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(54) **ROOF WINDOW COMPRISING REMOVABLE INSULATED GLASS UNITS ARRANGED IN A COMMON MOVABLE FRAME**

(57) The present disclosure relates to a roof window (1) for installation in a roof structure (100) of a building. The roof window (1) comprises a fixation frame (10) and a movable frame (20) which is movably connected to the fixation frame (10) by means of a hinge arrangement. the movable frame comprises structural elongated profiles comprising an elongated top profile (21a), an elongated bottom profile (21b) and parallel, elongated side profiles (21c, 21d). The movable frame (20) supports at least a first insulated glass unit (2) and a second insulated glass unit (3).

The roof window comprises at least one division bar arrangement (30, 230) wherein said division bar arrangement (30, 230) is arranged between and separates a first

frame opening (4a, 4b, 4c) and a second frame opening (4a, 4b, 4c) of the movable frame (20), wherein the first insulated glass unit (2) is arranged to cover the first frame opening, and wherein the second insulated glass unit (3) is arranged to cover the second frame opening. The first insulated glass unit (2) and the second insulated glass unit (3) are arranged side by side in a common glass unit plane (PL1). A releasable, mechanical holding system (40, 50, 60) is arranged to secure the first and second insulated glass units (2, 3) at the movable frame (20). Moreover the present disclosure relates to a method of installing a roof window (1) in a roof structure (100) of a building.

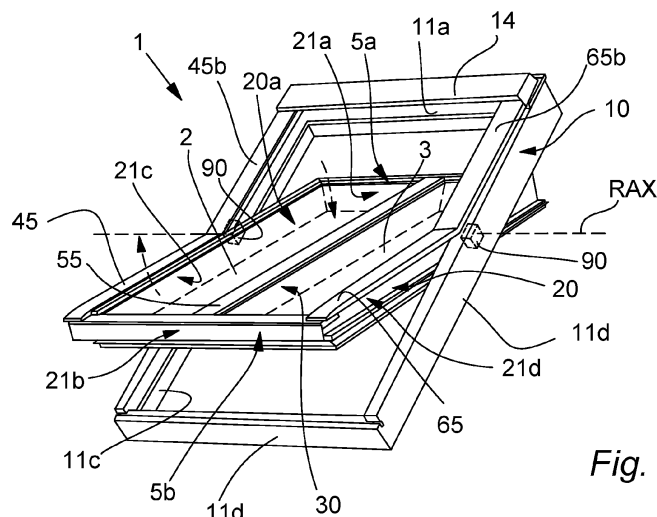


Fig. 2

Description

[0001] The present disclosure relates to a roof window for installation in a roof structure of a building, wherein the total weight of the roof window is more than 35 kg, and a method of installing a roof window in a roof structure of a building.

Background

[0002] Roof windows, also known as "skylights" are popular window solutions that provides desirable inflow of sunlight, and if it is the roof window types that may be opened and hence comprises a movable frame that is movably fixated to a fixation frame, it also provides advantageous ventilation options. Additionally, roof windows may enable providing sunlight to some parts of a building interior that may otherwise be left less illuminated and heated by sunlight.

[0003] Over the recent years, roof window designs have been improved in order to for example meet market demands and/or regulations relating to e.g. improved heat insulation performance, a safety impact test typically involving a 50kg impact, burglary resistance, , increased daylight influx, ease of installation, more costs efficient solutions and/or the like.

This has resulted in roof windows that meets, or even outmatch, the market demands and/or regulations. The drawback of such roof windows may be a more complex roof window design and increased window weight. The working environment of a person installing the roof window may hence be challenged, also due to the elevated installation location of roof windows which may require relatively heavy lifts to elevated positions during roof window installation, and in some situations relatively heavy lifts to a level above shoulder level of an installation person.

[0004] In some situations, this issue has been handled by assigning more installation personnel for installing a single roof window due to the weight and general construction of the roof window, so that the personnel together can lift the roof window. This may however still provide drawbacks with regard to working environments, and it may also result in a cost increase of the roof window installation.

[0005] Another solution is to provide a specialized lifting tool for use during roof window installation. Patent document EP3348513 A1 discloses such a solution. Such a tool may help to reduce working environment issues such as help to reduce the need of relatively heavy manual lifts to locations that may be especially wearing to the installation personnel, but a drawback is that the tool may still suffer from increased installation time and hence installation costs, for example as the tool needs to be properly arranged.

[0006] A still further solution comprises renting a vehicle with a crane and use this crane during roof window installation as e.g. disclosed in EP3192943 A1.

[0007] The present disclosure provides a solution where the above mentioned drawbacks are reduced, and hence where improved working environment may be obtained during roof window installation and which may facilitate a more cost efficient roof window installation.

Summary

[0008] The present disclosure relates in a first aspect to a roof window for installation in a roof structure of a building. The total weight of the roof window may be more than 35 kg. The roof window comprises a fixation frame and a movable frame which is movably connected to the fixation frame by means of a hinge arrangement. The movable frame comprises structural elongated profiles comprising an elongated top profile, an elongated bottom profile and parallel, elongated side profiles, and the movable frame supports at least a first insulated glass unit and a second insulated glass unit.

The roof window moreover comprises a releasable, mechanical holding system and at least one division bar arrangement. The division bar arrangement is arranged between and separates a first frame opening and a second frame opening of the movable frame, and the first insulated glass unit is arranged to cover the first frame opening, and the second insulated glass unit is arranged to cover the second frame opening. The first insulated glass unit and the second insulated glass unit are arranged side by side in a common glass unit plane. The fixation frame may substantially surround the movable frame. The releasable, mechanical holding system is arranged to secure the first and second insulated glass units at the movable frame.

[0009] The above solution enables fast roof window installation where also improved working environment can be obtained. One person may provide substantially the entire installation process involving lifting of reduced weight.

[0010] Providing the division bar arrangement, (may also be known as a structural "mullion" or "mullion bar") in the movable frame provides that the total insulated glass unit mass in the roof window is divided between two or more individual insulated glass units that may be individually installed to cover the respective first and second frame openings of the movable frame.

[0011] Hence, an installation person may first install the frame arrangement in the roof structure. Subsequently, the installation person can then first install or at least fixate one of the first and second insulated glass units in the movable frame, and thereafter install or at least fixate the other of the of the first and second insulated glass units in the movable frame. Thereafter, the person may install, or finalize installation of, the holding system so that the insulated glass units

are maintained in the movable frame in a tight manner.

[0012] Larger sized roof windows may often have a total weight of above 34 kg (naturally dependent on size and type), and the weight of the total insulated glass unit mass may here provide more than 40%, such as more than 50% of the total roof window weight.

[0013] The use of two or more separate insulated glass units arranged in the same plane may e.g. also help to enable further reduction of weight as these glass units may be made from/comprise thinner glass sheets since they are smaller and hence strength requirements may be reduced than if a single "full size" insulated glass unit should be installed in the movable frame.

[0014] When the fixation frame surrounds the movable frame an opening pivot rotation about a central portion (RAX) may be provided, preferably an opening pivot rotation to above 120 degrees. This helps with access and also helps installing the first and second insulated glass units for example from the inside of the building.

[0015] This may e.g. be applied by providing a pivoting of the movable frame where the movable frame is movably connected to the fixation frame by means of a hinge connection so that a top end part of the movable frame is configured to move inwards and a bottom end part of the sash/movable frame is configured to move outwards when opening the sash from a closed position.

[0016] The hinge arrangement may in embodiments of the present disclosure be arranged so that the top end part of the movable frame/sash is configured to move inwards and a bottom end part of the movable frame is configured to move outwards when opening the movable frame from a closed position.

[0017] When the fixation frame surrounds the movable frame the movable frame may in some embodiments hence e.g. be inserted and installed from the inside of the building into the fixed frame. This helps installing the movable frame separately and further e.g. reduces the installation weight needed to be lifted individually.

[0018] In one or more embodiments of the present disclosure, the movable frame comprises the division bar arrangement wherein said division bar arrangement is arranged between and separates a first frame opening and a second frame opening of the movable frame.

[0019] In other embodiments of the present disclosure, the division bar arrangement may be attached to one of the insulated glass units, so that when that glass unit is installed, the division bar arrangement is installed thereby.

[0020] Providing the solution where first and second glass units are installed above may also help to reduce the strength demands for the glass unit as the size, such as width, of the glass units are reduced compared to a full size glass unit. This may allow usage of one or thinner glass sheets for the respective insulated glass unit which helps to reduce glass unit weight.

[0021] In embodiments of the present disclosure, the roof window may have a U_{window} value that is less than $2 \text{ W/m}^2\text{k}$, such as less than $1.5 \text{ W/m}^2\text{k}$ or less than $1.2 \text{ W/m}^2\text{k}$.

[0022] In one or more embodiments of the present disclosure, opposing, parallel edges of the first and second insulated glass units overlaps and are supported by a part, such as an interior part, of the division bar arrangement.

[0023] In one or more embodiments of the present disclosure, the roof window is configured to be installed in a roof having an inclination/pitch of above 8° , such as above 15° , such as above 25° when compared to horizontal.

[0024] In one or more embodiments of the present disclosure, the roof window is configured to be installed in a roof having an inclination/pitch below 85° , such as below 75° when compared to horizontal.

[0025] In one or more embodiments of the present disclosure, the total weight of the roof window is more than 45 kg, for example more than 65 kg.

[0026] In some embodiments of the present disclosure, the mullion bar may also provide a further attachment option so two covers such as blinds, e.g. roller blinds or venetian blinds rather than one, can be installed at the interior side of the sash, as one cover such as a blind may be attached for each frame opening to cover each their respective frame opening. Hence the respective blind has a lower size, such as width, than a "full width" blind that is configured to cover the total frame opening area of the sash. Hence displacement due to gravity of the covering material such as a fabric, flexible sheet or slats, when the cover is in a covering position to cover at least a part of the frame opening may be reduced. Additionally or alternatively it may provide a user with the option of only covering one, or a part of one, frame opening, thereby providing the user with further covering options. That may for example also be relevant if the division bar extends between top and bottom part of the movable frame, as this may give the user an option of covering "side portions" of the movable frame with the covering material.

[0027] In one or more embodiments of the present disclosure, the holding system may comprises re-usable mechanical glass overlapping securing means, such as a glazing bead arrangement.

[0028] Re-usable mechanical glass overlapping securing means such as elongated glazing beads ensure proper uniform gasket pressure and water tightness while allowing to remove and reinstall the insulated glazing units.

[0029] This may help installation personnel to provide a faster installation. Additionally or alternatively, it may help to assure that the correct, assigned securing means are used at the roof window which may be beneficial in order to reduce the risk of installation errors.

[0030] In some embodiments, the roof window may, upon arrival at the installation site, be delivered substantially fully

assembled, e.g. so that at least the movable frame and fixation frame are interconnected and so that the first and second insulated glass units are substantially fully installed in the movable frame. The installation personnel can then consider whether the installation task would benefit from temporarily disconnecting one or more of the first and second insulated glass units from the movable frame before installation, or whether the present location and working environment allows for installation without removing the first and/or second glass units from the movable frame.

[0031] In one or more embodiments of the present disclosure, the re-usable mechanical glass overlapping securing means may comprise one or more glazing beads with a plurality of screws and/or a releasable snap-fit assembly or glazing beads such as with extruded hinge assembly.

[0032] In one or more embodiments of the present disclosure, the holding system may comprise primary securing means, such as glass overlapping securing means, such as a glazing bead arrangement, and wherein the holding system moreover comprises secondary holding means, such as displaceable holding means, for temporarily maintaining the insulated glass units in the movable frame.

[0033] The secondary holding means may be present on one such as two or more sides of the insulated glazing units. In one example the secondary holding means may comprise at least two or at least four displaceable holding means for each insulated glazing unit. Hereby an installer can hold the insulated glazing for example by hand or with a tool such as a suction cup tool while activating the displaceable holding means. It may be preferred that the secondary holding means such as displaceable holding means can be activated/operated automatically or by one hand only, such as without any tools or fasteners.

The displaceable holding means may e.g., in embodiments of the present disclosure, comprise one or more of clamps, snap keeper, turn knobs, slider locks or similar known hardware.

[0034] The displaceable holding means are displaceable between two configurations, a first configuration where the insulated glass unit is released and a second configuration where the insulated glass unit is secured to the movable frame).

[0035] Insulated glazing units of roof windows need to comply with impact requirements and transfer large forces so the displaceable holding means are considered a temporary aid during install of the insulated glazing unit and the major structural holding strength is provided by the primary securing means such as the glazing bead arrangement.

[0036] One or more gaskets such as rubber gaskets, elastomer gaskets and/or the like may be provided between a part of the movable frame and the respective insulated glass unit, and/or between a part of the respective insulated glass unit and a part of the holding system, so as to provide said water tightened connection between the movable frame and the insulated glass units.

[0037] In one or more embodiments of the present disclosure the insulating glass unit abutting seals and gaskets are releasable and thereby devoid of adhesive and sealant such as butyl. The seal and gaskets abutting the insulated glass unit may be compression seals which use deformation to ensure tightness.

[0038] In one or more embodiments of the present disclosure, one or more elongated water covers may be attached to the movable frame. The water cover(s) may extend over a part of the insulated glass units and extend over a part of the movable frame.

[0039] The elongated water covers may be arranged to cover said holding system and/or said holding system may comprises the elongated water covers.

In certain embodiments this/these water covers, or some of the water covers of the window, may be attached to the division bar arrangement.

[0040] Water tightening, such as rain water or melting water tightening, of roof windows may be a rather complex task as roof windows may be especially subjected to rain and also rainwater from the roof structure and issues with melting ice and snow. Covering the holding system by means of water covers or assuring that the holding system comprises/provides the elongated water covers may be relevant to assure sufficient water tightening.

[0041] In some embodiments of the present disclosure, a water cover may be attached to the division bar arrangement and extend over/cover both the first and second insulated glass unit.

[0042] In one or more embodiments of the present disclosure, the movable frame may comprise an exterior side for facing the exterior of the building when the movable frame is in a closed position, and an interior side for facing the interior of the building when the movable frame is in a closed position. In some embodiments, the releasable holding system may be accessible at said exterior side of the movable frame. Here, in some further embodiments of the presents disclosure, the hinge arrangement may comprises a centre hinge arrangement configured so that the movable frame is configured to rotate at least 90°, such as at least 120°, from the closed position to an open position, and wherein the insulated glass units are configured to be installed in and removed from the movable frame from the exterior side of the movable frame by manipulating the releasable holding system.

[0043] This provides that at least a part of the exterior major surfaces of the insulated glass units that will normally face away from the interior of the building in which the window is installed, when the movable frame is in a closed position, can be reached from the inside of the building when installing or replacing the insulated glass units in the movable frame. Hence, a person may install the individual insulated glass units one after each other when installing the roof window so as to cover each their frame opening of the movable frame. This installation of the insulated glass units may be provided

after the frame arrangement has been fixed to a structure of the building by fixating the fixation frame to the building structure, and hence, weight issues during installation are reduced.

This may additionally allow to use stepped insulated glass units, where the exterior glass sheet is larger than the interior glass sheet, for example one or both sides can extend beyond the interior glass.

[0044] This may also provide an advantages with regard to providing a more simple movable frame and/or more simple and efficient water sealing solution between the movable frame and insulated glass units.

[0045] In some embodiments of the present disclosure, the centre hinge arrangement provides that the movable frame is movably connected to the fixation frame so that a top end part of the movable frame is configured to move inwards and a bottom end part of the movable frame is configured to move outwards when opening the sash from a closed position.

[0046] In one or more embodiments of the present disclosure, the movable frame may comprise an exterior side for facing the exterior of the building when the movable frame is in a closed position, and an interior side for facing the interior of a building when the movable frame is in a closed position. In this embodiment, the releasable holding system may be accessible at said interior side of the movable frame, and the insulated glass units are configured to be installed in and removed from the movable frame from the interior side of the movable frame by manipulating the releasable holding system. The releasable holding system is attached to interior parts of a plurality of the elongated profiles of the movable frame.

[0047] This may e.g. help to provide a solution where a user may install the insulated glass units while the movable frame is in a closed position, or only opened to a limited extent. Additionally or alternatively, it may assure that water tightening solutions at the exterior side may be substantially fixed/permanent, and hence may be less prone to installation errors increasing the risk of damage from rainwater and/or melting water originating from snow. In some further embodiments of the present disclosure, said releasable holding system may comprise interior elongated holding profiles attached to said elongated profiles by means of one or more mechanical, releasable fixation members.

[0048] In one or more embodiments of the present disclosure, The movable frame may be releasably connected to the fixation frame. This may in embodiments of the present disclosure be provided by means of a releasable hinge connection, so as to allow the movable frame to be movably connected to, and disconnected from, the fixation frame.

[0049] Here releasable hinge connection may be understood as a two-piece hinge connection designed for fast connection and separation without any further disassembly required or without any removal of the fasteners.

[0050] This improves working environment during window installation. When the window is to be installed in a roof structure of a building, the fixation frame may initially be installed at the roof structure, and the movable frame may then subsequently be connected to the fixation frame. After this the individual insulated glass units may be installed in the movable frame.

[0051] In one or more embodiments of the present disclosure, the movable frame comprises first hinge parts of the hinge arrangement, and the fixation frame comprises a second hinge parts of the hinge arrangement. These first and second parts movably engages when the movable frame is connected to the fixation frame, and the first hinge parts are configured to be detached from the second hinge parts so that the movable frame can be detached from the fixation frame.

[0052] In one or more embodiments of the present disclosure the fixation frame may substantially surround the movable frame and the movable frame may substantially overlap in the same plane PL1 such as in common with the first and second insulated glass units plane.

Hereby the plane intersects the fixation frame and the movable frame allowing the movable frame to easily be inserted from the inside and also allowing the movable frame to rotate and pivot within the fixed frame.

[0053] In one or more embodiments the releasable hinge connection is a central pivot releasable hinge connection where a pivoting opening can be realized with the movable frame rotating at a central portion of the window sides. As explained such central pivot releasable hinge connection allows favourable fixed frame installation by separation of the movable frame from the fixation frame, and favourable first and second insulated glazing unit IGU install due to the large opening angle and good access from the inside of the building.

[0054] In one or more embodiments of the present disclosure, the roof window may be configured to be separated into individual separate roof window sub parts for individual lifting, where said individual separate roof window sub parts comprises:

- a first roof window sub part comprising the first insulated glass unit,
- a second roof window sub part comprising the second insulated glass unit, and
- a third roof window sub part comprising the fixation frame, such as the fixation frame joined to the movable frame, or alternatively the fixation frame and movable frame dismantled from each other but still together be considered the third sub-part.

Each of said separate roof window sub parts may weighs below 55% of the total roof window weight, such as below 45% of the total roof window weight.

[0055] The inventor has realized that the insulated glass unit mass may generally become the heaviest component

of the roof window. Further because the prior art insulated glass unit is fixed in the movable frame the weight of the glass and the weight of the movable frame is combined. So by employing a first and second insulated glass units which are removable from the movable frame the lifting weight for the installer can be significantly lowered.

[0056] As an example, today, existing 78x118cm window (about 35kg total weight) may require the installer to lift fixation frame (about 9kg) and movable frame with glazing (about 26kg). So the heaviest part is (26kg/35kg) 75% of the total roof window weight.

[0057] According to embodiments of the present disclosure, as an example, a 78x118cm window (about 35kg total weight) with a removable insulated glass unit according to embodiments of the present disclosure, may result in the installer has to lift: first insulated glass unit about 8-11kg, second insulated glass unit about 8-11kg, separate fixation frame about 9kg, separate movable frame about 9kg. Hence the heaviest separate part to lift is (11kg/35kg) 32% of the total window weight.

[0058] In another example, according to embodiments of the present disclosure, a 78x118cm window (about 35kg total weight) with a removable insulated glass unit results in the installer has to lift: first insulated glass unit about 8-11kg, second insulated glass unit about 8-11kg, joined fixation frame and movable frame about 18kg. Hence the heaviest separate part to lift is (18kg/35kg) 52% of the total window weight.

[0059] In a still further example, according to embodiments of the present disclosure, a 134x160 cm window (about 71kg total weight) with a removable insulated glass unit results in the installer has to lift: first insulated glass unit about 21kg, second insulated glass unit about 21kg, joined fixation frame and movable frame about 27kg. Hence the heaviest separate part to lift is (27kg/71kg) 38% of the total window weight.

[0060] The fixation frame and the movable frame are joined by a hinge. In one or more embodiments the fixation frame and movable frame can be separated to further reduce the lifting weight.

[0061] This may help to improve working environment and/or help to provide a solution that may be fast to install by one person with reduced lifting weight per manual lift..

[0062] In one or more embodiments of the present disclosure, the total insulated glass unit weight/mass provided by all insulated glass units of the roof window is higher than the total weight of the fixation frame and the movable frame.

[0063] Insulated glass units, especially modern insulated glass units of roof windows comprising at least three or at least four glass sheets in order to improve heat insulation performance and/or to improve safety (e.g. by means of a lamination glass solution) may be heavy.

[0064] The total insulated glass unit mass of the roof window may (in embodiments of the present disclosure) be above 17 kg, such as above 40kg, such as above 55 kg, for example between 17 kg and 75 kg, such as between 40 kg and 75 kg, such as between 55 kg and 75kg, or even more, dependent on the size and type of insulated glass unit installed. The present inventor has realized that if a single insulated glass unit provides this total insulated glass unit mass, this may result in that a person or persons installing the glass unit may at least in some situations experience more wear and undesirable working environment during installation.

[0065] By providing multiple insulated glass units in a roof window according to the present disclosure, this weight is divided between individually installable insulated glass units which may help to enable more cost efficient installation and/or improved working environment during roof window installation.

[0066] In one or more embodiments of the present disclosure, the roof window may comprise at least two insulated glass units, such as at least three or at least four insulated glass units arranged in the common glass unit plane.

[0067] In one or more embodiments of the present disclosure, the total surface area of the insulated glass units of the roof window described by exterior major surfaces of the insulated glass units configured to face away from the interior of the building when the movable frame is in a closed position is more than 0.6 m², such as more than 1 m².

[0068] If such a surface area should be provided by a single insulated glass unit, this may provide inconvenient handling due to size and/or weight to the person installing the roof window, and by dividing such a surface area between individually installable insulated glass units, this may provide improve working environment and/or facilitate faster roof window installation.

[0069] In one or more embodiments of the present disclosure, the insulated glass units are of substantially the same physical size and/or weight.

[0070] In one or more embodiments of the present disclosure, the roof window may consists essentially of one fixed frame and one movable frame comprising the insulated glass units.

[0071] In one or more embodiments of the present disclosure, said insulated glass units are arranged side by side and extend at least 70%, such as at least 80%, such as at least 90% of the entire height of the movable frame.

[0072] In one or more embodiments of the present disclosure, the insulated glass units may each comprises at least three glass sheets, preferably at least four glass sheets.

[0073] This may provide insulated glass units with improved heat insulation performance and/or improved safety, e.g. in case the insulated glass units comprises a lamination glass solution.

[0074] In one or more embodiments of the present disclosure, the insulated glass units each comprises two or more insulating gaps separated by an intermediate glass sheet.

[0075] In one or more embodiments of the present disclosure, the insulated glass units each comprises a lamination glass attached to another glass sheet of the insulated glass unit by means of an interlayer/lamination layer.

[0076] In one or more embodiments of the present disclosure, one or both of the insulated glass units have a front side and a back side and where a side, such as preferably one or both of these front and back sides, is marked. Additionally or alternatively, a shape may prevent wrong side install. The front side and back side may be exterior major surfaces of the insulated glass unit.

[0077] Roof window insulated glass units must face the outside and inside correctly due to use of safety hardened, such as tempered glass and/or safety laminated glass and solar coatings and anti-dew coatings. When dealing with multiple insulated glass units in a moving frame facing errors may easily be made. By marking the glass direction or adding a shape (such as protrusion or tongue) which cannot be mirrored a wrong install is mitigated.

[0078] In one or more embodiments of the present disclosure, one or both of the insulated glass units may comprises a peripheral enclosure comprising a securing arrangement, such as an angular part, extending from the insulated glass units and/or where the insulated glass units comprises a sealing arrangement.

[0079] Providing the insulated glass unit with a peripheral enclosure may help to enable faster glass unit installation and/or replacement, and may also help to provide improved water tightness performance of the roof window.

[0080] For example, the peripheral enclosure may comprise a moulded edge solution, such as for example a polymer edge solution, where this solutions fixates a fastening arrangement such as a fitting/mounting to the insulated glass unit. The fastening arrangement may provide be configured to be attached to the movable frame by means of mechanical fasteners such as screws, a releasable snap-fit assembly and/or the like.

In some further embodiments, the moulded edge solution may comprise alignment recesses, such as slits, or protrusion that may be configured to engage with opposing protrusions or recesses of the movable frame, so as to improve glass unit alignment and hence correct installation of the respective insulated glass unit.

[0081] In one or more embodiments of the present disclosure, said roof window may be arranged inside a common/joint delivery packaging, such as a cardboard packaging. Hence, after removing at least a part of the delivery packaging, a person may remove/disconnect the movable frame from the fixation frame, and remove one or both insulated glass units too. This enables that the user can divide the total weight of the roof window into at least three or four sub parts.

[0082] In other embodiments of the present disclosure, the roof window may be delivered as a set of unassembled roof window parts, e.g. in each their package. This set of unassembled roof window parts may comprise

- a first set part comprising a fixation frame,
- a second set part comprising a movable frame which is configured to be connected to the fixation frame by means of a hinge arrangement, wherein the movable frame comprises a top profile, a bottom profile and parallel side profiles, wherein the movable frame comprises at least one division bar arrangement arranged between and separating a first frame opening and a second frame opening of the movable frame,
- a third set part comprising a first insulated glass unit configured to be installed at the movable frame so as cover the first frame opening, and
- a fourth set part comprising a second insulated glass unit configured to be installed at the movable frame so as cover the second frame opening, so that the first insulated glass unit and the second insulated glass unit are arranged side by side in a common glass unit plane,
- the set also comprises a holding system configured to be attached to the moveable frame so as to secure the first and second insulated glass units at the movable frame.

The total weight of the set of roof window parts is more than 35 kg such as more than 45 kg, for example more than 65 kg.

[0083] The present disclosure moreover, in a second aspect, relates to a method of installing a roof window in a roof structure of a building, such as in a roof structure having a roof inclination above 8° such as above 15°. The total weight of the roof window may be more than 35 kg. The method comprises the steps of:

- providing a frame arrangement wherein said provided frame arrangement comprises a fixation frame and a movable frame. The fixation frame may be configured to substantially surround the movable frame. The movable frame is configured to be movably connected to the fixation frame by means of a hinge arrangement, and the movable frame comprises structural elongated profiles comprising an elongated top profile, an elongated bottom profile and parallel, elongated side profiles. A division bar arrangement is configured so as to be arranged between and separate a first frame opening and a second frame opening (4b) of the movable frame,
- installing the frame arrangement in the roof structure,
- providing a first insulated glass unit and arranging the first insulated glass unit in the movable frame of the installed frame arrangement so as to cover said first frame opening of the movable frame,

- providing a second insulated glass unit and arranging the second insulated glass unit in the movable frame of the installed frame arrangement so as to cover said second frame opening of the movable frame, so that said insulated glass units are arranged side by side in a common glass unit plane, and

- securing said insulated glass units to the movable frame by means of a releasable, mechanical holding system.

[0084] It is understood that in one or more embodiments of the present disclosure, the roof window to be installed by means of the method may be a roof window as described according to one or more of the above, previously mentioned embodiments.

[0085] Said step of installing the frame arrangement in the roof structure may in embodiments of the method comprise fixating the fixation frame to the roof structure, and subsequently attaching the movable frame to the fixated fixation frame by means of the hinge arrangement.

[0086] In one or more embodiments of said method, the movable frame comprises an exterior side for facing the exterior of the building when the movable frame is in a closed position, and an interior side for facing the interior of the building when the movable frame is in a closed position, wherein the hinge arrangement comprises a centre hinge arrangement allowing the movable frame to rotate at least 45°, such as at least 90°, such as at least 120° from the closed position to an open position. The steps comprising arranging the first and/or second insulated glass units in the movable frame may be provided at least partly by an installation person from the interior of the building while the movable frame is in the open position.

[0087] In one or more embodiments of the method, the step of securing the insulated glass units to the movable frame by means of the releasable, mechanical holding system may comprise:

using a secondary holding system, such as retaining parts such as clamps, for temporarily retaining the insulated glass units at the respective frame opening, and

subsequently securing the insulated glass units at the movable frame by means of further primary releasable, mechanical securing means for securing the insulated glass units to the movable frame.

[0088] The primary securing means may, e.g. together with proper water sealing means such as gaskets and/or a sealing material such as an elastomer or butyl material provide a water tightened connection between the movable frame and the insulated glass units when the insulated glass units are secured to the movable frame by means of the primary securing means.

[0089] It is generally to be understood that in embodiments of the present disclosure, the secondary holding system may comprise displaceable holding means as previously explained.

[0090] It is understood that the secondary holding means may be delivered together with the roof window and either be pre-attached to one or more parts of the roof window upon window delivery, and/or may be attached to the roof window such as the movable frame during or prior to glass unit installation.

[0091] In one or more embodiments of the method, the method may further comprise the one or both of the steps of

- initially unpacking the a roof window from a delivery packaging and disconnecting the movable frame from a fixation frame of the frame arrangement of the unpacked roof window, and/or
- loosening a releasable, mechanical holding system fixating the insulated glass units in the movable frame of the unpacked roof window, and removing one or both insulated glass units from the movable frame of the unpacked roof window.

[0092] It is generally to be understood that the edges of the insulated glass unit(s) to be installed in some embodiments of the present disclosure may be processed and blunt.

[0093] In one or more embodiments of the present disclosure, said roof window installed by means of said method may be a roof window according to any one or more of the above mentioned embodiments and/or a roof window according to any of claims 1-11.

Figures

[0094] Aspects of the present disclosure will be described in the following with reference to the figures in which:

fig. 1 : illustrates a roof window according to embodiments of the present disclosure installed in a roof structure,

fig. 2 : illustrates a pivot roof window comprising a division bar arrangement according to embodiments of the present disclosure,

- fig. 3 : illustrates a roof window comprising a division bar arrangement according to embodiments of the present disclosure,
- fig. 4 : illustrates an installation method according to embodiments of the present disclosure,
- fig. 5 : illustrates an installation method according to embodiments of the present disclosure where the roof window is a pivot window/center hung window and where a movable frame has been rotated so that an exterior side faces inwards,
- fig. 6 : illustrates a roof window comprising interior, releasable securing means according to embodiments of the present disclosure,
- figs. 6-9b : illustrates different embodiments of the present disclosure where secondary holding means are provided,
- figs. 10-11 : illustrates different embodiments of the present disclosure where a shape help to prevent wrong side installation of an insulated glass unit, according to embodiments of the present disclosure,
- fig. 12 : Illustrates an insulated glass unit comprising an peripheral enclosure arrangement, for installation in a movable frame, according to embodiments of the present disclosure,
- fig. 13 : Illustrates an embodiments of the present disclosure where a marking is provided to prevent/avoid wrong side installation of an insulated glass unit,
- figs. 14-15b : illustrates roof windows according to further embodiments of the present disclosure, comprising different division bar arrangement solutions, and
- fig. 16 illustrates an embodiment of the present disclosure wherein division bar arrangement is attached to an insulated glass unit prior to installation of the glass unit in the movable frame.

Detailed description

- [0095]** Fig. 1 illustrates schematically illustrates a roof window 1 according to embodiments of the present disclosure, seen from the exterior of the building and towards the roof. The roof window is installed in a roof structure 100 and is hence directly or indirectly attached to the roof structure so as to cover a building aperture in the roof. A roofing 101 such as e.g. roof tiles, roofing felt, thatching or the like covers a carrying roof structure (not illustrated). A fixation frame (not illustrated in fig. 1) of the roof window 1 may e.g. be directly or indirectly fixated to the carrying roof structure.
- [0096]** The roofing of the roof structure of the building comprising the roof structure may in embodiments of the present disclosure be arranged/ designed to have a roof pitch of above 8°, such as above 15°, such as above 25° when compared to horizontal.
- [0097]** The roofing of the roof structure of the building comprising the roof structure may in embodiments of the present disclosure be arranged/ designed to have a roof pitch below 85°, such as below 75° when compared to horizontal.
- [0098]** Such roofing pitch usually requires the installer to carry the window through the building up to the loft and install the window from the inside.
- [0099]** The roof window 1 comprises a first insulated glass unit 2 and a second insulated glass unit 3 arranged side by side. The roof window moreover comprises at least one division bar arrangement 30 that is arranged between and separates a first frame opening 4a and a second frame opening 4b of a movable frame of the roof window. The first insulated glass unit 2 is arranged to cover the first frame opening, and the second insulated glass unit 3 is arranged to cover the second frame opening 4b. As can be seen from fig. 1, the insulated glass units 2, 3 may in some embodiments of the present disclosure be arranged side by side and extend in the height direction of the movable frame by at least 70%, such as at least 80%, such as at least 90% of the entire height of the movable frame 20, hence, often resulting in an elongated shape of the insulated glass units 2, 3. Here, the insulated glass units may hence extend between the top and bottom profiles 21a, 21b.
- [0100]** In embodiments of the present disclosure, the roof window may be a roof window comprising a centre hung movable frame/sash. Figs. 1 and 2 illustrates an embodiment of such a centre hung roof window, also known as a pivot roof window.
- [0101]** As can be seen, the window 1, and hence the movable frame of the window (described in more details below) has a height direction HD and a width direction WD.

[0102] Fig. 2 illustrates schematically and in perspective a centre hung roof window according to embodiments of the present disclosure, where the movable frame 20 is connected movably, such as pivotably, to the fixation frame 10 of the roof window by means of a hinge arrangement 90.

[0103] Such centre hung roof windows provides an axis of rotation RAX placed between the top and bottom of the window. Often the axis of rotation RAX is substantially about the centre part of the side elongated side frame arrangements of the fixation frame 10 and the side elongated side frame arrangements/profiles 21c, 21d of the movable frame. But sometimes the axis of rotation RAX can for example be raised such as 1/3 of the total window height, and it is understood that this may also provide a centre hung roof window/pivot window as understood in the present disclosure. The hinge arrangement 90 may be arranged so that the top end part 5a of the movable frame/sash 20 is configured to move inwards and a bottom end part 5b of the movable frame 20 is configured to move outwards when opening the movable frame from a closed position. The advantages, however, may remain the same: for example, a pivot/centre hung roof window allows rotation of the movable frame so the exterior may be cleaned from the inside. The weather proofing and water drain must be carefully designed for such pivoting roof windows.

[0104] It is generally understood that the fixation frame may comprise elongated profiles comprising parallel side profiles 11c, 11d, and a top profile 11a that is substantially parallel to a bottom profile of the fixation frame. Hence, these profiles 11a-11d may provide a rectangular shaped profile providing a fixation frame opening that is configured to be covered by the movable frame 20 when the movable frame 20 is in the closed position.

[0105] In one or more embodiments of the present disclosure, the hinge arrangement 90 may be configured so that the movable frame 20 is configured to rotate at least 90°, such as at least 120° around the rotation axis RAX from the closed position to an open position.

[0106] In some embodiments, the movable frame 20 may be rotatably arranged and connected to the fixation frame 10 by means of the hinge arrangement 90 so that the exterior side 20a of the movable frame that normally faces away from the building interior 70 and towards the building exterior 80 when the movable frame 20 is closed, may face towards the interior of the building when the movable frame is rotated around the axis RAX to its other extreme open position where the movable frame may be rotated no further from the closed position. It is to be understood that the movable frame 20 may be placed in various positions between the closed movable frame position and the other extreme open movable frame position.

[0107] The hinge arrangement 90 may generally comprise a releasable hinge connection understood as a two-piece hinge connection designed for fast connection and separation without any further disassembly required or without any removal of the fasteners. Such kind of hinges may often be used in modern roof windows and are e.g. disclosed in EP3252255B1 and EP1038083B1. The hinges stand out, e.g. because their two pieces automatically engage and lock to each other in a safe manner when the fixation frame 10 piece and movable frame 20 piece are connected during installation, so the movable frame 20 and the fixation frame 10 are assembled.

[0108] In one or more embodiments of the present disclosure, the releasable hinge connection may be or comprise a central pivot releasable hinge connection where a pivoting opening can be realized with the movable frame 20 rotating at a substantially central portion of the window sides 11c, 11d (see e.g. fig. 2).

[0109] The bottom end part 5b of the movable frame 20 comprises an elongated, structural elongated bottom profile 21b having an inner surface facing towards the top end part of the sash, and an opposite exterior surface facing away from the top end part. The top end part 5a of the movable frame 20 comprises an elongated, structural top profile 21a having an inner surface facing towards the bottom end part of the sash, and an opposite exterior surface facing away from the bottom end part.

[0110] The movable frame additionally comprises structural elongated side profiles 21c, 21d. The side profiles 21c, 21d may be arranged parallel, and the top and bottom profiles 21a, 21b are substantially parallel. The top and bottom profiles 21a, 21b extends substantially perpendicular to the longitudinal directions of the side profiles 21c, 21d, and hence, the periphery of the movable frame 20 has a rectangular, peripheral shape which encloses the first frame opening 4a and a second frame opening 4b of a movable frame 20.

[0111] As mentioned above, the movable frame 20 comprises a division bar arrangement 30 that is arranged between and separates the first frame opening 4a and the second frame opening 4b of the movable frame 20. It may also be understood that the division bar arrangement 30 divides a large movable frame opening defined by the profiles 21a-21d into two sub-frame openings, i.e. the first and second frame openings 4a, 4b.

[0112] In the examples of figs. 1 and 2, the division bar arrangement 30 extends between and interconnects the top and bottom profiles 21a, 21b, and may be substantially parallel to the structural side profiles 21c, 21d of the movable frame. The division bar arrangement 30 may also be referred to as a "mullion" or "mullion bar".

[0113] In one or more embodiments of the present disclosure, the total weight of the roof window is more than 35 kg, such as more than 45 kg, for example more than 65 kg.

[0114] In one or more embodiments of the present disclosure, the total weight of the roof window may be more than 35 kg such as more than 45 kg, for example more than 65 kg, wherein the total weight of the roof window comprises or consists of the total weight of said glass units for installation in the movable frame, the weight of the movable frame and

the weight of the fixation frame.

[0115] The total insulated glass unit 2, 3 mass of the roof window may in embodiments of the present disclosure be above 17 kg, such as above 40kg, such as above 55 kg. For example, in some embodiments of the present disclosure, For example, the total insulated glass unit 2, 3 mass of the roof window may In embodiments of the present disclosure be between 17 kg and 75 kg, such as between 40 kg and 75 kg, such as between 55 kg and 75kg, or even more, dependent on the size and type of insulated glass units installed.

[0116] Fig. 3 illustrates schematically a cross sectional view of a roof window 1 comprising the division bar arrangement 30 according to embodiments of the present disclosure.

[0117] In the figures of the present disclosure illustrating a cross section of the roof window 1 according to embodiments of the present disclosure, the insulated glass units are illustrated with cut-through indicating that the figures does not illustrate the full width of the insulated glass units 2, 3, in order to improve understanding of the figures and avoid the frame arrangement to get too small for the figures.

[0118] The insulated glass units 2, 3 each comprises multiple glass sheets 6a-6d, and at least one insulated gap 8a, 8b between two opposing glass sheets. In embodiments of the present disclosure, the insulated glass units 2, 3 comprises at least two glass sheets such as at least 3 glass sheets, such as at least 4 glass sheets 6a-6d. In the example of fig. 3, the insulated glass units 2, 3 each comprises four glass sheets 6a-6d. The glass sheets 6a-6d are placed so that an intermediate glass sheet 6b is placed between two other glass sheets 6a, 6c, thereby providing two insulated gaps 8a, 8b. one or both of the gaps 8a, 8b may be filled with a gas such as an inert gas, such as argon. In other embodiments of the present disclosure one or both of the gaps 8a, 8b may be evacuated, thereby providing an insulated glass unit. In that case, support structures such as a plurality of pillars may be arranged in the evacuated gap to maintain the distance between the glass sheets enclosing the gap.

[0119] Generally, the gaps 8a, 8b are also sealed at the edge of the insulated glass unit by means of an edge seal 9. Such an edge seal 9 may comprise various components and/or materials dependent on the type of insulated glass unit 2, 3 in order to provide different functionalities such as one or more of heat insulation, moisture absorption, glass sheet 6a-6c spacing and/or the like.

[0120] It is understood that more or less glass sheets may be provided in order to provide that the insulated glass unit comprises at least one gap, such as at least two gaps, such as at least three or four gaps separated by glass sheets of the insulated glass unit 2,3.

[0121] The insulated glass units 2, 3 may be of substantially the same physical size and/or weight. Smaller roof windows may often have a total weight of above 34 kg (naturally dependent on size and type), and the weight of the total insulated glass unit mass may here provide more than 40%, such as more than 50% of the total roof window weight.

[0122] In embodiments of the present disclosure, the total surface area of the insulated glass units 2, 3 of the roof window 1 described by outer major surfaces 2b, 3b of the insulated glass units configured to face away from the interior of the building when the movable frame is in a closed position may be more than 0.6 m², such as more than 0.8 m², such as more than 1 m², such as more than 1.5 m².

[0123] In one or more embodiments of the present disclosure, the roof window may have a size of at least 0.92m², such as at least 1.4 m², such as at least 2m² (described by the outermost side and top surfaces of the roof window.)

[0124] In embodiments of the present disclosure, the individual weight of each of the insulated glass units 2, 3 may be less than the total weight of the fixation frame 30 and the movable frame 20.

[0125] In fig. 3, the insulated glass units 2, 3 are laminated insulated glass units, such units may comprise a further glass sheet 6d, e.g. called a lamination glass that is attached to the glass sheet 6c by means of an interlayer/lamination layer 7 such as a PVB (polyvinyl butyral) layer or EVA (Ethylene Vinyl Acetate) layer.

The lamination glass 6d faces the interior of the building as a safety measure.

[0126] In embodiments of the present disclosure, the frame arrangement design and insulated glass unit design may together provide that the roof window may have a U value, also called a "U_{window}" value that is less than 2 W/m²K, such as less than 1.5 W/m²K or less than 1.2 W/m²K.

[0127] Table 1 below provides examples of different roof windows 1 where the (round off) weight of a frame arrangement of various types and sizes, the weight of insulated glass units (IGU) of various types and sizes, and the total window weight of various window types and sizes, are exemplified. This is provided for two roof window sizes comprising a "regular" roof window size (78 cm x 118 cm providing a total surface area defined by the fixed frame of about 0.92 m²), and a "large" roof window size (134 cm x 160 cm providing a total surface area defined by the fixed frame of about 2.14 m²) respectively. It is noted that the weight of the insulated glass units in Table 1 relates to the total insulated glass unit mass, and hence, in accordance with embodiments of the present disclosure, this weight may substantially be divided between the first and second insulated glass units 2, 3, or even more insulated glass units if present, according to embodiments of the present disclosure.

Table 1

Regular window 78×118cm (0,92m ²)		Approximate weight (kg)
	Frame arrangement of polymer material	19
	Frame arrangement of wood material (at least solid wood material core)	18
	2 layer IGU (3+3lami 4mm)	17
	3 layer IGU (3+3lami 3mm 4mm)	22
	Total polymer frame with 2 layer IGU	36
	Total polymer frame with 3 layer IGU	41
	Total wood frame with 2 layer IGU	35
	Total wood frame with 3 layer IGU	40
Large window 134×160cm (2,14m ²)		Approximate weight (kg)
	Frame arrangement of polymer material	33
	Frame arrangement of wood material (at least solid wood material core)	27
	2 layer IGU (3+3lami 4mm)	44
	3 layer IGU (3+3lami 3mm 4mm)	58
	Total polymer frame with 2 layer IGU	77
	Total polymer frame with 3 layer IGU	91
	Total wood frame with 2 layer IGU	71
	Total wood frame with 3 layer IGU	85

[0128] For example, a "3+3lami 3mm 4mm" IGU 2, 3 comprises the following glass sheets:

- Outer Glass sheet 6a comprising exterior surface 2b or 3b: 4 mm thick glass sheet, such as a 4 mm tempered, such as thermally tempered glass sheet, for improved strength
- Intermediate glass sheet 6b: 3 mm annealed or tempered glass sheet
- Glass sheet 6c: 3 mm annealed or tempered glass sheet
- Lamination glass sheet 6d comprising exterior surface 2a or 3a: 3 mm thick annealed or tempered glass sheet.

[0129] A "3+3lami 4mm" IGU comprises a single insulating cavity 8a, and hence comprises the following glass sheets:

- Outer Glass sheet 6a comprising exterior surface 2b or 3b: 4 mm thick glass sheet, such as a 4 mm thick glass sheet, such as tempered, such as thermally tempered glass sheet for improved strength
- Glass sheet 6c: 3 mm thick annealed or tempered glass sheet
- Lamination glass sheet 6d comprising exterior surface 2a or 3a: 3 mm thick annealed or tempered glass sheet.

[0130] The weight of the frame arrangement specifies the combined weight of the fixation frame 10 and the movable frame 20. Generally each frame part (fixation frame and movable frame) may have a weight about 50% each, or the combined weight of the fixation frame 10 and the movable frame 20 may be distributed with a weight distribution of 40-60% for one of the fixation frame and movable frame, where the other of the weight of the fixation frame and movable frame provides the remaining weight up to 100% of the frame arrangement.

[0131] In fig. 3, the movable frame 20 is arranged in a closed position, and hence, in this position, tightening arrangements 12 such as resilient gaskets, for example rubber gaskets assure tightness between the movable frame 20 and fixed frame 10.

[0132] The movable frame also comprises a water tightening arrangement 13 comprising a gasket or the like, e.g. a rubber gasket or an elastomer gasket, a butyl gasket solution or the like for improving water tightness at the exterior side 20a of the movable frame 20.

[0133] The insulated glass units 2, 3 are secured to the movable frame 20 by means of a holding system such as a releasable, mechanical holding system 40, 50, 60

[0134] The insulated glass units 2, 3 may as illustrated, in embodiments of the present disclosure, be secured to the movable frame by means of mechanical securing means 41, 51, 61, such as a clamping arrangement, of the holding system 40, 50, 60. In some embodiments, the mechanical securing means may be re-useable and hence be disconnected from the movable frame and reconnected to the movable frame 20 by means of mechanical fastening arrangement (not illustrated) such as comprising one or more of a clamping system, a plurality of screws and/or a releasable snap-fit assembly.

[0135] The mechanical securing means 41, 51, 61 are in fig. 3 arranged at the side 20a of the movable frame configured to face the exterior 80 of the building when the movable frame 20 is in a closed position.

[0136] The water tightening arrangement 13 may be arranged between, such as clamped between, the mechanical securing means 41, 51, 61 and the insulated glass unit 2, 3 so as to provide sufficient water tightness.

[0137] The mechanical securing means 41, 51, 61 may in embodiments of the present disclosure be or comprise re-usable mechanical glass overlapping securing means such as a glazing beads.

[0138] One or more elongated water covers 45, 55, 65 (see also figures described further below) may in embodiments of the present disclosure be attached to the movable frame 20. In the example of fig. 3, the water cover 55 is placed to cover a part of the division bar arrangement 30, and is fixated directly or indirectly to the division bar arrangement 30 by means of fastening means 55a for fastening the water cover. Hence, after the mechanical securing means 41, 51, 61 are installed and secures the insulated glass unit 2, 3, the water cover(s) may be placed to provide improved water tightness by guiding water such as rain water and melting water to the exterior major surface of the insulated glass unit. Hence, the elongated water cover 5 comprises side one or more parts that extend over a part of the insulated glass unit 2, 3 and another part that overlap a part of the movable frame. Hence water may be guided either towards the insulated glass unit or towards the roof dependent on where the water cover is placed at the roof window.

[0139] It is generally understood that the elongated water covers 45, 55, 65 may be considered parts that are separate to the mechanical holding system 40, 50, 60 such as separate to the mechanical securing means 41, 51, 61.

In such a case, the elongated water covers 45, 55, 65 may be arranged to cover the mechanical holding system 40, 50, 60 such as the mechanical securing means 41, 51, 61.

[0140] In other embodiments of the present disclosure, the holding system 40, 50, 60 may comprise the elongated water covers. For example, in some embodiments of the present disclosure (not illustrated), the elongated water covers 45, 55, 65, such as the one(s) arranged at the division bar arrangement 30, may be integrated in the mechanical securing means 41, 51, 61. For example, if the mechanical securing means 51 comprises a mechanical elongated clamping profile extending parallel to the division bar arrangement 30, this may also provide the water cover 55.

[0141] The water cover designs at the division bar arrangement 30 and at the location of the side profiles 21c, 21d respectively may vary. This may for example be the case if the movable frame 20 is a centre hung frame/pivot frame as the water covers may here need to be divided into separate parts where one water cover, such as lower water coverers (see refs 45 and 65 in fig. 2), are fixed to the movable frame 20, e.g. at the side profiles 21c, 21d and other upper water covers (45b, 65b at fig. 2) are fixed to e.g. side profiles of the fixation frame 10. When the movable frame 20 is in the closed position, the lower and upper water covers at the window sides may be arranged in continuation of each other. When the movable frame is opened, this provides a reduced angle between the lower and upper water covers at the roof window sides when compared to the angle at when the movable frame is in the closed position. This solution may not need to be the provided for the water cover at the division bar arrangement 30 as this water cover e.g. may comprise an elongated, such as single piece, water cover profile that extends from the bottom profile 21b and substantially all the way to the top profile 21a, dependent on the division bar design.

[0142] The fixation frame 10 may also comprise a top water cover 14 that extends in over and covers the upper part of the movable frame 20, such as extend in over and cover at least a part of the top profile 21a, when the movable frame 20 is in a closed position. This top water cover 14 may extend along the longitudinal direction of an upper fixation frame profile 11a.

[0143] The division bar arrangement 30 and the side profiles 21c, 21d (and possibly also the top and/or bottom profiles 21a, 21b) of the movable frame 20 comprises glass unit supporting part 44, 34, 54 that comprises support surfaces supporting the insulated glass units 2, 3 at/near the edges of the insulated glass units 2, 3, preferably by the outer surfaces 2a, 3a resting directly or indirectly on the glass unit supporting part 44, 34, 54.

[0144] The division bar arrangement 30 comprises an elongated profile that comprises a lower glass unit supporting part 34 that comprises support surfaces 31 which faces the outer surface 2a, 3a of the respective insulated glass unit 2, 3 that faces towards the interior 70 of the building when the movable frame 20 is closed. A resilient tightening 32, such as a resilient gasket such as a rubber gasket, a butyl material or the like is arranged between the glass unit surface 2a, 3a and the surface 31 of the lower glass unit supporting part 34.

[0145] In the example of fig. 3, the insulated glass units 2,3 are at the edges clamped between the surfaces 31 and the securing means 51 such as securing means comprising one or more removable clamps, where the surfaces 31 may act as counter hold. This clamping may deform one or both of the tightening 32, 13, hence providing an improved water and/or air tightening between the supporting division bar part 30 and the insulated glass units 2, 3.

[0146] As can be seen the division bar arrangement 30 may comprise a division part 30b that extends between the opposing, parallel edges 2c, 3c of the insulated glass units 2, 3 and is integrated in or fixed to the supporting part 34. This division part 30b may in some embodiments of the present disclosure help to provide improved heat insulation performance.

[0147] The division part 30b may additionally or alternatively act as a connection interface for the holding system 50, for example, the mechanical securing means 51, such as comprising one or more claps, may be detachably fixated to the division part 30b.

[0148] It is generally understood that one or more of the profiles 21a-21d and/or the profile of the division bar arrangement 30, such as a profile comprising the lower glass unit supporting part 34, may be substantially solid and e.g. comprise a wooden/wood material core. However, in other embodiments of the present disclosure, one or more of the profiles 21a-21d and/or the profile of the division bar arrangement 30, and in some embodiments also the profiles 11a-11d of the fixation frame may be hollow. Here, the frame profile interior may comprise heat insulation material such as a polymer material, such as a foamed polymer, such as a Polyurethane insulation or the like. Additionally or alternatively, the heat insulation material in the profile interior may comprise mineral wool, glass wool, a natural fibre insulation material and/or the like. In some embodiments, the profiles 21a-21d, and/or the profile of the division bar arrangement 30 may comprise an air filled interior comprising one or a plurality of division walls placed in the profile interior. The profiles may e.g. be made by means of extrusion, pultrusion and/or any other suitable type profile manufacturing type such as e.g. a moulding solution. Metal reinforcements may be placed in these profiles in some embodiments of the present disclosure. Also, the division part 30b may in some embodiments of the present disclosure be hollow as mentioned above and comprise heat insulating air filled cavities divided by partition walls and/or cavities filled with a heat insulation material as e.g. mentioned above.

[0149] As can be seen, the division bar arrangement 30 comprises outer side surfaces 33a, 33b facing towards each their frame opening 4a, 4b of the movable frame. These surfaces may face towards and be placed opposite to the outer surfaces 22 of the respective side profiles 21c, 21d of the movable frame 20 that faces the same respective frame opening 4a, 4b.

[0150] The insulated glass units 2, 3 are placed in the common glass unit plane PL1. This plane PL1 may be defined by the interior surfaces 2a, 3a, or exterior surfaces 2b, 3b of the insulated glass units. In the example of fig. 3, the interior surfaces, 2a, 3a defines/is comprised in the common glass unit plane PL1.

[0151] The glass units 2, 3 may as also mentioned above be of the same physical size and comprise the same number of glass sheets, and may have the same thickness (determined between the surfaces 2a, 2b and 3a, 3b respectively).

[0152] The insulated glass units 2, 3 may be individually installed in and removed from the movable frame 20.

[0153] In one or more embodiments of the present disclosure the fixation frame 10 substantially surrounds the movable frame 20. Further the fixation frame 10 and the movable frame 20 may substantially overlap in the same plane, such as in common with the first and second insulated glass units plane PL1. Hereby as seen on fig. 3 (see also fig. 6) the plane PL1 intersects the fixation frame 10 and the movable frame 20.

[0154] In some embodiments of the present disclosure, the mullion bar/division bar arrangement 30 may also provide a further attachment option so that two covers (not illustrated) such as blinds, e.g. roller blinds or venetian blinds, rather than one, can be installed at the interior side of the sash, as one cover such as a blind may be attached for each frame opening 4a, 4b to cover each their respective frame opening. Hence, guiding rails for guiding the fabric or the like may be placed on/attached to and extend along both side profiles 21c, 21d, and further guiding rails or the like may be attached to and extend along the division bar arrangement 30. The guiding rails prevents the covering material from falling into the room of the building due to gravity. Thereby a first cover, such as a roller blind, may comprise a fabric or other sheet material that is placed to cover the frame opening 4a, and extends between the side profile 21c and the division bar arrangement 30. A further, second cover, such as a further roller blind, may comprise a further fabric or other sheet material that is placed to cover the frame opening 4b, and extends between the division bar arrangement 30 and the side profile 21d. The covering devices may be configured to be controlled simultaneously or separate to each other by means of a control system that controls an electric motor for displacing the covering material of the respective cover.

[0155] An example of an installation method according to embodiments of the present disclosure is illustrated in fig. 4. Here, the movable frame 20 is configured to be releasably connected to the fixation frame 10 by means of a releasable hinge connection 90 as e.g. previously described.

This provides that the movable frame 20 can be movably connected to, and disconnected from, the fixation frame 10.

[0156] Initially, the roof window 1 is transported to the installation site. The roof window may here be delivered substantially assembled and arranged inside a common/joint delivery packaging, such as a cardboard packaging (not illustrated). The roof window is then unpacked from the delivery package.

[0157] The installation person may then consider whether the installation process would benefit from removing one or both of the insulated glass units 2, 3 from the roof window 1, dependent on the installation location and/or installation means available.

[0158] If the installation person finds that it may be an advantage that one or both insulated glass units 2, 3 are temporarily removed during the installation process, the releasable, mechanical holding system 40, 50, 60 fixating the insulated glass units 2, 3 in the movable frame 20 of the unpacked roof window are loosened, and one or both insulated glass units 2, 3 is/are removed from the movable frame 20 of the unpacked roof window 1.

[0159] Additionally, the installation person may remove the movable frame 20 from the unpacked window by disconnecting hinge part or parts of the movable frame 20 from a hinge part or parts of the fixation frame 10, so that the movable frame 20 may be installed at the fixation frame 10 again after the fixation frame 10 has been properly installed at the roof structure.

[0160] Then the installation person arranges the fixation frame 10 at the installation location, and fixates the fixation frame 10 to the roof structure 100 of the building. The installation person then subsequently attaches the movable frame 20 to the fixated fixation frame 10 by means of the hinge arrangement 90.

[0161] Then the first insulated glass unit 2 is provided and arranged in the movable frame 20 so as to cover the first frame opening 4a of the movable frame 20. In the present case, the installation person found that it was also beneficial to temporarily remove the second insulated glass unit 3 too, and hence, the second insulated glass unit 3 is subsequently provided and arranged in the movable frame 20 of the installed frame arrangement so as to cover the second frame opening 4b of the movable frame.

[0162] Hereby, the insulated glass units 2, 3 are arranged side by side in the movable frame in the common glass unit plane PL1 as illustrated in e.g. fig. 3. The insulated glass units may be arranged in the movable frame that is connected to the fixated fixation frame by means of the hinge arrangement one by one consecutively.

[0163] Then the insulated glass units 2, 3 are secured to the movable frame 2 by means of the releasable, holding system 40, 50, 60 one by one, or simultaneously dependent on the holding system.

[0164] In some further embodiments, water covers 45, 55, 65 may also be installed.

[0165] In some embodiments of the present disclosure, the insulated glass unit 2, 3 may comprise a sealing arrangement, such as a gasket arranged at the insulated glass unit. The gasket may be used for water tightening and/or air tightening when the insulated glass unit is installed at the movable frame. A sealing arrangement may e.g. be attached to the surface 2b, 3b and/or surface 2a, 3a of the insulated glass unit.

[0166] Fig. 5 illustrates schematically a cross sectional view of a roof window 1 according to embodiments of the present disclosure, where the insulated glass units 2, 3 are installed in the movable frame 20 while the frame is in an open position. It is understood that the movable frame 20 may be connected to and hang in the fixation frame 10 by means of the hinge arrangement 90 during this, but the fixation frame 10 has been omitted from the figure for the sake of simplicity.

[0167] In fig. 5, the roof window is of the centre pivot type, such as e.g. illustrated in fig. 2.

[0168] Here, the movable frame 20 comprises an first exterior side 20a for facing the exterior 80 of the building when the movable frame 20 is in a closed position (see fig. 3), and a second interior side 20b for facing the interior 70 of the building when the movable frame 20 is in a closed position (see fig. 3).

[0169] The hinge arrangement 90 comprises a centre hinge arrangement allowing the movable frame 20 to rotate at least 45°, such as at least 90°, such as at least 120° from the closed position to an open position.

[0170] In the present example of fig. 5, the movable frame has been moved/pivoted to an open position providing that the first side 20a faces inwards towards the building interior 70.

[0171] In fig. 5, the first and second insulated glass units are hence installed in the movable frame 20 while the movable frame is in this open position.

[0172] Gravity Fg, such as a component thereof, may provide that the insulated glass units 2, 3 may be arranged in the movable frame but may fall out of the movable frame if not retained either by hand, or by a holding system, such as a secondary holding system, during the installation process.

[0173] Hence, when installing the window, the fixation frame 10 (not illustrated in fig. 5, see e.g. figs 2-4) is first fixated to the roof structure. Then the movable frame 20 may be installed/mounted movably, such as mounted pivotably around the rotation axis as previously described - see e.g. also fig. 2 - in the fixated fixation frame by means of the hinge arrangement 90.

[0174] Then the movable frame 20 is pivoted/rotated around the rotation axis so that the first side 20a faces inwards towards the building interior 70. When the movable frame 20 is in that position, the first and/or second insulated glass units 2, 3 are installed in/secured to the movable frame 20 by an installation person from the interior of the building.

[0175] This may comprise that the person places the first insulated glass unit 2 in the movable frame 20 to cover the frame opening 4a, and then fixates the first insulated glass unit to the movable frame by means of a holding system 40, 50 so that the holding system holds the insulated glass unit around the edges of the insulated glass units.

[0176] Subsequently, if the second insulated glass unit 3 is also to be installed in the movable frame the installation person placed the second insulated glass unit 3 in the movable frame 20 to cover the frame opening 4b, and then fixates the second insulated glass unit to the movable frame by means of a holding system 50, 60 so that the holding system holds the insulated glass unit around the edges of the insulated glass units.

The water covers 45, 55, 65 may be integrated in the holding system (not illustrated), or may finally be installed at the movable frame.

[0177] Fig. 6 illustrates an embodiment of the present disclosure where the insulated glass units may be installed from the second interior side 20b, and where the releasable holding system 40, 50, 60 is an interior holding system that is accessible at the interior side 20b of the movable frame. The insulated glass units 2, 3 are thus configured to be installed in and removed from the movable frame 20 from the interior side 20b of the movable frame 20 by manipulating the releasable holding system 40, 50, 60. The releasable holding system is attached to interior parts of a plurality of the elongated profiles 21a-21d, 30 of the movable frame 20, and the releasable holding system 40, 50, 60 comprises interior elongated holding profiles 48, 58, 68 attached to said elongated profiles by means of one or more mechanical, releasable fixation members 49, 59, 69 such as one or more screws, (as illustrated), one or more nails, one or more snap-fit solutions and/or the like.

[0178] In other embodiments, the releasable holding system 40, 50, 60 may comprise one or more clamps such as one or more displaceable clamps, and a covering profile may then be arranged to visually cover these clamps upon finished window installation.

[0179] As can be seen, the holding profiles 48, 58, 68 may in embodiments of the present disclosure comprise or provide the previously mentioned lower glass unit supporting part 34 that comprises the support surface 31 which faces the outer surface 2a, 3a of the respective insulated glass unit 2, 3 that faces towards the interior 70 of the building when the movable frame 20 is closed.

[0180] A counter hold 57, 47, 67 such as elongated lists of the movable frame may be arranged at the exterior surface 2b, 3b, so that when the holding profiles 48, 58, 68 are properly fixated to the movable frame 20 and the insulated glass units 2, 3 are hence secured in the movable frame, the insulated glass units 2, 3 are held, such as clamped between the counter holds and the holding profiles.

[0181] In embodiments of the present disclosure, the holding profile 48, 58, 68 may comprise an elongated rim 48a, 58, 68a or slit extending in the longitudinal direction of the holding profile that is configured to engage with a counterpart, such as a slit or rim in the respective elongated profile 21c, 21d, 30. In fig. 6, the rim is placed at the respective holding profile, and is configured to engage with a slit in the respective profile by extending into the slit. This may help to improve alignment of the holding profile and/or help to temporarily maintain the holding profile at the respective profile of the movable frame, until the fixation members 49, 59, 69 are provided.

[0182] In some embodiments, the holding profiles 48, 58, 68 may be capable of temporarily maintain the insulated glass unit in the movable frame until an installation person provides/fixates the fixation members 49, 59, 69.

[0183] Here, the rim and slit may act as a secondary holding means for temporarily retaining the insulated glass units 2, 3 at the respective frame opening 4a, 4b, and the insulated glass units 2, 3 are hence subsequently, finally secured at the movable frame (20) by means of mechanical securing means 49, 59, 69 acting as further primary releasable means for securing the insulated glass units 2, 3 to the movable frame.

[0184] A tightening system 13 such as a resilient gasket, an elastomer tightening, a butyl material and/or the like as previously mentioned may be provided to ensure water tightness between the movable frame and the insulated glass unit 2, 3 at the exterior side 20a.

[0185] The same applies for the interior side 20b, where one or more resilient gaskets 32 or the like may be placed, e.g. between the holding profiles 48, 58, 68 and the like may be placed to assure water tightness and/or air tightness at the interior side 20b.

[0186] The counter holds may be maintained connected to the movable frame 20 through the roof window installation process, and an installation person may hence press/push the insulated glass units towards the counter holds from the interior side 20b when installing the insulated glass units in the respective frame opening 4a, 4b. The counter holds 57, 47, 67 may be integrated in the movable frame or be releasable connected thereto.

[0187] In some further embodiments, the installation person may after installation of the insulated glass units 2, 3 in the movable frame, in some embodiments, provide water covers 45, 55, 65 and/or water tightening 13, such as further water tightening (e.g. by means of gaskets and/or elastomer material) at the outer surface 20a of the movable frame, either from the exterior side of the roof structure while the side 20a faces outwards, or by rotating the movable frame 20 so that the side 20a faces inwards as previously described. However, the water covers 45, 55, 65 may in embodiments of the present disclosure where the releasable, mechanical holding system 40, 50, 60 is placed at the interior side 20b not be removed during the installation process as illustrated in fig. 6.

[0188] Figs. 7-9a illustrates various embodiments of the present disclosure, wherein the holding system 40, 50, 60 comprises secondary holding means 42, 52, 62 which are present as further securing means as an addition to primary securing means.

[0189] In fig. 7. The secondary holding means 42, 52 are provided at the movable frame 20. The figure schematically illustrates a part of the movable frame 20 comprising only the insulated glass unit 3 for improved figure simplicity.

[0190] The secondary holding means 42, 52 here comprises displaceable holding means, where a plurality of holding means, in the present example comprising a turn knob solution is provided.

[0191] Hence, when the movable frame 20 is rotated when connected to the fixation frame 10 so that the outer surface 20a faces inwards towards the building interior, an installation person can place the insulated glass unit 2, 3 in the movable frame 20 to cover the desired frame opening 4a, 4a (see previous figs.), and manipulate/trigger the turn knobs so that these extend in over the relevant insulated glass unit 2, 3. Then, the installation person can let go of the insulated glass unit as it will now be temporarily held in the movable frame and not fall away from the movable frame due to gravity, and the installation person may then install the other insulated glass unit in the movable frame in the same manner by means of secondary holding means (not illustrated in fig. 7). These secondary holding means 42, 52 may then hold the insulated glass units temporarily in the movable frame until the installation person installs/reinstalls the primary securing means (not illustrated in fig. 7) such as glazing beads so that the insulated glass unit is properly secured to the movable frame in a water tight manner.

[0192] It is understood that in embodiments of the present disclosure, the secondary holding means such as displaceable holding means may be activated/operated automatically or by one hand only without any tools or fasteners. These displaceable holding means may e.g., in embodiments of the present disclosure, comprise one or more of clamps, snap keeper, turn knobs, slider locks or similar known hardware. The displaceable holding means may be displaceable between two configurations, a first configuration where the insulated glass unit is released and can be moved from the movable frame, and a second configuration where the insulated glass unit is secured to the movable frame 20. The displaceable holding means may in some embodiments also cooperate with other holding elements. For example one side of the insulated glass unit may be held by a glass overlapping fitting (not shown) while the opposite side of the insulated glass unit is held by the displaceable holding means.

[0193] Fig. 8a-8b illustrates schematically a cross sectional view of another embodiment of the present disclosure, wherein movable frame 20 comprises secondary holding means comprising a snap-fit solution. Here, resilient displaceable holding means 52 are provided. These secondary holding means may be attached to and/or integrated in the movable frame construction. Hence, an installation person may by hand or by means of a tool, or by means of the insulated glass unit itself dependent on the constitution of the resilient holding means 52, temporarily displace the resilient holding means 52, and when the insulated glass unit 2 is in its intended position, the resilient holding means 52 "snaps" into position due to the resiliency of the resilient holding means 52, thereby providing that a part of the resilient holding means 52 overlaps a part of the surface 2b of the glass unit 2. This may be provided at two, three, four locations or more locations around the respective insulated glass unit, thereby providing that these together hold the respective insulated glass unit temporarily in the movable frame 20 until the installation person installs/reinstalls the primary securing means (not illustrated in fig. 8a). Fig. 8b then illustrates that the primary securing means 51, such as a glazing bead, are installed and proper water tightening 13 may hereby be provided. The primary securing means 51 may be attached to the movable frame by means of mechanical, releasable securing means such as screws, nails, a clamping arrangement or the like.

[0194] As can be seen, the primary securing means 51 are to be considered separate to the secondary holding means 52, and hence, when a person e.g. wants to remove the insulated glass unit from the frame 20, the user may first need to remove the primary securing means 51, and then deactivate/manipulate the secondary holding means 52 before the person is able to remove the glass unit from the movable frame.

[0195] The secondary holding means may in some embodiments of the present disclosure only provide limited or no holding of the insulated glass unit when the primary securing means 51 has been installed.

[0196] In figs. 7-8b, the movable frame 20 may upon delivery comprise the secondary holding means 42, 52 attached thereto and ready for use.

[0197] Figs. 9a-9b illustrates schematically an embodiment of the present disclosure, where individual secondary holding means comprises a clips/clamp arrangement that may be arranged, such as snapped, into engagement with the movable frame and here hold the glass unit. Hence, an installation person may arrange the insulated glass unit to cover the frame opening, and then install the secondary holding system comprising so that it engages with the movable frame. Here, it may as illustrated snap into engagement with a receiving slit or opening 75 in the movable frame. It is generally understood that different snap-fit solutions and holding means designs may be used in order to enable a safe secondary holding of the insulated glass unit in the frame.

[0198] The secondary holding means may then be disconnected from the movable frame again, should a person desire to remove the insulated glass units from the movable frame. Fig. 9b illustrates an embodiment where both the primary glass overlapping securing means 51, in this example an elongated glazing bead, and a water cover 55 is installed. The water cover 55 is placed to cover the primary securing means 51, and these primary securing means 51 are arranged to cover the secondary holding means 52.

[0199] Hence, a method of installing the roof window may comprise:

Initially using a secondary holding system, 42, 52, such as retaining parts such as clamps, for temporarily retaining the insulated glass units 2, 3 at the respective frame opening 4a, 4b, and subsequently securing the insulated glass units 2, 3 held by the secondary holding system at the movable frame 20 by means of the further primary, releasable, mechanical securing means 41, 51, 61 such as glazing beads, for securing the insulated glass units 2, 5 to the movable frame, preferably in a water tight manner. It is understood that the water tightening 13 may either be pre-mounted/pre-adhered

to the IGU at the outer surface 2b, 3b, or may be pre-mounted/pre-adhered to the securing means 41, 51, 61 such as glazing beads, e.g. in a recess of the securing means as illustrated, such as a channel or slit. Alternatively, the installation person may provide the water tightening 13 before mounting the securing means 41, 51, 61.

[0200] It may generally be relevant to provide a solution that may help to ensure that the insulated glass units 2, 3 are not installed with the wrong outer surface facing the exterior, as the present disclosure relates to a roof window where an installation person may provide installation of the insulated glass units in the movable frame 20. Insulated glass units may comprise a constitution as previously explained where e.g. the outer glass sheet 6a may be thicker than the other glass sheets and/or may be tempered. Additionally or alternatively, the inner glass sheet 6d may be a lamination glass helping to assure that glass pieces may not fall towards the room of the building in case the insulated glass unit is shattered.

[0201] Hence, if an installation person by mistake installs the insulated glass units 2, 3 so that the glass sheet 6a by mistake faces inwards, this may reduce safety.

[0202] Accordingly, the roof window may in embodiments of the present disclosure be designed with measures so that the chances of correct glass unit 2, 3 installation is increased. This may e.g. be provided by means of markings and/or by means of one or more shapes that may prevent "wrong side installation".

[0203] Different embodiments of such measures are disclosed in figs. 10-12, according to various embodiments of the present disclosure.

[0204] In fig. 10 and 11 a shape restricts wrong side install. Here, the shape is provided by means of a protrusion 110 of the movable frame 20, and this protrusion extends into a stepped shape 120, such as a recess of the insulated glass unit 2. In fig. 10, the stepped shape is provided by making the lamination glass sheet 6d slightly smaller than the other glass sheets 6a-6c of the insulated glass unit 2, thereby providing a space into which the protrusion 110 of the frame may extend. In fig. 11, the stepped shape is provided by making the lamination glass sheet 6d, and the glass sheet 6c slightly smaller than the other glass sheets 6a-6b of the insulated glass unit 2. The edge seal 9 is hence arranged with a distance to the outer edge of the intermediate glass sheet 6b. This provides a larger space into which the protrusion 110 of the frame may extend. If the insulated glass unit 2 was tried to be installed with the surface 2b facing the interior 70 (when the movable frame is in a closed position) instead, the insulated glass unit 2 could not be installed correctly as the protrusion 110 would prevent the glass unit 2 from this since the size of the glass sheet 6a is larger. Moreover, the secondary holding means and/or the primary holding means as previously described may in some embodiments not be able to extend over and hold the glass unit if the insulated glass unit 2 was tried to be installed with the surface 2b facing the interior 70 (when the movable frame is in a closed position). The installation person would discover that the insulated glass unit 2, 3 does not fit properly in the frame and hence either consult the instruction manual and here be informed of the mistake, or alternatively, due to intuition, figure out that the orientation of the glass unit should be changed so that the surface 2b faces outwards instead.

[0205] It is generally to be understood that the edges of the insulated glass unit(s) to be installed in some embodiments of the present disclosure may be processed and blunt. For example each glass pane edge may be polished, grinded and/or as double chamfered (e.g. at the glass unit manufacturing location). This may help to reduce the risk of installation persons getting harmed by cutting or the like on edges or corners of the insulated glass unit(s) during installation in the movable frame.

[0206] Fig. 12. illustrates a further embodiment of the present disclosure. Here, the insulated glass unit comprises a peripheral enclosure arrangement 130, 140 comprising a polymer edge material 130. Here, the insulated glass unit comprises a securing arrangement 140 that is configured so that the insulated glass unit 2 can be fixated/secured to the frame profile 21c of the movable frame 20 by means of mechanical fastening means 145 such as screws. Such a solution is disclosed in more details in patent document EP2188462 B1. The securing arrangement 140 may comprise an elongated, angular part such as a metal or polymer profile, comprising walls/lips 140a, 140b, where a first part 140a of this is embedded in or attached to the polymer edge material 130. A second part 140b extends away from the insulated glass unit, e.g. so as to be attached to and/or so as to abut a surface 150 of the movable frame facing away from the frame opening.

[0207] The securing arrangement 41 disclosed in fig. 12 may be considered a re-usable mechanical securing means, here, the securing arrangement may in some embodiments as illustrated comprise a glass overlapping part 140a that is the one that is attached to the insulated glass unit 2 by means of the polymer edge 130. In further embodiments, an adhesive may be used for this and the polymer edge may be omitted.

[0208] In this embodiment, the securing means 140 are fixed to the insulated glass unit and hence, an installation person may remove the insulated glass unit from the movable and install it at the movable frame by means of the mechanical fastening means 145 such as one or a plurality of screws. These may be configured to extend into pre-provided screw holes 146, or these screw holes may alternatively be provided during the first insulated glass unit installation by a self-cutting screw 145. The securing arrangement 140 may comprise recesses or through going openings for receiving such mechanical fastening means 145. In some embodiments of the present disclosure (not illustrated in fig. 12), the mechanical fastening means 145 may comprise a clamp for engaging with a lip or protrusion of the securing arrangement 140 so as to secure the insulated glass unit to the movable frame.

[0209] The securing arrangement 140 provides a shape that helps to restrict/prevent wrong side install as the second part 140b extends away from the insulated glass unit and intuitively indicates the orientation of the insulated glass unit.

[0210] As can be seen, the polymer edge material 130 may in further embodiments comprise a protrusion 160 such as a ridge or tongue that is configured to extend into a recessed portion 161 such as a groove of the movable frame 20. This may help to provide improved alignment of the insulated glass unit 2 during installation. In other embodiments, the movable frame may naturally comprise the protrusion, and the polymer edge material may comprise the recessed portion such as a groove.

[0211] Fig. 13 illustrates an embodiment of the present disclosure, where a side of the insulated glass unit is marked in order to prevent wrong side install, and hereby assure that the correct side of the insulated glass unit, such as a side comprising a lamination glass, faces the interior of the building when the movable frame is in a closed position. Here, a removable marking/label 170 such as a sticker or the like, is attached to a major surface of the insulated glass units 2, 3, and are in the present example visible when the insulated glass units 2, 3 are installed in the frame 20. The marking 170 comprises information 171 such as one or more of image, photo, sign and/or writing, indicating whether the side of the insulated glass unit at which the marking 170 is installed, should face inwards or outwards. For example, information such as "This side out", "This surface out when window is closed" or the like may be provided as information 170. Additionally or alternatively, a machine readable code, such as a QR code or a barcode may be provided at the marking as a part of the information 171, and when read by a device, such as a handheld device, such as a smartphone, or the like, (e.g. by means of a camera at that device) it may redirect a user to further installation information by means of an app installed at the device or by means of an internet browser.

[0212] It is understood that in some embodiments, markings 170 comprising information 171 may be placed at both sides 2a, 2b of the insulated glass units. The information at these may be slightly different in order to inform the installation person of orientation information relating to the insulated glass unit.

[0213] In some embodiments, the marking(s)/label(s) 170 may be considered and/or configured to be, permanent, and hence in some embodiments the marking(s) may be partly or fully hidden in the frame 20. In further embodiments, both removable and permanent markings may be provided.

[0214] Fig. 14 illustrates an embodiment of the present disclosure, where the movable frame comprises four individual insulated glass units that may be installed in each their area and cover each their frame opening of the movable frame. Here, the insulated glass units does not extend at least 70%, such as at least 80%, such as at least 90% of the entire height of the movable frame 20. Instead a transverse division bar arrangement 230 extends parallel to the width direction WD of the roof window 1 between sides of the movable frame 20 and a division bar arrangement 30 that extends in the height direction HD of the window. The transverse division bar arrangement 230 extends in the width direction WD of the movable frame between the previously mentioned top and bottom profiles 21a, 21b, see fig. 2. The transverse division bar arrangement 230 may generally be provided as e.g. previously disclosed and securing means such as primary securing means and/or secondary holding means may in some embodiments be attached thereto, and the same applies for the previously mentioned water covers.

[0215] Figs. 15a-15b illustrates embodiments of the present disclosure wherein the roof window 1 comprises three elongated insulated glass units arranged side by side to cover each their frame opening 4a-4c, where the frame openings are divided by each their division bar arrangement 30 extending in the height direction HD between the top and bottom profiles 21a, 21b (see fig. 2) of the movable frame 1. The insulated glass units extends at least 70%, such as at least 80%, such as at least 90% of the entire height of the movable frame in the height direction HD. In some embodiments, as e.g. illustrated in figs. 1-3, the movable frame 20 may comprise just one division bar arrangement 30 extending in the height direction HD of the movable frame, and hence two insulated glass units 2, 3 extending at least 70%, such as at least 80%, such as at least 90% of the entire height of the movable frame in the height direction HD.

[0216] Fig. 16 illustrates an embodiment of the present disclosure wherein the division bar arrangement 30 is attached to one of the insulated glass units, in this case the unit 2, so that when that glass unit 2 is installed at the movable frame, the division bar arrangement 30 is also installed thereby. This provides that the division bar arrangement divides the overall frame opening between the opposing outer surfaces 22 of the respective side profiles 21c, 21d of the movable frame 20 that faces the into the two frame openings 4a, 4b as illustrated in the figures previously described. The division bar arrangement 30 may here be pre-attached to the glass unit by means of a releasable mechanical holding system 50, such as e.g. previously described. However, additionally or alternatively, in embodiments of the present disclosure, an adhesive and/or a moulding material may fixate the division bar arrangement 30 to the glass unit.

[0217] When installing the glass unit 2, the ends or end parts of the division bar arrangement 30 may engage (not illustrated) with a recess or another engagement interface or the like of the top and bottom profiles, or the side profiles, of the movable frame dependent on the extension direction of the division bar arrangement. The division bar arrangement 30 may hence in some embodiments mechanically engage with one or more of the top and bottom or side profiles, and be fixed thereto. This fixation between the division bar arrangement 30 and the respective top, bottom and/or side profiles of the movable frame may preferably be releasable so that the glass unit and division bar arrangement attached thereto can be removed again and e.g. exchanged. This fixation between the division bar arrangement 30 and the respective

top, bottom and/or side profiles of the movable frame may in some embodiments involve utilizing mechanical fastening means such as screws or nails, or alternatively or additionally a latch/notch solution or the like. A holding system such as of a type previously described, or the like, may additionally or alternatively be used for this purpose.

[0218] It is furthermore understood that in some embodiments of the present disclosure, the movable frame may be of a design for accommodating both regular "full size" insulated glass units too, and hence, a visible interface part at these components for connecting with the division bar arrangement may be omitted at the respective top, bottom and/or side profiles, or at least such interface may be made of only reduced visibility (e.g. by small markings, recesses, indications or the like). A person ordering the window may hereby determine whether a division bar arrangement 30 solution is needed or not, as the movable frame may e.g. be used for both types.

[0219] After installing the division bar 30 and glass unit 2 part/assembly, the second glass unit 3 may be installed. Here, the second glass unit may be installed substantially as e.g. illustrated in fig. 5.

[0220] In other embodiments as seen in e.g. fig. 4, the movable frame 20 may comprise the division bar arrangement 30 so that the division bar arrangement 30 is arranged between and separates neighbouring/adjacent frame openings such as the openings 4a, 4b, 4c of the movable frame as e.g. previously described. Here, the division bar arrangement 30 may be pre-attached to, such as integrated in, the movable frame for example already when leaving the frame manufacturing factory.

[0221] While the present disclosure has been described in detail in connection with only a limited number of embodiments or aspects, it should be readily understood that the present disclosure is not limited to such disclosed embodiments or aspects. Rather, the present disclosure can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate in scope with the present disclosure. Additionally, while various embodiments or aspects of the present disclosure have been described, it is to be understood that aspects of the present disclosure may include only some of the described embodiments or aspects or combinations of the various embodiments or aspects. Accordingly, the present disclosure is not to be seen as limited by the foregoing description.

Claims

1. A roof window (1) for installation in a roof structure (100) of a building, wherein the total weight of the roof window (1) is more than 35 kg,

wherein the roof window (1) comprises:

- a fixation frame (10),
- a movable frame (20) which is movably connected to the fixation frame (10) by means of a hinge arrangement, wherein the movable frame comprises structural elongated profiles comprising an elongated top profile (21a), an elongated bottom profile (21b) and parallel, elongated side profiles (21c, 21d), and wherein the movable frame (20) supports at least a first insulated glass unit (2) and a second insulated glass unit (3),
- a releasable, mechanical holding system (40, 50, 60),
- at least one division bar arrangement (30, 230)

wherein said division bar arrangement (30, 230) is arranged between and separates a first frame opening (4a, 4b, 4c) and a second frame opening (4a, 4b, 4c) of the movable frame (20), wherein the first insulated glass unit (2) is arranged to cover the first frame opening, and wherein the second insulated glass unit (3) is arranged to cover the second frame opening,

wherein the first insulated glass unit (2) and the second insulated glass unit (3) are arranged side by side in a common glass unit plane (PL1), and

wherein the fixation frame (10) substantially surrounds the movable frame (20),

wherein the releasable, mechanical holding system (40, 50, 60) is arranged to secure the first and second insulated glass units (2, 3) at the movable frame (20).

2. A roof window (1) according to any of the preceding claims, wherein the holding system (40, 50, 60), comprises reusable mechanical glass overlapping securing means (41, 51, 61, 140), such as a glazing bead arrangement.

3. A roof window (1) according to any of the preceding claims, wherein the holding system (40, 50, 60), comprises primary securing means (140, 41, 51, 61), such as glass overlapping securing means, such as a glazing bead arrangement, and wherein the holding system (40, 50, 60) moreover comprises secondary holding means (42, 52, 62), such as displaceable holding means, for temporarily maintaining the insulated glass units (2, 3) in the movable

frame (20).

4. A roof window (1) according to any of the preceding claims, wherein one or more elongated water covers (45, 55, 65) are attached to the movable frame (20), such as attached to the division bar arrangement (30, 230), so as to extend over a part of the insulated glass units (2, 3) and so as to extend over a part (21a-21d, 30) of the movable frame, wherein the elongated water covers (45, 55, 65) are arranged to cover said holding system (40, 50, 60) and/or wherein said holding system (40, 50, 60) comprises the elongated water covers (45, 55, 65).

5. A roof window (1) according to any of the preceding claims, wherein the movable frame (20) comprises an exterior side (20a) for facing the exterior (80) of the building when the movable frame (20) is in a closed position, and an interior side (20b) for facing the interior (70) of the building when the movable frame (20) is in a closed position,

wherein the releasable holding system (40, 50, 60) is accessible at said exterior side (20a) of the movable frame (20),

wherein the hinge arrangement (90) comprises a centre hinge arrangement configured so that the movable frame (20) is configured to rotate at least 90°, such as at least 120°, from the closed position to an open position, and wherein the insulated glass units (2, 3) are configured to be installed in and removed from the movable frame (20) from the exterior side (20a) of the movable frame (20) by manipulating the releasable holding system (40, 50, 60).

6. A roof window (1) according to any of the preceding claims, wherein the movable frame (20) comprises an exterior side (20a) for facing the exterior (80) of the building when the movable frame (20) is in a closed position, and an interior side (20b) for facing the interior (70) of a building when the movable frame (20) is in a closed position,

wherein the releasable holding system (40, 50, 60) is accessible at said interior side (20b) of the movable frame (20),

wherein the insulated glass units (2, 3) are configured to be installed in and removed from the movable frame (20) from the interior side (20a) of the movable frame (20) by manipulating the releasable holding system (40, 50, 60),

wherein the releasable holding system is attached to interior parts of a plurality of the elongated profiles (21a-21d, 30) of the movable frame, such as wherein said releasable holding system comprises interior elongated holding profiles attached to said elongated profiles by means of one or more mechanical, releasable fixation members.

7. A roof window (1) according to any of the preceding claims, wherein the movable frame (20) is releasably connected to the fixation frame (10), preferably by means of a releasable hinge connection, so as to allow the movable frame (20) to be movably connected to, and disconnected from, the fixation frame (10).

8. A roof window (1) according to any of the preceding claims,

wherein the roof window is configured to be separated into individual separate roof window sub parts for individual lifting, where said individual separate roof window sub parts comprises:

- a first roof window sub part comprising the first insulated glass unit (2,3),
- a second roof window sub part comprising the second insulated glass unit (2,3), and
- a third roof window sub part comprising the fixation frame (10), such as the fixation frame (10) joined to the movable frame (20), or the fixation frame (10) and movable frame (20) dismantled from each other,

wherein each of said separate roof window sub parts weighs below 55% of the total roof window weight, such as below 45% of the total roof window weight.

9. A roof window (1) according to any of the preceding claims, wherein the insulated glass units (2, 3) each comprises at least three glass sheets (6a,6c, 6d), preferably at least four glass sheets (6a, 6b, 6c, 6d).

10. A roof window (1) according to any of the preceding claims, where the insulated glass units (2, 3) have a front side and a back side and where a side is marked and/or where a shape prevents, wrong side install.

11. A roof window (1) according to any of the preceding claims, where the insulated glass units (2, 3) comprises a

peripheral enclosure (130, 140) comprising a securing arrangement (140), such as an angular part, extending from the insulated glass units (2, 3) and/or where the insulated glass units (2, 3) comprises a sealing arrangement.

- 5 **12.** A method of installing a roof window (1) in a roof structure (100) of a building, such as in a roof structure having a roof inclination above 8° such as above 15°, wherein the total weight of the roof window (1) is more than 35 kg, wherein the method comprises the steps of:

10 - providing a frame arrangement (10, 20) wherein said provided frame arrangement (10, 20) comprises a fixation frame (10) and a movable frame (20), wherein the fixation frame (10) is configured to substantially surround the movable frame (20), wherein the movable frame (20) is configured to be movably connected to the fixation frame (10) by means of a hinge arrangement (90) and wherein the movable frame (20) comprises structural elongated profiles comprising an elongated top profile (21a), an elongated bottom profile (21b) and parallel, elongated side profiles (21c, 21d), and wherein a division bar arrangement (30, 230) is configured so as to be arranged between and separate a first frame opening (4a) and a second frame opening (4b) of the movable frame (20),

15 - installing the frame arrangement (10, 20) in the roof structure (100),
 - providing a first insulated glass unit (2) and arranging the first insulated glass unit (2) in the movable frame (20) of the installed frame arrangement so as to cover said first frame opening (4a) of the movable frame (20),
 20 - providing a second insulated glass unit (3) and arranging the second insulated glass unit (3) in the movable frame (20) of the installed frame arrangement so as to cover said second frame opening (4b) of the movable frame, so that said insulated glass units (2, 3) are arranged side by side in a common glass unit plane (PL1), and
 - securing said insulated glass units (2, 3) to the movable frame (2) by means of a releasable, mechanical holding system (40, 50, 60).

- 25 **13.** The method according to claim 12, wherein said step of installing the frame arrangement (10, 20) in the roof structure (100) comprises fixating the fixation frame (10) to the roof structure, and subsequently attaching the movable frame (20) to the fixated fixation frame (10) by means of the hinge arrangement (90).

- 30 **14.** The method according to claim 12 or 13, wherein the movable frame (20) comprises an exterior side (20a) for facing the exterior (80) of the building when the movable frame (20) is in a closed position, and an interior side (20b) for facing the interior (70) of the building when the movable frame (20) is in a closed position, wherein the hinge arrangement (90) comprises a centre hinge arrangement allowing the movable frame (20) to rotate at least 45°, such as at least 90°, such as at least 120° from the closed position to an open position, wherein the steps comprising arranging the first and/or second insulated glass units (2, 3) in the movable frame (20) are provided at least partly by an installation person from the interior of the building while the movable frame (20) is in the open position.

- 35 **15.** The method according to any one or more of claims 12-14, wherein the step of securing the insulated glass units (2, 3) to the movable frame (20) by means of the releasable, mechanical holding system (40, 50, 60) comprises

40 using a secondary holding system, (42, 52), such as retaining parts such as clamps, for temporarily retaining the insulated glass units (2, 3) at the respective frame opening (4a, 4b), and subsequently securing the insulated glass units (2, 3) at the movable frame (20) by means of further primary releasable, mechanical securing means (41, 51, 61) for securing the insulated glass units (2, 5) to the movable frame.

- 45 **16.** The method according to any one or more of claims 12-15, further comprising the steps of

50 - initially unpacking the a roof window (1) from a delivery packaging and disconnecting the movable frame (20) from a fixation frame (10) of the frame arrangement of the unpacked roof window, and
 - loosening a releasable, mechanical holding system (40, 50, 60) fixating the insulated glass units (2, 3) in the movable frame (20) of the unpacked roof window, and removing one or both insulated glass units (2, 3) from the movable frame (20) of the unpacked roof window (1).

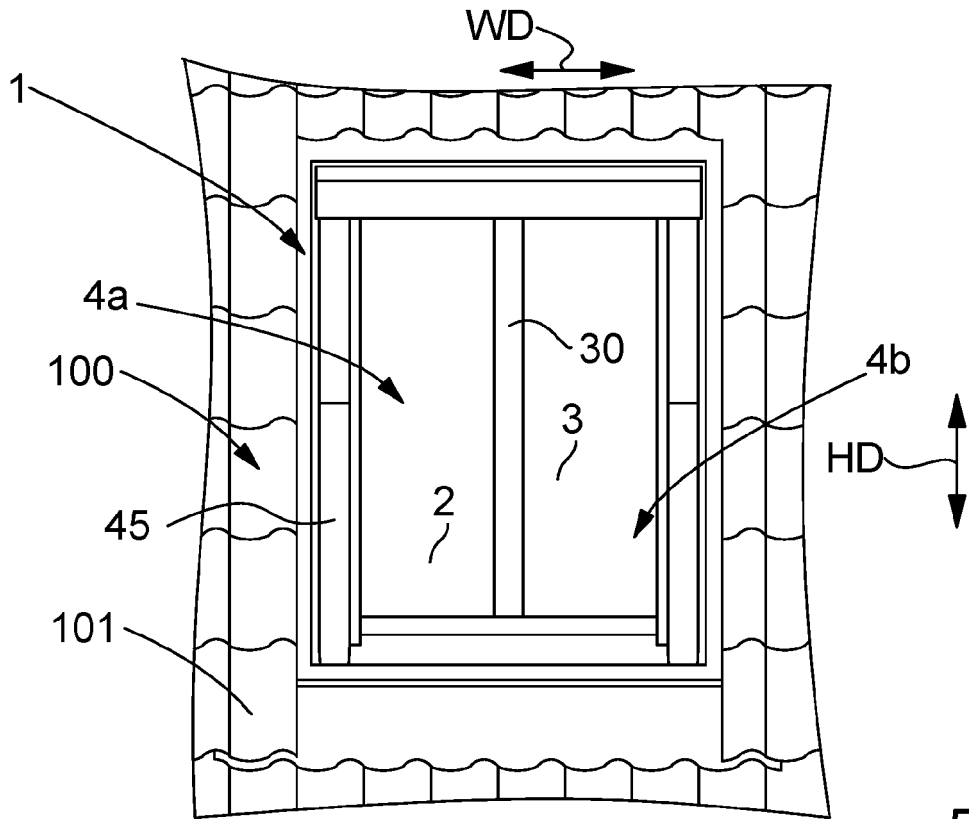


Fig. 1

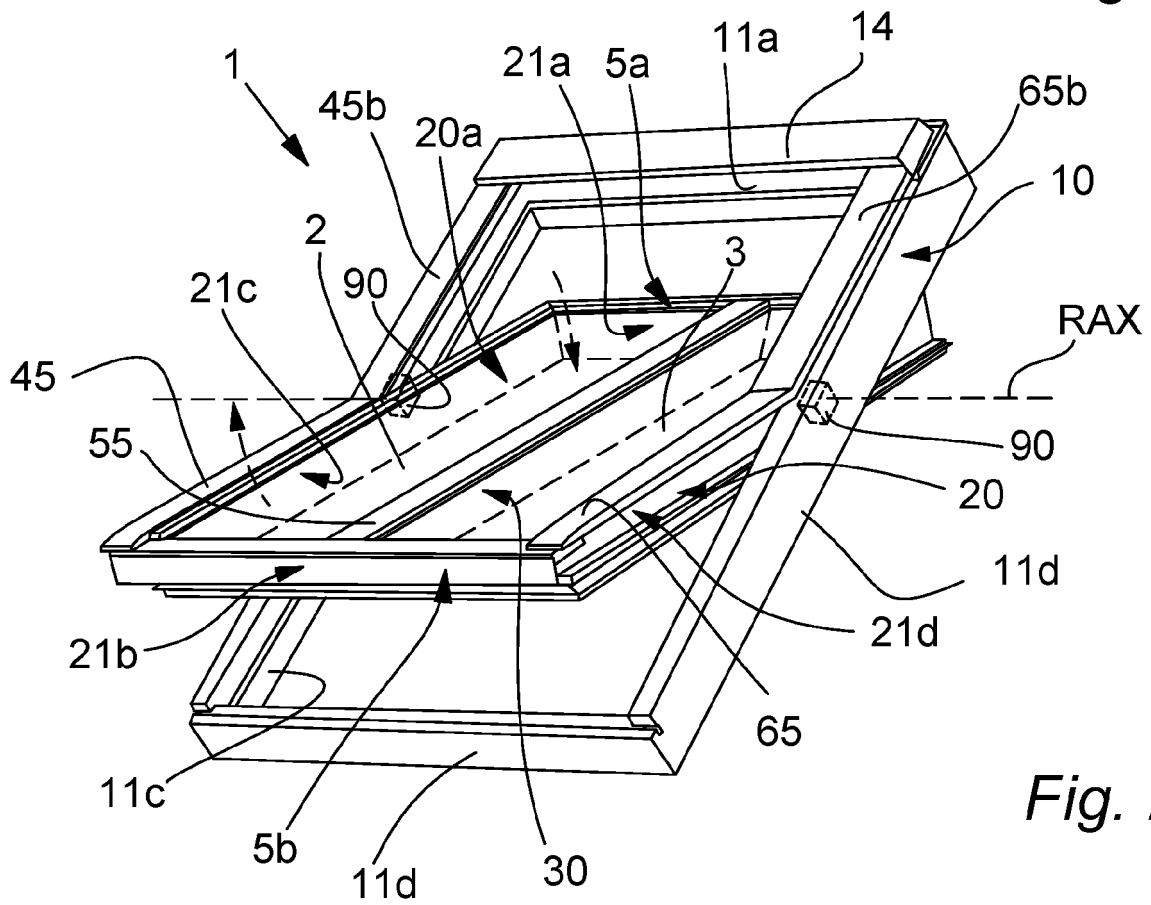
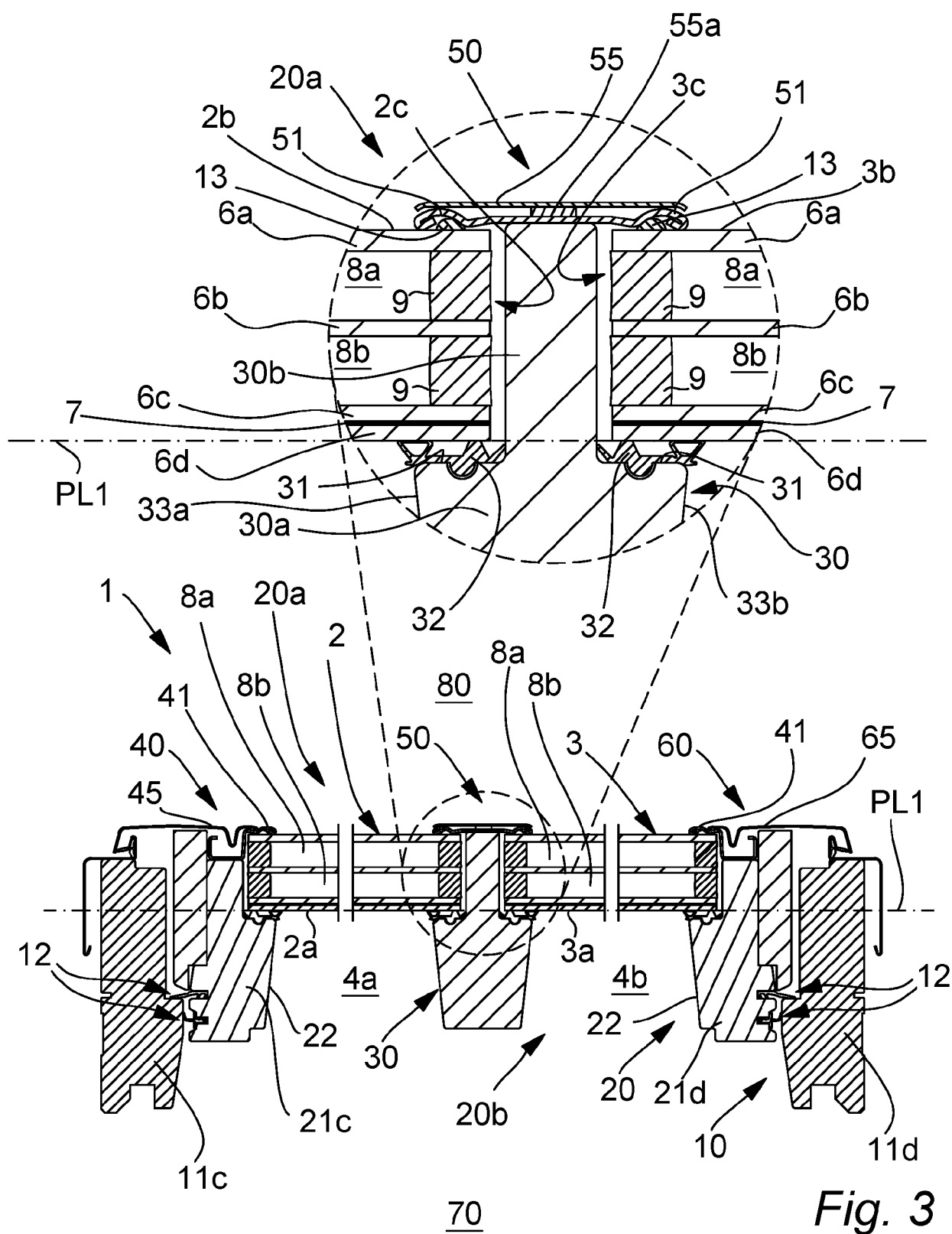
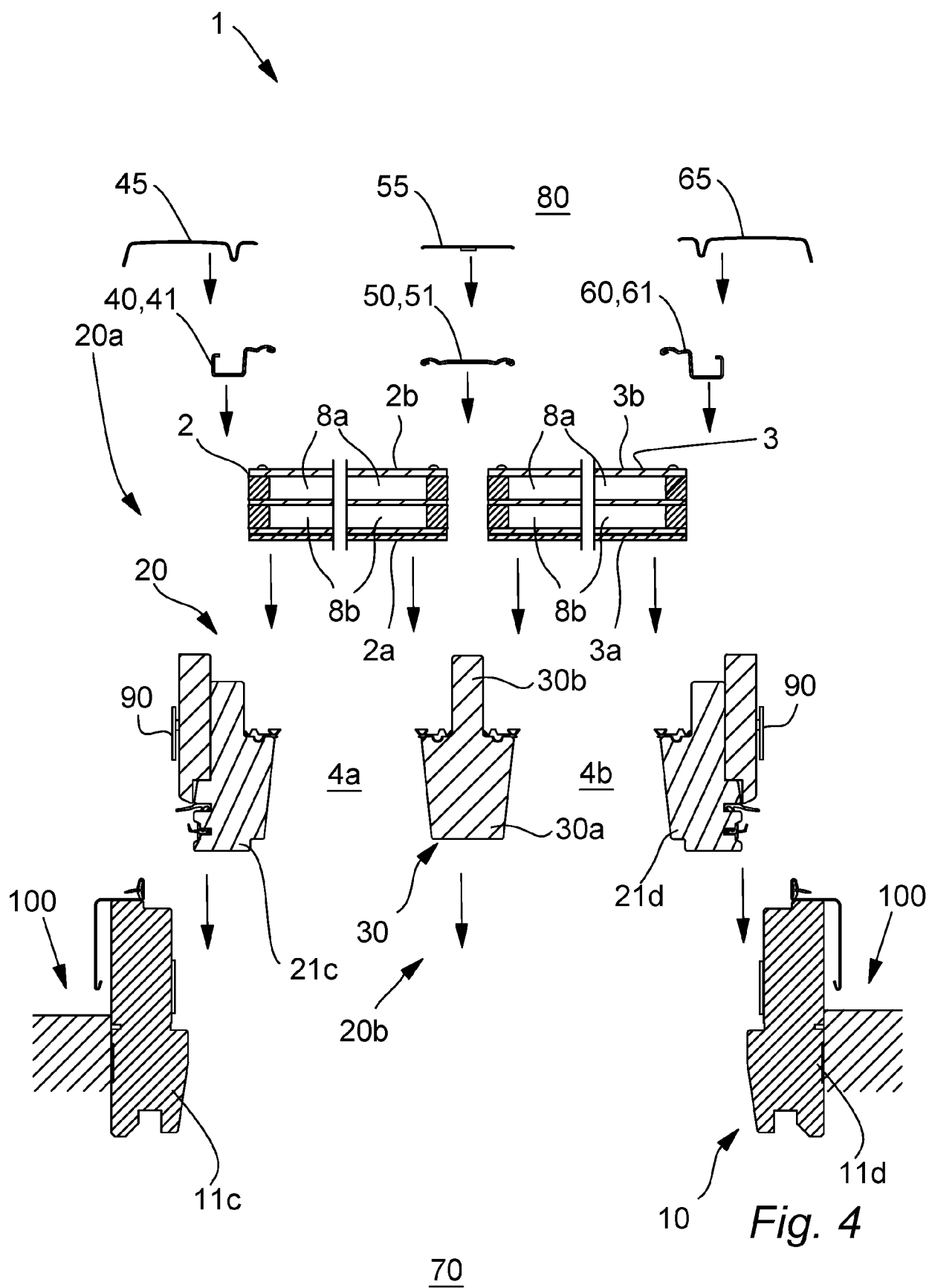
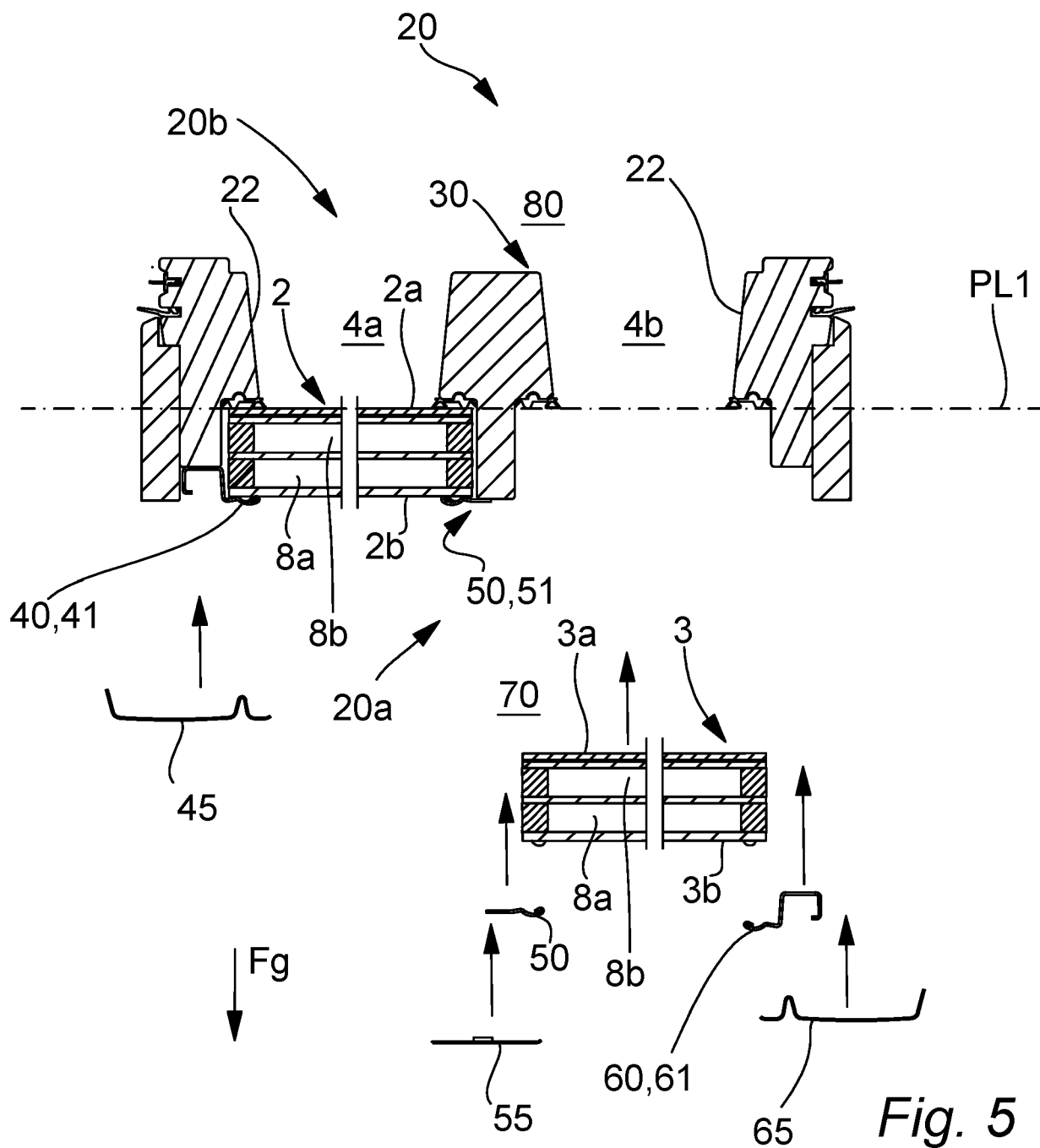
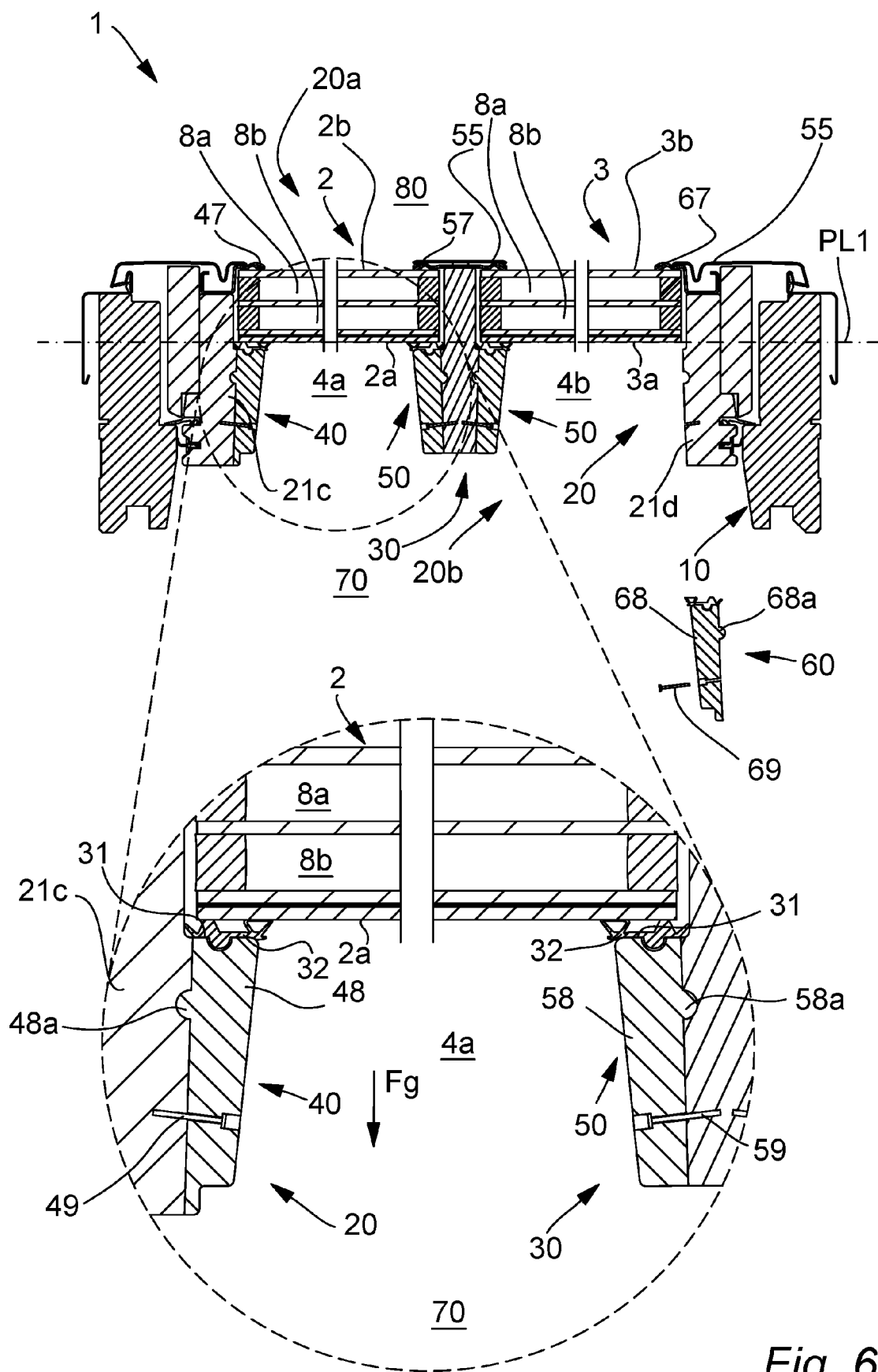


Fig. 2









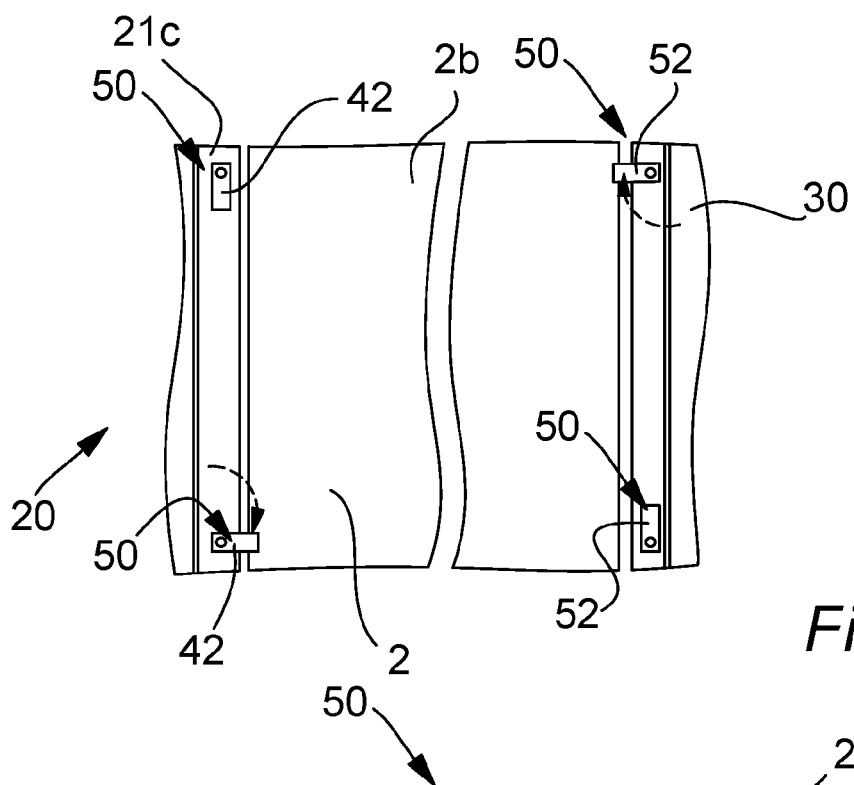


Fig. 7

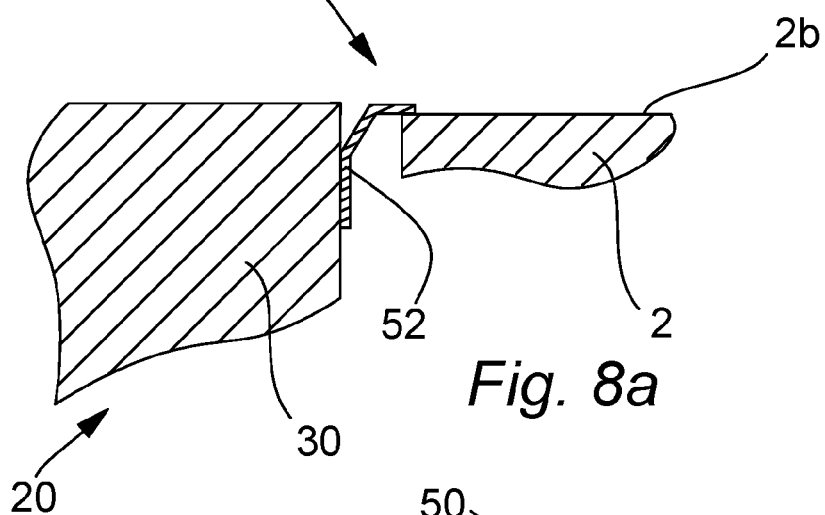


Fig. 8a

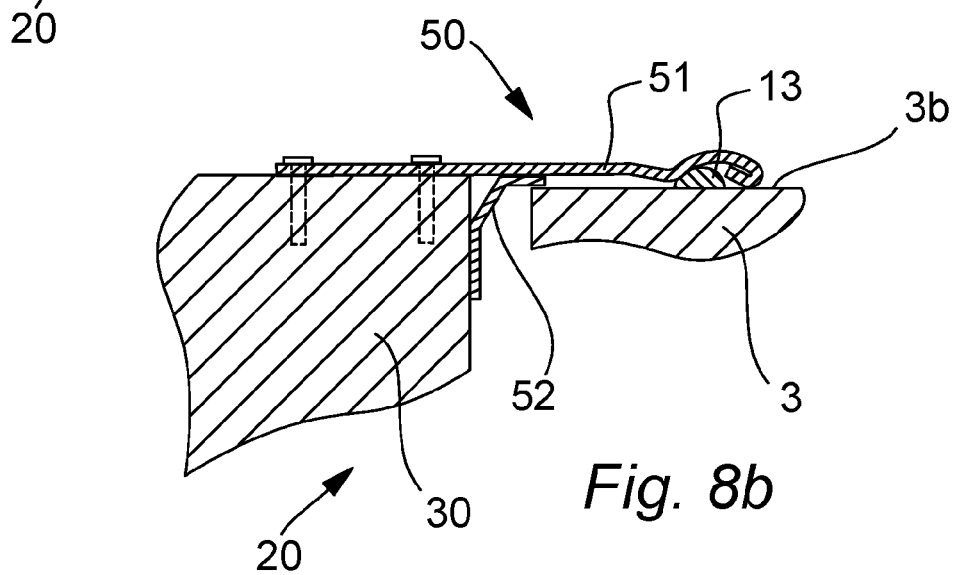


Fig. 8b

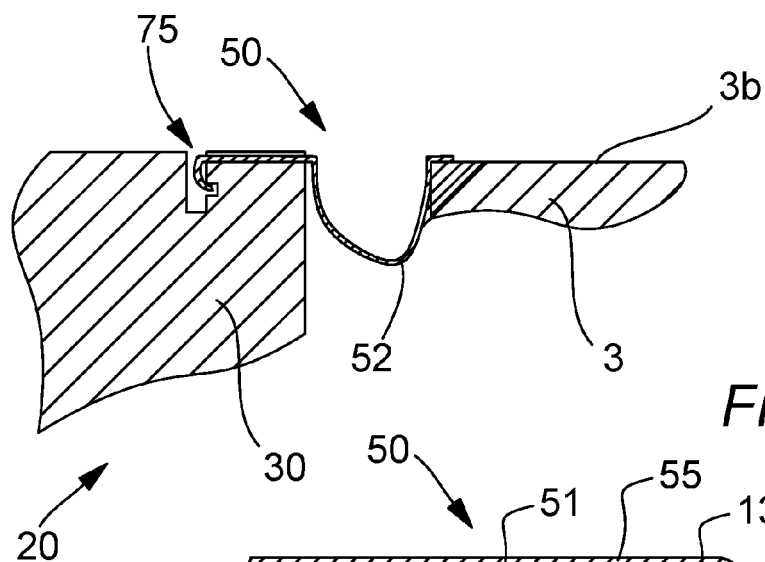


Fig. 9a

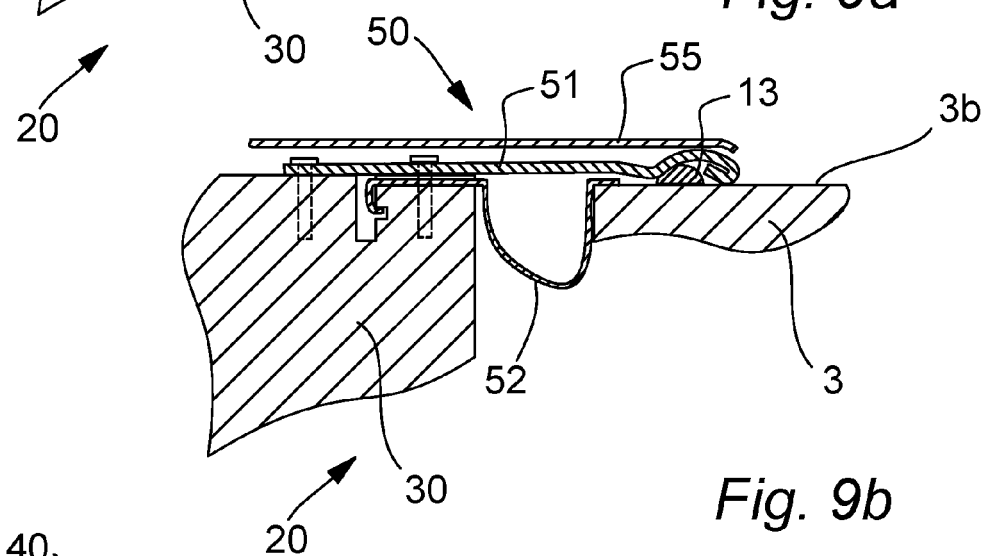


Fig. 9b

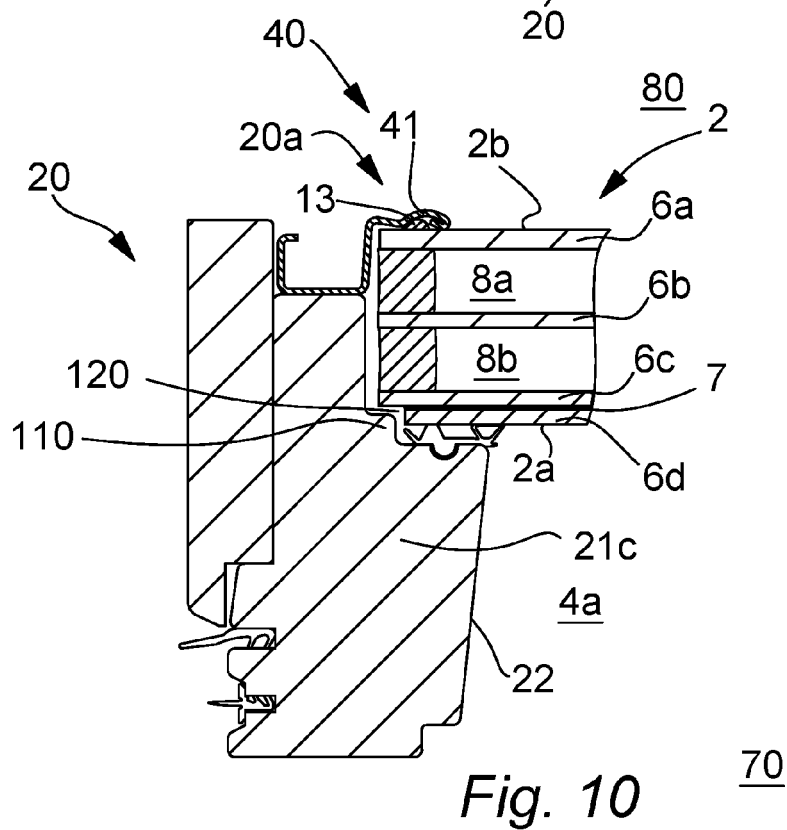


Fig. 10

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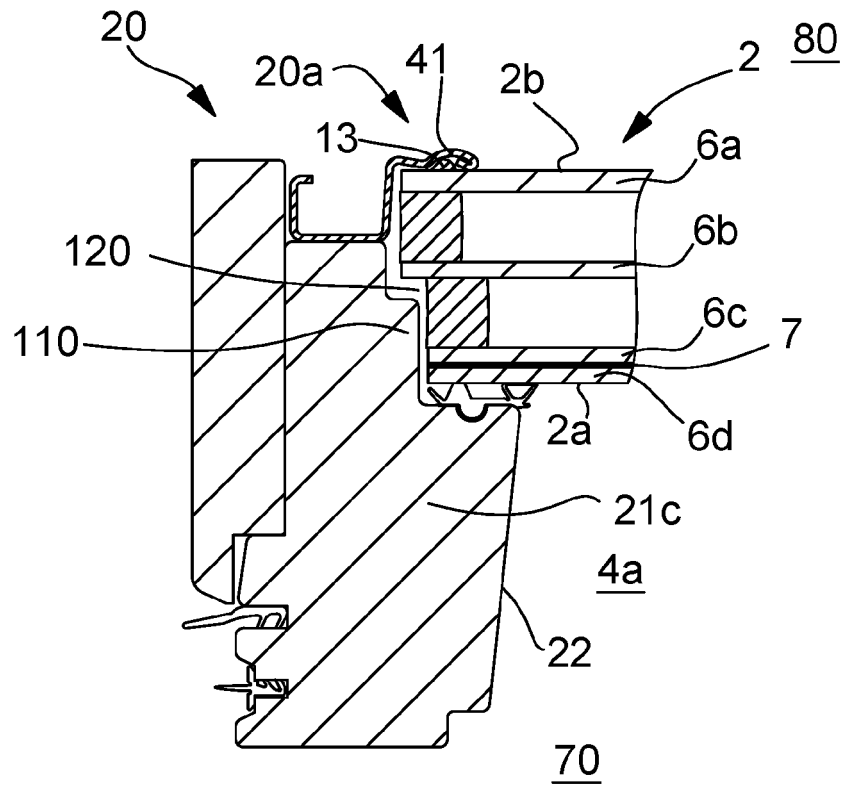


Fig. 11

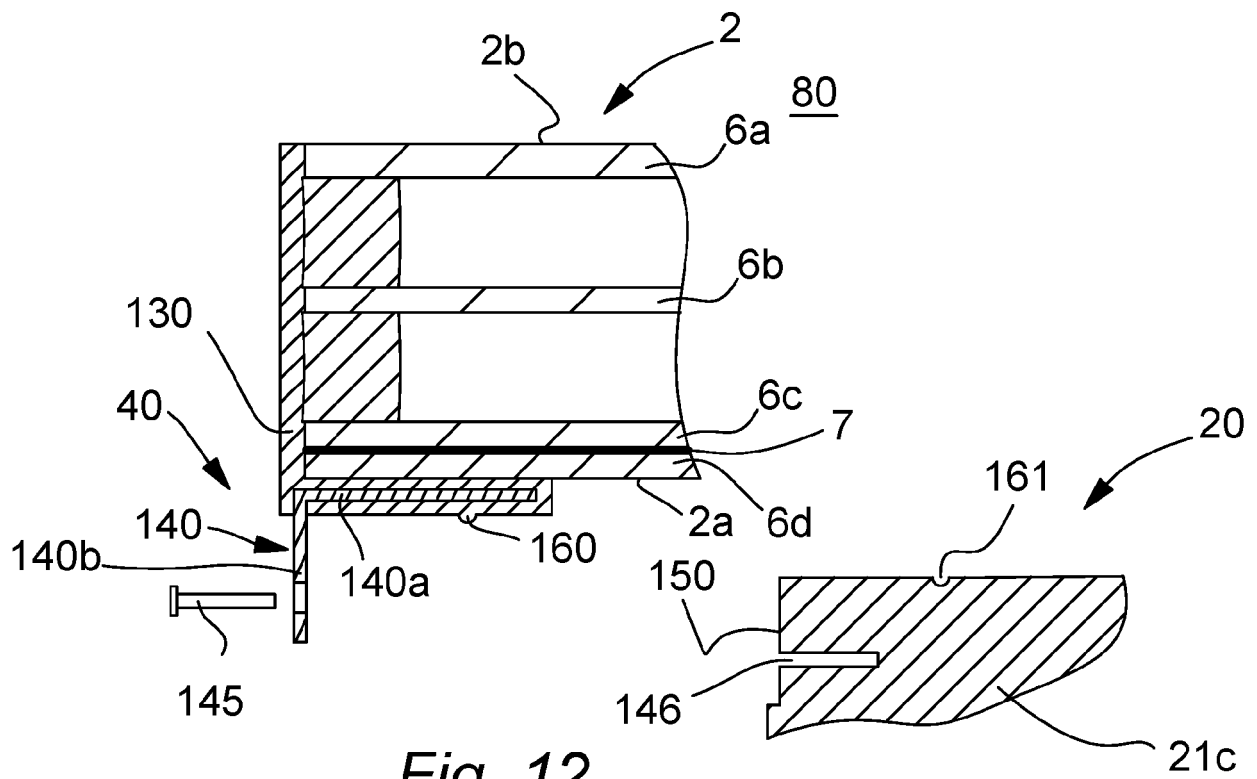
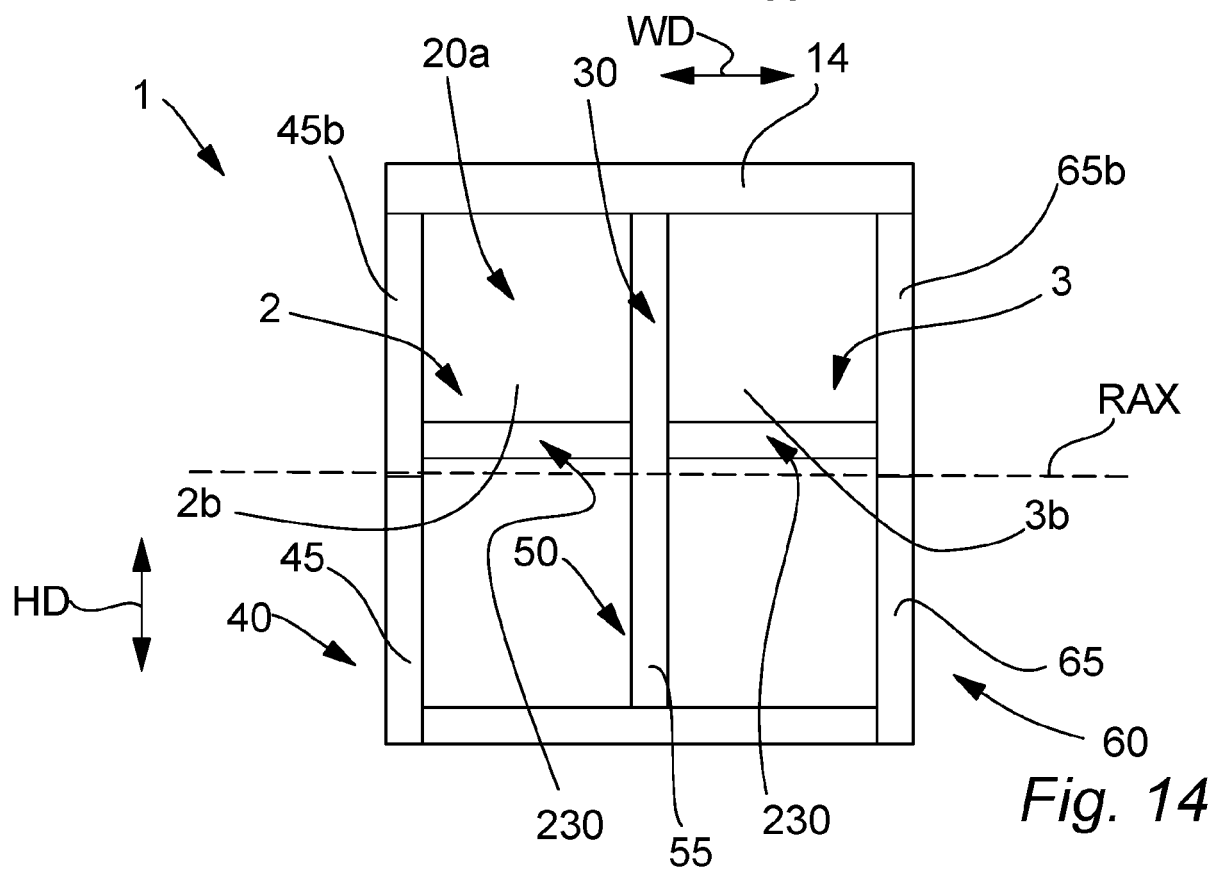
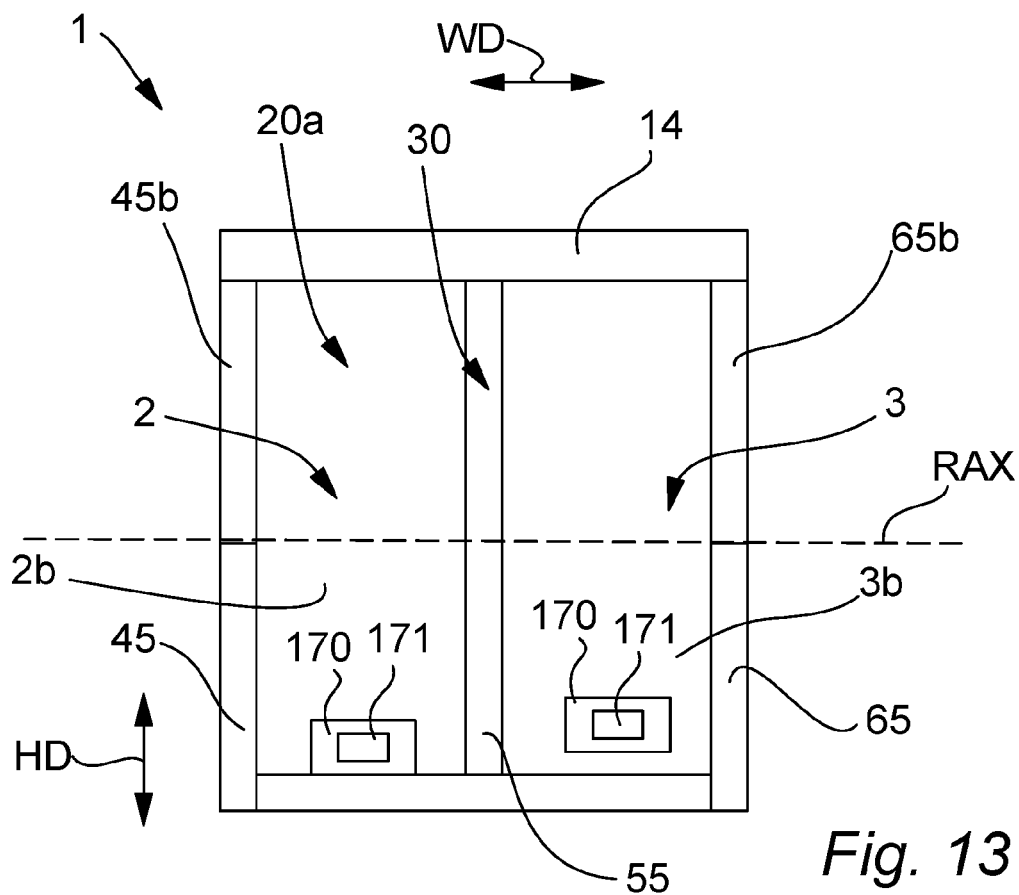


Fig. 12



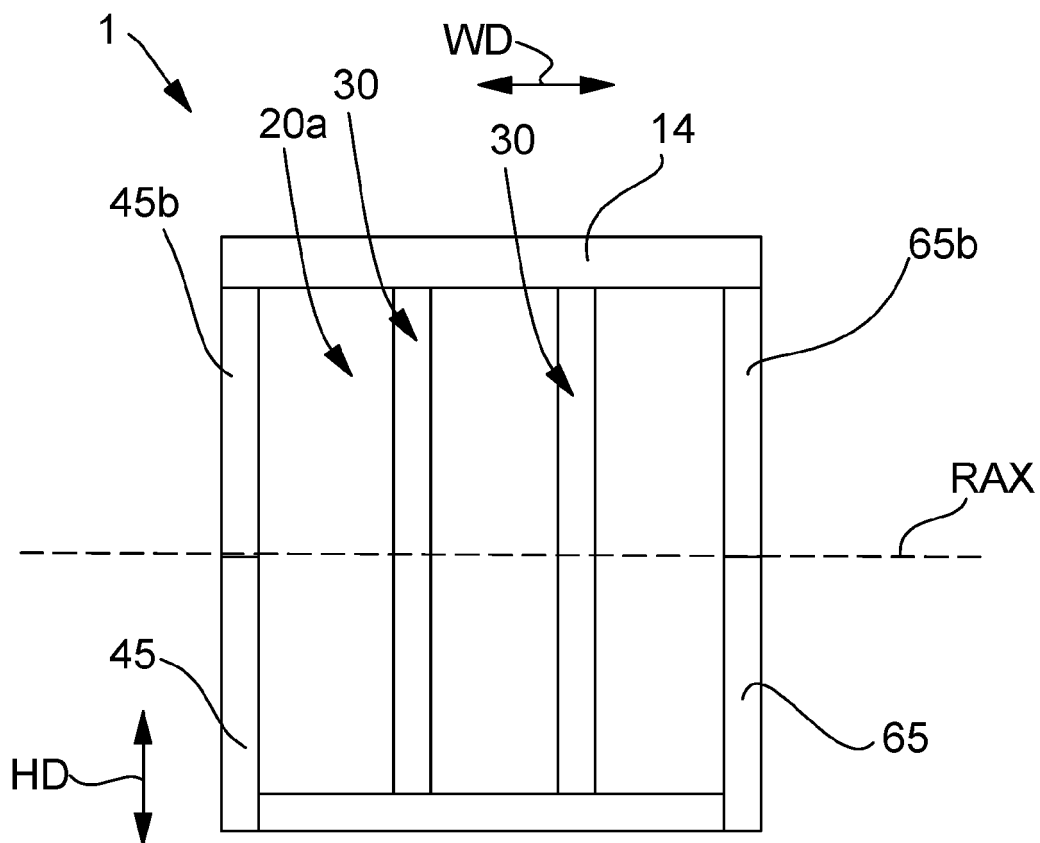


Fig. 15a

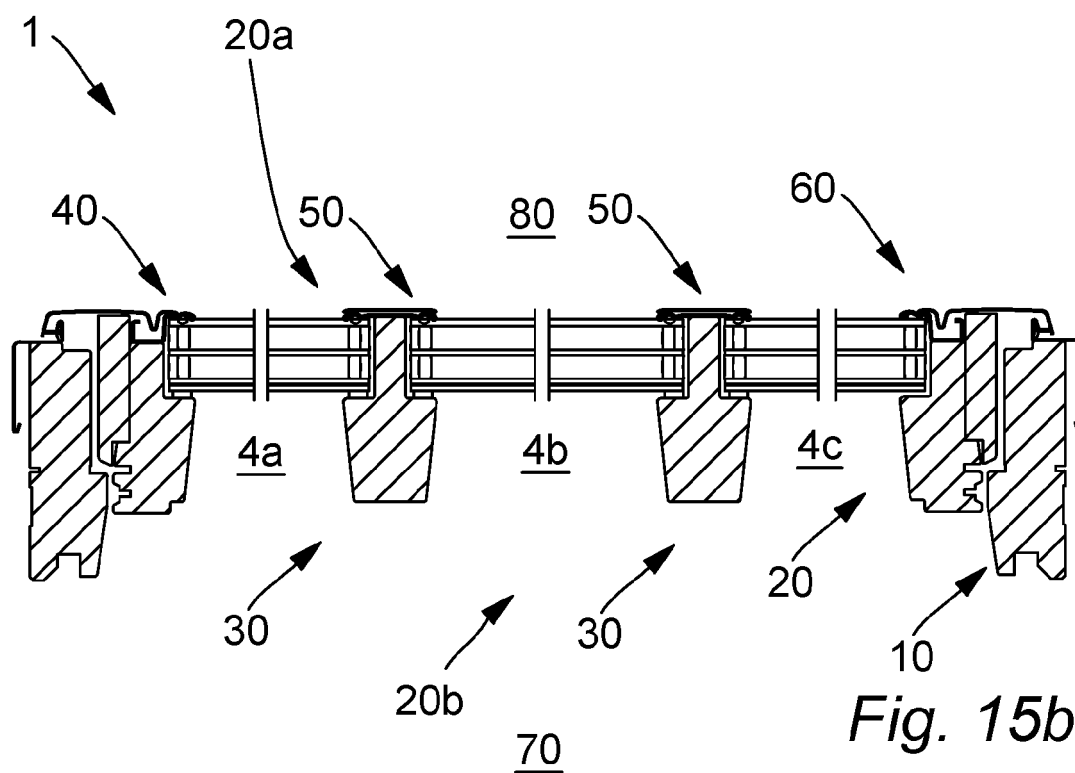


Fig. 15b

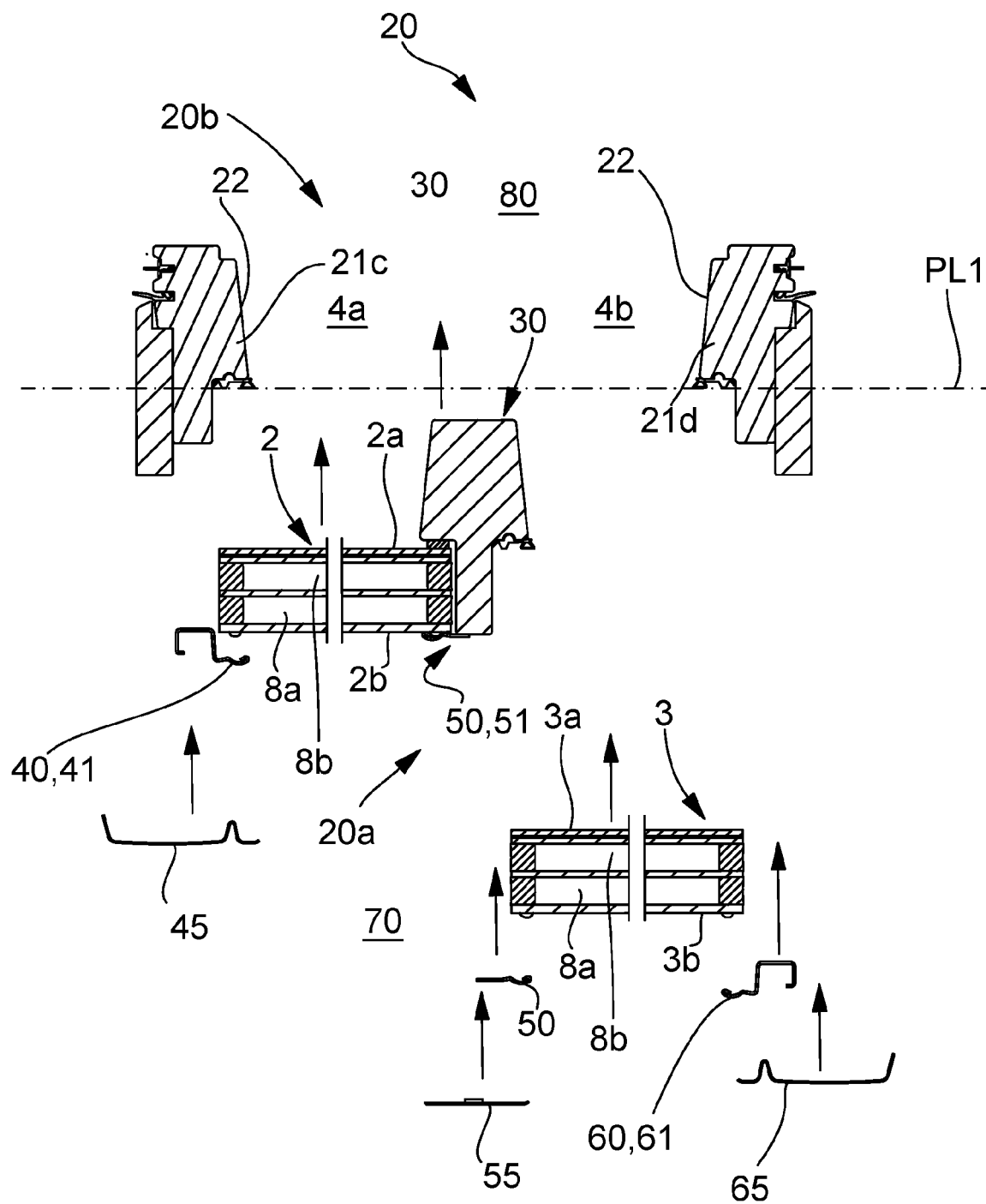


Fig. 16



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Place of search The Hague		Date of completion of the search 21 January 2022	Examiner Leroux, Corentine
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			

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