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(54) **A SKYLIGHT WINDOW FOR BEING INSTALLED IN A ROOF OF A BUILDING**

(57) A skylight window with frame side members supporting an IGU wherein said first frame side member comprises a load-carrying structure for carrying at least part of the IGU, wherein the skylight window further comprises a first insulation member comprising an insulation material and extending in the longitudinal direction along the first frame side member, and wherein said first insulation member is provided separately from said first frame side member and between said external surface of said load-carrying structure and the side surface of the interior pane.

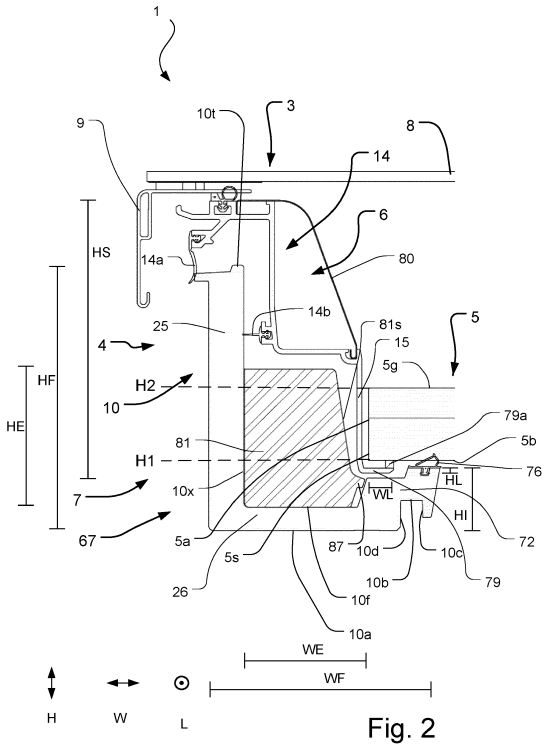

Fig. 2

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Description

[0001] The present invention relates to a skylight window configured for being installed in or on a roof of a building, wherein the skylight window comprises: a window frame having four frame side members, the frame side members extending along an IGU having multiple transparent layers of glazing and at least one spacing comprising an inert gas fill, such as argon or krypton, or vacuum, a weather shield configured to protect a window portion of the skylight window, the window portion comprising the frame and the IGU, said IGU having an exposed interior major surface for facing an interior of said building the interior pane comprising a side surface extending substantially along the first frame side member, said IGU further having an exterior major surface facing towards an exterior of the skylight window, wherein a first of the frame side members has a frame height extending in a height direction, the height direction being substantially perpendicular to at least one of the major surfaces of the IGU, the first of the frame side members extending in a longitudinal direction along the side surface of the interior pane, wherein said first frame side member comprises a load-carrying structure for carrying at least part of the IGU, said load-carrying structure having an external surface facing the side surface of the interior pane, wherein the skylight window further comprises a first insulation member comprising an insulation material and extending in the longitudinal direction along the first frame side members.

[0002] In general, skylight windows of the prior art may be associated with relatively poor insulating properties and/or limited entry of light into an interior of the building on which the skylight window is installed, limited visibility through the window from the interior of the building, as well as limited compatibility with different roof angles. This may be attributed to the way in which skylight windows are installed on a roof structure of a building which generally results in a larger proportion of the window portion structure being exposed to the surrounding environment, thus allowing for greater thermal losses. Furthermore, with a weather shield attached to the top of the skylight, there are more layers of glazing which may result in a long travel path for light entering through the skylight window into the interior of the building.

[0003] Extensive literature can be found on thermal insulation members installed on skylight windows to minimize the thermal losses, such as EP 2 947 253 A1. Polyurethane (PUR) is a commonly used material preferred for its weather resistance, insulation, mouldability etc. However, it may be difficult to reach low values of thermal losses using PUR to meet the strict requirements set by newer building regulations. Expanded polystyrene (EPS) is also used in skylight windows providing higher insulation, such as in EP 3 415 705 A1, where a core member made of EPS is used in the frame structure, the EPS having high density to provide stiffness and strength. However, there is a continuing challenge of creating solutions that improve the insulation properties of a skylight window in a cost-effective and easily installed manner.

[0004] On this background, it may be seen as an object of the present invention to provide a skylight window according to the introduction in which the insulation properties are improved. A further object of the invention may be to provide a skylight window that is easy to install or replace and/or is or is more burglar-proof.

[0005] It may also be seen as an object of the invention to provide a skylight window by which it is possible to improve its insulating properties without compromising other parameters such as functionality, installation, use, replacement, and/or safety.

[0006] These and further objects may be achieved with a skylight window of the kind mentioned in the introduction which is characterised in that the first insulation member is provided separately from the first frame side member and between the external surface of the load-carrying structure and the side surface of the interior pane or, if the skylight window is openable, positioned between the external surface and the side surface of the interior pane in the closed position of the skylight window.

[0007] One advantage that may be gained by the skylight window according to the invention is providing a skylight window that with lower thermal losses at the periphery of the IGU, thus improving the overall heat transfer coefficient of the skylight window. In addition, the first insulation member being provided separately from the first frame side member may allow for the window to be customized according to a user's needs and/or to be easily replaced. Furthermore, the insulation member being provided separately may make it easier to replace the IGU. The insulation member may also allow for a burglar-proof solution, as the insulation member may be fragile, rendering the insulation member unsuitable to be gripped by a tool such as a crowbar. Forces applied to the insulation member by a burglar to displace the skylight window may shatter the insulation member, leaving the burglar unable to displace the window.

[0008] The insulation material may be a material which has a lower thermal conductivity compared to its environment, whereby the insulation material reduces heat transfer between the surroundings of the insulation material. The provision of the insulation member comprising insulation material may thus significantly or substantially reduce heat transfer through the skylight window to or from the environment of the skylight window.

[0009] An insulation material which may be suitable may have a thermal conductivity which is less than 0.2 W/(m*K), preferably less than less than 0.1 W/(m*K), more preferably less than 0.05 W/(m*K). Alternatively, or additionally the insulation material may have a thermal conductivity in the in the range of 0.01 to 0.05 W/(m*K), such as 0.03 to 0.04 W/(m*K).

[0010] Typical insulation materials used in building construction and/or roof/skylight windows are fiberglass, mineral wool, cellulose, natural fibres, foamed or expanded plastic polymers, polystyrene, such as expanded pol-

ystyrene (EPS), polyisocyanurate, polyurethane, vermiculite and perlite, urea-formaldehyde foam, cementitious foam and phenolic foam.

[0011] The insulation material of the insulation member may be covered at least partly by an insulation facing, where the facing may act as a vapour- barrier.

[0012] The terms "insulation", "insulating", "insulation properties", and/or "insulating properties" are to be understood in the sense of thermal insulation and thermal insulation properties and thermally insulating and insulating properties. However, other insulation may also be provided such as, for example, acoustic insulation.

[0013] The load-carrying structure of the first frame side member is the structure of the first frame side member which structurally supports at least part of the IGU or, if the skylight window is openable, structurally supports at least part of both the sash and the IGU. By the term "structurally support" is meant that the load-carrying structure bears/carries a weight, such as part of the weight of the IGU or part of the IGU and the sash, without yielding to the weight.

[0014] The load-carrying structure of the first frame side member may carry at least the part of the IGU associated with the first frame side member, or, if openable, at least the part of the IGU and the sash associated with the first frame side member.

[0015] The load-carrying structure of the first frame side member may carry at least 20 %, 25 %, 40 % or 50 % of the weight of the IGU, or, if openable carry at least 20 %, 25%, 40 % or 50 % of the weight the IGU and the sash.

[0016] One, two or three of the other frame side members may comprise load-carrying structures similar to the load-carrying structure of the first frame side member, whereby the load-carrying structures of the frame side members may collectively carry at least 80, 90, 95 or 99 % of the weight of the IGU or, if the skylight window is openable, 80, 90, 95 or 99 % of the weight of the IGU and the sash. The load-carrying structures of the frame side members may collectively carry the weight of the IGU or, if the skylight window is openable, the weight of the IGU and the sash.

[0017] In a non-openable skylight window, the IGU may engage and be supported by part of the first frame side member, a structural load of the IGU being applied to first frame side member, whereby the first frame side member is the load-carrying structure. There may be provided intermediate elements, such as sealings, between the IGU and the first frame side member, in which case the load-carrying structure of the first frame side member carries weight of the intermediate elements and part of the IGU.

[0018] In an openable skylight window, a first sash side member may engage and be supported by the first frame side member and the IGU may engage and be supported by the first sash side member. The first sash side member may be engaged to the first frame side member by a hinge connecting the first sash side member to the first frame side member. In such a case, a structural load of the IGU is applied to the first sash side member and transferred to the first side member along with a structural load of the first sash side member, in which case the load-carrying structure carries the structural load of the IGU and the sash. Hinges may be linear displacement mechanisms or multi-link mechanisms. The skylight window may be hinged to open in the exterior direction i.e. away from the interior of the building.

[0019] The load carrying structure may be a rigid load-carrying structure, such as a metal, plastic or wooden structure. The load carrying structure may substantially comprise a dimensionally stable material.

[0020] The load-carrying structure may carry at least part of the IGU or, if the skylight window is openable, carry at least part of the IGU and the sash, such the IGU and sash, if any, is held or supported in the skylight window.

[0021] The load-carrying structure of the first frame side member may additionally carry at least part of the weather shield.

[0022] The insulation member may be non-load-carrying, and may not, potentially may not substantially, carry a load of or structurally support the skylight window and/or the IGU, except potentially its own load. Alternatively, the insulation member may partly carry a load of the skylight window and/or the IGU, such as less than 50 %, 60 %, 70 %, 80 %, 90%, 95 % or 99 % of a load of the skylight window and/or the IGU.

[0023] The insulation member may include a non-load-carrying covering member or cover, which may be of a non-insulation material and/or may be more rigid than the insulation material, and/or which may cover at least part of an exposed external surface of the insulation material. The cover may include several parts, and/or the insulation material may be at partly encased by the cover. The cover may cover all or parts of an external surface of the insulation member not covered by the first frame side member. Such a cover is not part of the load-carrying structure of the first frame side member and, as such, does not carry any substantial part of a load of the IGU or, if the skylight window is openable, does not carry any substantial part of both the sash and the IGU, potentially in the closed position of the skylight window. The cover may abut and/or be attached to the external surface of the load-carrying structure.

[0024] The term "provided separately from" may involve that the insulation member is discrete and not provided within, such as within a spacing of, the load-carrying structure of the first frame side member. This term does not exclude that the insulation member is attached to and/or abuts the first frame side member or the load-carrying structure thereof. The term "provided separately from" may also involve that the insulation member is detachable or detached from the frame and/or attachable or attached to the frame. The term "provided separately from" may also involve that the insulation member is not integrated or embedded with the load-carrying structure

of the first frame side member. The insulation member may further potentially be mechanically detachable and attachable without causing substantial damage to the skylight window or the insulation member itself.

[0025] The separate provision of the insulation member may allow for a faster and easier manufacturing and assembly, requiring less space compared to conventional hollow profiles that need to be filled up. Furthermore, the separate insulation member may enable the use of the same frame side member for both openable and non-openable windows, by simply changing the insulation members and adding a window sash in the case of an openable window, thus providing a flexible and versatile solution.

[0026] The load-carrying structure may include a box structure or hollow structure or frame structure including load-carrying external plates (which may be connected to each other or be integrally formed) surrounding or enclosing one or more internal spacings, wherein further insulation members may be provided inside the spacings.

[0027] The frame and/or potential sash and/or load-carrying structure may have a general hollow core structure with one or more hollows inside spacings or cavities surrounded by thin layers or plates of material, such as plastic or PVC, specifically fiber-reinforced PVC, which plates may extend in the longitudinal direction and may be connected to each other at corners thereof such as to form a shell structure surrounding the spacings. In a first frame side member having a hollow structure, the load carrying structure of the first frame side member constitutes the shell structure. One or more spacings may comprise a filler and/or an insulating and/or stiffening material or member, which may for example comprise or consist of wood and/or a foamed polymer material. The plates of material may be extruded, and may optionally be extruded as one or more separate elements for each frame or potential sash side member, which are subsequently attached to each other, and a filler material potentially being positioned in the core spacings afterwards. As an alternative, the surrounding material may be moulded around a core of filler material. These structures may provide good strength and insulation properties and may be low-cost in manufacture. Alternatively, the surrounding material or plates may comprise or substantially consist of metal, such as steel and/or aluminium.

[0028] Generally, one or more of the frame and/or potential 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 glassfibre reinforced PUR, and/or wood and/or metal such as aluminum or composites or combinations thereof.

[0029] One or more further insulation members may similarly extend along one or two or all of the other three side frame members, potentially in a manner similar to the insulation member at the first frame side member.

[0030] In an embodiment, the skylight window is non-openable and has only one closed position.

[0031] The term IGU is an abbreviation of "Insulating Glazing Unit" and is a concept well-known to the skilled person.

[0032] The IGU may have multiple layers of glass or glazing, which layers may define a potentially sealed volume or spacing between them, the spacing potentially comprising an inert gas, an aerogel, or a vacuum. The IGU may in a conventional manner comprise one, two, three or more layers of glazing, i.e. layers of glass, polycarbonate or the like, or glass panels, which may be 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 properties of the IGU. One or more of the layers of glazing may have a low emissivity coating or coating stack. One or more of the layers of glazing may be laminated e.g. the interior layer of glazing. One or more of the layers of glazing may be tempered. Similarly, the weather shield as a whole may be tempered. The IGU may be see-through transparent to provide a view out. The exposed interior major surface of the IGU may be a lower major surface of a lowermost of the layers of glazing. Sealing and/or supporting members or spacers may be provided at one or more of four peripheral sides of the IGU between the layers of glazing and may form a so-called spacer frame. The sealing and/or supporting members may distance adjacent layers of glazing from each other and may together with lateral edges of the layers of glazing form respective side or lateral surfaces of the IGU. These side surfaces may be substantially plane and/or extend substantially in the height direction as defined herein.

[0033] The sash may be made movable in relation to the window frame by the sash being outwardly hung, i.e. being rotatable about an axis extending along one of the sash side members. Generally, by "outwardly hung" it is to be understood that the sash moves outwards from the frame during opening. The sash being outwardly hung may be achieved by using a rotary hinge positioned at a sash side member and connecting this sash side member with an associated, adjacent 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.

[0034] The exposed interior major surface of the IGU may be a lower surface of the IGU and/or may face in a downwards direction towards an interior of the building in an installed position of the skylight window. The exposed interior major surface may face in a direction away from the weather shield.

[0035] The IGU comprises an exposed exterior major surface positioned oppositely from the exposed interior major surface and facing towards the outside, in an in-

stalled position of the skylight window. The exterior major surface may be substantially parallel with and/or may have substantially the same or the same shape and size as the interior major surface of the IGU. A distance between the two major surfaces defines a thickness of the IGU, which distance may be measured in the height direction.

[0036] The IGU may have a rectangular shape and may have further second to fourth peripheral sides that each extends linearly along, potentially along a substantially total extent of, a corresponding respective sash member. The peripheral sides may define a shape of the IGU.

[0037] 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, which may allow the sash to be embedded within the frame in the closed position of the skylight window.

[0038] The interior pane may be an interior one of the layers of glazing of the IGU.

[0039] Especially if the skylight window is openable, an external surface of the first insulation member facing the IGU may be inclined or stepped in relation to the height direction so that a lower portion of the insulation member is wider than an upper portion of the insulation member. Especially if the skylight window is non-openable, and, potentially substantially an entire, external surface of the first insulation member facing the IGU may extend substantially in the height direction.

[0040] One or more gaskets or sealing members may be provided between the external surface of the insulation member facing the IGU and the IGU.

[0041] In another embodiment, the skylight window further comprises the weather shield attached to the frame or, if the skylight window is openable, to the window sash so as to protect a window portion of the skylight window, the window portion comprising the frame, IGU and, if the skylight window is openable, the window sash.

[0042] The weather shield may be dome-shaped. In an openable skylight window and during an opening movement, the weather shield may typically follow the movement of the sash. The main purpose of the dome or weather shield is to protect the sash and frame from the weather and to avoid accumulation of precipitation and dirt on the IGU.

[0043] The weather shield may be provided as a unitary structure, which is detachably attached to the to the potential sash. The weather shield may be attached detachably to the potential sash, providing for access to clean the IGU; this may also be of advantage during mounting 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.

[0044] The weather shield is mounted on the window portion to protect it from the elements and preventing rain and other downfall from entering into gaps or slots in the roof or the window portion.

[0045] The weather shield may comprise a weather shield pane that may be surrounded by a weather shield skirt that may extend on an outer side of 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 of the weather shield pane. Alternatively or additionally, the weather shield pane may be a transparent window pane that may be of glass or hardened glass. The weather shield pane may comprise only one single layer of glazing. The weather shield may be understood as a transparent cover member, preferably a dome of glass or a clear polymer.

[0046] In alternative embodiments, the weather shield is replaced by a flat window pane, which may be positioned to be substantially parallel to the window portion.

[0047] The weather shield pane may extend further than the IGU at one peripheral side of the weather shield defined by an outer edge and/or the circumference of the weather shield. The weather shield pane may extend further than the IGU at both peripheral sides (in the width direction) or all peripheral sides of the weather shield defined by the outer edges of the circumference, such that a major part of the first frame side member is covered by the weather shield pane. By a major part of the first frame side member, it is meant that the first frame side member may be entirely covered or at least 80%, 90% or 95% of the width of the first frame side member is covered by the weather shield pane.

[0048] In an embodiment, the first frame side member may be substantially L-shaped. The first frame side member may have a first leg, the first leg extending in the height direction, and the second leg, the second leg extending from a lower portion of the first leg in a width direction toward the IGU.

[0049] The distance between an end of the IGU, as defined by a side surface of the IGU, and a corresponding peripheral side of the weather shield pane arranged at the same side of the roof window, may be equal to or exceed the width of the second leg of the first frame side member. The distance between an end of the IGU and the corresponding peripheral side of the weather shield pane may be 4 times or more larger than the width of the first leg of the frame side member.

[0050] The weather shield may cover the entire window portion comprising the IGU and the window frame, such that no part of the IGU and/or window frame extends further than the weather shield in the width direction.

[0051] In an embodiment of an openable skylight window, the sash side members are connected to the exterior major surface of the IGU and extending away from the interior major surface of the IGU, i.e. not extending below the exterior major surface of the IGU in the mount-

ed state. In this way the IGU may be positioned as deep as possible in relation to the roof structure, thereby potentially improving the insulating properties of the window.

[0052] The first sash side member may have a first leg connected to a supporting section of the first sash side member supporting the IGU, the first leg extending in said longitudinal direction and extending substantially in a height direction substantially perpendicularly to at least one of said major surfaces of the IGU.

[0053] The sash side member may further comprise a second leg and possibly further legs in order to allow a more complex structure. The second and/or possible further legs may also be substantially plate-shaped.

[0054] In an embodiment, the legs form a stepped profile, when the cross-section perpendicular to the longitudinal direction. An upper surface of the second leg may be denoted a step surface. A step profile may be achieved by making the sash side member with two, three or more legs where each leg is substantially perpendicular to an immediately preceding leg and/or an immediately following leg.

[0055] A stepped configuration of adjacent surfaces of the first sash and frame side members may thus be achieved by means of the stepped profile of the first sash side member as described and an associated stepped profile of the first frame side member according to the present embodiment. This stepped configuration may provide a labyrinth like structure of a potential between the sash and frame side member resulting in a less direct path for air, precipitation or dirt to pass between the interior and exterior of the building. The stepped profile also provides the possibility of placing sealing elements along the profile such that sealing is facilitated between two parallel surfaces, i.e. a surface of the frame side member and a parallel sash side member. The sealing between the stepped profile of the sash and frame side member may further be aided by the load transfer of the load exerted by the IGU through the sash. Furthermore, insulating sealing members may conveniently be positioned between the first sash and frame side members at respective corners of the stepped configurations, e.g. as described in the above. Hereby, insulating and sealing properties of the skylight window may be further increased.

[0056] Such a step may also be used for supporting a screening device, such as a roller blind, or a chain actuator.

[0057] In one embodiment, the first sash side member may extend from an interior glazing plane defined by the exposed interior major surface of the IGU towards the exterior of the building or may extend substantially above the interior glazing plane, such that only a small part of the first sash side member extends below the interior glazing plane. In other words, a major or an entire part of the first sash side member extends above the interior glazing plane when seen in the height direction, extending towards the exterior and/or the weather shield. In one embodiment, the part of the first sash side member extending below the interior glazing plane in the height direction is up to 10% of the total height of the sash side member in the height direction. Thus, in this embodiment, the window sash extending below the interior glazing plane does not exceed 10% in the height direction of the total height of the window sash.

[0058] In a preferred embodiment of an openable skylight window, the first sash side member may comprise a supporting leg being positioned below the interior major surface of the IGU. The supporting leg may carry at least part of the weight of the IGU. In one embodiment, the height of the supporting leg constitutes up to 10%, preferably 8%, of the total height of the first sash side member in the height direction. No other leg of the window sash can be extending below the interior glazing plane.

[0059] In an embodiment, an interior glazing plane H1 is defined by the exposed interior major surface or, if the skylight window is openable, is defined by the interior major surface in the closed position of the skylight window. An exterior glazing plane H2 is defined by the exterior major surface or, if the skylight window is openable, is defined by the exterior major surface in the closed position of the skylight window. The first insulation member may in the height direction extend at least from the interior glazing plane H1 to the exterior glazing plane H2 or, if the skylight window is openable, extend at least from the interior glazing plane H1 to the exterior glazing plane H2 in the closed position of the skylight window.

[0060] The first insulation member may in the height direction extend from a position lower than the interior glazing plane H1 to a position higher than the exterior glazing plane H2 or, if the skylight window is openable, extend from a position lower than the interior glazing plane H1 to a position higher than the exterior glazing plane H2 in the closed position of the skylight window.

[0061] The first insulation member may be at least 20, 30, 40, 50, or 60 mm high. The first insulation member may extend at least 20, 30, 40, 50, 60, 70, 80, 90% of the frame height of the first frame side member in the height direction. The first insulation member may extend at at least 100, 200, 300, 400% of the height of the IGU, defined as the distance between the interior and exterior major surfaces of the IGU.

[0062] In an embodiment, the first insulation member in the height direction extends below the interior glazing plane H1 or, if the skylight window is openable, extends below the interior glazing plane H1 in the closed position of the skylight window.

[0063] Alternatively or additionally, the first insulation member may extend above the exterior glazing plane H2 in the height direction.

[0064] In an embodiment, a width direction extends perpendicularly to the longitudinal direction and to the height direction, a width in the width direction of the insulation member being equal to or larger than the height of the IGU.

[0065] The first insulation member may be at least 20,

30, 40, 50, 60, 70 or 80 mm wide. The width of the first insulation member may be 10, 20, 30, 40, 50, 60, 70, 80, 90, 100% or more than 100% larger than the height of the IGU.

[0066] Alternatively or additionally, the width of the insulation member may be at least 10, 20, 30, 40, 50, 60 or 70 % of a width of the first frame side member.

[0067] In a preferred embodiment, the insulation member is 7 cm wide.

[0068] The first insulation member may have a substantially rectangular cross section or cross-sectional profile.

[0069] The sash, if any, may comprise a sealing or gasket element positioned above the insulation member in the height direction to reduce thermal losses and/or avoid the creation of thermal bridges in the sash and/or frame. The sealing element may extend longitudinally and may extend to the insulation member, potentially an upper surface thereof, in the closed position of the window.

[0070] In an embodiment, no part of the load-carrying structure of the first frame side member is positioned above the insulation member in the height direction.

[0071] In an embodiment, a surface of the first insulation member is attached to a surface of the first frame side member. This surface of the first insulation member may be a lower surface of the first insulation member and may be attached to an exterior surface of the first frame side member, the exterior surface potentially facing upwardly in a height direction. This surface or another surface of the insulation member, in particular a side surface of the insulation member, may be attached to the external surface of the load-carrying structure.

[0072] The first insulation member may generally be attached to the first frame side member by an adhesive, glue, double sided tape(s), nail(s), screw(s), one or more brackets, and/or or by means of one or more recesses and potentially associated projections.

[0073] In an embodiment, the insulation material comprises or substantially consists of expanded polymer such as polystyrene. Expanded polysterene or EPS is commonly used in buildings and construction due to its strength, durability, thermal insulation properties, and light weight. The EPS may be a closed cell material and may not readily absorb water. Even when subjected to prolonged saturation in water, the EPS may still maintain its shape, size, structure, and physical appearance and may retain a high proportion of its thermal value.

[0074] The thermal conductivity of the EPS may be between 0.01 and 0.1, 0.02 and 0.6, or 0.03 and 0.04 W/m.K.

[0075] The insulation material may have a density less than 200, 175, 150, 125, 100, 75, 50, 25, 20, or 15 kg/m^3. The density of the insulation material may be in a range of approximately 10 to 100 kg/m^3, 10 to 50 kg/m^3, 10 to 40 kg/m^3, 20 to 40 kg/m^3 or 15 to 30 kg/m^3.

[0076] The insulation material may comprise fiberglass, mineral wool, cellulose, natural fibers, wood fibers, an expanded polymer, polystyrene, such as EPS, polyisocyanurate, polyurethane, vermiculite and perlite, urea-formaldehyde foam, cementitious foam, and/or phenolic foam.

[0077] In an embodiment, the first insulation member is at least partly encased in a cover, the cover at least covering parts of surfaces of the insulation member facing away from the first frame side member and/or not covered by the first frame side member, wherein the cover is not part of the load-carrying structure of the first frame side member.

[0078] The cover may be located above and/or adjacent to the first insulation member. The cover may be a plate, which may be bent, or may comprise several plates. It may be light-reflective or heat-shielding such that it protects the insulation member from UV radiation and/or heat. The cover may comprise metal and/or plastic.

[0079] One or more external surfaces of the insulation member may include one or more gripping openings or projections, such as recesses, cut-outs, grooves or the like.

[0080] The cover may attach the first insulation member to the first frame side member or to the weather shield, wherein potentially the insulation member may not be attached to the first frame side member by any other means.

[0081] In an embodiment, the first insulation member may comprise a recess on a side surface of the insulation member facing towards the side surface of the IGU, wherein the cover may be attached to the recess. The recess may be in the form of a cut-out, a slot, a step surface having a reduced material thickness in the lower part of the insulation member compared to its upper part and/or a groove.

[0082] The first insulation member may further comprise a recess or a groove in a top corner and/or bottom corner of the member, facing towards the frame. The recess may form an inclined or oblique surface and/or a step surface. The inclined surface at the top corner of the insulation member facing the frame may allow a better corner connection with an adjacent insulation member. The recess or step surface located at or in close proximity with the top corner of the insulation member is intended to form a protrusion that enables the safe attachment of a cover to the insulation member.

[0083] The insulation member may have further recesses in all sides of it enabling the attachment of other elements, such as electric wiring and/or sealing elements. The recesses may also enable the engagement of different insulation members with each other.

[0084] The first insulation member may further comprise a recess on a top surface of the insulation member facing toward the weather shield. The recess may be positioned substantially in the middle of the top surface of the first insulation member in the width direction. The recess may allow for attachment of corner key elements such that two adjacent insulation members are joined at a corner of the window forming an angle. The corner keys

may be attached to respective insulation members or other adjoining members in hollows thereof. The corner keys may be made substantially of a rigid and hard material, such as metals like aluminium or steel, or wood. The corner keys act to prevent insulation members from moving out of alignment with interconnected insulation members respectively.

[0085] The adjoining insulation members may engage with each other, by abutting on each other, such that a tight connection is achieved. In a preferred embodiment, the angle formed by main axes of two adjoining insulation members extending in the longitudinal direction is substantially 90 degrees in a rectangular or square window frame.

[0086] Two or more insulation members may be connected or adjoined at the respective corners by a tongue and groove connection or other means of connection, such as a snap-on connection, corner brackets etc. The connection at the respective corners of the adjoining insulation members may allow for a tighter and more robust connection and thus result in lower thermal losses at the corners than the ones that would occur if they were arranged loosely abutting each other, resulting in an overall better insulation performance of the window. Similarly, the frame side members and their covers are configured to be safely and tightly connected with the adjoining members at the corners of the window. Hence, a compact solution may be achieved due to the better corner connection of the different elements.

[0087] At least two insulation members, a first and a second insulation member, may be covered or encased or protected by two covers, a first and a second cover, wherein each cover may comprise a tongue and a groove configuration at the ends of the cover defined in the longitudinal direction, such that a tongue of a first cover may be brought into engagement with a groove of a second cover, wherein the first and second covers are adjacent to each other.

[0088] The insulation member may be further covered by different covering members comprising a snap-on configuration to allow easy connection with other elements.

[0089] The cover of the insulation member may comprise a first leg extending in the width direction such that it covers the top surface of the insulation member. The cover may also comprise a second leg extending in the height direction, attached to the first leg such that it is configured to be attached to a recess of the insulation member located on the side surface of the insulation member. The two legs may be integrally formed and may together form a continuous curved surface of the cover. Alternatively, the two legs may be formed by a plate bent such that two inclined surfaces are created. Preferably, the two surfaces may be perpendicular to each other such that a right angle is formed between the two surfaces. At an outer part of the intersection of the two legs or surfaces of the cover, a recess may be comprised to allow for attachment of a sash covering leg.

[0090] In an embodiment, the first insulation member may comprise an adhesion-promoting surface covering or coating promoting adhesion to the first frame side member. This may allow for a more tight and safe connection of the insulation member to the frame.

[0091] In an embodiment, the IGU may further comprise a cover profile or a mask, which may be provided on the exterior major surface of the IGU substantially covering the periphery of the IGU. The mask may be integrated with the cover of the insulation member, in continuation of the cover of the insulation member, or provided separately such that it projects over the IGU. The mask may comprise enamel. Alternatively, the exterior major surface of the IGU may be covered by a cover of the insulation member.

[0092] In an embodiment, the skylight window may further comprise a screening device including a screening body, the screening body being moveable between a first, non-screening end position in which it may be in a collapsed, such as a rolled-up, pleated or folded, state at the first frame side member and a second, screening end position in which, for the screening of the IGU, it may be extended between the first frame side member and a second frame side member parrallel to the first frame side member, wherein the screening device in the height direction may be mounted above said first insulation member.

[0093] In an embodiment, the skylight window may further comprise a sash covering leg which may be attached to the window sash. The sash covering leg may be inclined, forming an angle of 20° to 60° with the height direction. The sash covering leg may be provided separately such that it is detachable from the window. The sash covering leg may be removed and replaced by a shade or an awning.

[0094] In an embodiment, the skylight window is non-openable, wherein the first insulation member extends substantially from the external surface of said load-carrying structure to the side surface of the interior pane.

[0095] In an embodiment, the first frame side member includes a supporting section position in the height direction beneath the internal major surface of the IGU. A lower part of the insulation member may be positioned in a recess of the first frame side member defined by a side surface of the supporting section, an exterior surface of the first frame side member, the exterior surface facing upwardly in a height direction, and the external surface of the load-carrying structure.

[0096] In an embodiment, the skylight window is openable, wherein the first sash side member has a first leg connected to a supporting section of the first sash side member supporting the IGU. The first leg may extend in the longitudinal direction and extend substantially in a height direction substantially perpendicularly to at least one of the major surfaces of the IGU. The first leg may have a thickness in the width direction, at least at portion of the first leg of the first sash side member being generally plate-shaped, consisting of only one single section

of substantially solid material having a thickness less than 1 cm.

[0097] The outer side of the first frame side member may be substantially flat. The outer side of the first frame side member may be adapted for receiving a curb flange or a cant strip.

[0098] In an embodiment, the skylight window may further comprise a motor-driven actuator comprising an elongated lifting element connecting the frame and the sash for moving the sash between the open position and the closed position, said elongated lifting element having a top end and a first position in which the skylight window is in the closed position and a second position in which the skylight window is in the open position. The top end of the elongated lifting element may abut or be attached to the sash. The motor-driven actuator may be positioned between the IGU and the frame in a direction parallel with the exposed interior major surface of the IGU in the closed position of the skylight window. The motor-driven actuator may be a chain actuator, the elongated lifting element may be a chain, and the top end may be a top end of a top joint of the chain. The lifting element in the closed position may be collapsed, rolled-up, folded-up, telescopically retracted or in another way compacted. The lifting element may be unrolled, unfolded, telescopically extended, or in another way extended in the open position.

[0099] The chain actuator may comprise a push-pull chain which can extend and retract to open and close the skylight window. Such a chain may be referred to as a trust chain as it may transmit a push force. The chain may be driven by an electric motor. A reduction gear may be provided. The reduction gear may comprise a worm and/or multiple gear drive. A final sprocket gear may engage the chain. A spindle may be used to drive the chain. The chain actuator may fold the chain when the chain is retracted and stored. The chain may be stored to substantially extend in a storing direction or such that one or more lengths of the chain extend substantially in a storing direction. The chain extending to open the skylight window may extend substantially perpendicularly to the storing direction. The storing direction may be the same as the longitudinal direction, in which case the chain may be stored to substantially extend in the longitudinal direction along a frame side member. This may provide a compact solution.

[0100] The chain actuator may be hidden inside a window frame or sash or otherwise arranged out of sight, e.g. outside a periphery of the skylight window. The chain actuator may be arranged in a spacing defined between the sash and the frame in the closed position of the skylight window. Preferably the chain actuator may be arranged inside a frame profile or inside a sash profile. The chain actuator may comprise an actuator housing. The chain may extend and retract through an opening in the actuator housing. The actuator housing may be an elongated actuator housing. The actuator housing may extend substantially extend in parallel with the storing direction. The chain extending to open the skylight window may extend substantially perpendicularly to the actuator housing. The chain actuator housing may be hinged to the skylight window so the chain can tilt during movement such as extending and/ or retracting to open and/or close the skylight window. The chain actuator may be self-locking and support and/or hold the weight of sash and IGU. The chain actuator may also be assisted by a spring to carry some of the weight of sash and IGU. The chain actuator may comprise a locking mechanism and/or brake to lock-up the chain. Besides the compact design a chain actuator may have other advantages. The chain actuator may provide a stable opening force from the very beginning of the opening movement.

[0101] In an embodiment, at least part of the actuator is positioned within a spacing of or a cut-out in the insulation member.

[0102] 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.

[0103] 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.

[0104] In another embodiment the skylight is to be installed in a roof with an inclination between 5 and 15 degrees relative to horizontal. In an embodiment a distance in the width direction is delimited by a side surface of the first insulation member and the side surface of the IGU, or, if the skylight window is openable, delimited by a side surface of the first insulation member and the side surface of the IGU in the closed position of the skylight window, said distance being less than about 10 % of the frame height.

[0105] In an embodiment the frame height of the first frame side member is less than 20 cm, such as about 15 cm.

[0106] In an embodiment, the skylight window is a non-openable skylight window, wherein the skylight window comprises: a window frame having four frame side members, the frame side members supporting an IGU having multiple layers of glazing, said IGU having an exposed interior major surface for facing an interior of said building, the interior pane comprising a side surface extending substantially along the first frame side member, said IGU further having an exterior major surface facing towards an exterior of the skylight window, wherein a first of the frame side members has a frame height extending in a height direction, the height direction being substantially perpendicular to at least one of the major surfaces of the IGU, the first of the frame side members extending in a longitudinal direction along the side surface of the interior pane, wherein said first frame side member comprises a load-carrying structure for carrying at least part of the IGU, said load-carrying structure having an external surface facing the side surface of the interior pane, wherein the skylight window further comprises a first insulation member comprising an insulation material and extending in the longitudinal direction along the first of the frame

side members, and wherein said first insulation member is provided separately from said first frame side member and between said external surface of said load-carrying structure and the side surface of the interior pane.

[0107] In an embodiment, the first frame side member 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 a 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 section.

[0108] The skylight window may comprise a removable lining panel protrusion and/or recess. The removable lining panel protrusion and/or recess may be separately affixed to the frame and may be a part that is separate from the frame i.e. not an integral part of the frame.

[0109] Embodiments and advantages described with reference to one aspect of the invention also applies to the other aspect(s) disclosed herein unless otherwise stated.

[0110] The invention will be described in more detail below by means of nonlimiting examples of embodiments and with reference to the schematic drawings, in which

Fig. 1 shows a perspective view of an openable skylight window,

Fig. 2 shows a cross-sectional view of part of an openable skylight window according to an embodiment of the present invention,

Fig. 3 shows a cross-sectional view of part an openable skylight window according to an embodiment of the present invention,

Fig. 4 shows a cross-sectional view of part of a non-openable skylight window according to an embodiment of the present invention,

Fig. 5 shows a cross-sectional view of the skylight window of Fig. 4 installed in a roof of a building,

Fig. 6 shows another cross-sectional view of the skylight window according to Fig. 4 installed in a roof of a building and showing a distribution of isotherms,

Fig. 7 shows a cross-sectional view of a non-openable skylight window according to an embodiment of the present invention,

Fig. 8 shows a cross-sectional view of an openable skylight window according to an embodiment of the present invention and comprising an actuator, and

Fig. 9 shows a cross-sectional view of an openable skylight window according to an embodiment of the present invention and comprising an actuator,

Fig. 10 shows a perspective view of an embodiment of the skylight window where a part of the window has been removed,

Fig. 11 shows an exploded view of another embodiment of the skylight window where a part of the window, including the IGU, has been removed.

[0111] Fig. 1 shows an embodiment of a skylight window 1 according to the present invention installed in a roof 2 of a building and covering an opening (not shown) in the roof 2. The skylight window 1 comprises a weather shield 3 protecting a window portion 4, which includes an IGU 5, a sash 6 supporting the IGU 5, and a frame 7. A roofing felt (not shown) may in a conventional manner be positioned to seal between outer surfaces of the frame 7 and of the roof 2. These outer surfaces of the frame 7 are in this embodiment formed by a curb flange 40 of the frame 7. The weather shield 3 may also include a flashing or cladding (not shown).

[0112] The weather shield 3 is attached to the sash 6 so as to protect the window portion 4 of the skylight window 1. The weather shield 3 comprises a transparent weather shield pane 8 and a skirt 9, which cover the sash 6 and the IGU 5. In other embodiments, the skylight window 1 does not include the weather shield 3. The slightly curved weather shield pane 8 as seen in Fig. 1 extends over the entire roof opening (not shown), which opening the skylight window 1 is positioned to cover. The weather 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 four frame side members. No sealed gas-filled spacing is provided between the weather shield pane 8 and the IGU 5; rather, this spacing is ventilated. In other embodiments, the spacing provided between the weather shield pane 8 and the IGU 5 is sealed, providing a closed spacing.

[0113] In the embodiment of Fig. 1, both the entire sash 6 and the entire frame 7 are positioned above an upper roof surface of the roof 2, also denoted the exterior roof surface. The skylight window 1 may, however, also be positioned so that a part of the frame 7 and/or the sash 6 are positioned below the exterior roof surface level.

[0114] The flat roof 2 shown in Fig. 1 has a roof inclination of about 0 degrees in relation to horizontal. The skylight window may, however, also be installed in an inclined roof having a roof inclination larger than 0 degrees.

[0115] Referring to Fig. 2, showing the overall appearance and principles underlying a skylight window 1 according to another embodiment of the present invention, the skylight window 1 is openable and comprises a substantially flat weather shield 3 attached to the window sash 6 so as to protect a window portion 4 of the skylight window 1. The skylight window 1 shown in Fig. 2 may be according to the embodiment of Fig. 1 unless otherwise stated in the following. However, the curb flange 40 is not included in this embodiment. The window portion 4 of Fig. 2 comprises a frame 7, an IGU 5, and a sash 6. The weather shield 3 may alternatively be shaped simi-

larly to the weather shield pane 8 and weather shield 3 shown in Fig. 1.

[0116] The IGU 5 is shown more schematically in Figs. 2, 3, 4, and 5, and may be identical to the IGU of any one of the embodiments shown in Figs. 6, 7, 8 and 9.

[0117] The IGU 5 has an exposed interior major surface 5b for facing an interior of the building in the closed position of the skylight window 1, the exposed interior major surface being of an interior pane of the IGU 5. The interior pane, not shown in Fig. 2, comprises a side surface 5s extending substantially along the first frame side member 10 and first sash side member 14. The IGU 5 further has an exterior major surface 5g facing towards an exterior in the closed position of the skylight window 1, wherein the first frame side member 10 has a frame height HF extending in a height direction shown in Fig. 2. The height direction H is substantially perpendicular to the major surfaces of the IGU 5 in the closed position of the skylight window 1. Further details on embodiment of the IGU 5 are provided in description of Figs 6 to 9.

[0118] The first frame side member 10 and the first sash side member 14 extend in a length or longitudinal direction L, also shown in Fig. 2, along the side surface 5s of the interior pane in the closed position of the skylight window 1.

[0119] In this embodiment that the skylight window is openable, the first sash side member 14 has a supporting leg 79, the supporting leg 79 being positioned below the interior major surface 5b. The supporting leg 79 carries at least part of the weight of the IGU 5, which in turn is carried by the load-carrying structure 67 of the first frame side member 10. A sealing element 79a is provided between the supporting leg 79 and the interior major surface 5b. The first sash side member 14 further has a first leg 15 connected to the supporting leg 79. The first leg 15 extends in the longitudinal direction L and in the height direction H. The first leg 15 is generally plate-shaped and consists of only one single section of substantially solid material having a thickness in the width direction of less than 1 cm. As an alternative, the supporting leg 79 can be connected to the upper side or exterior major surface of the IGU or the supporting leg 79 can engage into the spacer bar of the IGU e.g. in between the glazing panes. Alternatively, the first leg 15 can be discontinuous, so that it is not an elongated profile but rather a plurality of legs holding the IGU.

[0120] The first frame side member 10 in Fig. 2 is substantially L-shaped having a first leg 25, the first leg 25 extending in the height direction H, and the second leg 26, the second leg 26 extending from a lower portion of the first leg 26 in the width direction W toward the IGU. The first frame side member further has a supporting section 72, the supporting section 72 is connected to the second leg 26 and is positioned below the IGU 5 in the height direction H. The first frame side member 10 comprises a load-carrying structure 67 for carrying at least part of both the sash 6 and the IGU 5 in the closed position of the skylight window 1. In the embodiment shown in Fig 2, the load-carrying structure 67 is the first leg 25, second leg 26 and the supporting section 72. In the closed position shown in Fig. 2, the supporting section 72 carries a structural load of the IGU 5 and the first sash side member 14. The supporting section 72 is connected to the second leg 26, and in an installed position of the skylight window 1 on a roof (not shown) the structural load from the IGU and the first sash side member 14, is transferred from the supporting section 72 to the second leg 26 and further to the roof. The load-carrying structure has an external surface 10x facing the side surface 5s of the interior pane. A sealing element 76 is provided between the supporting section 72 and the interior major surface 5b. Generally, the supporting section 72 may comprise a lining panel connector which has a recess 10b or a tip with a first surface 10cfor connecting a lining panel 50 (shown in fig. 5,6).

[0121] The skylight window 1 further comprises a first insulation member 81 comprising an insulation material and extending in the longitudinal direction L along the first frame side member 10 in the closed position of the skylight window 1 shown in Fig. 2. The first insulation member 81 is provided separately from the first frame side member 10 and is positioned between the external surface 10x and the side surface 5s of the interior pane in the closed position of the skylight window 1. The first insulation member 81 extends substantially along an entire length of the first frame side member 10.

[0122] The insulation member 81 being provided separately from the first frame member 10 means that it is not provided within the first frame side member 10. However, the insulation member 81 is attached to and abuts the first frame side member 10 or the load-carrying structure 67 thereof. The insulation member 81 is detachable or detached from the frame 7 and/or attachable or attached to the frame 7. This means that the insulation member 81 may further potentially be mechanically detachable and attachable without causing substantial damage to the skylight window 1 or the insulation member 81 itself.

[0123] An interior glazing plane H1 is defined by the exposed interior major surface 5b in the closed position of the skylight window 1, whereas an exterior glazing plane H2 is defined by the exterior major surface 5g in the closed position of the skylight window 1 as shown in Fig. 2. In Fig. 2, the first insulation member 81 extends in the height direction H from the exterior surface 10f of the first frame side member 10, the exterior surface 10f being positioned below the interior glazing plane H1, to a position above the exterior glazing plane H2, in the closed position of the skylight window 1. Thus, the first insulation member 81 extends between the interior glazing plane H1 and exterior glazing plane H2, in the closed position of the skylight window 1.

[0124] A width direction W shown in Fig. 2 extends perpendicularly to the longitudinal direction L and to the height direction H. In the embodiment of Fig. 2, a width in the width direction W of the insulation member 81 is

larger than a height of the IGU 5. The height of the IGU 5 is equal to the distance in the height direction H between the interior 5b and exterior 5g major surfaces of the IGU 5.

[0125] As can be seen in Fig. 2, no part of the load-carrying structure 67 of the first frame side member 10 is positioned above the insulation member 81 in the height direction. The first insulation member 81 is attached to the first frame side member 10. The first insulation member 81 is positioned in abutment with the first frame side member 10, abutting part of both the external surface 10x and the exterior surfrace 10f of the first frame side member 10. The insulation material of the first insulation member 81 consists of expanded polystyrene (EPS). The density of EPS used here is in the range of 15-30 kg/m^3. The insulation member 81 comprises a protrusion 87 in a lower part thereof, said protrusion 87 is positioned below the supporting leg 79 of the first sash side member 14.

[0126] In the embodiment of Fig. 2, the first insulation member 81 has a cross-section or profile substantially shaped as a right trapezoid. The first insulation member 81 has a side surface 81s facing the IGU 5, the side surface 81s is inclined in relation to the height direction so that a lower portion of the insulation member 81 is wider than an upper portion of the insulation member 81. A height of the first insulation member HE is about 53 % of the a frame height HF, and a width of the first insulation member WE is about 47 % of the frame height HF.

[0127] In the embodiment of Fig. 2, a sash height HS is about 106% of the frame height HF and a height of the interior part HI is about 23% of the frame height HF. A height of the supporting leg HL is about 0.3% of the total frame height HF. A ratio of the height HL of the supporting leg 79 to the supporting leg width WL is about 1:5, and a ratio of a supporting leg width WL to a sash height HS is about 1:12. A frame width of the first first frame side member WF in the width direction W is about 92 % of the frame height HF.

[0128] The first sash side member 14 comprises a first sealing element 14a near the weather shield skirt 9 for sealing against the first frame side member 10 to prevent air, precipitation and/or debris such as dust or dirt from entering between the sash 6 and frame 7. The first sash side member 14 further comprises a second sealing element 14b located above the insulation member 81 and having the same purpose.

[0129] The skylight window 1 further comprises a sash covering leg 80 which is attached to the first leg 15 of the sash side member. The sash covering leg 80 is inclined, forming an angle of approximately 30° with the height direction. The sash covering leg is provided separately in this embodiment, such that it is detachable from the window.

[0130] Fig. 3 shows part of an embodiment of a skylight window 1 in a similar cross-sectional view to the view of Fig. 2. Parts of the embodiment of Fig. 3 are identical or similar to the embodiment of Fig. 2 unless otherwise stated in the following and only features of Fig. 3 which are not present in Fig. 2 are described in the following.

[0131] In the embodiment of Fig. 3, the first frame side member 10 further comprises a recess 85 which is positioned in an outer surface of the first frame side member 10. The recess 85 is provided so that an attachment device (not shown) may be inserted into the recess 85 to be attached to the first frame side member 10, the attachment device having an inner geometry for temporary interlocking with a lifting device (not shown) for lifting the skylight window 1 during or before installation thereof. A sealing element 86, shown in Fig. 3, is positioned above the insulation member 81 and is attached to the first sash side member 14. The sealing element 86 extends between the first sash side member 14 and the insulating member 81 in the shown closed position of the skylight window 1 in order to seal a spacing between these.

[0132] In the embodiment of Fig. 3, the first frame side member 10 is made of a core material encapsulated in an encapsulation material. The load-carrying structure 67 thus includes a box structure or hollow structure including load-carrying external plates (which are connected to each other) surrounding or enclosing one or more internal spacings. Inside these spacings, further insulation members 81 or filler material or stiffening material may be provided.

[0133] The frame 7 and the load-carrying structure 67 may alternatively have a general hollow core structure with one or more hollows inside spacings or cavities surrounded by thin layers or plates of material. These plates may extend in the longitudinal direction L and may be connected to each other at corners thereof such as to form a shell structure surrounding the spacings. In a first frame side member 10 having a hollow structure, the load carrying structure 67 of the first frame side member may constitute the shell structure.

[0134] Figs 4 to 6 show a skylight window 1 accoding to another embodiment of the present invention in cross-sectional views, this skylight window 1 being non-openable, the skylight window of Figs. 4-6 accordingly not including the sash 6 and the first side sash member 14 according to the previous embodiments. In the embodiment of Figs 4-6, in contrast to the previous embodiments, at least part of the IGU 5 and the weather shield 3 are, accordingly, carried directly by the first frame side member 10, i.e. no first sash side member 6 is provided between them. To carry the weather shield 3 on the first frame side member 10, the weather shield 3 in Fig. 4 includes a weather shield support 65. Other parts of the embodiment of Figs 4-6 are identical or similar to the previous embodiments, unless stated otherwise in the following.

[0135] The weather shield support 65 shown in Figs. 4-6 is positioned between the first frame side member 10 and the weather shield 3 in the height direction H. The weather shield support 65 extends along the length of the first frame side member 10. The weather shield support 65 engages both the first leg 25 of the first frame side member 10 and the weather shield 3, the weather

shield support 65 carrying at least part of the weather shield 3 and the first leg 25 carrying the weather shield support 65 and at least part of the weather shield 3. The weather shield support 65 abuts an upper part of the external surface 10x of the load-carrying structure 67, and a support foot 65a abuts an exterior surface of the first leg 25.

[0136] In Figs 4-6, the weather shield support 65 has a recess 65b which receives a protrusion 10t of the first frame side member 10. The recess 65b and protrusion 10t being provided to faciliate the positioning of the weather shield support 65 on the first frame side member 10.

[0137] In Fig. 5 the weather shield support 65 is attached to the first frame side member 10 by a fastener 65d, the fastener 65 being mounted through the weather shield support 65 and the external surface 10x of the load-carrying structure 67.

[0138] In Fig. 4 and 5 the IGU is shown schematically whereas in Fig 6 the IGU is shown as a more realistic represenation of the IGU. The IGU 5 of Fig. 4-5 is identical to the IGU 5 of Fig. 6.

[0139] In Figs 4-6 the load-carrying structure 67 of the first frame side member 10, comprises the first leg 25, second leg 26 and supporting section 72. The load-carrying structure 67 carries at least part the weight of the IGU, the weather shield 3 and the weather shield support 65. The IGU 5 is supported and at least party carried by the supporting section 72, and the weather shield 3 and weather shield support 65 are supported by the first leg 25, the first leg 25 and supporting section 72 being supported by the second leg 26.

[0140] In the embodiment of Figs 4-6, the first insulation member 81 is partly encased in a cover 82 covering parts of surfaces of the first insulation member 81 facing away from the first frame side member 10. Such a cover could also be included in the previous embodiments. The cover 82 is not part of the load-carrying structure 67 of the first frame side member 10. The insulation member 81 of this embodiment further comprises a recess 83 on a side surface 81s of the insulation member 81 facing towards the side surface 5s of the IGU 5, wherein the cover 82 is attached to the recess 83.

[0141] The first insulation member 81 extends substantially from the external surface 10x of the load-carrying structure to the side surface 5s of the interior pane. The first frame side member 10 includes a supporting section 72 positioned in the height direction beneath the internal major surface 5b of the IGU 5. A lower part of the insulation member 81 is positioned in an upwardly facing recess 84 of the first frame side member 10, the recess 84 being defined by a side surface 72s of the supporting section 72, an exterior surface 10f of the first frame side member 10, the exterior surface 10f facing upwardly in a height direction, and the external surface 10x of the load-carrying structure 67.

[0142] The first insulation member 81 comprises chamfered corners, which facilitate its installation in the skylight window 1 and allow for installation of optional auxiliary wedge parts provided for a smooth transition between the frame 7 and the insulation member 81.

[0143] In Fig 4 the frame width WF is about 85 % of the frame height HF, the height HE and width WE of the first insulation member 81 is about 59 % and 44 % of the frame height HF respectively.

[0144] As can be seen in Fig. 5, the skylight window 1 further comprises a curb flange 40 (not shown in Figs 4 and 5) which is attached to the outer surface of the first frame side member 10. The outer surface of the first frame side member 10 is here a flat surface. The curb flange 40 comprises a bottom flange surface 41a, a side flange surface 41b, and an inclined flange surface 41c, which inclined flange surface 41c connects said bottom 41a and side 41b flange surfaces. The curb flange 40 is adapted for extending along a longitudinal extent of the first side frame member 10 in an installed position of the skylight window 1. The bottom flange surface 41a is positioned in abutment with an exterior surface of said roof 2 and the side flange surface 41b is positioned in abutment with the first side frame member 10, whereby the inclined flange surface 41c functions as a roofing felt mounting surface. The curb flange 40 can be attached to and detached from the first frame side member 10. In the example shown this is achieved by screws (not shown). It may however also be achieved with nails, with clips, such that snaplock, or with other fasteners, that engage with one or more pre-defined holes in a groove or recess on the frame side member 10. It is also possible to attach the curb flange 40 by means of an adhesive or a hook-and-loop type fastener. A similar curb flange may be provided in the previous embodiments.

[0145] Fig. 6 shows a distribution of isotherm curves of the skylight window 1 as shown in Fig. 4 installed in or on a roof 2 as shown in Figs 5 and 6. An isotherm curve is a curve or line along which the temperature has a constant value. The insulation member 81 consists of EPS as in the previous embodiments and extends beyond the IGU 5 in up and down directions, the up direction being toward the exterior and the down direction being toward the interior of the building. The distribution of isotherm curves at the periphery of the IGU 5 and throughout the first insulation member 81 is homogeneous, since the distances between the isotherm curves are substantially equal. This indicates the good insulating properties of the insulation member 81 and its effect on heat transfer through the skylight window 1. A similar distribution of isotherm curves is achieved with the previous embodiments in a closed position of the skylight window 1.

[0146] Fig 6 shows the IGU 5 having multiple glazing panes 5c, 5d, 5e positioned above one another in the height direction H, the glazing panes defining two spacings 5i between adjacent glazing panes 5c, 5d, 5e. The spacings 5i may comprise a gas fill, such as argon or krypton. The spacings are sealed by sealing and supporting members 22 extending along the first peripheral side of the IGU 5a. The exterior glazing pane 5c has an

exterior major surface 5g and the interior glazing pane 5e has an exposed interior major surface 5b. The interior pane 5c has a side surface 5s at the first peripheral side 5a of the IGU 5.

[0147] Fig. 7 shows a modified embodiment of the non-openable skylight window 1 of Figs 4-6, where the IGU 5 comprises three glazing panes 5c, 5d 5e and a single spacing 5i between the glazing panes 5c and 5d, the spacing 5i being separated and/or possibly sealed by a sealing element 22 . Parts of the skylight window of Fig. 7 not described in the following are identical or similar to the skylight window 1 of Figs 4-6. The curb flange 40 is not shown in Fig. 7.

[0148] In Fig. 7, the insulation member 81 extends, at an inner, right side in the figure, from a point lower than the interior glazing plane H1 and until exterior glazing plane H2. The insulation member 81 further comprises a recess 88 in an upper surface, said recess 88 being provided for accommodating an attachment element such as a wedge (not shown). Above the insulation member 81, a cover element 89 is positioned. The cover element 89 comprises a recess in its lower part, such that an attachment element or wedge can be attached between the recess 88 of the insulation member 81 and the recess included in the cover element 89. This attachment element or wedge can provide a resilient connection between the two elements. The insulation member 81 is provided as an L-shaped member, forming a leg 90 facing the external surface 10x of the load-carrying structure 67, thus being adapted to receive the cover element 89.

[0149] Figs 8 and 9 show a part of modified embodiments of the openable skylight window shown in Fig 2, the modified embodiments comprising an actuator 37. Figs. 8 and 9 show a cross-sectional view of a frame side member, this frame side member being opposite and parallel to the frame side member shown in Fig. 2. The frame side member shown in Fig. 8 and 9 may also be considered to be the first frame side member 10 according to the invention. Parts of the embodiment of Figs 8-9 are identical or similar to the previous embodiments, unless stated otherwise in the following.

[0150] In Figs 8 and 9, an actuator 37 is positioned within a spacing (Fig. 9) of or a cut-out (Fig. 8) in the insulation member 81.

[0151] The insulation member 81 is positioned between the external surface 10x of the load-carrying structure and the side surface 5s of the interior pane 5b, the first insulation member 81 being adjacent to the actuator 37. The first insulation member 81 is positioned between the actuator 37 and the side surface 5s. The actuator 37, which is a motor-driven actuator, comprises an elongated lifting element 37a connecting the frame side member 10 and the sash side member 14 for moving the sash 6 between the open position and the closed position. The elongated lifting element 37a has a top end 37e and a first position in which the skylight window 1 is in the closed position and a second position in which the skylight window 1 is in the open position. The top end 37e of the lifting element 37a is at or above a height level of the interior major surface 5b of the IGU 5 in the height direction in the closed position of the skylight window 1. The first insulation member 81 in Fig. 8 has a smaller width compared to the previous embodiments, the width WE and height HE of the first insulation member 81 being approximately 18 % and 53 % of the frame height HF, respectively. The small width allows the window frame 7 to accommodate the actuator 37 while providing thermal insulation at the side surface 5s.

[0152] The first insulation member 81 in Fig. 9 has a substantially triangular cross-section or profile and is wider at the lower part compared to the upper part of the first insulation member. The width WE and height HE of the first insulation member 81 being about 12 % and 53 % of the frame height HF respectively

[0153] The load-carrying structure 67 of the first frame side member 10 in Figs 8 to 9 is the first leg 25, second leg 26 and supporting section 72. The first sash side member 14 supports the IGU 5 by the supporting leg 79 of the first sash side member 14. The actuator 37 in turn supports the first sash side member 14 by its elongated lifting element 37a. The actuator is supported by the second leg 26, and thus the second leg 26 which is part of the load-carrying structure 67, supports and carries at least part of the weight of the IGU 5, the first sash side member 14 and the actuator 37.

[0154] The IGU 5 in the embodiments of Figs 8-9 are similar to the IGU shown in Fig 6. However, the IGU 5 of Fig. 8 further comprises an additional layer of glazing or gas adjacent to the interior glazing pane 5d.

[0155] A screening device 63 is also comprised in the skylight window 1 of Fig. 9. The screening device 63 comprises a screening body (not shown), which is moveable between a first, non-screening end position in which it is in a collapsed, such as a rolled-up, pleated or folded, state at the first frame side member 10 and a second, screening end position in which, for the screening of the IGU 5, it is extended between the first frame side member 10 and a second frame side member parallel to the first frame side member 10, wherein the screening device 63 in the height direction is mounted above said the insulation member 81. The stepped configuration of the first sash side member 14 supports the screening device 63, which may be a roller blind. A rotary hinge 91 is also comprised in this embodiment.

[0156] Fig. 10 shows a perspective view from above of an embodiment of the skylight window 1 according to the present invention installed in a roof 2, where a part of the window has been removed for illustration purpose. The window frame 7 and the window sash 6 correspond to the ones shown in Figs 2 and 3. The weather shield pane 8 here has been removed for clarity. Fig. 10 also shows a screening device 34, which is mounted in a spacing delimited in the width direction W by the first 14 and second sash side members. It is to be understood that the second sash member is substantially identical to the first sash side member 14 so that the exterior sides of

the sash side members together define an exterior side of the sash 6 which extends substantially in parallel to the exterior major surface 5g of the IGU 5.

[0157] Towards the interior, the spacing is delimited in Fig. 10 by the step surface 17c formed by the third leg 17 of the sash side member 14. The step surface 17c thus serves as a screening device support section extending from the first leg 15. The screening device 34 is here depicted as a roller curtain in which the screening body 36 is a covering cloth, which at least partially rolled up on a collection device 35 in the form of a collection roller in the first non-screening, end position, but which is here shown in a second, screening end position, where it is extended towards second sash side members for covering the IGU 5. The screening device 34 might, however, also be another type of blind or a shutter. In Fig. 10, also a fixation member 39 is attached to the first sash side member 14 and extending towards the second sash side member. The fixation member 39 contributes to retaining a top casing of the screening device 34 by preventing it from moving upwards, away from the exterior major surface 5g of the IGU.

[0158] Fig. 11 shows an exploded view of a different embodiment of the skylight window 1, where the IGU and the weather shield has been removed to show other parts better. The IGU and the weather shield may for example be embodied as shown in Fig. 2. The first insulation member 81 comprises a recess 93 on the side surface 81s of the insulation member 81, which is formed as a step surface. The step surface 93 results in a reduced material thickness in the lower part of the insulation member 81 compared to an upper part of it.

[0159] The first insulation member 81 further comprises a recess 94 in a top corner and bottom corner of the member (better shown in figs 4-6), facing towards the frame. The recess is formed as an oblique surface such that no sharp edges of the insulation member 81 are created facing the frame.

[0160] The first insulation member comprises a recess 95 on a top surface of the insulation member 81 facing toward the weather shield (not shown). The recess 95 is positioned in the middle of the top surface of the first insulation member 81 in the width direction. The recess 95 allows for attachment of corner key elements 96 such that two adjacent insulation members are joined at a corner of the window forming an angle. The adjoining insulation members 81, 92 are tightly connected with each other. The angle formed by main axes of two adjoining insulation members 81, 92 extending in respective longitudinal directions is 90 degrees.

[0161] The two adjoining insulation members, a first 81 and a second insulation member 92, are covered by two covers, a first 82 and a second cover 97, wherein the first cover 81 is engaged with the second cover 97.

[0162] The cover 82 of the insulation member comprises a first leg 98 extending in the width direction such that it covers the top surface of the insulation member 81 in the mounted state. The cover 82 also comprises a second leg 99 extending in the height direction, attached to the first leg 98. The two legs are in this embodiment integrally formed. A recess 100 is included in the cover 82 such that it matches with a recess 101 on the insulation member 81 at the joint of the two legs 98, 99, when the insulation member and the cover are brought into contact. The recess 101 of the insulation member also allows for attachment of the sash covering leg 80 (as shown in figs 4-6).

List of reference numerals

[0163]

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
5i	Gas layer or spacing
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
10s	Sealing surface of frame side member
10t	Top surface of frame side member
10x	External surface of load-carrying structure
10f	Exterior surface of frame side member
14	First sash side member
14a	Sealing element
14b	Sealing element
15	First leg of first sash side member
22	Sealing member
25	First leg of first frame side member
26	Second leg of first frame side member
37	Actuator
37a	Elongated lifting element
37e	Top end
40	Curb flange
41a	Curb flange bottom surface
41b	Curb flange side surface
41c	Curf flange inclined surface
50	Reveal panel or lining panel
63	Screening device
65	Weather shield support

65a	Weather shield support foot
65b	Weather shield support recess
67	Load-carrying structure
72	Supporting section
75	Thermal break
76	Sealing element
79	Supporting leg
791	Lower surface of the supporting leg
80	Sash covering leg
81	First insulation member
81s	Side surface of insulation member
82	Cover
83	Recess of insulation member
84	Recess of first frame member
85	Recess for attachment device
86	Sealing element
87	Protrusion on low part of insulation member
88	Recess on upper part of insulation member
89	Cover element
90	Leg of insulation member
91	Rotary hinge
92	Second insulation member
93	Step surface on side surface of insulation member
94	Recess in corner of insulation member
95	Recess on top surface of insulation member
96	Corner key element
97	Second cover
98	First leg of cover
99	Second leg of cover
100	Recess on cover
101	Recess on insulation member
H	Height direction
L	Longitudinal direction
W	Width direction
HF	Frame height
HI	Frame interior part height
HL	Supporting leg height
HS	Sash height
WL	Supporting leg width
WE	Width of insulation member
WF	Width of frame

Claims

1. A skylight window (1) for being installed in or on a roof (2) of a building, wherein the skylight window (1) comprises:

a window frame (7) having four frame side members, the frame side members extending along an Insulating Glazing Unit (IGU) (5) having multiple transparent layers of glazing (5c-5e) and at least one spacing comprising an inert gas fill, such as argon or krypton, or vacuum,

a weather shield (3) configured to protect a window portion (4) of the skylight window (1), the window portion (4) comprising the frame (7) and the IGU (5),

said IGU (5) having an exposed interior major surface (5b) for facing an interior of said building, the exposed interior major surface (5b) being of an interior pane (5d) of the IGU (5), the interior pane (5d) comprising a side surface (5s) extending substantially along a first (10) of the frame side members,

said IGU (5) further having an exterior major surface (5g) facing towards an exterior,

wherein the first frame side member (10) has a frame height (HF) extending in a height direction (H), the height direction being substantially perpendicular to at least one of the major surfaces (5b, 5g) of the IGU (5),

the first frame side member (10) (14) extending in a longitudinal direction (L) along the side surface (5s) of the interior pane (5d),

wherein said first frame side member (10) comprises a load-carrying structure (67) for carrying at least part of the IGU (5), said load-carrying structure (67) having an external surface (10x) facing the side surface (5s) of the interior pane (5d),

wherein the skylight window (1) further comprises a first insulation member (81) comprising an insulation material and extending in the longitudinal direction along the first frame side member (10), and

wherein said first insulation member (81) is provided separately from said first frame side member (10) and between said external surface (10x) of said load-carrying structure and the side surface (5s) of the interior pane (5d).

2. A skylight window (1) according to claim 1, wherein said window is openable, the skylight window (1) further comprising a window sash (6) having four sash side members, said window sash (6) being movable in relation to the window frame (7) between an open and a closed position of the window, such that the load carrying structure (67) is configured for carrying at least part of both the sash (6) and the IGU (5) in the closed position of the skylight window.

3. A skylight window (1) according to claim 1 or 2 wherein an interior glazing plane H1 is defined by the exposed interior major surface (5b) or, if the skylight window (1) is openable, is defined by the interior major surface (5b) in a closed position of the skylight window (1),

wherein an exterior glazing plane H2 is defined by the exterior major surface (5g) or, if the skylight window (1) is openable, is defined by the exterior major surface (5g) in a closed position of the skylight win-

dow (1), and
wherein the first insulation member (81) in the height direction (H) extends at least from the interior glazing plane H1 to the exterior glazing plane H2 or, if the skylight window (1) is openable, extends at least from the interior glazing plane H1 to the exterior glazing plane H2 in a closed position of the skylight window (1).

4. A skylight window (1) according to any one of the previous claims, wherein the first insulation member (81) in the height direction (H) extends below the interior glazing plane H1 or, if the skylight window (1) is openable, extends below the interior glazing plane H1 in a closed position of the skylight window (1).

5. A skylight window (1) according to any one of the previous claims, wherein a width direction (W) extends perpendicularly to the longitudinal direction (L) and to the height direction (H), a width in the width direction (W) of the insulation member (81) being equal to or larger than a height of the IGU (5), the height of the IGU being equal to a distance between the interior (5b) and exterior (5g) major surfaces of the IGU (5).

6. A skylight window (1) according to any one of the previous claims, wherein no part of the load-carrying structure (67) of the first frame side member (10) is positioned above the insulation member (81) in the height direction (H).

7. A skylight window (1) according to any one of the previous claims, wherein a surface of the first insulation member (81) is attached to a surface of the first frame side member (10).

8. A skylight window (1) according to any one of the previous claims, wherein the first insulation material comprises or substantially consists of expanded polymer such as polystyrene.

9. A skylight window (1) according to any one of the previous claims, wherein the first insulation member (81) is at least partly encased in a cover (82), the cover (82) at least covering parts of surfaces of the insulation member (81) facing away from the first frame side member (10), wherein the cover (82) is not part of the load-carrying structure (67) of the first frame side member (10).

10. A skylight window (1) according to any one of the previous claims, wherein the first insulation member (10) comprises an adhesion-promoting surface covering or a coating promoting adhesion to the first frame side member (10).

11. A skylight window (1) according to any one of the previous claims, further comprising a screening device (63) including a screening body, the screening body being moveable between a first, non-screening end position in which it is in a collapsed, such as a rolled-up, pleated or folded, state at the first frame side member and a second, screening end position in which, for the screening of the IGU (5), it is extended between the first frame side member (10) and a second frame side member parrallel to the first frame side member (10), wherein the screening device in the height direction (H) is mounted above said first insulation member (81) or, if the skylight window is openable, is located above said first insulation member (81) in a closed position of the skylight window (1).

12. A skylight window (1) according to any one of the previous claims, wherein the skylight window (1) is non-openable, and wherein the first insulation member (81) extends substantially from the external surface (10x) of said load-carrying structure (67) to the side surface of the interior pane (5d).

13. A skylight window (1) according to any one of the previous claims, wherein the first frame side member (10) includes a supporting section (72) positioned in the height direction (H) beneath the internal major surface (5b) of the IGU (5), and preferably wherein a lower part of the insulation member is positioned in a recess (84) of the first frame side member (10) defined by a side surface (72s) of the supporting section , an exterior surface (10f) of the first frame side member, the exterior surface (10f) facing upwardly in a height direction (H), and the external surface (10x) of the load-carrying structure.

14. A skylight window (1) according to any one of the previous claims, wherein the skylight window(1) is openable, and wherein said first sash side member (14) has a first leg (15) connected to a supporting section (79) of the first sash side member (14) supporting the IGU (5).

15. A skylight window (1) according to any one of the previous claims, the first frame side member (10) having a primary leg (25), which is positioned lateral to and extends along an outwardly facing surface of said first peripheral side (5a) of the IGU, and a secondary leg (26), which extends lateral to and along a part of said interior major surface (5b) of the IGU, wherein said primary leg (25) extends up to or beyond the exterior major surface (5g) of the IGU (5) in the height direction.

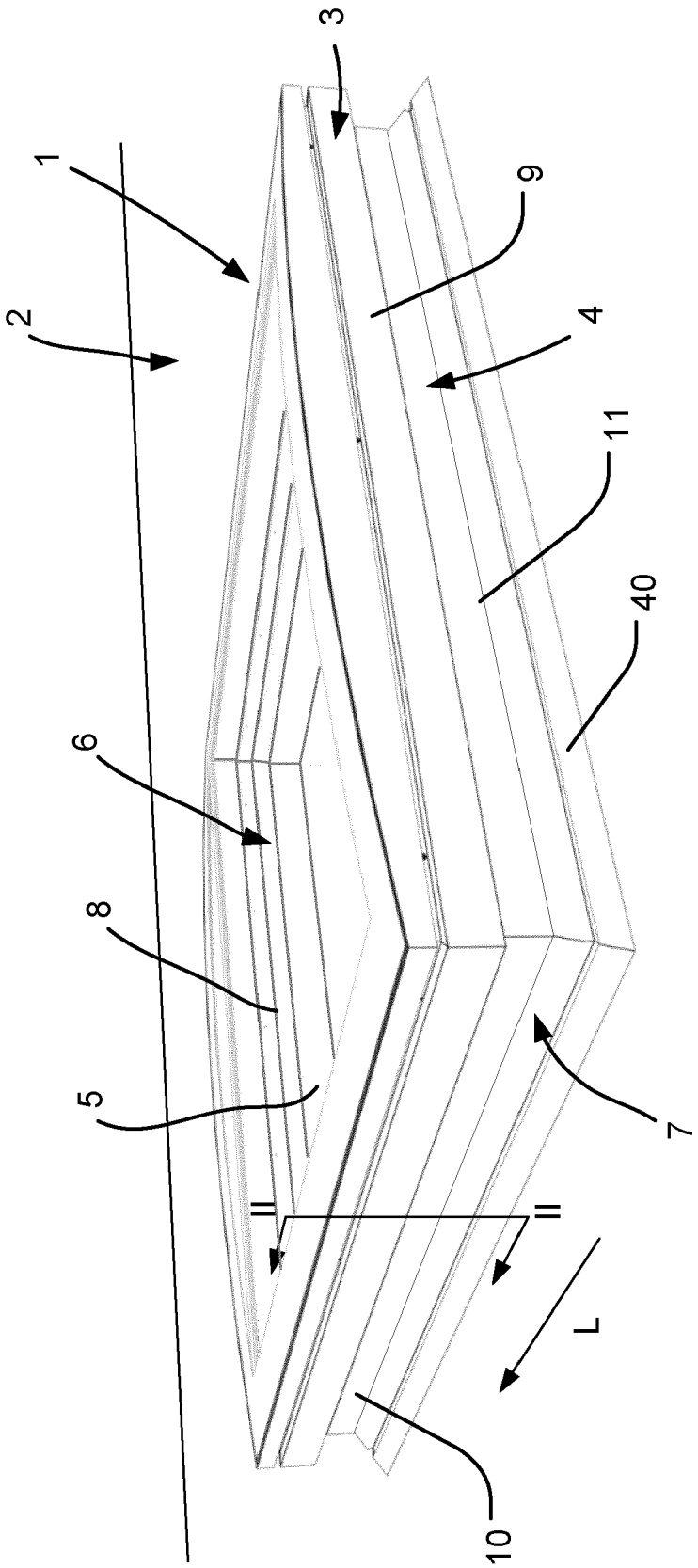

Fig. 1

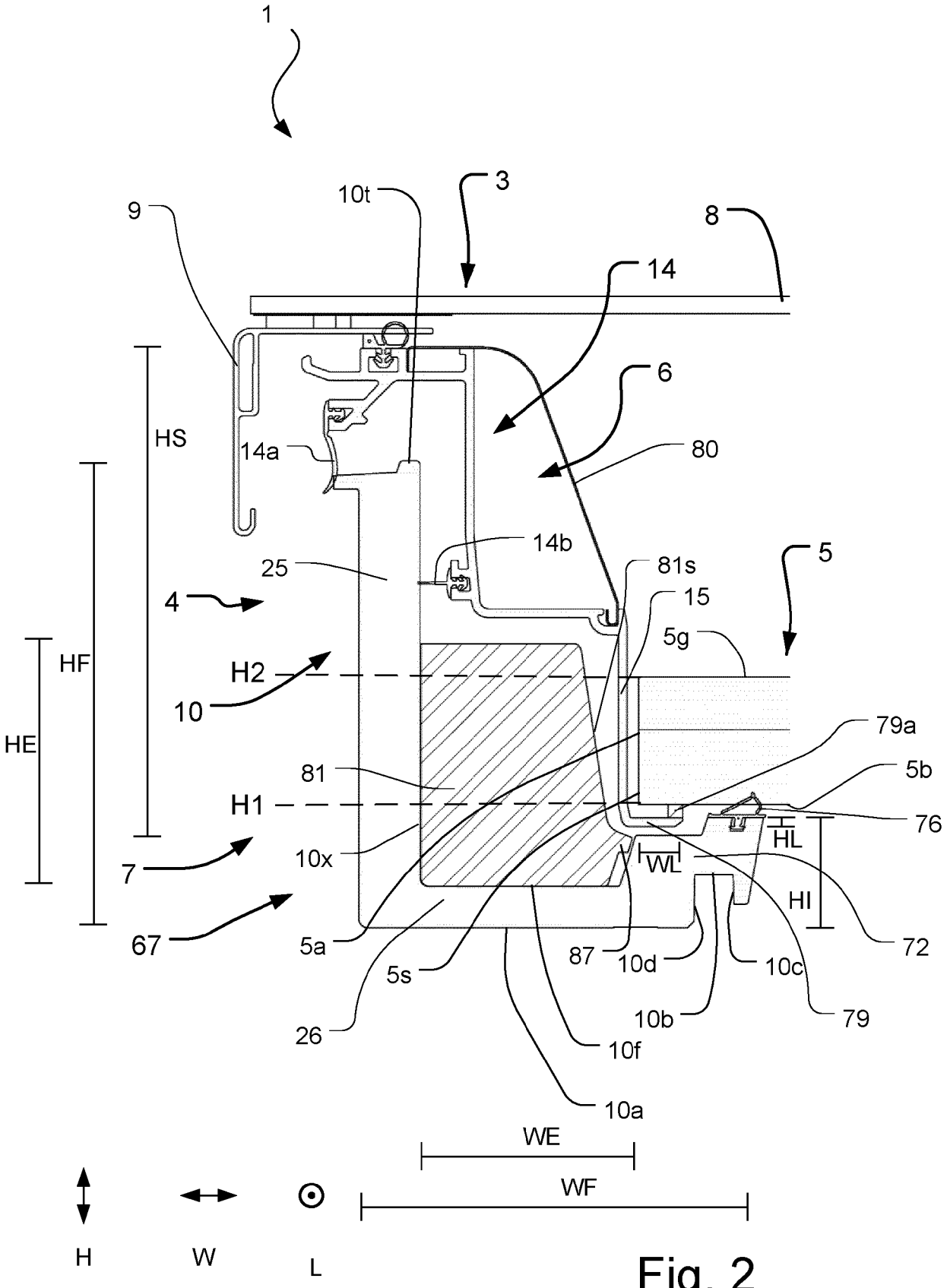
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Fig. 2

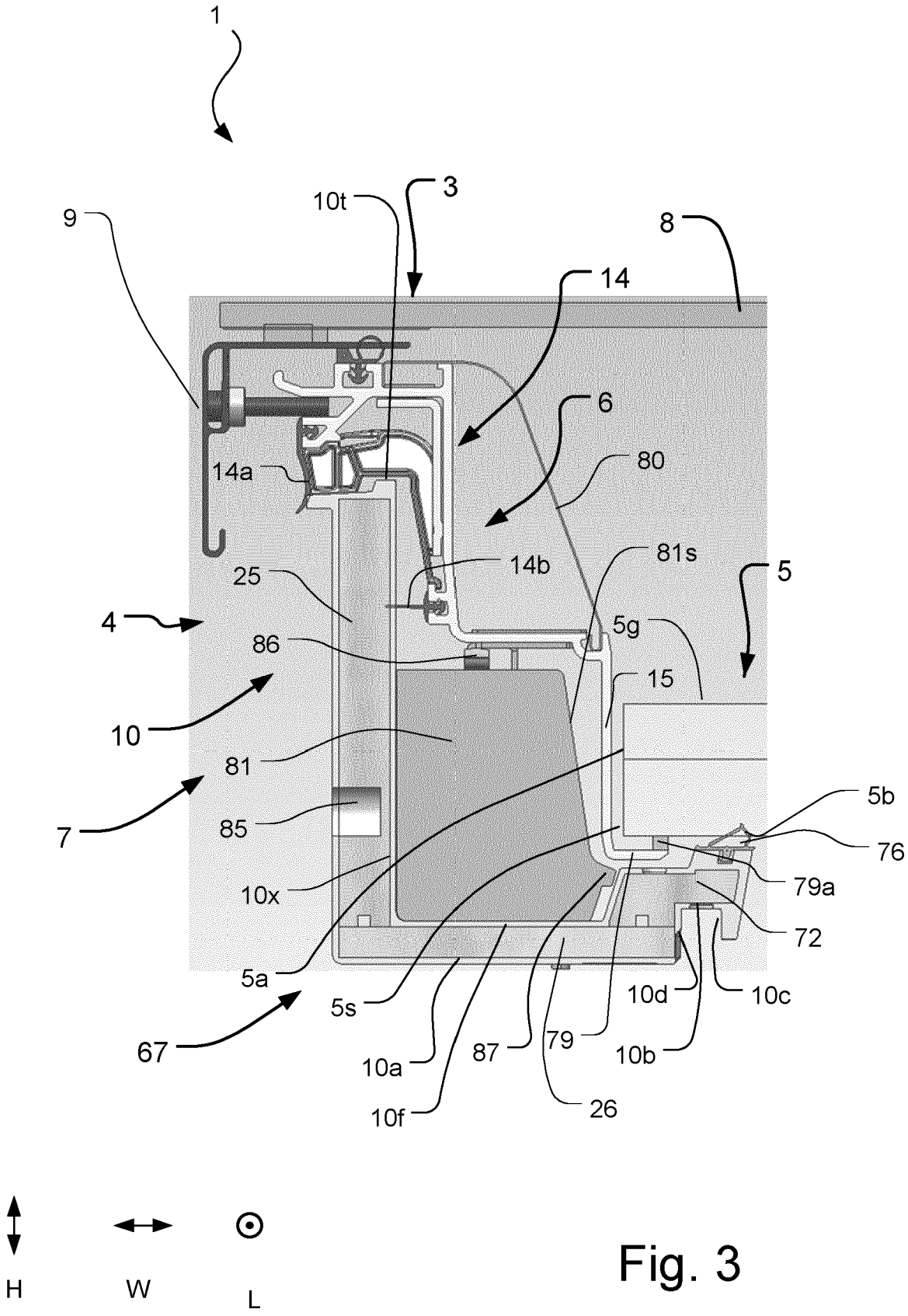
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Fig. 3

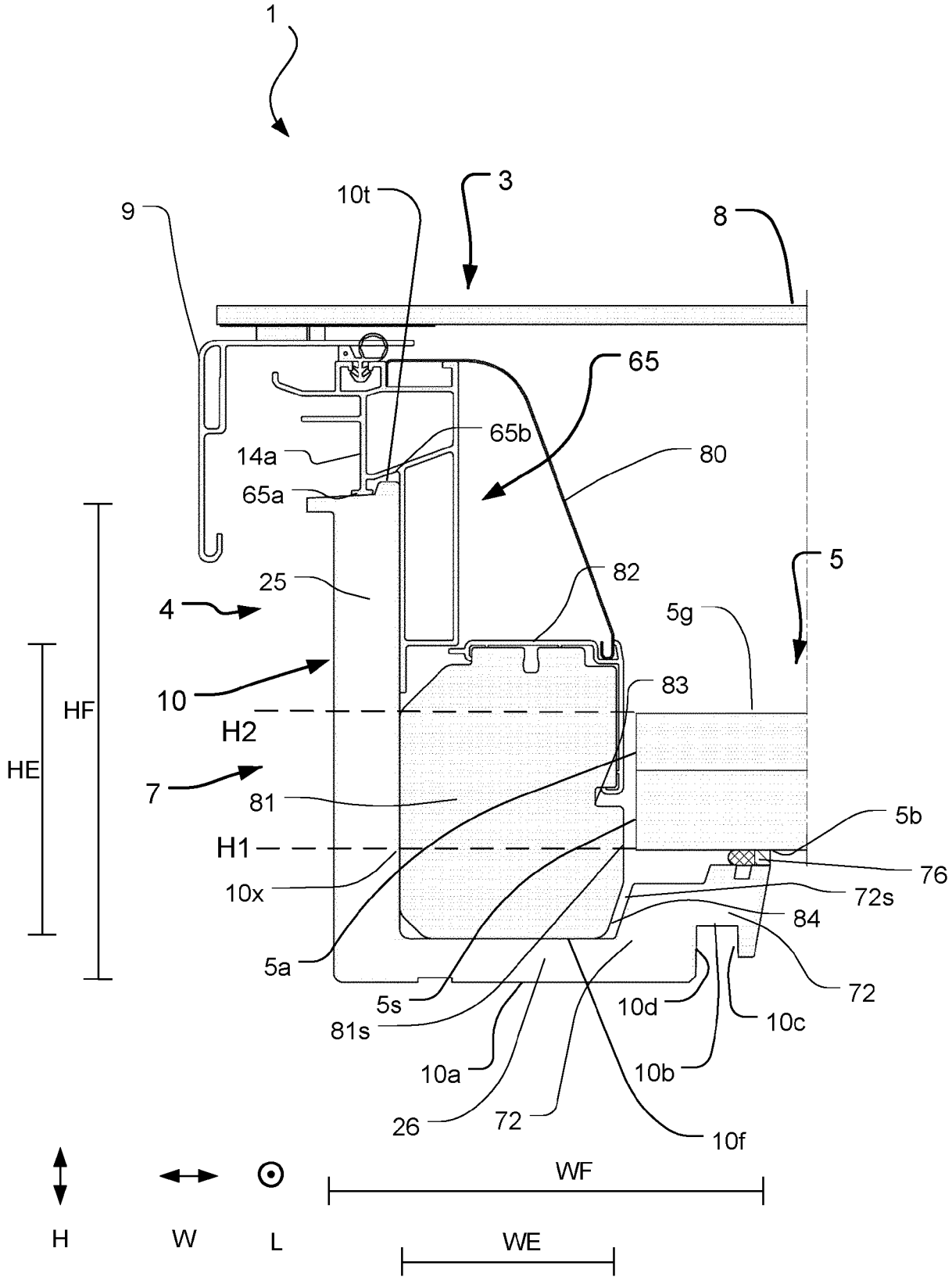
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Fig. 4

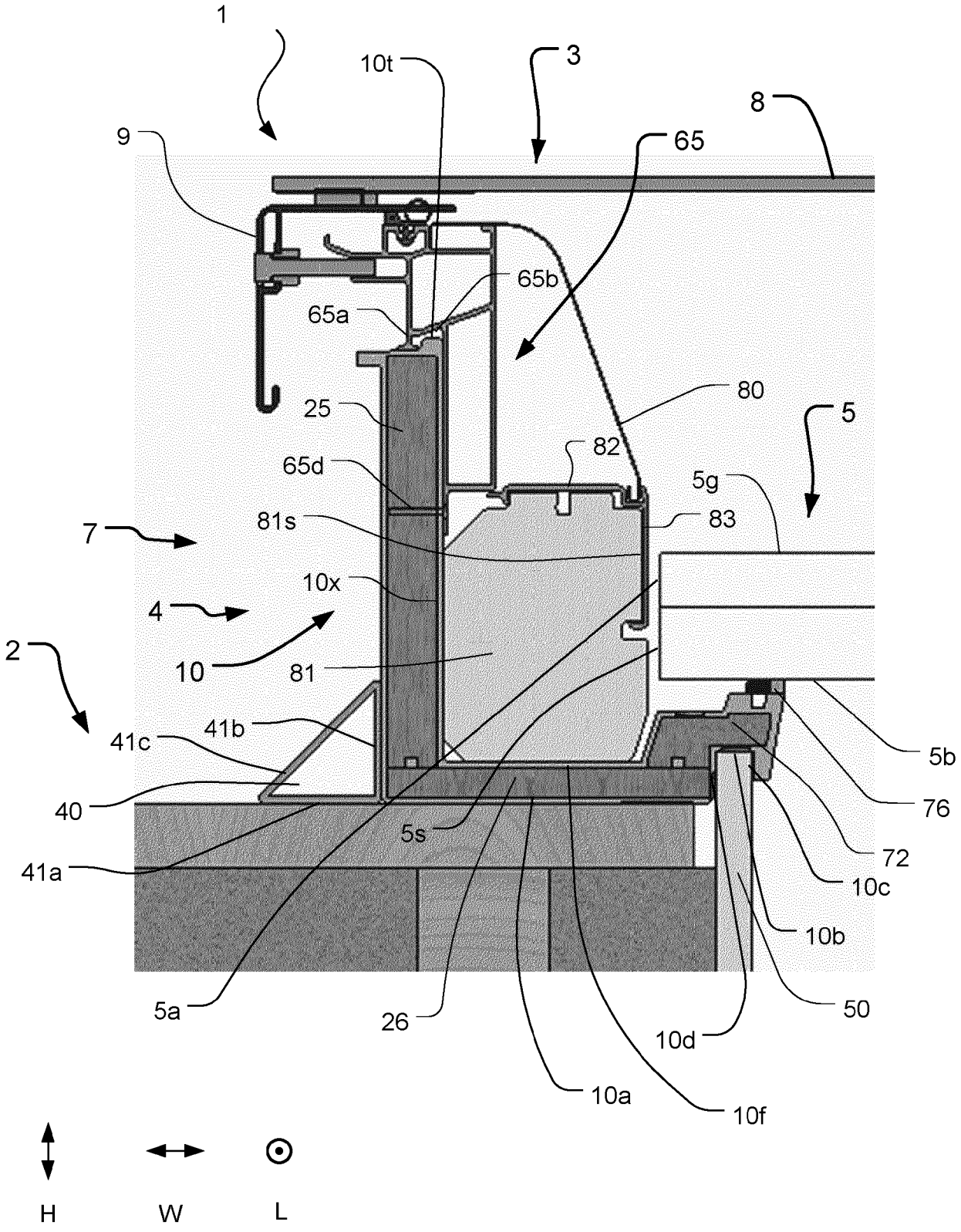
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Fig. 5

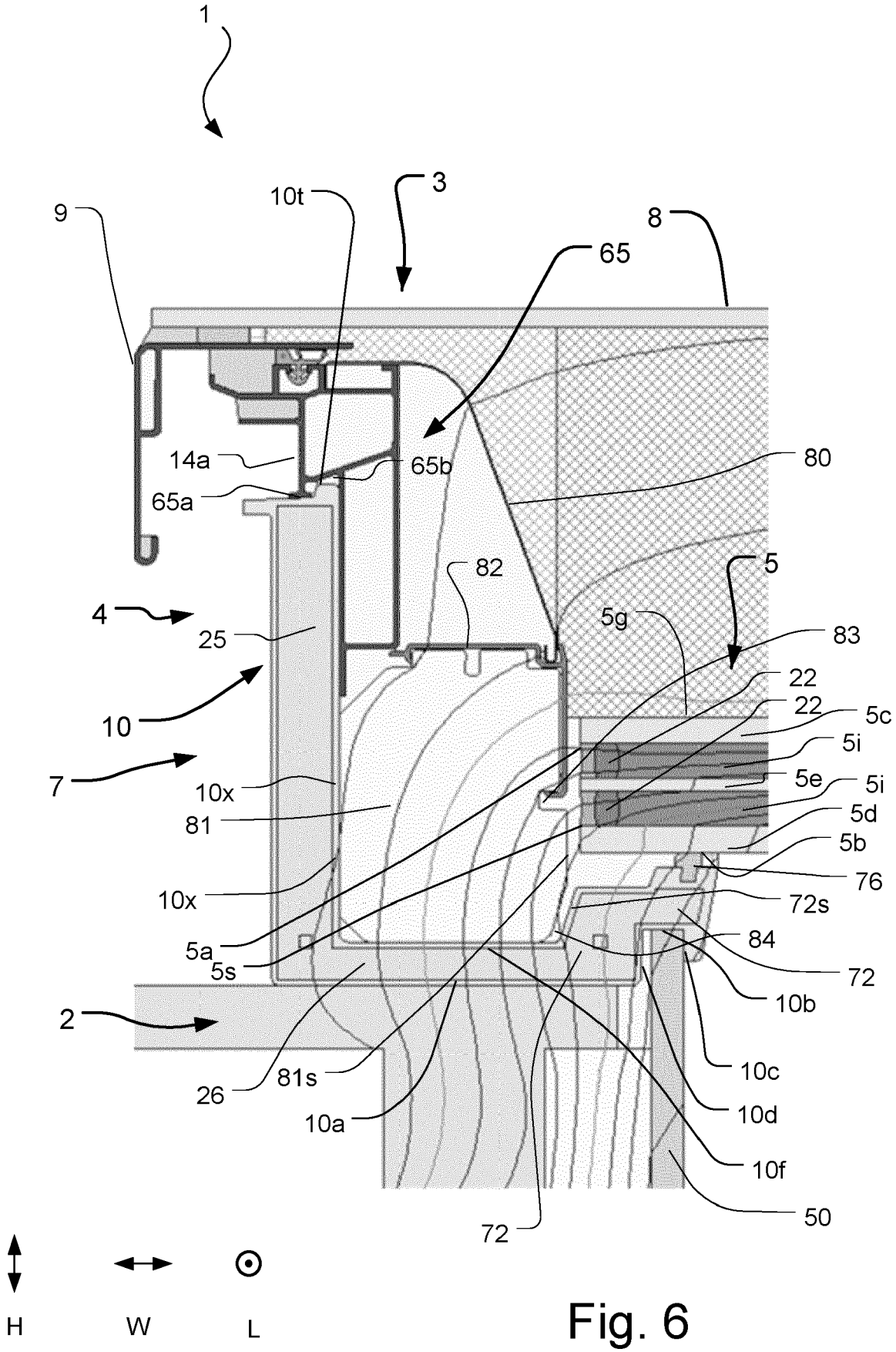
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Fig. 6

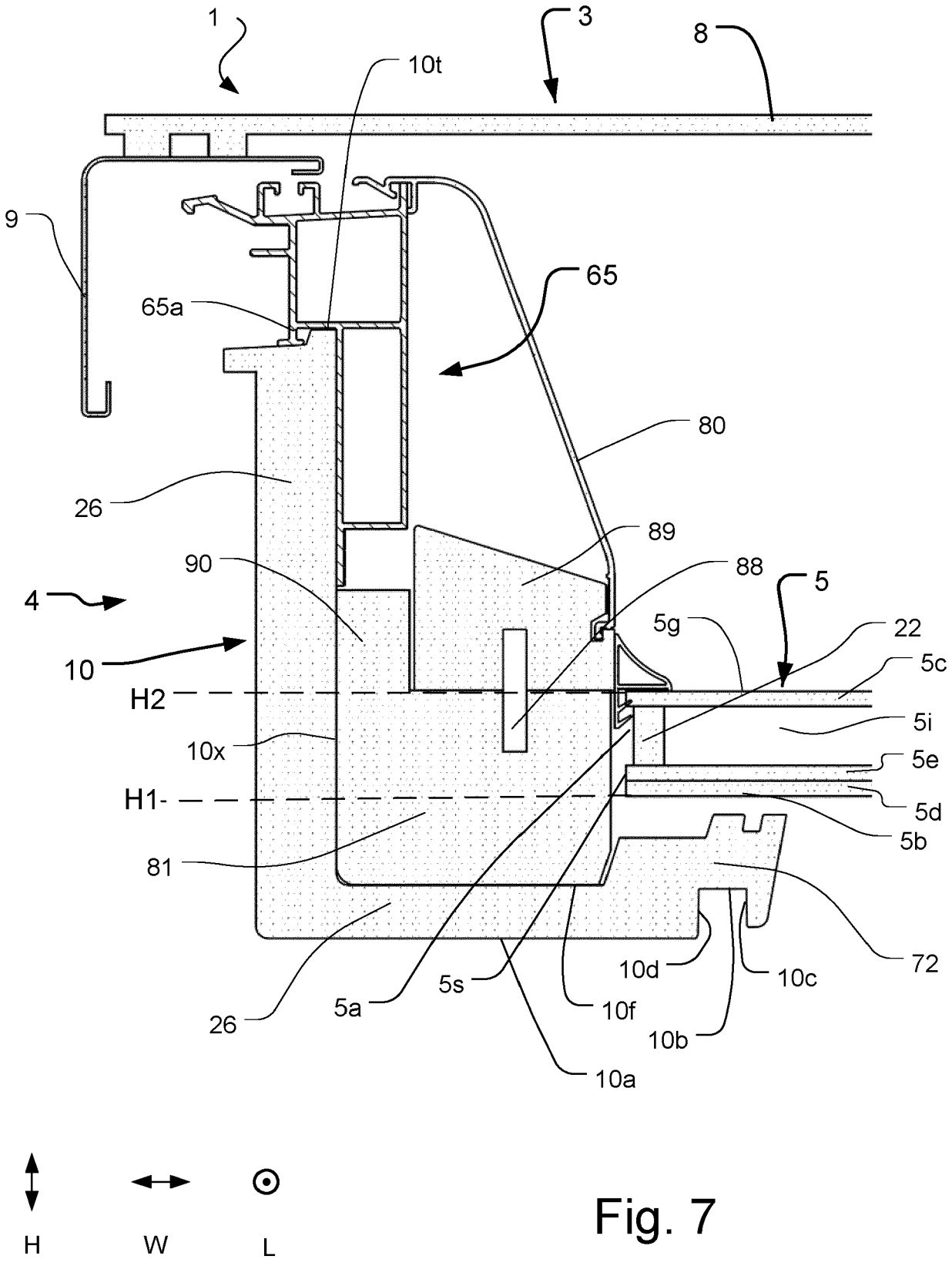
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Fig. 7

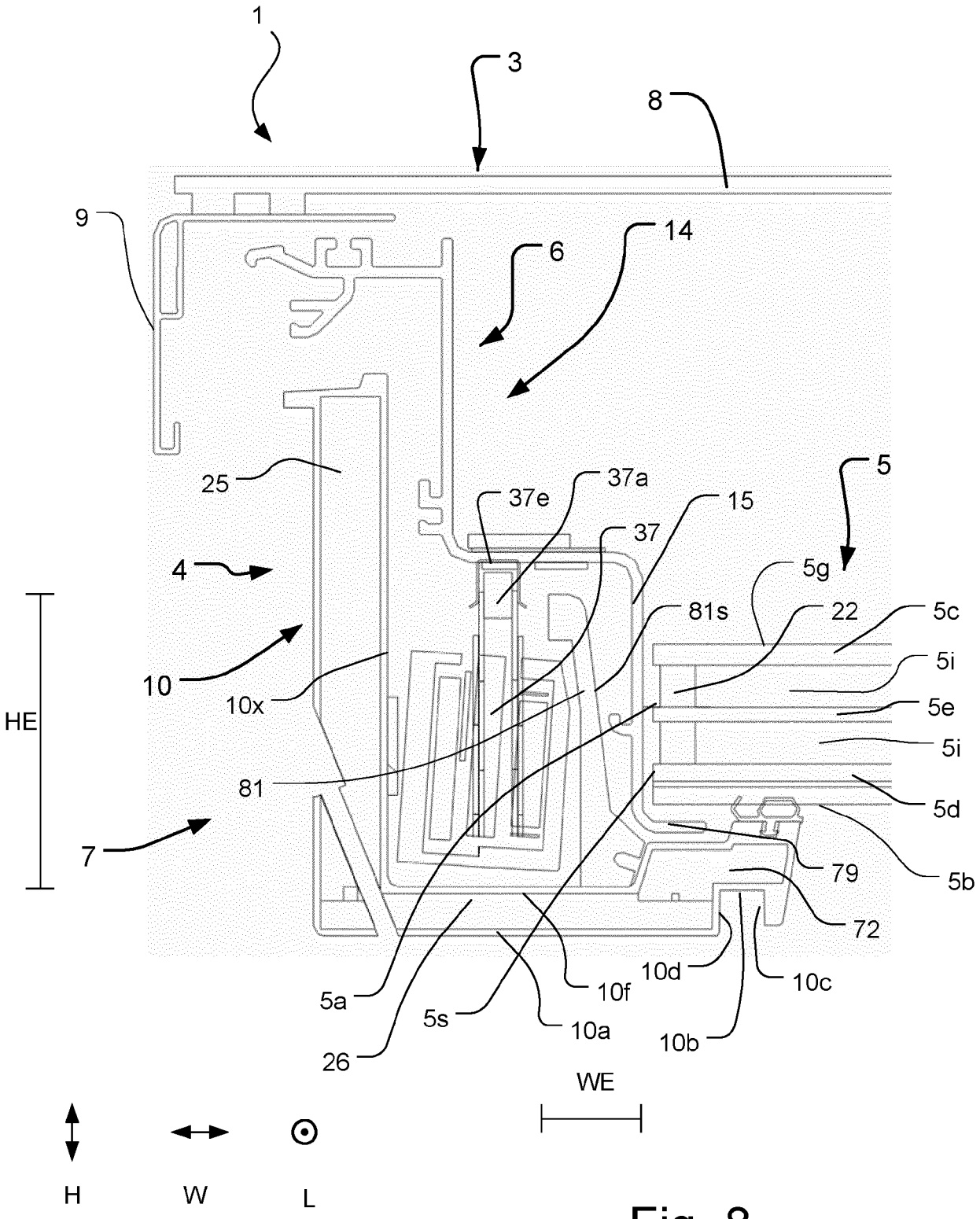
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Fig. 8

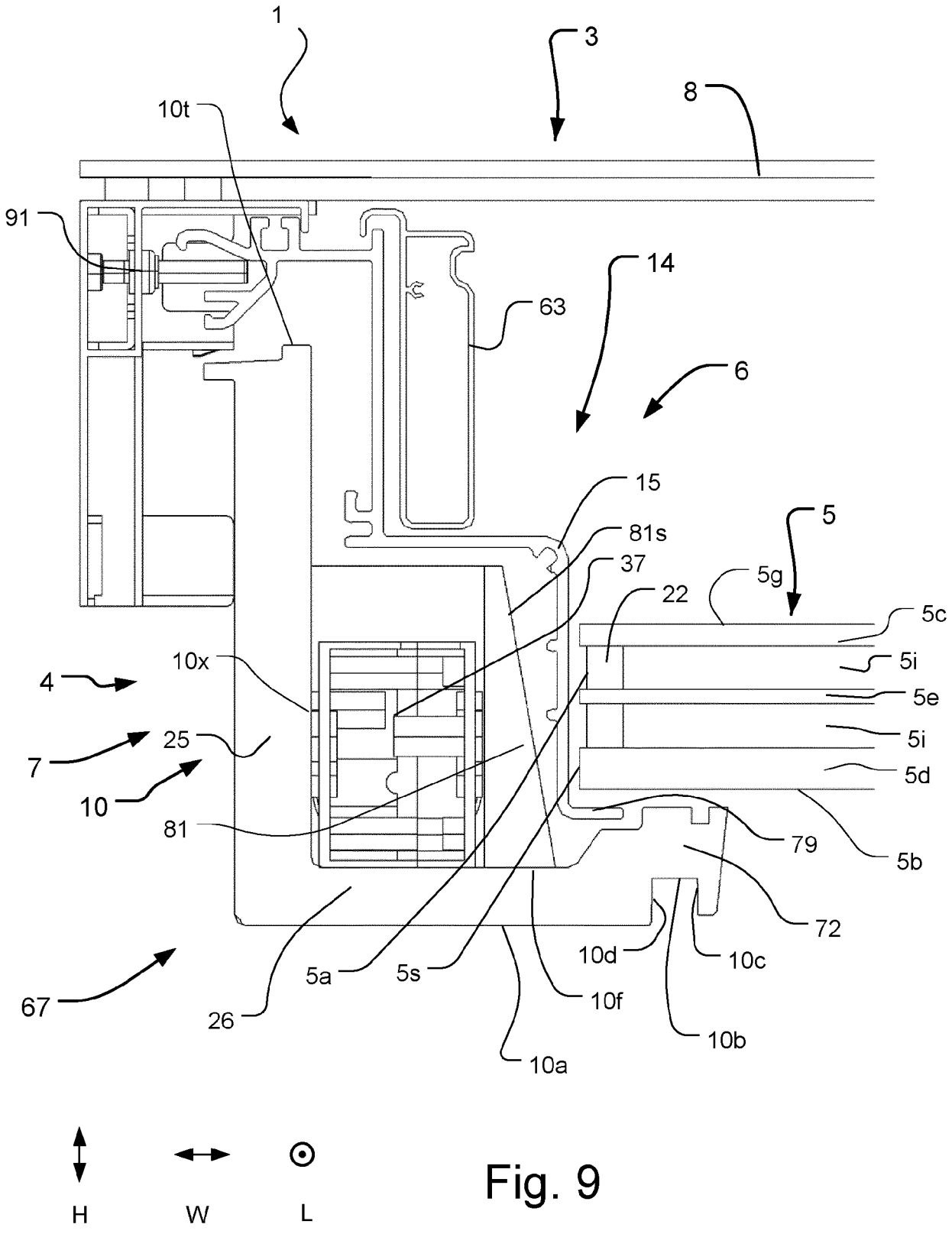
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Fig. 9

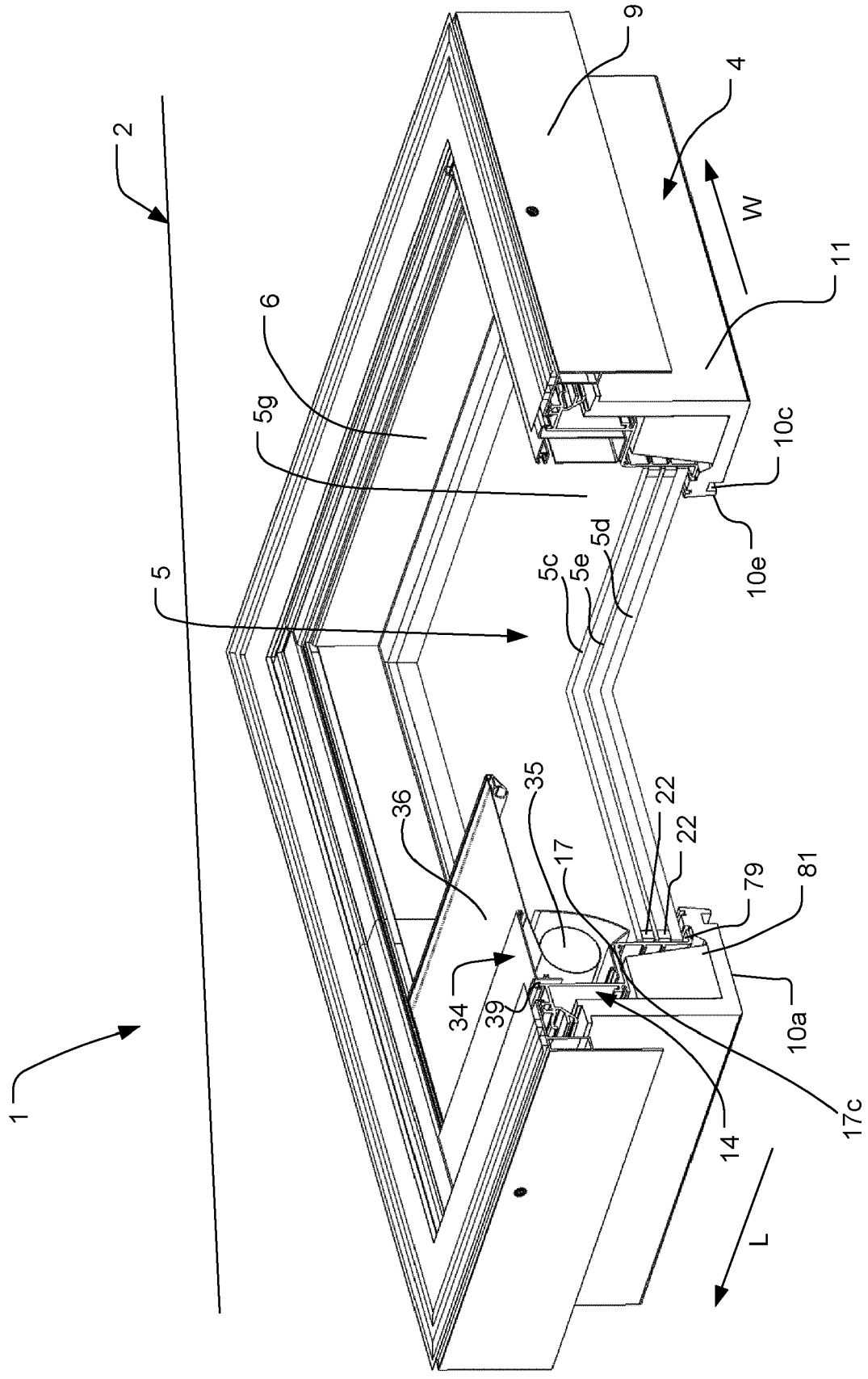
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Fig. 10

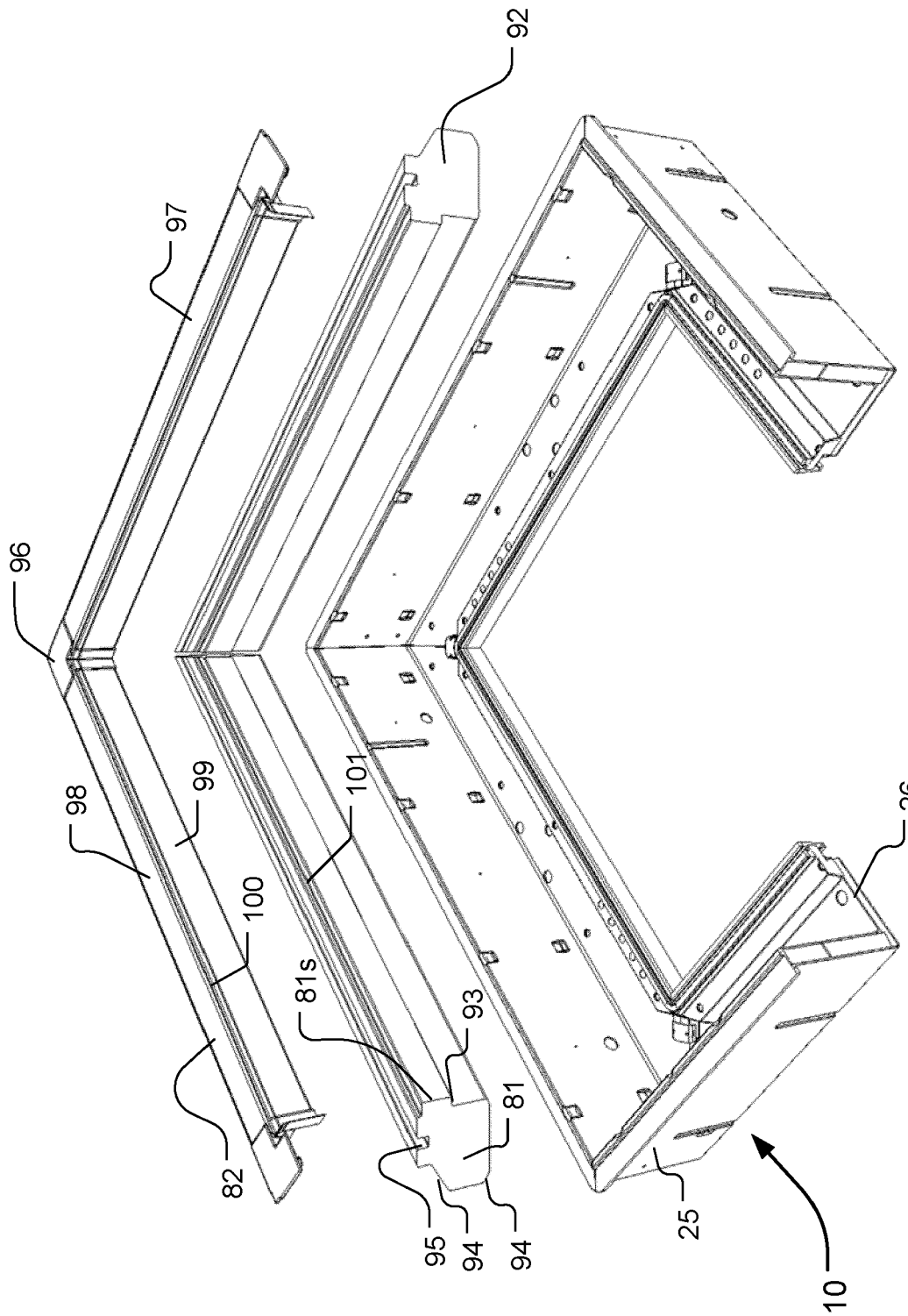

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 20 21 0455

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