



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.02.2021 Bulletin 2021/07

(51) Int Cl.:
E04D 13/035 (2006.01) **E05F 15/616 (2015.01)**
E05F 15/619 (2015.01) **E05F 15/622 (2015.01)**

(21) Application number: **20155249.4**

(22) Date of filing: **03.02.2020**

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

- **Grønborg, Kristian Nitzsch**
2970 Hørsholm (DK)
- **Kristensen, Lars**
2970 Hørsholm (DK)
- **Østergaard, Iben Bjerre**
2970 Hørsholm (DK)
- **Pedersen, Rasmus Klercke**
2970 Hørsholm (DK)

(71) Applicant: **VKR Holding A/S**
2970 Hørsholm (DK)

(74) Representative: **AWA Denmark A/S**
Strandgade 56
1401 Copenhagen K (DK)

(72) Inventors:
 • **Bertram, Jacob**
2970 Hørsholm (DK)

(54) **A SKYLIGHT WINDOW**

(57) A skylight window for being installed in a roof of a building, the skylight window comprising a window frame having four frame side members, a window sash having four sash side members, and an IGU, said window sash being movable in relation to the window frame between an exterior open position and a closed position of the skylight window, a motor-driven actuator comprising an elongated lifting element connecting between 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, wherein at least the top end of the lifting element is at or above a height level of the interior major surface of the IGU in the height direction in the closed position of the skylight window.

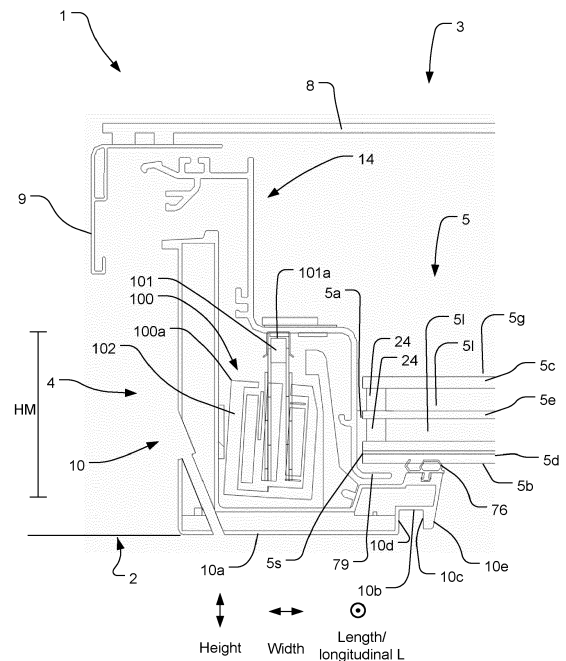


Fig. 2

Description

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

a window frame having four frame side members, a window sash having four sash side members supporting an IGU having multiple layers of glazing, said window sash being movable in relation to the window frame between an exterior open position and a closed position of the skylight window, a motor-driven actuator comprising an elongated lifting element connecting between 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, said IGU having an exposed interior major surface for facing an interior of the building in an installed position of the skylight window, the exposed interior major surface being of an interior pane of the IGU, and an exterior major surface facing in a direction opposite to the interior of the building towards an exterior, a height direction extending substantially perpendicularly to at least one of the major surfaces of the IGU in a closed position of the skylight window, and a lateral direction extending in parallel with the exposed interior major surface of the IGU in the closed position of the skylight window.

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

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

[0004] It is common today to use a skylight window in flat roofs and potentially cover the window portion with a dome-shaped weather shield. One example of this type of skylight window is disclosed in WO 2009/080026 A1 and EP 2500488 B1. The roof window in WO 2009/080026 A1 comprises a standard VELUX® outwardly openable window, to the sash of which a dome-shaped weather shield is attached.

[0005] Window sashes have typically comprised box

structures consisting of hollow spacings as an attempt to provide structural support and thermal insulation through cavities. A typical example of such structures is presented in US2010269426. Windows comprising such sashes have typically a quite rough appearance, while limiting the view. What is more, these windows are usually associated with high materials and processing costs in terms of manufacturing the window sash.

[0006] For convenience of opening and closing roof windows they may be provided with an actuator, one such example is provided in EP 3348737 A1.

[0007] There is also a general desire to provide skylight windows with higher influx of light and better insulation properties to provide better illumination of the interior of buildings as well as reduce the energy consumption required for illumination, heating and cooling of buildings.

[0008] On this background it may be an object of the invention to provide a skylight window according to the introduction in which the insulation properties are improved.

[0009] Furthermore, it may be an object of the invention to provide a skylight window in which a view through the window is improved.

[0010] According to the invention, one or more of these objects may be met by a skylight window according to the introduction characterized in that at least the top end of the lifting element is at or above a height level of the interior major surface of the IGU in the height direction in the closed position of the skylight window.

[0011] In this way the skylight window may be more compact i.e. with a lower total height in the height direction, whilst still comprising a motor-driven actuator for opening and closing the skylight window. A skylight window that is compact in the height direction may improve insulation properties as less thermally conducting sash or frame material may need to be provided.

[0012] Throughout this disclosure, the term "total height" may be understood as a total height of a respective part or component in the height direction from a lowest point of the respective part or component to an uppermost point of the respective part or component. The term "total height" can alternatively or additionally be denoted a "largest height".

[0013] Furthermore, the IGU may be mounted lower in the skylight window, i.e. closer to a bottom of the window frame and closer to the interior of the building. A lower mounting of the IGU may increase the relative proportion the IGU takes up of a thermal energy exchange interface between the building and the skylight. The IGU typically has better insulation properties than other components of the skylight window. Therefore, increasing a relative proportion the IGU takes up of this thermal energy exchange interface may improve the insulation properties of the skylight window as a whole. Furthermore, a high influx of light and good view through the skylight window may also be achieved as less light and/or view obstructing elements of the skylight window may be positioned between the IGU and the bottom of the window frame.

[0014] The window frame members may generally define an inner opening, each frame member having an inner side facing said inner opening and an outer side facing in an opposite direction of the inner side and away from the inner opening, an interior side for, in an installed position, facing an interior of the building, and an exterior side for facing in an opposite direction of the interior side and away from the interior of the building.

[0015] An exterior or outwards open position in this context may be understood as an open position of the window in which the sash and IGU are moved away from the building in an exterior and/or outwardly direction. The sash and IGU may be moved away from the interior of the building.

[0016] The sash may be hinged to facilitate opening of the skylight window. The sash may be hinged via hinges which may be linear displacement mechanisms, multi-link mechanisms or the like. The skylight window may be hinged to open in the exterior direction i.e. away from the interior of the building.

[0017] The motor-driven actuator may be an electric actuator, hydraulic actuator, pneumatic actuator, coiled actuator, thermal actuator, magnetic actuator, vacuum actuator, chain actuator, or a combination thereof. The motor-driven actuator may comprise a linear actuator, non-linear actuator, a stepped actuator, or the like. The motor-driven actuator may comprise an electric motor. The motor-driven actuator may be telescopic i.e. extend telescopically to the open position and/or retract telescopically to the closed position. The motor-driven actuator may comprise one or more of: a top element, an actuator housing, an actuator motor, an actuator lead screw, an actuator lead nut, an actuator gear, an actuator spindle, an actuator stem, or an actuator spring. The top element and/or actuator housing and/or actuator motor and/or actuator lead screw and/or actuator lead nut and/or actuator gear and/or actuator spindle and/or actuator stem and/or actuator spring may be positioned at the same height or above the exposed interior major surface and/or at the same height or above the exposed exterior major surface of the IGU. The top element may be a top element of the actuator housing, actuator motor, actuator lead screw, actuator lead nut, actuator gear, actuator spindle, actuator stem, or actuator spring i.e. an element of the respective component positioned highest in the height direction. The actuator housing may comprise an opening for the elongate lifting element and/or an opening for the actuator. The actuator housing may substantially completely enclose the actuator. The actuator housing may substantially completely enclose the elongated lifting element in the closed position.

[0018] The elongated lifting element may be a lifting element such as a chain which may comprise one or more chain links or joints, a stem, a spindle, a screw, a telescopic lifting element which may comprise one or more telescopic sections, or a lifting rod which may comprise one or more lifting rod joints. 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. The motor-driven actuator may be adjustable between different intermediate positions between the open and closed position. The motor-driven actuator may be seamlessly adjustable between intermediate positions between the open and closed position. The motor-driven actuator may be automatically settable between the open and closed position and/or between pre-set intermediate positions. In an embodiment, the motor-driven actuator may be an electric motor and the elongated lifting element may be a chain that is rolled-up in the closed state and unrolled by the electric motor to move the window into the open position. The elongated lifting element may be directly connected to the sash i.e. directly attached and in contact with the sash.

[0019] 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.

[0020] 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.

[0021] Generally, one or more of the frame and/or sash side members may comprise or be made substantially of polymer materials, such as plastic, specifically PVC (polyvinyl chloride), chlorinated PVC, PUR (polyurethane), fibre reinforced PUR such as glass fibre reinforced PUR, pultruded polymers, polyester, and/or glass fibre and/or wood and/or metal such as steel or aluminium or composites or combinations thereof.

[0022] An outer surface of one or more frame side members may be flat and allow the attachment of a curb flange. The curb flange may be a detachably attachable curb flange. The term "detachably attachable" may be understood as the curb flange being attachable and detachable without causing substantial and/or permanent damage to the curb flange or skylight window.

[0023] The sash of the skylight window may further comprise one or more thermal breaks. The one or more thermal breaks may be made from a material of a lower thermal conductivity than other parts of the first sash side member. The one or more thermal breaks may be an insert or a joint joining parts of the sash. The insert or joint may be a separate part to the first sash side member. The insert or joint may be inserted into the first sash side member. The insert or joint may be attached between parts of the first sash side member. Likewise, the other sash side members may comprise one or more thermal breaks. This may have the advantage of improving the insulation properties of the skylight as a lower thermal conductivity through the supporting section or sash member may be achieved. Thermal breaks may also be used for interconnecting the window frame and the sash. The one or more thermal breaks may substantially consist of or comprise a polymer and/or foam.

[0024] The IGU (Insulated Glazing Unit) may have multiple layers of glass which define a volume comprising an inert gas or aerogels or vacuum. The IGU may in a conventional manner comprise one or, preferably two, three or more layers of glazing positioned at a distance from each other to form one or more sealed spacings or cavities between them. This spacing may be filled with an inert gas or may hold a vacuum to improve insulation. 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 pane may be tempered. The IGU may be see-through transparent to provide a view out. The exposed interior major surface of the IGU may in that case be a lower major surface of a lowermost of the layers of glazing. Sealing and/or supporting members may be provided at one or more of four peripheral sides of the IGU between the layers of glazing. The sealing and/or supporting members may distance adjacent layers of glazing from each other and may to-

gether with lateral edges of the window glazing layers form respective side or lateral surfaces of the IGU. These side surfaces may be substantially plane and extend substantially in the height dimension as defined herein. The term "lowermost" may be understood as interior-most. Similarly, the term "uppermost" may be understood as exterior-most.

[0025] The interior pane of the IGU may be a glazing pane. The interior pane may define a bottom of the IGU. The interior pane may constitute a layer of glazing of the IGU. The interior pane may be of substantially the same size as one or more or all other layer(s) of glazing of the IGU. The interior pane or an exterior pane of the IGU may be of a larger size than one or more of the other layer(s) of the glazing of the IGU. The interior pane may be substantially identical to one or more of the other layer(s) of glazing of the IGU. The interior pane may be different to one or more of the other layer(s) of glazing of the IGU. The interior pane may comprise a first side surface extending substantially along a first frame and sash side member.

[0026] The IGU may comprise an exterior-most layer of glazing of the skylight window. The exterior-most layer of glazing of the skylight window may be an interior or top pane of the IGU. The exposed exterior major surface of the IGU may be the exterior-most layer of glazing of the skylight window. The exterior-most layer of glazing may be substantially identical to the one or more or all other layer(s) of glazing of the IGU.

[0027] The skylight window may further comprise at least one sealing element for abutting a first sash side member in the closed position of the skylight window, said sealing element being located on a side of a first frame side member that faces the sash in the closed position of the skylight window, wherein the first sash side member is abutting said sealing element in the closed position of the skylight. This may have the effect of providing a good sealing of the skylight window.

[0028] In an embodiment, the motor-driven actuator is a chain actuator, the elongated lifting element is a chain, and the top end is a top end of a top joint of the chain.

[0029] In this way the motor-driven actuator may be made compact as the chain in the closed position may be rolled-up. This may have the further effect of allowing the skylight window to be made more compact, which may have the advantages as described above.

[0030] In an embodiment, the elongated lifting element is one of the following: a chain, a lifting rod, a stem, a spindle, a telescopic lifting element, or a screw.

[0031] In this way the motor-driven actuator may be made compact. In turn, this may allow the skylight window to be made more compact.

[0032] In an embodiment, the motor-driven actuator is 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.

[0033] In this way the skylight window may have better entry of light as the motor-driven actuator is positioned

outside the periphery of the IGU and so may not block light entering through the IGU. The term "periphery" may be understood as an outer perimeter.

[0034] In an embodiment, in the closed position of the skylight window, the actuator is mounted such that at least a part of the top end of the elongated lifting element is at or above a height level of the exposed exterior major surface of the IGU in the height direction.

[0035] At least substantially an entirety or an entirety of the elongated lifting element may be at or above a height level of the exterior major surface of the IGU in the height direction.

[0036] In this way the skylight window may be made more compact.

[0037] In an embodiment, in the closed position of the skylight window, at least a top element of the motor-driven actuator is at or above a height level of the interior major surface of the IGU in the height direction. Equal to or more than 10 %, 20 %, 30 %, 40 %, 50 %, 60 %, 70 %, 80 %, 90 % of a total height of the motor-driven actuator may be positioned above the exposed interior major surface. Similarly, equal to or more than 10 %, 20 %, 30 %, 40 %, 50 %, 60 %, 70 %, 80 %, 90 % of a total height of the motor-driven actuator may be positioned above the exposed exterior major surface. In this way the skylight window may be made even more compact

[0038] In an embodiment, in the closed position of the skylight window, a majority of the motor-driven actuator is at or above a height level of the interior major surface of the IGU in the height direction.

[0039] In this way the skylight window may be made even more compact.

[0040] Preferably an entirety of the motor-driven actuator may be positioned above the exposed interior major surface of the IGU.

[0041] In an embodiment, in the closed position of the skylight window, at least a top element of the motor-driven actuator is at or above a height level of the exterior major surface of the IGU in the height direction.

[0042] This may allow the skylight window to be made more compact

[0043] In an embodiment, the motor-driven actuator further comprises an actuator housing, wherein, in the closed position of the skylight window, at least a part of said actuator housing is at or above a height level of the exterior major surface of the IGU in the height direction.

[0044] In this way the skylight window may be made even more compact.

[0045] In a development of the previous embodiment, in the closed and installed position of the skylight window there is a maximum frame distance in the height direction from a top of said actuator housing to an interior surface of the frame of the skylight window, said maximum frame distance being 100 mm or less.

[0046] The said maximum frame distance may be equal to or less than 90 mm, 80 mm, 70 mm, 60 mm, 50 mm, 40 mm, or 30 mm.

[0047] In this way the skylight window may be made even more compact.

[0048] The interior surface of the frame of the skylight window may be a lowermost surface of the frame and/or a frame side member in the height direction.

[0049] There may be maximum roof surface distance in the height direction from the top of said actuator housing to an exterior roof surface for roof covering, said maximum roof surface distance being 100 mm or less.

[0050] The said maximum roof surface distance may be equal to or less than 90 mm, 80 mm, 70 mm, 60 mm, 50 mm, 40 mm, or 30 mm.

[0051] In an embodiment, the sash has a supporting leg extending beneath and supporting the exposed interior major surface of the IGU,

wherein, in the closed position of the skylight window, at least a part of the motor-driven actuator is at or above a height level of the supporting leg in the height direction.

[0052] This may further improve the compactness of the skylight window.

[0053] The supporting leg may extend from a first side surface of the interior pane. The supporting leg may extend along at least a part of a peripheral side of the IGU or along an entirety of a peripheral side of the IGU.

[0054] An entirety of the supporting leg may be located inside of the outer sides of the frame side members. An entirety of the supporting leg may be located within a periphery of the window frame. The periphery may be understood as the outer perimeter of the window frame.

In this way, the skylight window may be more compact. Additionally or alternatively, the supporting leg may constitute an entirety of a part of the first sash side member located within the periphery of the interior pane of the IGU.

[0055] The supporting leg may be substantially plate-shaped. The supporting leg may be substantially box-shaped. The supporting leg may include or consist of all parts of the sash extending beneath the exposed interior major surface of the IGU in the height direction.

[0056] In this way the supporting leg may be more specifically tailored in terms of structural and material properties to the particular environment and stresses it will be subjected to in use. A majority of the first sash side member may extend above the exposed interior major surface.

[0057] The supporting leg may be substantially solid. This may have the technical effect of providing a high-strength supporting leg. The term "substantially solid" may be understood as there being no holes and/or hollow spacings comprised in the material structure and/or holes or cavities on the surface.

[0058] In an embodiment, the skylight window further comprises a first insulating side member extending substantially along a first frame side member,

said first insulating side member comprising an insulating member cavity,

wherein at least a part of the motor-driven actuator is positioned between the first frame side member and the

insulating member cavity in the lateral direction. The term "cavity" may be understood as a hollow spacing in the insulating member. The hollow spacing may have one or more open sides or may be fully closed.

[0059] In this way the motor-driven actuator may be hidden from view when viewing through the skylight window from an interior of the building. A further effect may be to reduce the space taken up by the motor-driven actuator in the window skylight, thereby allowing a larger IGU to be used, thereby improving entry of light and insulating properties.

[0060] At least a part of the motor-driven actuator may be positioned inside the insulating member cavity. Substantially an entirety or an entirety of the motor-driven actuator may be positioned inside the insulating member cavity.

[0061] The first insulating member may comprise or substantially consist of an insulating material such as EPS (Expanded Polystyrene), foamed polymers, or the like.

[0062] In an embodiment, the frame comprises a first frame side member having an inner side facing towards the IGU in the lateral direction and an outer side facing in an opposite direction and away from the IGU in the lateral direction, and a lining panel protrusion protruding 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,

wherein the motor-driven actuator is positioned between the lining panel protrusion and the outer side of the first frame side member in the lateral direction. 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.

[0063] In this way the motor-driven actuator may be hidden from view when viewing through the skylight window from an interior of the building. It may also allow the footprint of the skylight window to be reduced as the motor-driven actuator may be positioned inside a periphery of the skylight window.

[0064] In an embodiment, the skylight window further comprises a weather shield attached to the sash so as to protect a window portion of the skylight window, the window portion comprising the sash, the frame, and the IGU, the weather shield comprising a weather shield pane.

[0065] The weather shield may be provided as a unitary structure, which is or may be detachably attached to the sash. This may have the effect of providing for access to clean the IGU; this may also be of advantage during installation of the skylight window, e.g. when positioning or attaching the window portion or when attaching roofing felt to cover a potential gap between the frame and the roof structure. The weather shield may be mounted on the window portion to protect it from the elements

and preventing rain and other precipitation from entering into gaps or slots in the roof or the window portion.

[0066] 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 one or more or all four sides of the frame, i.e. of the respective frame side members. The skirt may be manufactured from or include metal. The weather shield pane may curve upwards 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 weather shield pane that may be of glass, hardened or clear polymer. The weather shield pane may be considered as a transparent cover member for protection a window portion. The weather shield pane may comprise only one single layer of glazing, no further layers of glazing besides those of the weather shield potentially being provided in the skylight window. The weather shield pane may be dome-shaped or substantially flat. The weather shield pane may be of glass or of polymer. The weather shield may be a weather shield without a sealed gas-filled spacing between the weather shield pane and the IGU.

[0067] The motor-driven actuator may be positioned in the space delimited by the frame side members and the weather shield.

[0068] In an embodiment, the four sash side members each have an interior side facing the interior of the building in the installed position of the skylight window and an exterior side facing the exterior, said four sash side members including a first sash side member and a second sash side member, which is substantially parallel to the first sash side member, said first sash side member extending in a longitudinal direction along a first peripheral side of the IGU and said second sash side member extending in a longitudinal direction along a second peripheral side of the IGU,

a weather shield positioned over the exterior major surface of the IGU when seen in the height direction so as to cover the sash and the IGU for protecting a window portion of the skylight from the weather, said window portion comprising the sash, the frame, and the IGU, the weather shield comprising a weather shield pane, and a screening device 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 sash side member and a second, screening end position in which, for the screening of the IGU, it is extended between the first and second sash side members, wherein the screening device is mounted in a spacing delimited in the lateral direction by the first and second sash side members and in the height direction by the weather shield pane towards the exterior and by the sash and/or the exterior major surface of the IGU towards the interior, and in that the screening device is located below the exterior side of the first sash side member when seen in the height direction.

[0069] The fact that the screening device is located below the exterior side of the first sash side member means that the weather shield pane can be provided relatively close to the IGU, hence making the path to be travelled by sunlight in order to reach the interior of the building relatively short and thereby improving light entry.

[0070] 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.

[0071] 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.

[0072] In another embodiment the skylight is to be installed in a roof with an inclination between 5 and 15 degrees relative to horizontal.

[0073] The skylight window according to the invention will now be described in greater detail based on non-limiting exemplary embodiments and with reference to the drawings, on which:

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

FIG. 2 shows a cross-sectional view of a skylight window according to the present invention,

FIG. 3 shows a similar cross-sectional view of a skylight window according to the present invention wherein the motor-driven actuator is positioned inside an insulating member,

FIG. 4 shows a perspective cross-sectional view of the skylight window in FIG. 3.

[0074] Similar features in each of the figures have been given the same reference numbers unless otherwise specified.

[0075] 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. 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. 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 here formed by a curb flange 40 of the frame 7.

[0076] The weather shield 3 is attached to the sash 6 so as to protect the window portion 4 of the skylight window. The weather shield 3 comprises a transparent weather shield pane 8 and a skirt 9, which cover the sash and the IGU 5. It should be noted that the skylight window 1 in other embodiments does not include the weather shield 3. The slightly curved weather shield pane 8 as seen in FIG. 1 extends over an 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 respective frame side members, see FIG. 1. The weather shield 3

is a weather shield without a sealed gas-filled spacing between the weather shield pane 8 and the IGU 5.

[0077] In this embodiment, 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.

[0078] The four frame side members two of which 10, 11 are shown in FIG. 1 are made from PUR (polyurethane) and form a substantially rectangular shape. The four sash side members are made of aluminium and form a substantially rectangular shape. In the embodiment of FIG. 2, each frame side member is positioned at an outer side of a respective associated one of the four sash side members, i.e. on the side facing away from the IGU 5. The flat roof 2 shown in FIG. 1 has a roof inclination of about 0 degrees in relation to horizontal. The skylight window 1 may, however, also be installed in an inclined roof having a roof inclination of above 0 degrees.

[0079] A cross-sectional view of the invention is shown in FIGS. 2-3, the cross-sectional view is along line II-II in FIG. 1 and shows the elements of the skylight window 1. Although only a cross-section of a side of the skylight window is shown in FIGS 2-3, the embodiments shown in FIGS 2-3 are generally similar to the embodiment shown in FIG. 1, e.g. in that they comprise four frame and sash side members, an IGU, and a weather shield positioned in a manner similar to what is shown in FIG. 1.

[0080] Turning to FIG. 2, the IGU 5 in this embodiment comprises three layers of glazing 5c, 5e, 5d in the form of tempered glass panels, positioned at a distance from each other by sealing members 24 located at peripheral sides of the IGU between the layers of glazing to form two spacings 51. These spacings 51 are filled with inert gas to improve insulation. The IGU 5 further has an exposed interior major surface 5b facing downwards towards an interior of the building in the shown installed and closed position of the skylight window 1 and an exposed exterior major surface 5g facing in an opposite direction towards an exterior. The exposed interior major surface 5b is of an interior pane 5d of the IGU 5. The exposed interior and exterior major surfaces 5b, 5g of the IGU 5 are substantially parallel with each other and a plane defined by the roof surface 2, i.e. the exterior roof surface level. The interior pane 5d comprises a side surface 5s extending substantially along the first frame and sash side members 10, 14. It should also be noted that the layers of glazing 5c, 5e, and 5d of the IGU 5 are of the same size, which, however, need not be the case e.g. the top layer of glazing 5c may extend beyond the periphery of the other layers of glazing.

[0081] The four sash side members of which one 14 is shown support the IGU 5 which has multiple panes or layers of glazing 5c, 5d, 5e (the interior pane constitutes a layer of glazing of the IGU) and the sash is connected to the window frame 7 via rotary hinges 21 (as shown in FIG. 3) so that, in a conventional manner, it is movable

(pivotable) in relation to the frame 7 between an open (not shown) and a closed position of the skylight window 1. The hinge may alternatively be a linear displacement mechanism or a multi-link mechanism. The skylight window 1 is shown in the closed position in all of the figures. The first frame side member 10, comprising interior side 10a, is associated with the first sash side member 14, and both of these extend in a respective longitudinal direction L substantially in parallel with a respective first peripheral side 5a of the IGU 5 (i.e. into the drawing) in a closed position of the skylight window 1. The outer surface of the first frame side member 10 is flat and allows attachment of a curb flange. In this closed position of the skylight window 1, the first frame side member 10 is located farther from the side surface 5s of the interior pane 5d than the supporting leg 79. This helps covering and hiding the supporting leg 79 and first sash side member 14 when viewing through the window 1 from the interior of a building, thus providing a clean and aesthetic appearance. A sealing element 76 is provided on the first frame side member 10 for sealing between the interior major surface 5b of the IGU 5 and the first frame side member 10.

[0082] The first frame side member 10 further comprises a lining panel protrusion 10e located lower than the exposed interior major surface 5b of the IGU 5 in the height direction. The lining panel protrusion 10e protrudes away from the IGU 5 and has a first surface 10c for abutting a surface of the reveal panel or lining panel 50 so as to position a reveal panel or lining panel 50 as shown in FIG. 2. The reveal or lining panel 50 covering the first frame side member 10 to provide a seamless and clean aesthetic when viewing through the skylight window 1 from an interior of the building.

[0083] In the embodiments shown in FIGS. 2-4, in the closed position of the skylight window, the first surface 10c of the respective protrusion 10e of each embodiment in a lateral direction extending along the exposed interior major surface 5b of the IGU 5 is positioned farther away from the side surface 5s of the interior pane 5d than the supporting leg 79.

[0084] In the embodiments of FIGS. 2-4, the first surface 10c of the lining panel protrusion 10e together with a second surface 10d of the first frame side member form the sides of a lining panel recess 10b, which is an empty spacing that accommodates an upper part or upper end of a reveal panel or lining panel 50 in the installed position of the skylight window 1. It should be noted that the skylight window in other embodiments does not comprise a lining panel recess, but may just comprise a lining panel protrusion 10e. The skylight window alternatively or additionally 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.

[0085] As seen in FIG. 2, the entire supporting leg 79 is located within the periphery of the window frame 7 and

is substantially solid. The supporting leg 79 constitutes the part of the first sash side member 14 that is located below the exposed interior major surface 5b of the IGU 5 and within the periphery of the interior pane 5d of the IGU 5.

[0086] The skylight window 1 further comprises a motor-driven actuator in the form of a chain actuator 100 positioned between the IGU 5 and the frame 7 in a direction parallel with the exposed interior major surface 5b of the IGU 5 in the closed position of the skylight window 1 and between the lining panel protrusion 10e and the outer side of the first frame side member in the lateral direction. Positioning the chain actuator 100 outside the periphery of the IGU 5 improves the light entry and view through the skylight window. The motor-driven actuator 100 comprises an elongated lifting element in the form of a chain 101 connecting between the frame 7 and the sash 6, in this embodiment between a first frame side and sash side member 10 and 14, for moving the sash between the open position and the closed position of the skylight window. As shown in FIG. 3, the chain 101 has a top end 101 a, in this case a top end of a top joint of the chain. The motor-driven actuator 100 has a first position in which the skylight window 1 is in the closed position and a second position in which the skylight window is in the open position. In the closed position of the skylight window, the top end 101 a is positioned above the height level of the interior major surface 5b and above the height level of the exterior major surface 5g of the IGU 5 in the height direction. In other embodiments the top end 101a is only positioned above the interior major surface 5b of the IGU 5. Approximately 80 % of the total height HM of the chain actuator 100, as well as the top element 100a thereof, are positioned above the exposed interior major surface 5b of the IGU 5 in the height direction, so providing a compact skylight window 1. In this closed position, the chain 101 is rolled-up within the motor-driven actuator 100, with only the top of the chain 101 that is connected to the first sash side member 14 exposed. The lifting element may alternatively be a lifting rod, a stem, a spindle, a telescopic lifting element, a screw, or the like. To open the skylight window 1 from the closed position, the chain actuator 100 unrolls the chain 101 from the first position to the second position, thereby pushing the sash 6 together with the IGU 5 in the exterior direction and into the open position of the skylight window 1.

[0087] Turning to FIG. 3, which shows a cross-section of an embodiment similar to the embodiment in FIG. 2, the elongated lifting member in the form of a lifting rod (not shown) is fully retracted inside the actuator housing 102. The motor-driven actuator 100 is positioned within the insulating member 21. Approximately 70 % of the total height HM of the motor-driven actuator 100 is positioned above the exposed interior major surface 5b of the IGU 5 in the height direction. An opening (not shown) in the insulating member 81 for lifting rod to extend through is provided. A sash covering leg 80 is further

provided on the first sash side member 14 to cover and hide part of the sash from sight when viewing through the skylight window 1 from the interior of the building. The cover leg 80 also comprises a side guide rail 42a for guiding a screening body (as seen in FIG. 4).

[0088] FIG. 4 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 purposes. The window frame 7 and the window sash 6 correspond to the ones shown in FIG. 3, the motor-driven actuator 100 being hidden from view as it is positioned within an insulating member cavity of the insulating member 81. The weather shield pane 8 here has been removed for clarity. FIG. 4 also shows a screening device 34, which is mounted in a spacing delimited in the width direction W by the first 14 and second 13 sash side members. It is to be understood that the second sash member 13 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.

[0089] Towards the interior, the spacing is delimited in FIG. 4 by the step surface 17c formed by the sash side member 14. The step surface 17c thus serves as a screening device support section. The screening device 34 is here depicted as a roller curtain in which the screening body 36 is a covering cloth, which is 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 the second sash side member 13 for covering the IGU 5. The screening device 34 might, however, also be another type of blind or a shutter. In FIG. 4, a fixation member 39 is also attached to the first sash side member 14 and extends towards the second sash side member 13. 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 5.

[0090] The following is a list of reference numerals used throughout this specification.

1	Skylight window
2	Roof
3	Weather shield
4	Window portion
5	IGU
5a	First peripheral side
5b	Exposed interior major surface
5c	Layer of glazing
5d	Interior pane / layer of glazing
5e	Layer of glazing
5g	Exposed exterior major surface
5s	Side surface
5l	Spacing
6	Sash

7	Frame
8	Weather shield pane
9	Weather shield skirt
10	First frame side member
5 10a	Interior surface of frame side member
10b	Lining panel recess
10c	First surface
10d	Second surface
10e	Lining panel protrusion
10 11	First frame side member
13	Second sash side member
14	First sash side member
17c	Stepped surface
21	Rotary hinge
15 24	Sealing member
34	Screening device
35	Collection device
36	Screening body
39	Fixation member
20 40	Curb flange
42a	Side guide rail
50	Reveal panel or lining panel
75	Thermal break
76	Sealing element
25 79	Supporting leg
80	Sash covering leg
81	Insulating member
100	Motor-driven actuator / chain actuator
100a	Top element of motor-driven actuator
30 101	Elongated lifting element / chain
101a	Top end of elongated lifting element / top end of chain
102	Actuator housing
L	Length / longitudinal direction
35 W	Width direction
HM	Total height of motor-driven actuator

Claims

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

45 a window frame having four frame side members,
a window sash having four sash side members supporting an IGU having multiple layers of glazing, said window sash being movable in relation to the window frame between an exterior open position and a closed position of the skylight window,
50 a motor-driven actuator comprising an elongated lifting element connecting between 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, said IGU having an exposed interior major surface for facing an interior of the building in an installed position of the skylight window, the exposed interior major surface being of an interior pane of the IGU, and an exterior major surface facing in a direction opposite to the interior of the building towards an exterior, a height direction extending substantially perpendicularly to at least one of the major surfaces of the IGU in a closed position of the skylight window, and a lateral direction extending in parallel with the exposed interior major surface of the IGU in the closed position of the skylight window, **characterized in that** at least the top end of the lifting element is at or above a height level of the interior major surface of the IGU in the height direction in the closed position of the skylight window.
2. A skylight window according to claim 1, wherein the motor-driven actuator is a chain actuator, the elongated lifting element is a chain, and the top end is a top end of a top joint of the chain.
 3. A skylight window according to claim 1, wherein the elongated lifting element is one of the following: a chain, a lifting rod, a stem, a spindle, a telescopic lifting element, or a screw.
 4. A skylight window according to any of the preceding claims, wherein the motor-driven actuator is 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.
 5. A skylight window according to any of the preceding claims, wherein in the closed position of the skylight window, the actuator is mounted such that at least a part of the top end of the elongated lifting element is at or above a height level of the exposed exterior major surface of the IGU in the height direction.
 6. A skylight window according to any of the preceding claims, wherein, in the closed position of the skylight window, at least a top element of the motor-driven actuator is at or above a height level of the interior major surface of the IGU in the height direction.
 7. A skylight window according to any of the preceding claims, wherein, in the closed position of the skylight window, a majority of the motor-driven actuator is at or above a height level of the interior major surface of the IGU in the height direction.
 8. A skylight window according to any of the preceding claims, wherein, in the closed position of the skylight window, at least a top element of the motor-driven actuator is at or above a height level of the exterior major surface of the IGU in the height direction.
 9. A skylight window according to any of the preceding claims, wherein the motor-driven actuator further comprises an actuator housing, Wherein, in the closed position of the skylight window, at least a part of said actuator housing is at or above a height level of the exterior major surface of the IGU in the height direction.
 10. A skylight window according claim 9, wherein in the closed and installed position of the skylight window there is a maximum frame distance in the height direction from a top of said actuator housing to an interior surface of the frame of the skylight window, said maximum frame distance being 100 mm or less.
 11. A skylight window according to any of the preceding claims, wherein the sash has a supporting leg extending beneath and supporting the exposed interior major surface of the IGU, wherein in the closed position of the skylight window at least a part of the motor-driven actuator is at or above a height level of the supporting leg in the height direction.
 12. A skylight window according to any of the preceding claims, further comprising a first insulating side member extending substantially along a first frame side member, said first insulating side member comprising an insulating member cavity, wherein at least a part of the motor-driven actuator is positioned between the first frame side member and the insulating member cavity in the lateral direction.
 13. A skylight window according to any of the preceding claims, wherein the frame comprises a first frame side member having an inner side facing towards the IGU in the lateral direction and an outer side facing in an opposite direction and away from the IGU in the lateral direction, and a lining panel protrusion protruding 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, wherein the motor-driven actuator is positioned between the lining panel protrusion and the outer side of the first frame side member in the lateral direction.
 14. A skylight window according to any of the previous claims, further comprising a weather shield attached to the sash so as to protect a window portion of the skylight window, the window portion comprising the sash, the frame, and the IGU, the weather shield comprising a weather shield pane.

15. A skylight window according to any one of claims 1 to 13, wherein the four sash side members each have an interior side facing the interior of the building in the installed position of the skylight window and an exterior side facing the exterior, said four sash side members including a first sash side member and a second sash side member, which is substantially parallel to the first sash side member, said first sash side member extending in a longitudinal direction along a first peripheral side of the IGU and said second sash side member extending in a longitudinal direction along a second peripheral side of the IGU, a weather shield positioned over the exterior major surface of the IGU when seen in the height direction so as to cover the sash and the IGU for protecting a window portion of the skylight from the weather, said window portion comprising the sash, the frame, and the IGU, the weather shield comprising a weather shield pane, and

a screening device 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 sash side member and a second, screening end position in which, for the screening of the IGU, it is extended between the first and second sash side members, wherein the screening device is mounted in a spacing delimited in the lateral direction by the first and second sash side members and in the height direction by the weather shield pane towards the exterior and by the sash and/or the exterior major surface of the IGU towards the interior, and in that the screening device is located below the exterior side of the first sash side member when seen in the height direction.

5

10

15

20

25

30

35

40

45

50

55

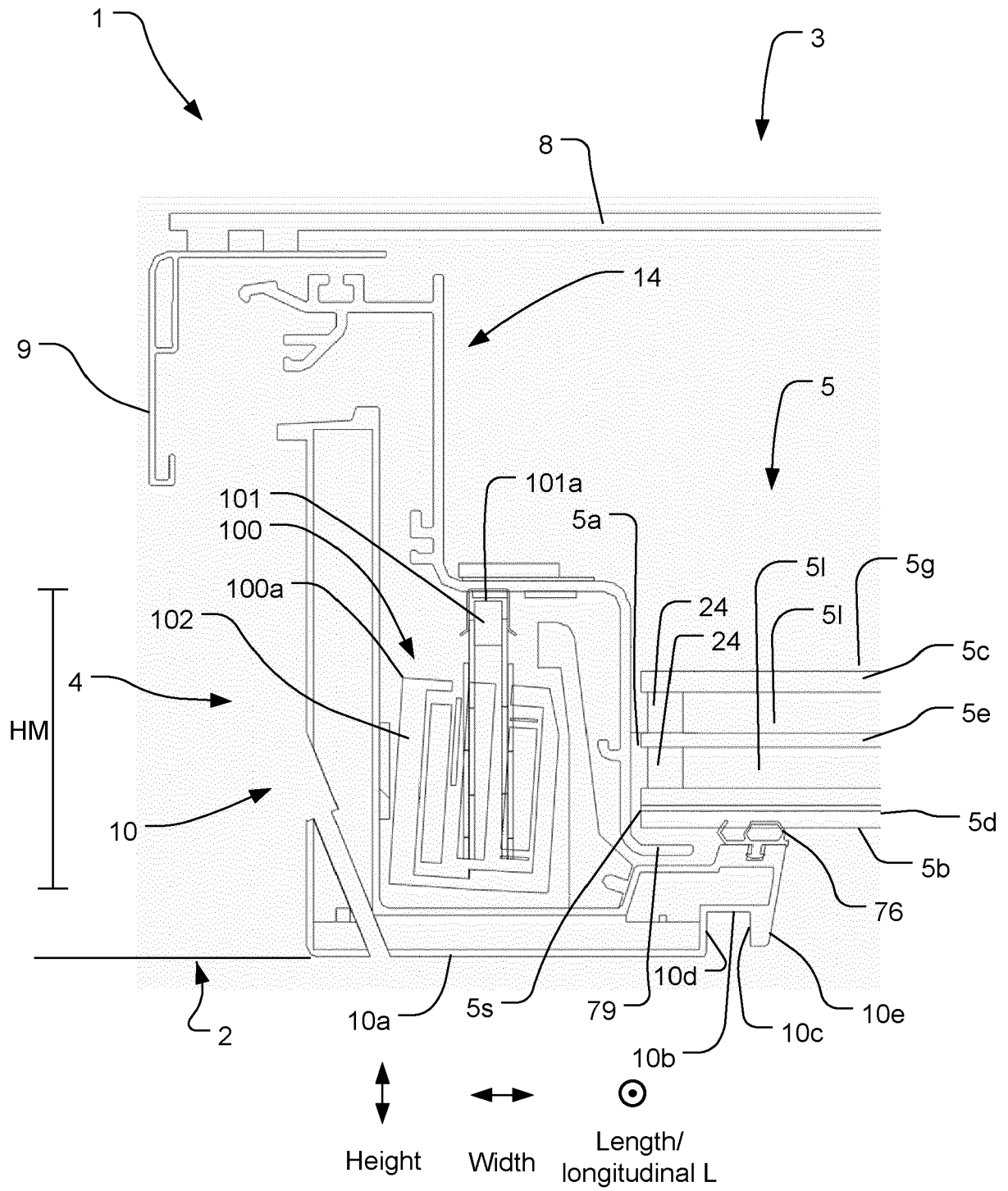


Fig. 2

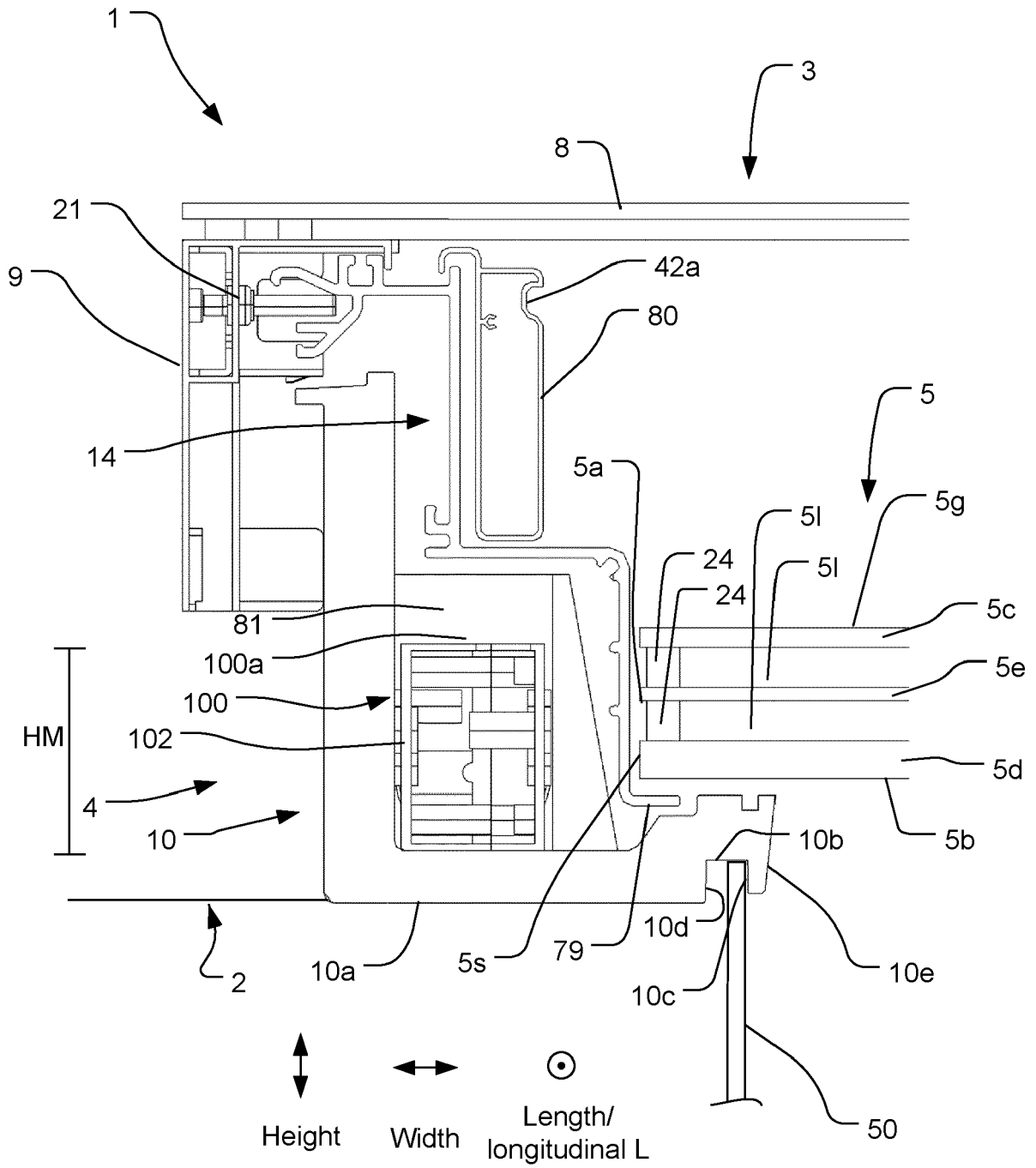


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 20 15 5249

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	NL 1 033 845 C2 (UBBINK BV [NL]) 18 November 2008 (2008-11-18) * figures 1,3,6,7 *	1-12,14,15	INV. E04D13/035 E05F15/616 E05F15/619 E05F15/622
X	EP 2 385 184 A1 (VKR HOLDING AS [DK]) 9 November 2011 (2011-11-09) * figures 7,8 *	1-3,11,13,14	
X	EP 3 505 712 A1 (VKR HOLDING AS [DK]) 3 July 2019 (2019-07-03) * paragraph [0047]; figures 4,6 *	1-9,11,14,15	
X	EP 2 472 026 A1 (VKR HOLDING AS [DK]) 4 July 2012 (2012-07-04) * figure 6 *	1-3,14	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			E04D E05G E05F
Place of search		Date of completion of the search	Examiner
The Hague		7 July 2020	Tran, Kim Lien
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/02 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 20 15 5249

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-07-2020

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
NL 1033845	C2	18-11-2008	NONE	
EP 2385184	A1	09-11-2011	EP 2385184 A1	09-11-2011
			PL 2385184 T3	31-12-2015
EP 3505712	A1	03-07-2019	NONE	
EP 2472026	A1	04-07-2012	CN 202577774 U	05-12-2012
			EP 2472026 A1	04-07-2012
			PL 2472026 T3	31-01-2019

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2009080026 A1 [0004]
- EP 2500488 B1 [0004]
- US 2010269426 A [0005]
- EP 3348737 A1 [0006]