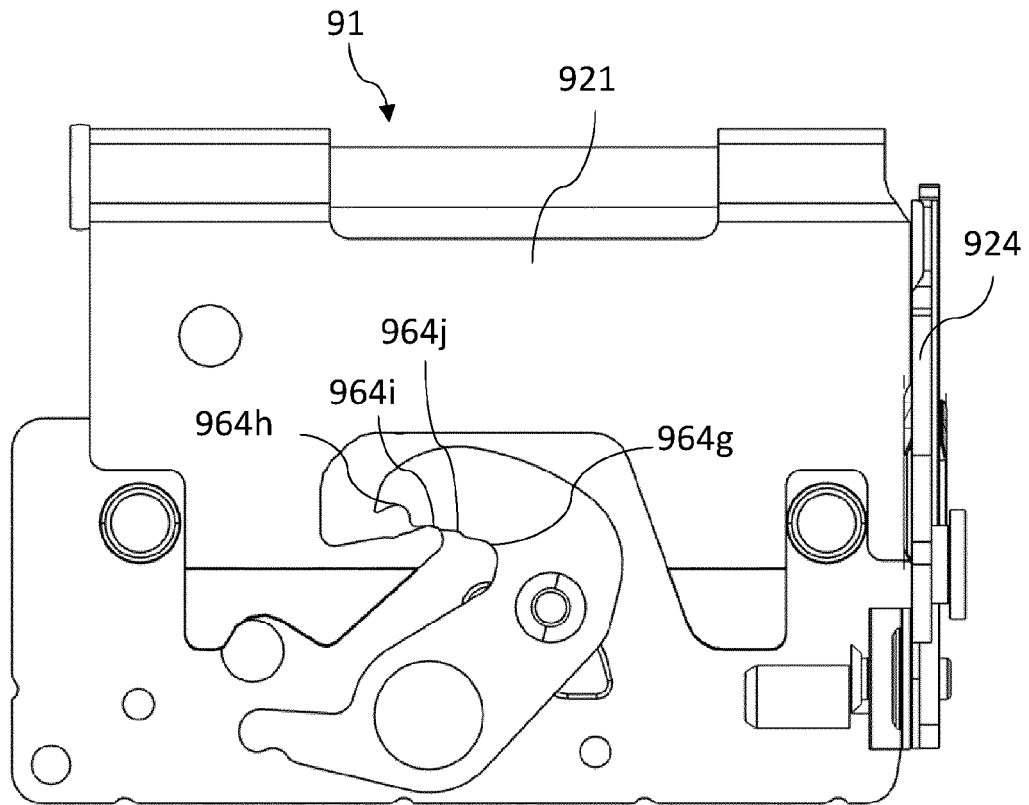


Fig. 21A

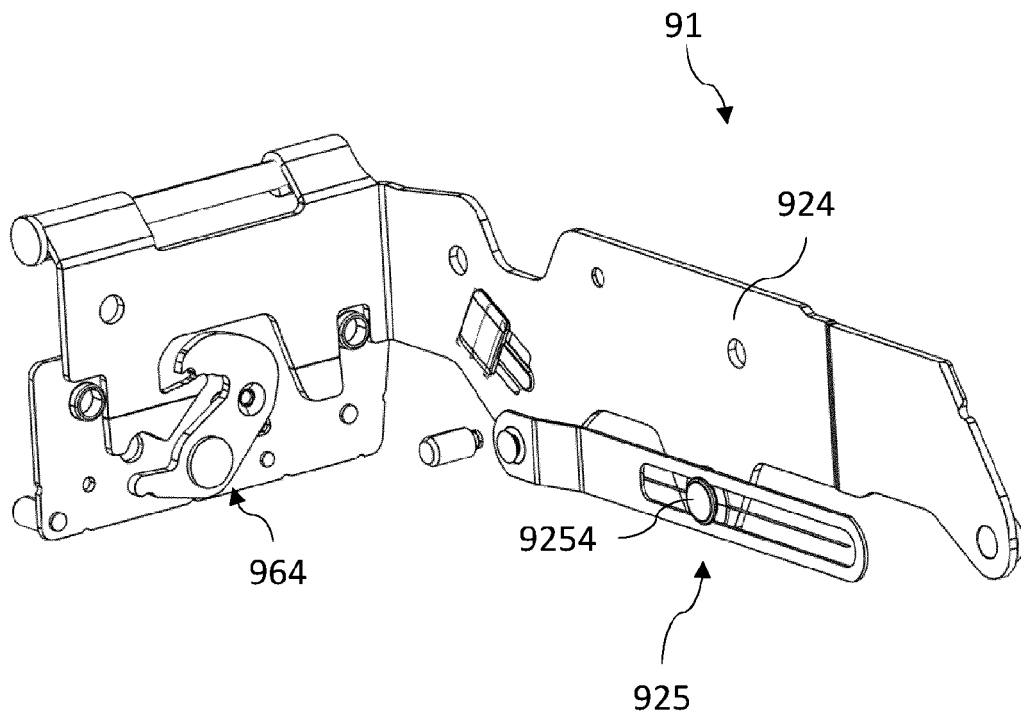


Fig. 21B

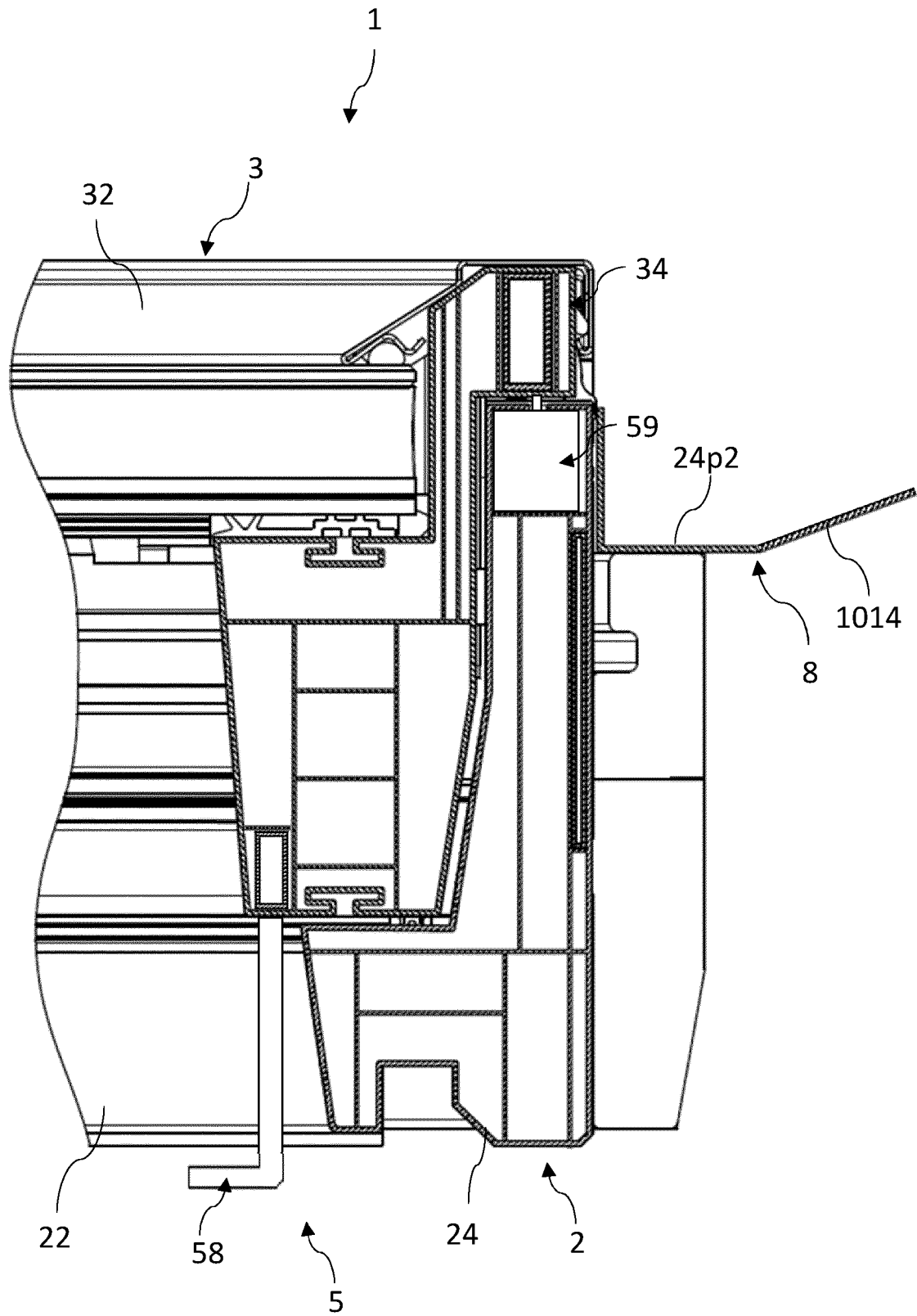


Fig. 22



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