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(54) **A SKYLIGHT WINDOW WITH AN IGU CLOSE TO THE WINDOW FRAME**

KLAPPFENSTER MIT EINEM IGU IN DER NÄHE DES FENSTERRAHMENS

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Description

[0001] The present invention relates to a skylight window for being installed in a roof of a building, the skylight window comprising:

a window frame having four frame side members, said frame side members defining an inner opening and each frame side member having an inner side facing said inner opening and an outer side facing in an opposite direction of the inner side and away from the inner opening, an interior side for, in an installed position, facing an interior of the building, and an exterior side for facing in an opposite direction of the interior side and away from the interior of the building,
a window sash having four sash side members supporting an Insulating Glazing Unit (IGU) having multiple layers of glazing, said window sash being movable in relation to the window frame between an open and a closed position of the skylight window,
a weather shield attached to the sash so as to protect a window portion of the skylight window, the window portion comprising the sash, the frame and the IGU, said weather shield being a weather shield without a sealed gas-filled spacing between the weather shield and the IGU, and a weather shield pane being made from a transparent or translucent material,
said IGU having an exposed interior major surface for facing an interior of said building in a closed position of the skylight window, said IGU further having an exposed exterior major surface facing in the opposite exterior direction in said closed position of the skylight window,
wherein a first peripheral side of the IGU extends from the interior major surface to the exterior major surface of the IGU,
a height direction which is substantially perpendicular to at least one of the major surfaces of the IGU,
a first of the frame side members being associated with a first of the sash side members, said first frame and sash side members extending in a respective longitudinal direction substantially in parallel with the first peripheral side of the IGU in a closed position of said skylight window,
and wherein, in the closed position of the skylight window, a first distance from the first peripheral side of the IGU in an outwards direction away from the inner opening of the frame to the inner side of the first frame side member, is 20mm or less, the outward direction being substantially parallel with at least one of the major surfaces of the IGU.

[0002] There is often a desire to position one or more windows in a roof of a building in order to allow daylight to reach the interior of the building. This, however, may give rise to a variety of challenges.

[0003] Inclined roof windows are typically built into an opening in an inclined roof structure with an angle above 15 degrees with a substantial part of the inclined skylight window is positioned within the inclined roof structure in an installed position. Flat roof skylight windows are generally installed on top of the exterior side of flat roofs of buildings, where the inclination of the roof is less than 5 degrees with respect to horizontal. In general, flat roof skylight windows are installed to cover an opening in the roof, i.e. a substantial part of the flat roof skylight window extends above an exterior side of the flat roof structure in an installed position.

[0004] It is common today to use a skylight window in flat roofs and potentially cover the window portion with a dome-shaped weather shield. One example of this type of skylight window is disclosed in WO 2009/080026 A1. This roof window comprises a standard VELUX ® outwardly openable window, to the sash of which a dome-shaped weather shield is attached.

[0005] Window sashes have typically comprised box structures consisting of hollow spacings providing structural support and thermal insulation through cavities. A typical example of such structures is presented in US2010269426. Windows comprising such sashes have typically a quite rough appearance, and are limiting the view. What is more, these windows are usually associated with high materials and processing costs in terms of manufacturing the window sash. EP 2500 488 discloses a skylight window according to the preamble of claim 1.

[0006] There is also a general desire to provide skylight windows with higher influx of light and better insulation properties to reduce the energy consumption required for illumination, heating and cooling of buildings.

[0007] On this background it may be an object of the invention to provide a skylight window according to the introduction in which the insulation properties are improved.

[0008] Furthermore, it may be an object of the invention to provide a skylight window in which a view through the window is improved.

[0009] According to the invention these and further objects may be met by a skylight window according to the introduction, characterized in that the first frame side member extends above the exposed exterior major surface of the IGU in the height direction.

[0010] The positioning of the IGU close to the frame side members may make it possible to fit an IGU in the frame with larger dimensions, in a plane of at least one of the major surfaces of the IGU, than the dimensions of the roof opening, i.e. the only obstacle for the influx of light may be a part of the frame and potentially a part of the sash supporting the peripheral sides of the IGU. Thus, the IGU being larger than the roof opening may increase the influx of light and can improve the view through the skylight window. The interior pane of the IGU may be a glazing pane. The interior pane may define a most interior part of the IGU. The interior pane may constitute a layer of glazing of the IGU. The interior pane may be of substantially the same size as one or more or all other layer(s)

of glazing of the IGU. The interior pane or an exterior pane of the IGU may be of a larger size than one or more of the other layer(s) of the glazing of the IGU. The interior pane may be substantially identical to one or more of the other layer(s) of glazing of the IGU. The interior pane may be different to one or more of the other layer(s) of glazing of the IGU. The interior pane may comprise a first side surface extending substantially along the first frame and sash side members. The glazing panes of the IGU having substantially the same size may allow almost all of the light travelling through the exterior major surface to travel through the interior major surface of the skylight IGU and thus, may improve the influx of light through the skylight window. The exterior pane may be a flat pane or a curved pane or a domed pane or a spherical pane.

[0011] The interior pane may comprise a first side surface extending substantially along the first frame side member which extends in the longitudinal direction, and an opposite second side surface extending along a second frame side member, in the longitudinal direction, substantially parallel with the first side surface. The total width of the interior major surface may be a total length of a third side surface of the interior pane extending in the lateral direction from the first side surface and to the second opposite, parallel side surface of the interior pane.

[0012] The IGU may comprise an exterior-most layer of glazing of the skylight window. The exterior-most layer of glazing of the skylight window may be an interior or top pane of the IGU. The exposed exterior major surface of the IGU may be the exterior-most layer of glazing of the skylight window. The exterior-most layer of glazing may be substantially identical to the one or more or all other layer(s) of glazing of the IGU.

[0013] The IGU may have multiple layers of glass which define a volume comprising an inert gas or aerogels or vacuum. The IGU may in a conventional manner comprise one or, preferably two, three or more layers of glazing, i.e. layers of glass, polycarbonate or the like or glass panels, positioned at a distance from each other to form one or more spacings or cavities between them. This spacing may be filled with a gas or may hold a vacuum to improve insulation. The exposed interior major surface of the IGU is in that case a lower major surface of a lowermost of the layers of glazing. Sealing and/or supporting members may be provided at one or more of four peripheral sides of the IGU between the layers of glazing. The sealing and/or supporting members may distance adjacent layers of glazing from each other and may together with the window glazing layers' peripheral sides form side surfaces of the IGU. These side surfaces may be substantially plane and extend substantially in the height dimension.

[0014] The second, third and fourth frame side members may have an inner side facing respective second, third and fourth peripheral sides of the IGU, wherein the first distance between the respective inner sides of the frame side members and the respective peripheral sides of the IGU is equal to or less than 20 mm, 18 mm, 16 mm, 14 mm, 12 mm, 10 mm, 8 mm, 6 mm, 5 mm, 4 mm, 3 mm, 2 mm or 1 mm.

[0015] The sash or part of the sash may be positioned between the first frame side member and the IGU, which may allow the sash to support the IGU on the interior major surface and may allow for the sash to lift the IGU when lifting the sash.

[0016] The sash or part of the sash can be positioned above the exterior major surface of the IGU and may be adhered to the exterior major surface, which may provide a space between the inner side of the first frame side member and the first peripheral side of the IGU

[0017] The first sash side member may comprise a second leg. The second leg may extend substantially in the height direction. The first or second leg may be substantially plate-shaped and/or substantially solid. A supporting leg may extend from the second leg. The supporting leg may extend from an end of the second leg. The supporting leg may extend in the lateral direction from the second leg. The supporting leg may extend substantially perpendicularly from the second leg.

[0018] The term "substantially solid" is understood as there being no holes and/or hollow spacings comprised in the material structure and/or holes or cavities on the surface.

[0019] Having a substantially plate shaped or solid second sash leg and a short distance from the first frame side member to the IGU may make it possible to position the IGU low, in the height direction, in the frame i.e. closer to a most interior side of the window frame and closer to the interior of the building. A lower mounting of the IGU close to the first frame side member may increase the relative proportion the IGU takes up of a thermal energy exchange interface between the building and the skylight.

[0020] The term "thermal energy exchange interface" refers to the areas and parts of a skylight window where the thermal energy exchange occurs i.e. the frame, the sash and the IGU.

[0021] The IGU may have better insulating properties than other components of the skylight window. Therefore, increasing its relative proportion of the thermal energy exchange interface may improve insulating properties of the skylight window as a whole.

[0022] The positioning of the IGU close to the first frame side member allows an increase of the dimensions of the major surfaces of the IGU, in the plane of at least one of the major surfaces, relative to a size of the skylight window i.e. a larger IGU can be fitted in an unchanged roof opening, which may increase the influx of light and can improve the view through the skylight window. Furthermore, a high influx of light and good view through the skylight window may also be achieved as less light and/or view obstructing elements of the skylight window is not positioned between the IGU and the frame side members.

[0023] A low positioned IGU may further provide more space for an IGU with a larger height, potentially with

several or higher layers of glazing or a higher gas-filled spacing between the panes, which may further improve insulation properties of the skylight window. The insulation properties may also be improved as less thermally conducting sash or frame material may need to be provided. The reduced the need for the sash being a certain size and/or frame being a certain size for insulation purposes, it may be possible to have a more compact frame and/or sash and thus allow for a more compact skylight window as a whole, i.e. with a lower total height and/or width.

[0024] Generally, one or more of the frames and/or sash side members may comprise or be made substantially of polymer materials, such as plastic, specifically PVC (polyvinyl chloride), chlorinated PVC, PUR (polyurethane), fibre reinforced PUR such as glass fibre reinforced PUR, pultruded polymers, polyester, and/or glass fibre and/or wood and/or metal such as steel or aluminium or composites or combinations thereof.

[0025] The four frame side members may together form a substantially rectangular shape. Additionally or alternatively, the four sash side members may together form a substantially rectangular shape. A rectangular shape of the four sash side members may be smaller than a rectangular shape of the four frame sash side members, in the plane of at least one of the major surfaces, which may allow the sash to be embedded within the frame.

[0026] According to the invention, the first frame side member of the skylight window extends, in a height direction which is substantially perpendicular to at least one of the major surfaces of the IGU, above the exposed exterior major surface of the IGU, in a closed position of the skylight window. A first frame side member extending above the exposed exterior major surface improves the insulation properties of the skylight window as the IGU can be positioned in a more interior position in the skylight window. Another advantage of the first frame side member extending above the IGU in the height direction is that, in an installed position, the first frame side member can protect the skylight window from weather and guide water on the roof surface away/around the IGU and thus, avoid accumulation of precipitation and dirt on the IGU.

[0027] The weather shield is a weather shield without a sealed gas-filled spacing between the weather shield and the IGU. Without the sealed gas-filled spacing the weather shield and the IGU may be considered as two separate components of the skylight window. In such an embodiment, the spacing between the IGU and the weather shield can be more than 1 mm, 2mm, 5 mm, 10 mm, 15 mm, 20 mm, 25 mm, 30 mm, 35, mm, 40 mm, 45 mm, 50 mm, 60 mm, 70 mm, 80 mm, 90 mm, 100 mm, 110 mm, 120 mm, in the height direction. Without the sealed gas-filled spacing between the weather shield and the IGU, the IGU can be positioned more interior in the skylight window and thus, improve the insulation of the skylight window as a whole.

[0028] The weather shield may be provided as a unitary structure, which is detachably attached to the sash so as to protect a window portion of the skylight window, the window portion comprising the sash, the frame, and the IGU, the weather shield comprising a weather shield pane. The weather shield may be attached detachably to the sash, providing for access to clean the IGU. This may also be of advantage during installation of the skylight window, e.g. when positioning or attaching the window portion or when attaching roofing felt to cover a potential gap between the frame and the roof structure. Further, it allows for the weather shield to be replaced if damaged. The weather shield may be mounted on the window portion to protect it from the weather and preventing rain and other precipitation from entering into gaps or slots in the roof or the window portion.

[0029] In an alternative embodiment the exterior major surface of the IGU may act as a weather shield as it is exposed to the exterior. The exterior major surface of the IGU acting as weather shield can allow for a shorter skylight window in the height direction as it eliminates the need for a separate weather shield.

[0030] In an embodiment, in the closed position of the skylight window, there is a second distance in the outwards direction from the first peripheral side of the IGU to the outer side of the first frame side member, wherein said first distance is 50%, 45%, 40%, 35%, 30%, 25%, 20%, 15%, 12% or less of the second distance.

[0031] In an alternative embodiment, the first frame side member has a total frame member width which is a largest width of the first frame side member in the outwards direction, wherein said first distance is equal to or less than 50%, 45%, 40%, 35%, 30%, 25%, 20%, 15%, 10% of the total frame member width.

[0032] These embodiments may add to improved insulating properties of the skylight window as they may define a smaller spacing between the first frame side member and the first peripheral side of the IGU, which potentially may comprise elements in the spacing such as the sash and thus, the relative area of the superior insulating IGU is increased relative to other parts in the spacing of the skylight window.

[0033] In an embodiment, the first sash side member and the first frame side member comprise upper sections, the upper sections being a part located above the interior major surface of the IGU in the height direction extends substantially away from the peripheral side of the IGU. The upper sections extending substantially away from the peripheral sides of the IGU may improve the influx of light and the view out of the skylight window, as no obstacles are blocking light from the exterior. Having the sections extending away from the IGU may even improve the light further as it can work as a funnel for light from the exterior towards the interior.

[0034] In an embodiment, in the closed position of the skylight window, a maximum height distance in the height direction from the interior major surface of the IGU to a lowermost interior side of the first frame side member is equal to or less than 100 mm, 90 mm, 80 mm 70 mm, 60

mm, 50 mm, 40 mm, 35 mm. This may position the IGU closer to or beneath the plan of a roof surface in an installed position of the skylight window, which may reduce the thermal conductivity of the skylight window. Thus, allowing the IGU to be positioned at a low position in the window frame may improve the insulating properties of the skylight window.

[0035] The weather shield may comprise a skirt that extend on an outer side of one or more or all four sides of the frame, i.e. of the respective frame side members. The skirt may be manufactured from or include metal. The weather shield pane may curve upwardly in relation to the window portion or the IGU to allow for rain and snow to slide or flow off the weather shield pane. According to the invention, the weather shield pane is a transparent or translucent weather shield pane that is made of a transparent or translucent material e.g. of glass or hardened glass or polymer. The weather shield pane may comprise only one single layer of glazing, no further layers of glazing besides those of the weather shield potentially being provided in the skylight window. The weather shield pane may be dome-shaped or substantially flat. The weather shield pane may be of glass or of a plastic polymer.

[0036] In an alternative embodiment the skylight window is an inclined skylight window. Inclined skylight windows are typically built into an opening in an inclined roof structure with an angle above 15 degrees relative to horizontal with a substantial part of the inclined skylight window positioned within the inclined roof structure in an installed position.

[0037] In an embodiment, the skylight window is installed in a flat roof, which may have an inclination equal to or less than 5 degrees relative to horizontal.

[0038] In an alternative embodiment the skylight is installed in an inclined roof, with an inclination equal to or more than 15 degrees relative to horizontal.

[0039] In another embodiment the skylight is to be installed in a roof with an inclination between 5 and 15 degrees relative to horizontal.

[0040] In an embodiment, the skylight window further comprises a lining panel protrusion located lower than the exposed interior major surface of the IGU in the height direction, wherein the interior pane comprises a side surface extending substantially along the first frame and sash side members,

wherein the lining panel protrusion protrudes away from the IGU, the lining panel protrusion comprising a first surface for abutting a surface of reveal panel or lining panel so as to position the reveal panel or lining panel, and

wherein, in the closed position of the skylight window, the first surface of the lining panel protrusion in a lateral direction extending along the exposed interior major surface of the IGU is positioned farther away from the side surface of the interior pane than the supporting leg.

[0041] Such protrusion can help an installer install a lining panel at the skylight window by guiding an upper end of the lining panel into contact with a first side of the protrusion, and may further ease the installation by hiding the upper end of said lining panel e.g. if the upper end is not flush with the interior side of the skylight window. The lining panel can be used to hide the skylight frame, for viewers, including insulation elements such as an insulting block and can thus, allow for improving the insulating properties of the skylight window as a whole. The skylight window may further comprise a second protrusion next to the first protrusion to create a lining panel recess for receiving a lining panel to be installed. Said lining panel recess would add to the guidance and ease of installation of the lining panel.

[0042] In an embodiment comprising at least one lining panel protrusion the distance, in the height direction, from the interior major surface of the IGU to the lining panel protrusion is equal to or less than 50 mm, 40 mm, 30 mm or 20 mm in a closed position of the skylight window. The short distance from the lining panel protrusion on the interior side of the skylight window to the IGU may position the IGU low in the frame, and thus add to the influx of light and insulation properties of the skylight window as a whole, as the IGU is closer to the roof element and fewer inferior insulating elements can be between the frame and the IGU.

[0043] In an embodiment, the window porting comprising the sash, IGU and weather shield is hinged to rotate around a hinge axis in relation to the plane of the roof in an installed position. The window portion may preferably be made movable in relation to the window frame by the sash being outwardly openable, i.e. being rotatable around an axis extending along one of the sash side members. Generally, by outwardly openable it is to be understood that the sash moves outwards from the frame during opening. This is contrary to centre hung skylights which have elements moving towards the interior and exterior during opening and employ a different design. The sash being outwardly hung may be achieved by using a rotary hinge positioned at the first sash side member and connecting the first sash side member with the associated, adjacent first frame side member. Alternatively or additionally, the sash may be parallel-displaceable so that all four sash side members shift upwardly or downwardly between the open and closed positions of the window in which case further or other hinges or the like connect the sash with the frame. The skylight window may be openable by a combination of a rotary movement and a shifting movement or other movement paths of the sash in relation to the frame.

[0044] In an alternative embodiment, the hinge axis is located above the exterior major surface of the IGU in the height direction in a closed position of the skylight window. Having the skylight window opening outwards can add to the ability of the skylight window to guide water away from the roof opening even in an open position.

[0045] In an alternative embodiment, the hinge axis is

located above the frame in the height direction in the closed position of the window.

[0046] In an embodiment, the skylight window may comprise one or more thermal breaks in the sash. Thermal breaks can be manufactured from a material of a lower thermal conductivity than other parts of the first sash side member. This may have the advantage of improving the insulation properties of the skylight window as a lower thermal conductivity through a sash side member may be achieved. The thermal break may be substantially made from or comprise a polymer or foam or a foamed polymer material. The thermal breaks may be located on the sash side member, so that thermal bridges are avoided. The thermal break may be positioned above the exterior major surface of the IGU when seen in the height direction, i.e. on the exterior side of the IGU.

[0047] In the enclosed drawings, which show non-binding examples of embodiments of the present invention,

Fig. 1 shows a perspective view from above of an embodiment of a skylight window according to the present invention installed in a roof,

Fig. 2 shows a cross-sectional view along line II-II of an embodiment of a skylight window according to the present invention with a dome shaped weather shield,

Fig. 3 shows a cross-sectional view along line II-II of an embodiment of a skylight window according to the present invention with a flat weather shield,

Fig. 4 shows a cross-sectional view along line II-II of an embodiment of a skylight window according to the present invention with a wide frame and a thermal break,

Fig. 5 shows a cross-sectional view along line II-II of an embodiment of a skylight window which is not according to the present invention and which has an exterior major surface as part of a weather shield.

Fig. 6 is a perspective view from above of an embodiment of the skylight window 1 according to the invention installed on a roof, where a part of the skylight window has been removed for the purpose of illustration.

[0048] Fig. 1 shows an embodiment of a skylight window 1 according to the present invention positioned or installed substantially horizontally in a flat roof 2 of a building and covering an opening in the roof. The skylight window 1 comprises a weather shield 3 and a window portion 4, which includes a transparent insulting glazing unit 5, abbreviated IGU, a sash 6 supporting the IGU 5, and a frame 7. The weather shield 3 comprises a transparent weather shield pane 8 and a skirt 9, which cover the sash and the IGU.

[0049] In this embodiment, both the entire sash 6 and the entire frame 7 are positioned above an upper roof surface, also denoted the exterior roof surface. The skylight window 1 may, however, also be positioned so that a part of the frame 7 and the sash 6 are positioned below the exterior roof surface level.

[0050] The flat roof 2 shown here has a roof inclination of less than 10% in relation to horizontal. The skylight window may however also be installed in an inclined roof.

[0051] As is seen in Figs 2-5 the IGU 5 has an exposed interior major surface 5b facing downwards towards an interior of the building in the shown installed position of the skylight window 1 and an exposed exterior major surface 5g facing in the opposite direction towards the weather shield pane 8 and the exterior. The interior and exterior exposed major surfaces of the IGU 5 are substantially parallel with a plane defined by the roof surface, i.e. the exterior roof surface level.

[0052] The frame 7 comprises four frame side members of which two 10, 11 are visible in Fig. 1, and one 10 is visible in Figs 2-5. Each frame side member is associated with one of four corresponding sash side members of which one 14 is visible in Figs 2-5. The frame side member 10 is associated with the sash side member 14 and both extend in a longitudinal direction L along a first peripheral side 5a of the IGU 5. The four frame side members form a substantially rectangular shape and, similarly, the four sash side members form a substantially rectangular shape. In this embodiment each frame side member is positioned at an outer side of a respective associated one of the four sash side members, i.e. on the side facing away from the IGU, so that the sash fits into the frame and the frame 7 encloses the sash 6 in the closed position of the skylight window 1.

[0053] The slightly curved weather shield pane 8 as seen in Fig. 1 extends over an entire roof opening (not shown), which roof opening the skylight window 1 is positioned to cover.

[0054] The shield pane 8 is surrounded by the weather shield skirt 9, which extends on an outer side of all four sides of the frame 7, i.e. of the respective frame side members, see Fig. 1.

[0055] The frame side member 10 is an embodiment of the first frame side member of the skylight window according to the invention. The frame side member 10 extends above the IGU in a height direction. The sash side member 14 is an embodiment of the first sash side member according to the invention.

[0056] The window sash 6 supports the IGU 5 and is connected to the window frame 7 via hinges (not shown) so that it is movable in relation to the frame 7 between an open (not shown) and a closed position of the skylight window 1. The window is shown in the closed position in Figs 1 to 5.

[0057] Referring in particular to Fig. 2, the four frame side members made from glass fibre reinforced PUR (polyurethane) form a substantially rectangular shape and, similarly, the four sash side members form a substantially rectangular shape. In the embodiment of Fig. 2, each frame side member is positioned at an outer side of a respective associated one of the four sash side members, i.e. on the side facing away from the IGU 5, so that

the sash fits into the frame 7 and the frame 7 encloses the sash 6 in the shown closed position of the skylight window 1.

[0058] The four sash side members made of pultruded glass fibre reinforced PUR support the IGU 5 which has multiple panes or layers of glazing 5c, 5d, 5e (the interior pane constitutes a layer of glazing of the IGU) and the sash is connected to the window frame 7 via hinges (not shown) so that, in a conventional manner, it is movable (pivotable) in relation to the frame 7 between an open (not shown) and a closed position of the skylight window 1. The skylight window 1 is shown in the closed position in all of the figures.

[0059] Although only a cross-section of a side of the skylight window is shown, the embodiments shown in FIGS. 2-5 similarly comprise four frame and sash side members, an IGU and a weather shield (with the exception of the embodiment shown in FIG. 5 which does not comprise a weather shield and which is not part of the invention). Similar features in each of the figures have been given the same reference numbers unless otherwise specified.

[0060] The first frame side member 10 is associated with the first sash side member 14, and both of these extend in a respective longitudinal direction L substantially in parallel with a respective first peripheral side 5a of the IGU 5 (i.e. into the drawing) in a closed position of the skylight window 1.

[0061] The first frame side member 10 further comprises a lining panel protrusion 10e located lower than the exposed interior major surface 5b of the IGU 5 in the height direction. The lining panel protrusion 10e protrudes away from the IGU 5 and has a first surface 10c for abutting a surface of the reveal panel or lining panel 50 so as to position a reveal panel or lining panel 50 as shown in FIG. 2. The reveal or lining panel 50 covering the first frame side member 10 to provide a seamless and clean aesthetic when viewing through the skylight window 1 from an interior of the building.

[0062] In Figs. 2 and Figs. 5 the first surface 10c of the lining panel protrusion 10e together with a second surface 10d of the first frame side member form the sides of a lining panel recess 10b, which is an empty spacing that accommodates an upper part or upper end of a reveal panel or lining panel 50 in the installed position of the skylight window 1. Other embodiments, Fig. 3 and Fig. 4, does not comprise a lining panel recess, but just comprise a lining panel protrusion 10e.

[0063] In Fig. 2, the weather shield 3 has a dome shaped pane 8 so as to protect the window portion. The weather shield is attached to the sash side member 14 above the first frame side member 10 in the height direction. There is a first distance between the inner surface 10i of the first frame side member facing a peripheral side of the IGU and a peripheral side of the IGU 5a. A portion of the first sash side member extends in the height direction in a spacing, defined by the first distance. The first sash side member 14 is generally plate-shaped, consists of one single section of substantially solid material and at least a portion of the sash side member 14 has a thickness of 10 mm.

[0064] The substantially plate shaped first sash side member allows for the first distance D to be 18 mm in the width direction, in the closed position of the skylight window shown as shown in Fig. 2.

[0065] A part of the sash extends beneath the interior major surface 5b and extends in the lateral direction substantially parallel with the interior major surface to support the IGU on the interior major surface.

[0066] The bottom surface of the first frame side member 10a is installed on a substantially flat roof 2. A part of the bottom surface stretches into the roof opening, this part of the bottom surface comprises a recess 10b for a lining/reveal panel. The recess is to assist the installation of a lining panel after installing the skylight window. A first surface 10c of the recess is for abutting a lining panel to be installed.

[0067] Referring in particular to Fig. 3, the embodiment depicts the skylight window with a flat pane 8 weather shield 3 and a first frame side member 10. The first sash side member 14 of Fig. 3 is only located above the IGU 5 and extends parallel to or away from the peripheral side 5a of the IGU. The first sash side member 14 is adhered to the exterior major surface of the IGU 5g e.g. by glue or a sealing member. In this way, the first sash side member 14 carries the IGU 5 in the open position (not shown) of the skylight window 1. As shown in the Figure, the adherence provided by the first sash leg being adhered to the exposed exterior major surface 5g of the IGU may be the substantially only attachment of the first sash side member 14 to the IGU 5.

[0068] The first sash side member 14 being above the IGU 5 allows the IGU 5 to be placed closer to the first frame side member 10. The first distance D between the first frame side member and the IGU is in this embodiment 1 mm.

[0069] A single sealing member 22 is the only element between the interior major surface of the IGU 5b and the first frame side member 10, only having one element connecting the IGU and the frame improves the insulation of the skylight window as a whole.

[0070] The bottom surface 10a of the first frame side member comprises a protrusion 10e for installation of a lining panel. The protrusion can provide guidance for a top end of a lining panel (not shown) and can hide the top end of said lining panel.

[0071] The few elements between the interior major surface of the IGU 5b and the first frame side member 10 makes it possible to position the IGU 5 low in the skylight window and thus, the height distance DH between the interior major surface and the bottom surface 10a of the first frame side member is 35 mm in the height direction. In a similar embodiment (not shown) without the protrusion 10e, the distance between the interior major surface 5b and the most interior surface of the frame side member would thus be 35 mm or less.

[0072] Referring in particular to Fig. 4, the embodiment depicts the invention with a wide frame potentially comprising insulation members or elements in the first frame member 10. The frame side member 10 and the first sash side member 14 has a stepped profile in the cross-section view. On the most exterior step of the sash 14, a design cover 63 is mounted to reflect light, repel dust and to hide the stepped profile of the sash 14. In a similar embodiment (not shown) the design cover could be replaced with a screening device such as a shade and mounted to the sash 14. The shade could be electronically controlled and in a closed position be hidden when looking out the window from the interior towards the exterior.

[0073] The sash leg 14 further comprises a thermal break 75 to reduce the thermal conductivity of the sash leg. The sash leg could comprise several thermal breaks.

[0074] The sash 14 is supporting the IGU on the major interior surface 5b and thus extends in the spacing defined by the first distance D between a peripheral side of the IGU 5a and the first frame side member 10.

[0075] The smallest first distance D between the peripheral side of the IGU 5a and the frame side member 10 is in this embodiment 10% of the maximum width W of the frame side member 10.

[0076] The smallest first distance D in this embodiment is 15% of the width distance DW from the first frame side member 10 to the peripheral side 5a of the IGU in a lateral direction. In a similar embodiment (not shown) the sash 14 could be adhered to the exterior major surface of the IGU 5g to reduce the first distance D between the peripheral side of the IGU and the frame.

[0077] The first frame side member may not be solid and allow for insulation elements or installation of e.g. a motor-driven actuator (not shown) in the first frame side member. A part of the motor-driven actuator could come into contact with the sash and move it between a closed and an open position.

[0078] The frame side member 10 and/or the sash 14 may comprise or be made substantially of polymer materials, such as plastic, specifically PVC (polyvinyl chloride), chlorinated PVC, PUR (polyurethane), fibre reinforced PUR such as glass fibre reinforced PUR, and/or wood and/or metal such as aluminium or composites or combinations thereof.

[0079] Referring in particular to Fig. 5, which shows an embodiment of a skylight window without a weather shield and which is therefore not part of the invention, the IGU 5 in this embodiment comprises three layers of glazing 5c, 5e, 5d in the form of glass panels, positioned at a distanced from each other by sealing members 24 located at peripheral sides of the IGU between the layers of glazing to form two spacings 51. These spacings 5l are filled with inert gas to improve insulation. The IGU further has an exposed interior major surface 5b facing downwards towards an interior of the building in the shown installed and closed position of the skylight window 1 and an exposed exterior major surface 5g facing in an opposite direction towards an exterior. The exposed interior major surface 5b is of an interior pane 5d of the IGU 5. The exposed interior and exterior major surfaces 5b, 5g of the IGU 5 are substantially parallel with each other and a plane defined by the roof surface, i.e. the exterior roof surface level. The interior pane 5d comprises a side surface 5s extending substantially along the first frame and sash side members 10, 14. It should also be noted that the top layer of glazing 5c in this embodiment is larger than the other layers of glazing 5e, 5d of the IGU 5 and extends farther in the width direction, the layers of glazing however, may be of equal size in other embodiments.

[0080] The frame side member 10 is a box structure with a bottom surface 10a for installation on a roof surface and a recess 10b on the bottom surface positioned above the plane of said roof surface in the height direction.

[0081] The recess 10b is for receiving a top end of a lining panel (not shown), which can abut at least one of the recess surfaces. Further, the recess 10b is for hiding the window frame 10 in an installed position when viewing the window from the interior towards the exterior.

[0082] The sash 14 comprises a thermal break 75 to reduce the thermal conductivity of the window. The sash 14 supports the interior major surface of the IGU 5b and extends in the height direction in the spacing S between the frame side member 10 and a peripheral side of the IGU 5a. The spacing S between the peripheral side of the IGU 5a and an inner surface 10i of the frame side member in a direction substantially parallel with the interior major surface is 15 mm. In a similar embodiment, the spacing S could be reduced by moving the sash 14 and IGU closer to a surface of the frame member in a lateral direction.

[0083] The following is a list of reference numerals used throughout this specification.

1	Skylight window
2	Roof
3	Weather shield
4	Window portion
5	IGU
5a	First peripheral side
5b	Exposed interior major surface
5c	Layer of glazing
5d	Interior pane / layer of glazing
5e	Layer of glazing
5g	Exposed exterior major surface
5s	Side surface
6	Sash
7	Frame
8	Weather shield pane
9	Weather shield skirt
10	First frame side member
10a	Bottom surface of frame side member
10b	Lining panel recess
10c	First surface
10d	Second surface
10e	Lining panel protrusion

10i	Inner surface of frame side member
14	First sash side member
50	Reveal panel or lining panel
63	Design cover
75	Thermal break
D	First distance
DW	Width distance
DH	Height distance
W	Width of the first frame side member

Claims

1. A skylight window (1) for being installed in a roof of a building, the skylight window (1) comprising:

a window frame (7) having four frame side members, said frame members defining an inner opening and each frame member having an inner side facing said inner opening and an outer side facing in an opposite direction of the inner side and away from the inner opening, an interior side for, in an installed position, facing an interior of the building, and an exterior side for facing in an opposite direction of the interior side and away from the interior of the building,
a window sash (6) having four sash side members supporting an Insulating Glazing Unit (IGU) having multiple layers of glazing, said window sash being movable in relation to the window frame between an open and a closed position of the skylight window,
a weather shield (3) attached to the sash so as to protect a window portion (4) of the skylight window, the window portion (4) comprising the sash, the frame and the IGU,
said weather shield being a weather shield without a sealed gas-filled spacing between the weather shield and the IGU, and a weather shield pane (8) being made from a transparent or translucent material,
said IGU having an exposed interior major surface (5b) for facing an interior of said building in a closed position of the skylight window, said IGU further having an exposed exterior major surface (5g) facing in the opposite exterior direction in said closed position of the skylight window,
wherein a first peripheral side (5a) of the IGU extends from the interior major surface to the exterior major surface of the IGU,
a height direction which is substantially perpendicular to at least one of the major surfaces of the IGU,
a first of the frame side members (10) being associated with a first of the sash side members (14), said first frame side member (10) and sash side member (14) extending in a longitudinal direction substantially in parallel with the first peripheral side (5a) of the IGU in a closed position of said skylight window,
and wherein, in the closed position of the skylight window, a first distance (D) from the first peripheral side of the IGU (5a) in an outwards direction away from the inner opening of the frame to the inner side of the first frame side member, is 20mm or less, the outward direction being substantially parallel with at least one of the major surfaces of the IGU,
characterized in that
the first frame side member (10) extends above the exposed exterior major surface (5g) of the IGU in the height direction.

2. Skylight window according to any of the preceding claims, wherein in the closed position of the skylight window, there is a second distance in the outwards direction from the first peripheral side (5a) of the IGU to the outer side of the first frame member,
wherein said first distance is 50% or less of the second distance (D).

3. Skylight window according to any of the preceding claims, wherein said first frame member (10) has a total frame member width, which is a largest width of the first frame member in a direction substantially parallel with the interior major surface in the closed position of the window,
wherein said first distance (D) is 50% or less of the total frame member width.

4. Skylight window according to any of the preceding claims, wherein the sections of the first sash side member and first frame side member located above the interior major surface of the IGU, when seen in the height direction, extend substantially away from the IGU.

5. Skylight window according to any of the preceding claims, wherein, in the closed position of the skylight window, a maximum height distance, in the height direction, from the interior major surface (5b) of the IGU to a most interior, interior side of the first frame side member is 10 cm or less.

6. Skylight window according to any of the preceding claims, wherein the skylight window is configured for being installed in a substantially flat roof structure having an inclination between 0 to 5 degrees to horizontal.

7. Skylight window according to any of the preceding claims, wherein the skylight window further comprises a lining panel protrusion (10e), on an interior part of the first frame side member, protruding away from the IGU.

8. Skylight window according to any of the preceding claims, wherein, in the closed position of the skylight window, the distance from the interior major surface (5b) of the IGU to the lining panel protrusion (10e) is 5 cm or less in a height direction, which is substantially perpendicular to at least one of the major surfaces of the IGU (5b, 5g).

9. Skylight window according to any of the preceding claims, wherein the sash (6) is hinged to one of the frame side members to one of the sash side members to rotate about a hinge axis.

10. Skylight window according to claim 9, wherein in the closed position of the skylight window, the hinge axis is located above, in a height direction, the exterior major surface of the IGU which is substantially perpendicular to at least one of the major surfaces of the IGU.

11. Skylight window according to claim 9 or 10, wherein the hinge axis is located above the frame in a height direction which is substantially perpendicular to at least one of the major surfaces of the IGU in the closed position of the skylight window.

12. Skylight window according to any of the preceding claims, wherein the sash comprises one or more thermal breaks (75).

13. A skylight window according to any of the preceding claims, wherein the sash (6) comprises or substantially consists of metal, such as steel or aluminium and/or polymer fibre-reinforced polymer, PUR, pultruded, glass fibre, aluminium, polyester or composite.

Patentansprüche

1. Dachfenster (1) zum Einbau in ein Dach eines Gebäudes, wobei das Dachfenster (1) Folgendes umfasst:

einen Fensterrahmen (7), der vier Rahmenseitenelemente aufweist, wobei die Rahmenelemente eine innere Öffnung definieren und jedes Rahmenelement eine innere Seite, die der inneren Öffnung zugewandt ist, und eine äußere Seite,
die einer der inneren Seite entgegengesetzten Richtung zugewandt und von der inneren Öffnung abgewandt ist, eine Innenseite, die in einer Einbaustellung dem Inneren des Gebäudes zugewandt ist, und eine Außenseite, die einer der Innenseite entgegengesetzten Richtung zugewandt und vom Inneren des Gebäudes abgewandt ist, aufweist,
einen Fensterflügel (6), der vier Flügelseitenelemente aufweist, die eine Mehrscheibenisolierglaseinheit (MIG) tragen, die mehrere Glasschichten aufweist, wobei der Fensterflügel in Bezug zum Fensterrahmen zwischen einer geöffneten und einer geschlossenen Stellung des Dachfensters beweglich ist,
einen Wetterschutz (3), der am Flügel befestigt ist, um einen Fensterabschnitt (4) des Dachfensters zu schützen, wobei der Fensterabschnitt (4) den Flügel, den Rahmen und die MIG umfasst,
wobei der Wetterschutz ein Wetterschutz ohne einen abgedichteten, gasgefüllten Zwischenraum zwischen dem Wetterschutz und der MIG ist und eine Wetterschutzscheibe (8) aus einem transparenten oder lichtdurchlässigen Material gefertigt ist,
wobei die MIG eine freiliegende innere Hauptfläche (5b) aufweist, die in einer geschlossenen Stellung des Dachfensters dem Inneren des Gebäudes zugewandt ist,
wobei die MIG ferner eine freiliegende äußere Hauptfläche (5g) aufweist, die in der geschlossenen Stellung des Dachfensters der entgegengesetzten Außenrichtung zugewandt ist,
wobei sich eine erste Umfangsseite (5a) der MIG von der inneren Hauptfläche zur äußeren Hauptfläche der MIG erstreckt,
eine Höhenrichtung, die im Wesentlichen senkrecht zu mindestens einer der Hauptflächen der MIG verläuft,
wobei ein erstes der Rahmenseitenelemente (10) einem ersten der Flügelseitenelemente (14) zugeordnet ist,
wobei sich das erste Rahmenseitenelement (10) und Flügelseitenelement (14) in einer geschlossenen Stellung des Dachfensters in eine Längsrichtung im Wesentlichen parallel zu der ersten Umfangsseite (5a) der MIG erstreckt,
und wobei in der geschlossenen Stellung des Dachfensters eine erste Entfernung (D) von der ersten Umfangsseite der MIG (5a) in Auswärtsrichtung von der inneren Öffnung des Rahmens weg zur Innenseite des ersten Rahmenseitenelements 20 mm oder weniger beträgt, wobei die Auswärtsrichtung im Wesentlichen parallel zu mindestens einer der Hauptflächen der MIG verläuft,
dadurch gekennzeichnet, dass
sich das erste Rahmenseitenelement (10) in Höhenrichtung über der freiliegenden äußeren Hauptfläche (5g) der MIG erstreckt.

2. Dachfenster nach einem der vorstehenden Ansprüche, wobei es in der geschlossenen Stellung des Dachfensters eine zweite Entfernung in Auswärtsrichtung von der ersten Umfangsseite (5a) der MIG

zur Außenseite des ersten Rahmenelements gibt, wobei die erste Entfernung 50 % oder weniger der zweiten Entfernung (D) beträgt.

3. Dachfenster nach einem der vorstehenden Ansprüche, wobei das erste Rahmenelement (10) eine Gesamtrahmenelementbreite aufweist, die in der geschlossenen Stellung des Fensters die größte Breite des ersten Rahmenelements in eine Richtung im Wesentlichen parallel zur inneren Hauptfläche ist, wobei die erste Entfernung (D) 50 % oder weniger der Gesamtrahmenelementbreite beträgt.

4. Dachfenster nach einem der vorstehenden Ansprüche, wobei sich die Abschnitte des ersten Flügelseitenelements und des ersten Rahmenseitenelements, die sich in Höhenrichtung gesehen über der inneren Hauptfläche der MIG befinden, im Wesentlichen von der MIG weg erstrecken.

5. Dachfenster nach einem der vorstehenden Ansprüche, wobei in der geschlossenen Stellung des Dachfensters eine maximale Höhenentfernung in Höhenrichtung von der inneren Hauptfläche (5b) der MIG zu einer am weitesten inneren Innenseite des ersten Rahmenseitenelements 10 cm oder weniger beträgt.

6. Dachfenster nach einem der vorstehenden Ansprüche, wobei das Dachfenster dazu ausgelegt ist, in einer im Wesentlichen flachen Dachstruktur mit einer Neigung zwischen 0 bis 5 Grad zur Horizontalen installiert zu werden.

7. Dachfenster nach einem der vorstehenden Ansprüche, wobei das Dachfenster ferner einen Verkleidungsplattenvorsprung (10e) auf einem Innenteil des ersten Rahmenseitenelements umfasst, der von der MIG weg vorsteht.

8. Dachfenster, nach einem der vorstehenden Ansprüche, wobei die Entfernung von der inneren Hauptfläche (5b) der MIG zum Verkleidungsplattenvorsprung (10e) in der geschlossenen Stellung des Dachfensters in einer Höhenrichtung, die im Wesentlichen senkrecht zu mindestens einer der Hauptflächen der MIG (5b, 5g) verläuft, 5 cm oder weniger beträgt.

9. Dachfenster nach einem der vorstehenden Ansprüche, wobei der Flügel (6) an einem der Rahmenseitenelemente an einem der Flügelseitenelemente gelenkig befestigt ist, um sich um eine Scharnierachse zu drehen.

10. Dachfenster nach Anspruch 9, wobei sich die Scharnierachse in der geschlossenen Stellung des Dachfensters in Höhenrichtung über der äußeren Hauptfläche der MIG befindet, die im Wesentlichen senkrecht zu mindestens einer der Hauptflächen der MIG verläuft.

11. Dachfenster nach Anspruch 9 oder 10, wobei sich die Scharnierachse in der geschlossenen Stellung des Dachfensters in einer Höhenrichtung, die im Wesentlichen senkrecht zu mindestens einer der Hauptflächen der MIG verläuft, über dem Rahmen befindet.

12. Dachfenster nach einem der vorstehenden Ansprüche, wobei der Flügel eine oder mehrere Wärmesperren (75) umfasst.

13. Dachfenster nach einem der vorstehenden Ansprüche, wobei der Flügel (6) Metall, zum Beispiel Stahl oder Aluminium, und/oder ein polymerfaserverstärktes Polymer, PUR, stranggezogene, Glasfaser, Aluminium, Polyester oder ein Verbundmaterial umfasst oder im Wesentlichen daraus besteht.

Revendications

1. Puits de lumière (1) destiné à être installé dans un toit d'un bâtiment, le puits de lumière (1) comprenant :

un cadre de fenêtre (7) comportant quatre éléments latéraux de cadre, lesdits éléments de cadre définissant une ouverture intérieure et chaque élément de cadre comportant un côté intérieur orienté en direction de ladite ouverture intérieure et un côté extérieur orienté dans une direction opposée par rapport au côté intérieur et dans une direction s'éloignant de l'ouverture intérieure, un côté intérieur destiné, dans une position installée, à être orienté en direction d'un intérieur du bâtiment, et un côté extérieur destiné à être orienté dans une direction opposée par rapport au côté intérieur et dans une direction s'éloignant de l'intérieur du bâtiment,
un châssis de fenêtre (6) comportant quatre éléments latéraux de châssis supportant une unité de vitrage isolante (UVI) comportant de multiples couches de vitrage, ledit châssis de fenêtre étant mobile par rapport au cadre de fenêtre entre une position ouverte et une position fermée du puits de lumière,
un dispositif de protection contre les intempéries (3) attaché au châssis de façon à protéger une partie fenêtre (4) du puits de lumière, la partie fenêtre (4) comprenant le châssis, le cadre et l'UVI,
ledit dispositif de protection contre les intempéries étant un dispositif de protection contre les intempéries ne comportant pas d'interstice hermétiquement clos rempli de gaz entre le dispo-

sitif de protection contre les intempéries et l'UVI, et une vitre de protection contre les intempéries (8) étant faite d'un matériau transparent ou translucide,
ladite UVI comportant une surface principale intérieure exposée (5b) destinée à être orientée en direction d'un intérieur dudit bâtiment dans une position fermée du puits de lumière, ladite UVI comportant en outre une surface principale extérieure exposée (5g) orientée à l'opposé en direction de l'extérieur dans ladite position fermée du puits de lumière,
un premier côté périphérique (5a) de l'UVI s'étendant de la surface principale intérieure à la surface principale extérieure de l'UVI,
une direction de hauteur qui est essentiellement perpendiculaire à au moins une des surfaces principales de l'UVI,
un premier des éléments latéraux de cadre (10) étant associé à un premier des éléments latéraux de châssis (14), lesdits premiers élément latéral de cadre (10) et élément latéral de châssis (14) s'étendant dans une direction longitudinale de manière essentiellement parallèle au premier côté périphérique (5a) de l'UVI dans une position fermée dudit puits de lumière,
et une première distance (D), dans la position fermée du puits de lumière, entre le premier côté périphérique de l'UVI (5a) dans une direction allant vers l'extérieur s'éloignant de l'ouverture intérieure du cadre et le côté intérieur du premier élément latéral de cadre étant inférieure ou égale à 20 mm, la direction allant vers l'extérieur étant essentiellement parallèle à au moins une des surfaces principales de l'UVI,
caractérisé en ce que
le premier élément latéral de cadre (10) s'étend plus haut que la surface principale extérieure exposée (5g) de l'UVI dans la direction de hauteur.

2. Puits de lumière selon l'une quelconque des revendications précédentes, dans lequel, dans la position fermée du puits de lumière, le premier côté périphérique (5a) de l'UVI et le côté extérieur du premier élément de cadre sont séparés par une seconde distance dans la direction allant vers l'extérieur, dans lequel ladite première distance est inférieure ou égale à 50 % de la seconde distance (D).

3. Puits de lumière selon l'une quelconque des revendications précédentes, dans lequel ledit premier élément de cadre (10) présente une largeur totale d'élément de cadre, qui est une largeur maximale du premier élément de cadre dans une direction essentiellement parallèle à la surface principale intérieure dans la position fermée de la fenêtre, dans lequel ladite première distance (D) est inférieure ou égale à 50 % de la largeur totale d'élément de cadre.

4. Puits de lumière selon l'une quelconque des revendications précédentes, dans lequel les sections du premier élément latéral de châssis et du premier élément latéral de cadre situées au-dessus de la surface principale intérieure de l'UVI, en regardant dans la direction de hauteur, s'étendent essentiellement dans une direction s'éloignant de l'UVI.

5. Puits de lumière selon l'une quelconque des revendications précédentes, dans lequel, dans la position fermée du puits de lumière, une distance en hauteur maximale, dans la direction de hauteur, entre la surface principale intérieure (5b) de l'UVI et un côté intérieur, en position extrême vers l'intérieur, du premier élément latéral de cadre est inférieure ou égale à 10 cm.

6. Puits de lumière selon l'une quelconque des revendications précédentes, le puits de lumière étant conçu pour être installé dans une structure de toit essentiellement plane présentant une inclinaison comprise entre 0 et 5 degrés par rapport à l'horizontale.

7. Puits de lumière selon l'une quelconque des revendications précédentes, le puits de lumière comprenant en outre une saillie à panneau de garniture (10e), sur une partie intérieure du premier élément latéral de cadre, faisant saillie dans une direction s'éloignant de l'UVI.

8. Puits de lumière selon l'une quelconque des revendications précédentes, dans lequel, dans la position fermée du puits de lumière, la distance entre la surface principale intérieure (5b) de l'UVI et la saillie à panneau de garniture (10e) est inférieure ou égale à 5 cm dans une direction de hauteur, qui est essentiellement perpendiculaire à au moins une des surfaces principales (5b, 5g) de l'UVI.

9. Puits de lumière selon l'une quelconque des revendications précédentes, dans lequel le châssis (6) est articulé sur un des éléments latéraux de cadre sur un des éléments latéraux de châssis pour tourner autour d'un axe d'articulation.

10. Puits de lumière selon la revendication 9, dans lequel, dans la position fermée du puits de lumière, l'axe d'articulation est situé au-dessus, dans une direction de hauteur, de la surface principale extérieure de l'UVI qui est essentiellement perpendiculaire à au moins une des surfaces principales de l'UVI.

11. Puits de lumière selon la revendication 9 ou 10, dans lequel l'axe d'articulation est situé au-dessus du cadre dans une direction de hauteur qui est essentiellement perpendiculaire à au moins une des surfaces

principales de l'UVI dans la position fermée du puits de lumière.

12. Puits de lumière selon l'une quelconque des revendications précédentes, dans lequel le châssis comprend une ou plusieurs barrière (s) thermique(s) (75).

13. Puits de lumière selon l'une quelconque des revendications précédentes, dans lequel le châssis (6) comprend ou est constitué pour l'essentiel de métal, par exemple de l'acier ou de l'aluminium, et/ou de polymère renforcé avec des fibres polymères, PUR, pultrudé, fibre de verre, aluminium, polyester ou composite.

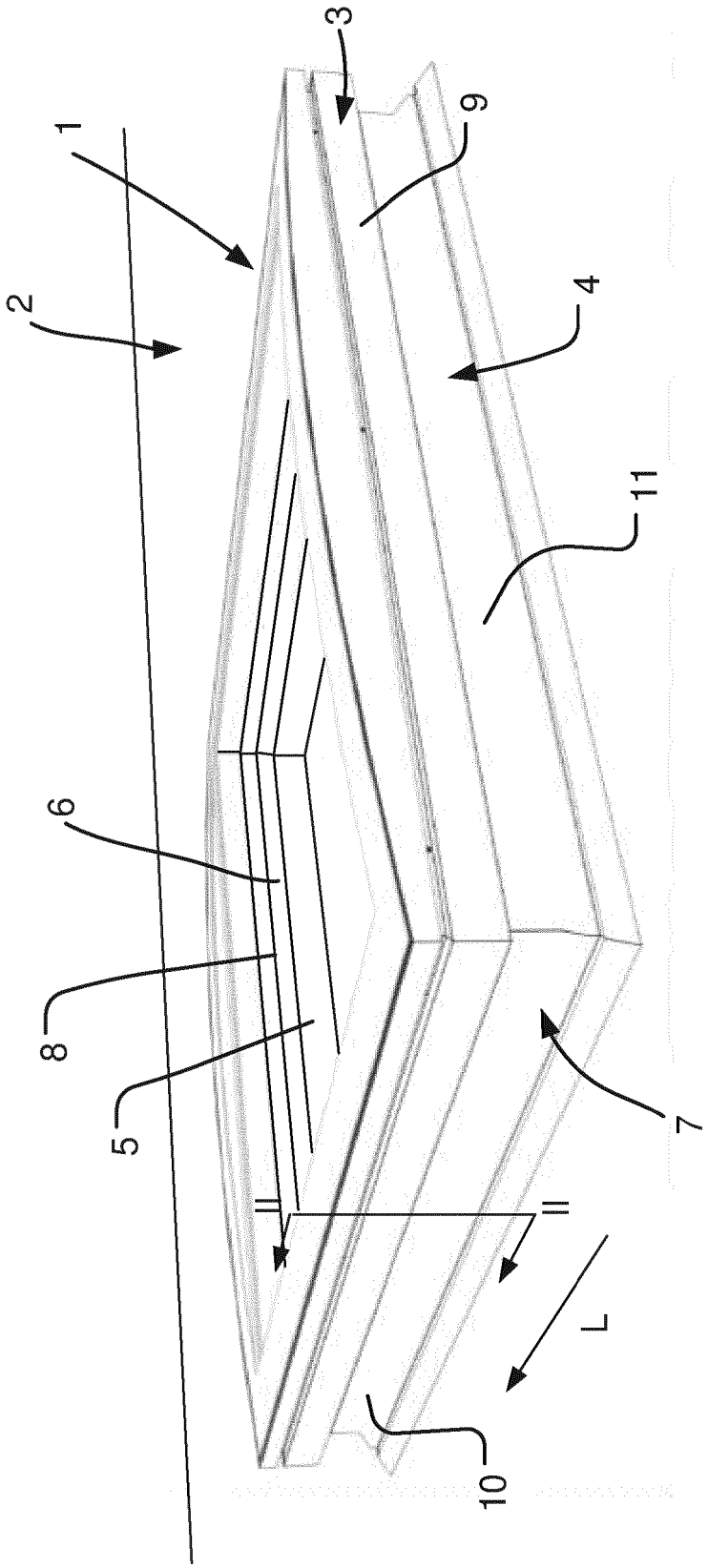

Fig. 1

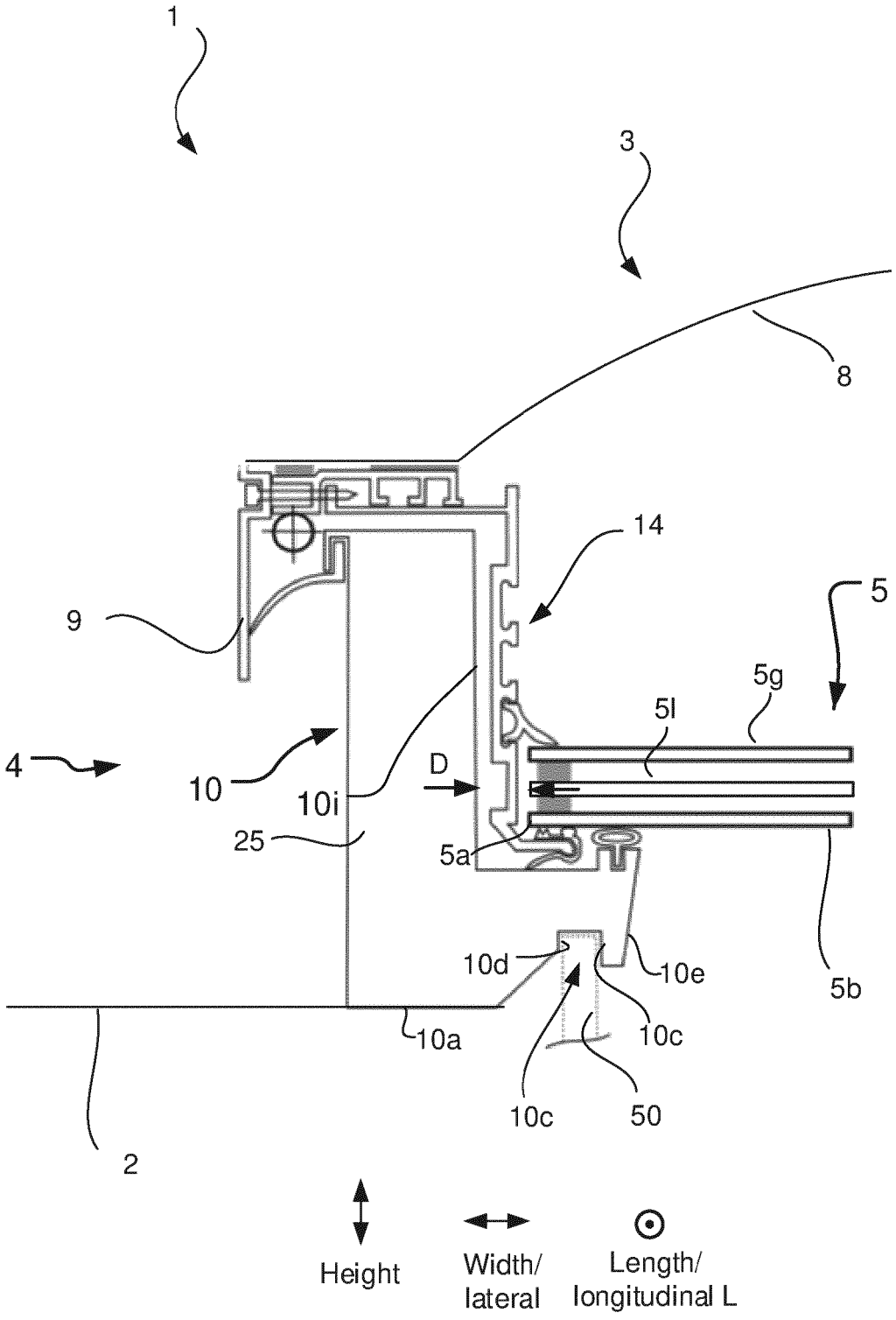
1
3
8
14
5
9
5g
5l
4
10
10i
D
25
5a
10d
10e
5b
10a
10c
10c
50
2
Height
Width/
lateral
Length/
longitudinal L

Fig. 2

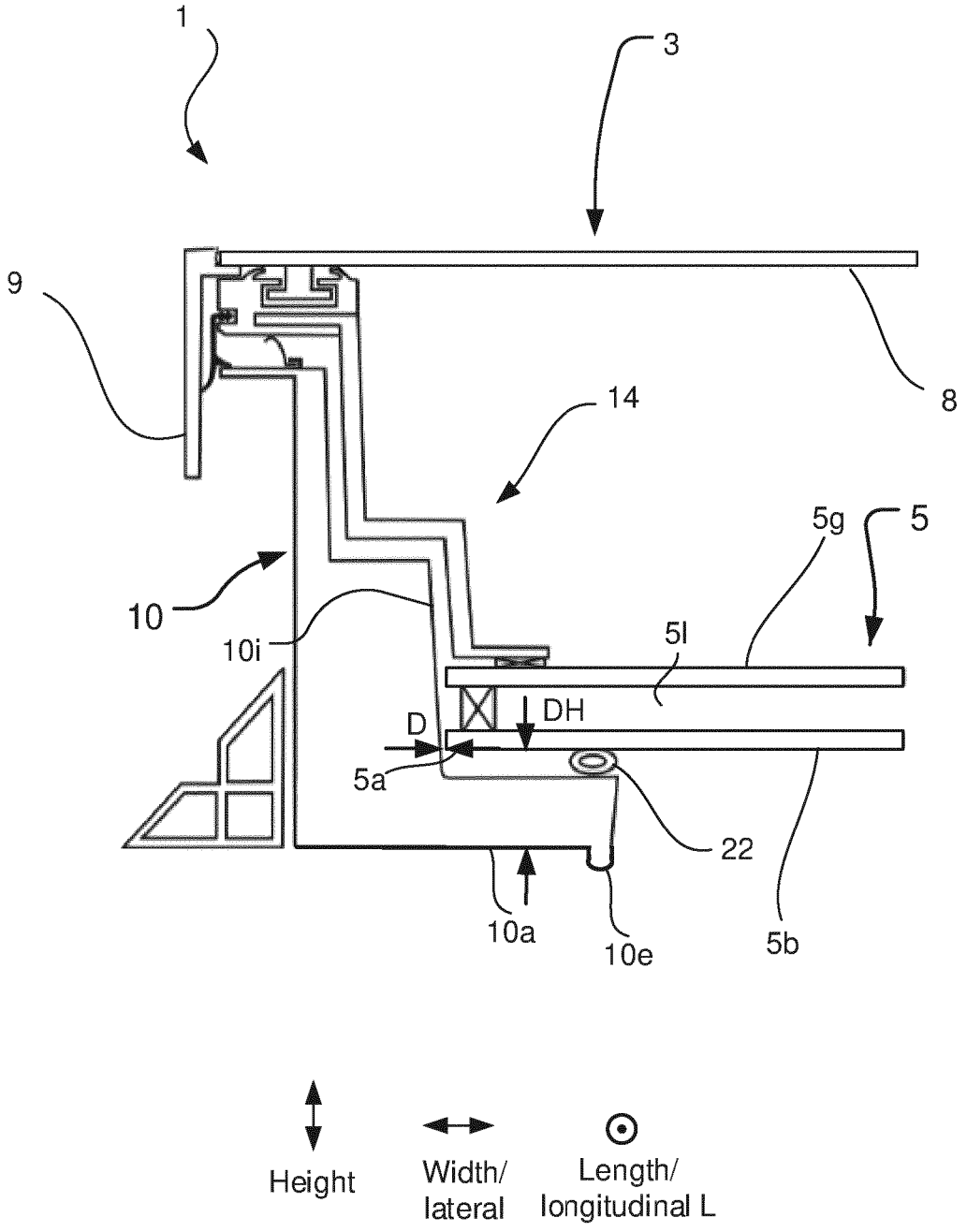
1
3
9
8
14
5g
5
10
10i
5l
DH
D
5a
22
10a
10e
5b
Height
Width/
lateral
Length/
longitudinal L

Fig. 3

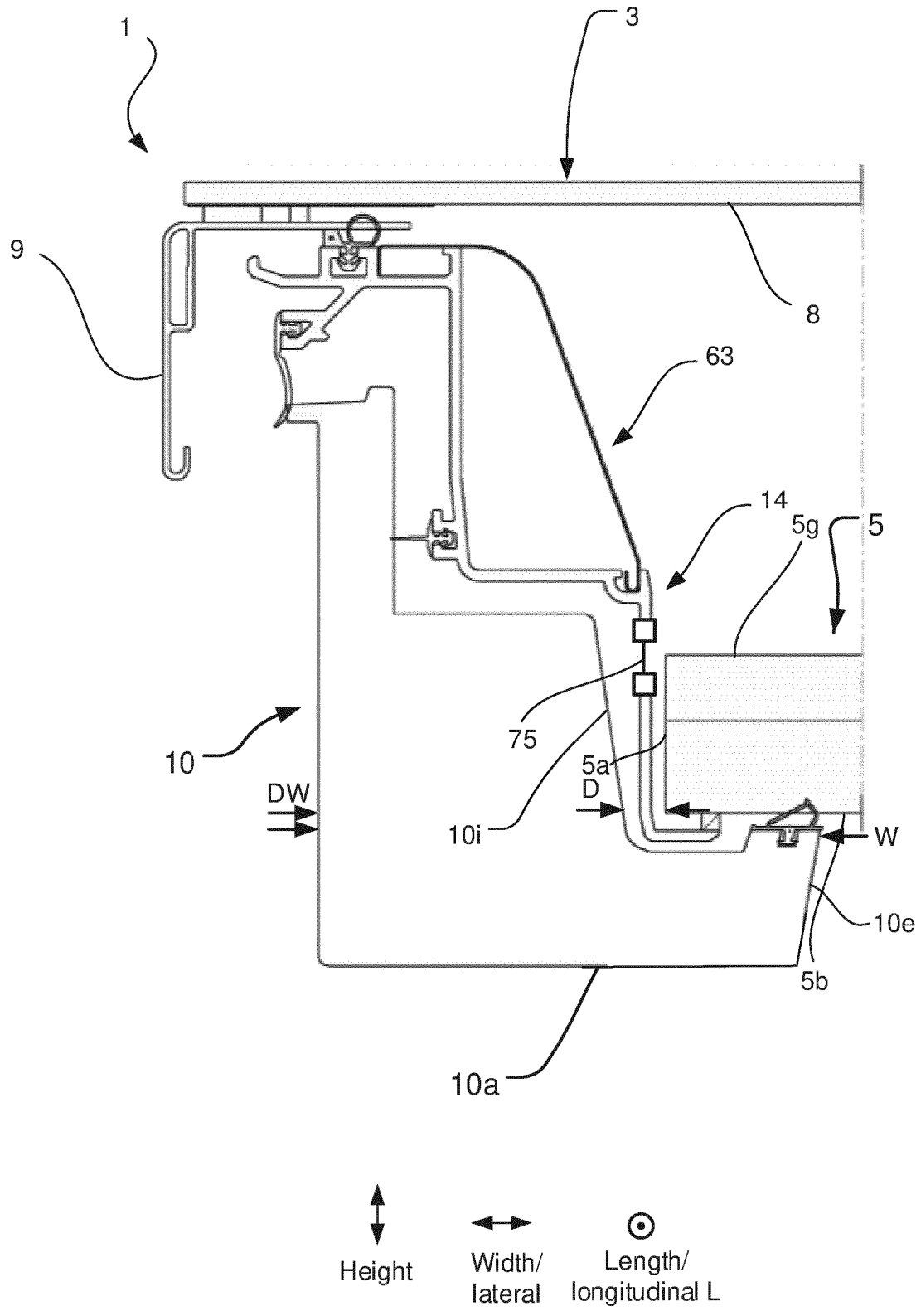
1
3
9
8
63
14
5g
5
75
10
5a
D
DW
10i
W
10e
5b
10a
Height
Width/
lateral
Length/
longitudinal L

Fig. 4

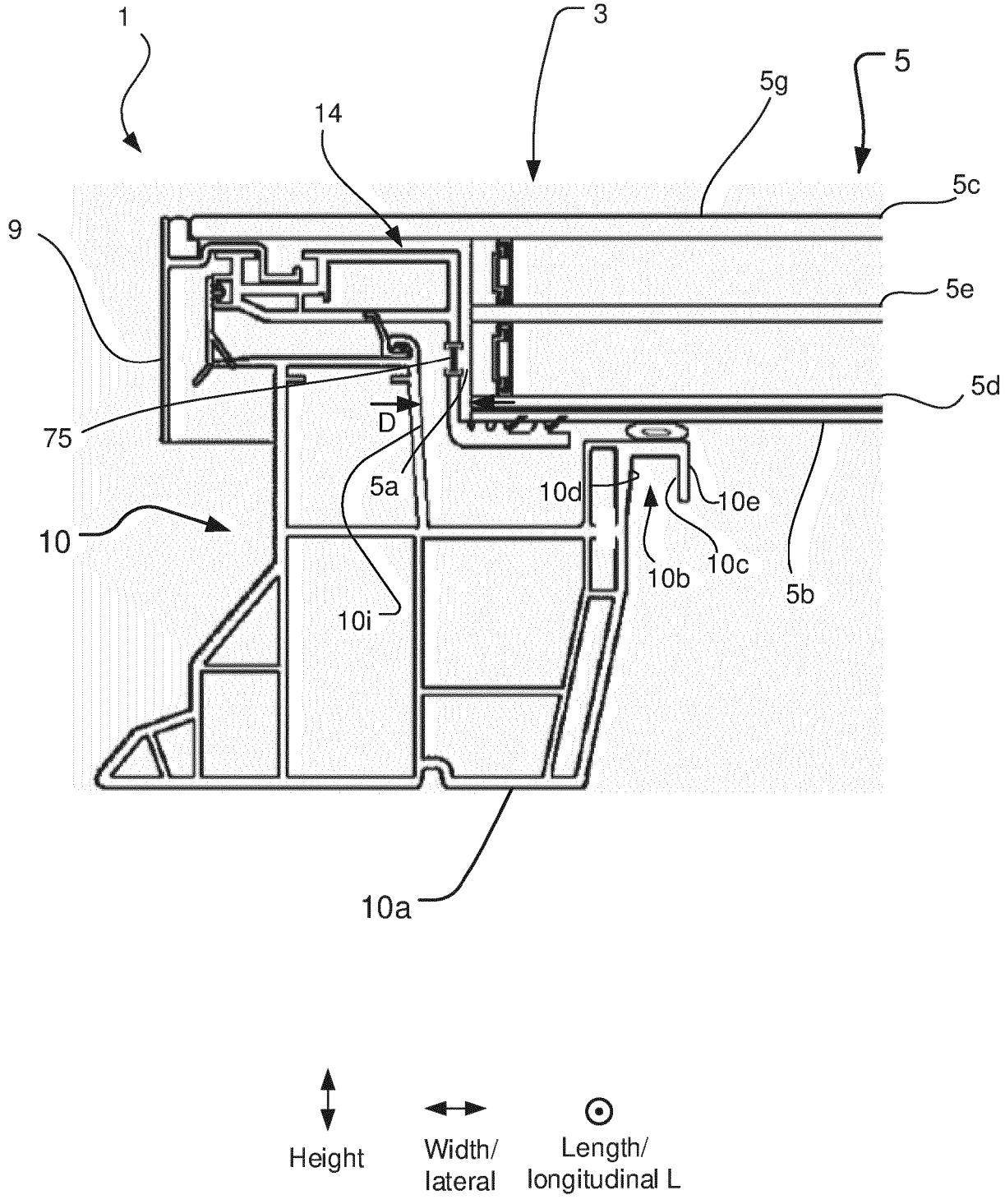
1
3
5
5g
14
5c
9
5e
5d
75
D
5a
10d
10e
10
10b
10c
5b
10i
10a
Height
Width/
lateral
Length/
longitudinal L

Fig. 5

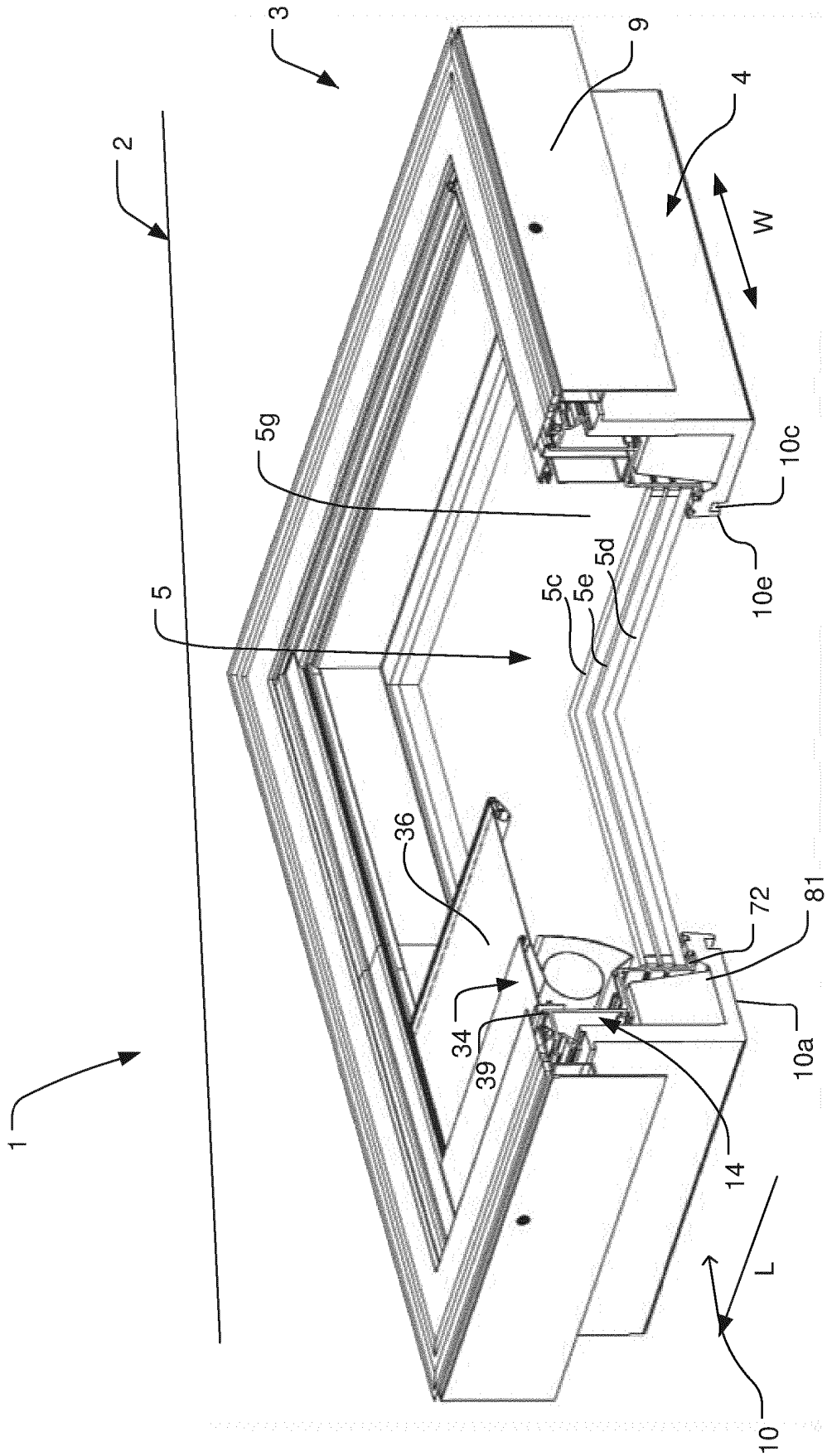

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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