



(12)

EUROPEAN PATENT APPLICATION

- (43)

Date of publication:
26.06.2024 Bulletin 2024/26
- (51)

International Patent Classification (IPC):
E05F 1/10^(2006.01)
- (21)

Application number: 23218122.2
- (52)

Cooperative Patent Classification (CPC):
E05F 1/1075; E05F 1/1058; E05Y 2201/499;
E05Y 2201/624; E05Y 2201/688; E05Y 2900/152
- (22)

Date of filing: 19.12.2023

- (84)

Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN
- (71)

Applicant: VKR Holding A/S
2970 Hørsholm (DK)
- (72)

Inventors:
• Holm, Michael Galsgård
2970 Hørsholm (DK)
• Øhlenschläger, Terkel
2970 Hørsholm (DK)
- (30)

Priority: 19.12.2022 DK PA202270629
- (74)

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

(54)

ROOF WINDOW WITH A LIFTING DEVICE

- (57)

In the roof window (100), the lifting device (10) further comprises a lifting arm (14) inserted between the primary frame (1) and the at least one secondary frame (2, 3). The lifting arm (14) has a first end (12) rotatably connected with a sledge (30) slidably connected with the primary frame (1) in a sledge guide (16) and a second end (13) rotatably connected with the at least one secondary frame (2, 3). The lifting device (10) further comprises a spring assembly (20) configured to be coupled to the sledge (30). The lifting arm (14) and the sledge guide (16) extend along a length direction (L) defining a central plane (P).

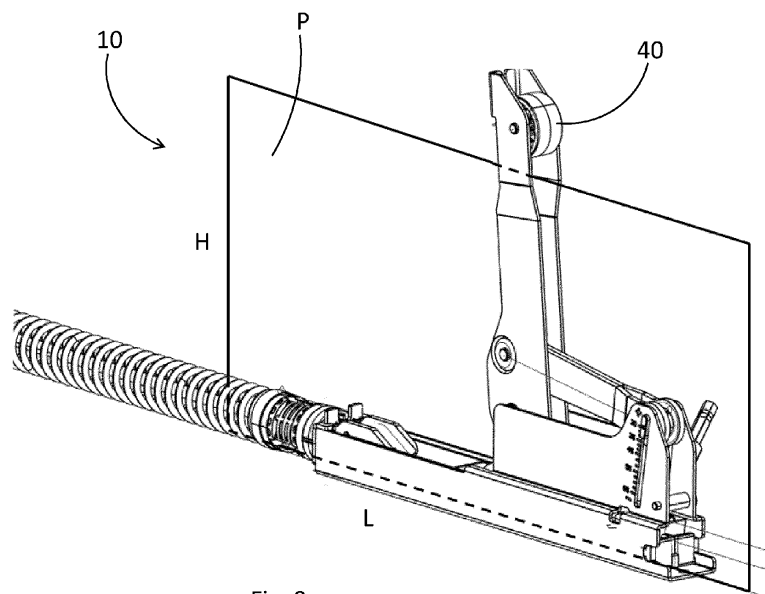


Fig. 9

Description

Technical Field

[0001] The present invention relates to a roof window with a stationary primary frame, at least one secondary frame such as a sash and/or intermediate frame, and a lifting device comprising a lifting arm inserted between the primary frame and the at least one secondary frame.

Background Art

[0002] Windows for installation in an inclined roof surface may be provided in a number of varieties and include more or less complicated operational structures to allow opening of the sash and to fulfil other functions, such as ventilation. Such roof windows include the type hinged at or near the centre, the top-hinged type, and finally the roof windows that are top-hinged during normal operation but in which the sash is able to perform a rotating movement substantially at a centre axis, either for cleaning or for providing an alternative manner of operation. Roof windows of the top-hinged type have a first hinge axis provided by a top hinge arrangement to provide a first operational condition, whereas rotation of the sash in a second operational condition is performed by means of an intermediate frame in which the sash is hinged to provide a secondary hinge axis. Typically, one hinge of the hinge arrangement will be located at either side of the roof window to define a substantially horizontal hinge axis.

[0003] Examples of top-hinged windows with a second operational condition are for instance disclosed in Applicant's WO-A-89/10460, EP 0 733 146 B1, EP 1 873 323 B1, EP 2 762 665 A2, and WO 2019/101281 A1. To make it possible to rotate the window sash approximately 180° to a convenient cleaning position, the sash structure is connected with an intermediate frame with frame arms, which in the closed position of the window are positioned between the upper parts of the frame and sash side members, and which during normal use of the window as a top-hung window follow the sash side members.

[0004] In roof windows in which the operation takes place either entirely or partially about a hinge axis at the top, it is known to balance at least part of the weight of the movable components by means of a lifting device. The purpose of this arrangement is to facilitate opening the window, and the dimensions may be chosen so that the spring can retain the top-hinged frame in equilibrium in a desired opening position.

[0005] Such a lifting device is for instance disclosed in the Applicant's WO2019/101281 A1 where a spring assembly acts as a force balancing element to the pane-carrying frame by operating on a lifting arm attached to the frame.

[0006] However, although the lifting device in the above example is to some extent capable of providing the desired force balance, there is still room for improve-

ment.

Summary of Invention

[0007] With this background it is an object of the present invention to provide a roof window with a stable and safe lifting device allowing the desired movement pattern and ease of operability.

[0008] This is achieved with a roof window of the kind mentioned in the introduction, which is further characterised in that the lifting arm has a first end rotatably connected with a sledge slidably connected with the primary frame in a sledge guide, and a second end connected with the at least one secondary frame. The lifting device furthermore comprises a spring assembly configured to be coupled to the sledge. The lifting device further comprises an adjustment arm having a first end rotatably connected to the lifting arm and a second end rotatably connected to the sledge guide, wherein the lifting arm and the sledge guide extend along a length direction defining a central plane, the central plane extending along the length direction and a height direction, the height direction being perpendicular to the length direction, and wherein the forces applied by the lifting arm onto the central plane are balanced.

[0009] This arrangement of arms and interconnections of arms with a sledge in a sledge guide provides a comfortable and balanced operation of the roof window. During opening and closing of the roof window, the lifting arm moves translationally in the sledge guide in the sliding direction of the sledge by having a rotational connection to the sledge at the first end of the lifting arm. At the same time, the second end of the lifting arm moves translationally along the secondary frame. This provides a low friction opening / closing movement of the roof window. Furthermore, the configuration of the lifting device results in any tension applied to the interconnection of the lifting arm with the sledge guide being counterbalanced. The stable configuration of the lifting device further ensures that no accidents or failures occur during opening or closing of the window.

[0010] In a preferred embodiment, the lifting arm and the sledge guide extend along a length or longitudinal direction, and which in a closed position of the window are parallel to each other. The central plane may extend along the length direction and a height direction, the height direction being perpendicular to the length direction. While opening and closing the window, the lifting arm and/or the adjustment arm may be extending along the central plane or along a plane being parallel to the central plane.

[0011] The sledge guide extends in the length or longitudinal direction.

[0012] The lifting arm may extend in the length or longitudinal direction in a closed position of the roof window.

[0013] The central plane extends in the length direction and the height direction.

[0014] The height direction is perpendicular to the

length direction.

[0015] The sledge guide may be symmetrical with respect to the central plane.

[0016] In an embodiment, the sledge guide comprises a main portion, preferably U-shaped, extending in a longitudinal direction having a width, the plane positioned in the centre of the width of the main portion of the sledge guide. The sledge guide may have elevated outer portions forming a channel where the sledge is configured to be attached into. The sledge guide may additionally comprise one or a plurality of longitudinal flanges projecting from one or both longitudinal edges of the sledge guide to ensure a stable movement of the lifting arm inside the sledge guide. The flanges may have a substantial L-shape. In a preferred embodiment, the sledge guide comprises two opposing flanges, a first flange and a second flange projecting from the longitudinal edges of the sledge guide and being formed as stepped projections, thereby forming a 90 degree angle with the outer portions of the sledge guide. This configuration of the sledge guide ensures a stable and safe support of the lifting device and ease of its operation.

[0017] The sledge guide may comprise elements, such as mounting brackets, rivets, runners, discs etc. which are not symmetrical with respect to the central plane.

[0018] In one embodiment, the sledge guide comprises a sledge guide rivet holding and connecting the two opposing flanges of the sledge guide together and keep them fixed at a mounted position. That provides a tight connection and eliminates any friction that may occur between the two flanges due to the opening and closing of the window.

[0019] The lifting arm may comprise a first lifting arm and a second lifting arm arranged symmetrically with respect to the central plane.

[0020] The two lifting arms may ensure a stronger construction of the lifting device, balancing the forces applied by the lifting device to the sledge and to the sledge guide and thus a longer lifetime of the lifting device. The two opposing lifting arms may also provide a stable and stiff connection to the secondary frame and facilitate the opening and closing movement of the window. Each of the first and second lifting arms may comprise a straight portion and/or an inclined portion with respect to the central plane.

[0021] The adjustment arm comprises a first adjustment arm and a second adjustment arm mounted to each other and arranged symmetrically with respect to the central plane.

[0022] In a preferred embodiment, the two opposing and adjacent adjustment arms are fixed together such that no relative movement between the two is allowed. That enables a secure and stable connection to the sledge guide. The two opposing adjustment arms may be distanced at each other at a connection point close to the adjustment system and/or they may be mounted firmly and tightly together at the connection point to the lifting arm. The tight connection means that no substan-

tial gap is created between the two arms.

[0023] The first adjustment arm and the second adjustment arm may be fastened on opposite sides of the adjustment screw.

[0024] The first and second adjustment arm may be abutting each other and be symmetrically positioned around the central plane. The sledge guide and the lifting arm may extend in the central plane. The central plane may extend through the middle of the width of the sledge guide. The central plane may therefore extend through the middle of the width of the sledge positioned in the sledge guide. The sledge may be arranged in the sledge guide to slide in a direction of the central plane.

[0025] The link connection between the adjustment arm and the sledge guide may be positioned in the central plane. This is to be understood such that the resulting force of the adjustment arm acting on the sledge guide is substantially in a direction defined by the central plane. It may be envisioned that the two adjustment arms are not structurally symmetric around the central plane, but that the resulting force from the adjustment arm acting on the sledge guide is still in a direction defined by the plane. It may also be envisioned that the adjustment arm may be equipped with sliding discs or other components not contributing significantly to the forces acting in the link between the adjustment arm and the sledge guide and in the link between the adjustment arm and the lifting arm.

[0026] Symmetrically arranged around the central plane is in general to be understood as arranged such that the direction of the resulting force acting on the symmetrically arranged feature or features extends in a direction defined by the plane.

[0027] The sledge may comprise at least one runner configured to facilitate operation of the sledge, the runner being arranged symmetrically with respect to the central plane.

[0028] In an embodiment, the runner attaches to the sledge and to the first end of the lifting arm, thus creating a durable connection to avoid any friction created between the two components. The runner may comprise plastic and/or an elastic material.

[0029] The second end of the lifting arm and the secondary frame may have a roller connection via sash wheel. Other forms of connection may also be envisioned. The second end of the lifting arm and the secondary frame may be connected via a sledge system comprising a sledge and a sledge guide. A sash wheel on the second end of the lifting arm provides a minimal friction connection to the secondary frame. A sash wheel connection also minimizes the wear and tear on both the secondary frame and the lifting arm.

[0030] Furthermore, it provides the opportunity of lifting the secondary frame from the lifting device which provides a more dynamic use of the roof window for example during maintenance or reparation of the roof window.

[0031] The sash wheel is preferably mounted on the lifting arm.

[0032] The lifting arm is further connected to the sledge guide through an adjustment arm which ensures that the lifting arm is securely attached to the sledge guide, while allowing the first end and second end of the lifting arm to slide/roll simultaneously. The adjustment arm is rotatably attached to the lifting arm at a point between the first end and second end of the lifting arm. This point may be closer to the first end of the lifting arm, or closer to the second end of the lifting arm or substantially half-way between the first end and second end of the lifting arm. Generally, the adjustment arm can rotate relative to the sledge guide. The adjustment arm may be rotatably connected to the sledge guide directly and/or indirectly. The adjustment arm may be attached to the sledge guide indirectly through a component separate from the wheel guide, but which is in some manner fixed to the sledge guide, such as a part comprised in the primary frame.

[0033] The lifting arm may further be provided with sliding discs on one side of both sides of the lifting arm towards the sledge guide. The sliding discs reduce the distance between the lifting arm and the sledge guide thereby adding stability to the lifting device when the lifting arm travels in the sledge guide. The sliding discs may comprise polymer. The sliding discs may be fastened to the lifting arm through holes on the lifting arm. The sliding discs may be fastened to the lifting arm by an adhesive.

[0034] The forces exerted by the adjustment arm and/or the sledge guide onto the central plane are balanced.

[0035] This configuration provides for an overall balanced lifting device, where support is provided at both sides extending in a longitudinal direction of the sledge guide. In a preferred embodiment, the adjustment arm and the sledge guide are substantially symmetrical with respect to the central plane. That means that the forces that are applied to each of the side of the lifting device are counterbalanced by the forces applied to the opposite side of the lifting device.

[0036] The sash wheel may be configured to roll on a wheel guide during an opening and/or closing movement of the roof window, the wheel guide being connected to the secondary frame. The sash wheel may further cooperate with the wheel guide by magnetic means or other types of engagement.

[0037] The wheel guide provides a suitable track for the sash wheel to move onto. The wheel guide may also provide a protective medium between the sash wheel and the secondary frame. The wheel guide may be made of steel. The wheel guide may be made of the same material as the sash wheel. The wheel guide may be fastened to the sash with fastening means such as screws, adhesive or rivets or by formfitting the wheel guide to the sash such that they are structurally interlocked, or any combination of thereof. The wheel guide may comprise longitudinal flanges projecting from one or both longitudinal edges of the guide to ensure a stable movement of the wheel on the guide. The flanges may thus form a channel where the sash wheel can move into.

[0038] The lifting arm may be connected to the sash wheel via a sash wheel rivet.

[0039] The sash wheel rivet provides an easy installation of the sash wheel in the lifting arm and a secure operation of the sash wheel. The rivet may be made of steel.

[0040] The sash wheel may comprise fibre-reinforced plastic. The sash wheel may comprise 25 - 45 %vol glass fibre.

[0041] Glass fibre in the sash wheel provides enhanced strength with an optimal strength found between 25 - 45 %vol glass fibre. The sash wheel may further comprise other types of plastic. Alternatively, the sash wheel may comprise metal such as copper or steel and/or an elastic material such as rubber or silicone.

[0042] The sash wheel and/or wheel guide may have fitting serrations.

[0043] Fitting serrations on the wheel and/or wheel guide provide an enhanced grip and prevents the sash wheel from undesired skidding. The sash wheel and/or wheel guide may alternatively comprise a track and an accommodated track wheel. Alternatively or additionally, the sash wheel and/or wheel guide may be provided with rough surfaces for enhanced grip.

[0044] The lifting device may further comprise an adjustment system. The adjustment arm may be rotatably connected to the sledge guide through an adjustment system.

[0045] The adjustment system provides a mechanism for adjusting the weight of the pane-carrying sash with the force provided by the spring assembly, according to the roof inclination, such that the pane-carrying frame can be balanced in various roof inclinations without modifications to the spring assembly. Alternatively, the adjustment arm may be connected to the lifting arm through an adjustment system.

[0046] The adjustment arm and the lifting arm may be connected at an angle (α_1), wherein the angle (α_1) assumes a second angle (α_2) by adjusting the position of the second end of the adjustment arm by means of the adjustment system.

[0047] The change of the angle (α_1) to a second angle (α_2) is to be understood as the adjustment arm changing position without movement of the lifting arm. Thus, an installer may open the window fully after installing the window and adjust the adjustment system according to the roof inclination. The adjustment system may provide a balanced sash in roof inclinations preferably in the range of 15° - 65°. Higher roof inclinations may also be accommodated with slight modifications to the lifting device. The roof inclination value may be pre-selected on the adjustment system to adapt to a specific roof inclination the roof window is intended to be installed on or can be changed on spot after the window is installed. Balanced is to be understood as the window taking a position between fully opened and fully closed without further opening or closing due to a pull from the spring assembly or from weight of the window, respectively.

[0048] The adjustment system may comprise an adjustment screw.

[0049] The adjustment screw provides a possible mechanism for adjusting the position of the adjustment arm. The adjustment screw may be fixed to an adjustment base. The adjustment screw can rotate about its longitudinal axis. The adjustment base may be fitted in the sledge guide. Alternatively, the adjustment screw may be fixed to the sledge guide through the adjustment base. The adjustment base may comprise plastic.

[0050] The second end of the adjustment arm is fitted to the adjustment screw such that the adjustment arm travels along the length direction of the adjustment screw when the adjustment screw is screwed upon. The adjustment screw may further comprise a cogwheel at one of its ends, preferably at the end located in proximity with the sledge guide when in a mounted position. The cogwheel may be adapted to cooperate with the outer geometry of a mechanical tool.

[0051] The adjustment system may further comprise an adjustment bushing, wherein the second end of the adjustment arm is connected to the adjustment screw through the adjustment bushing.

[0052] The adjustment bushing allows for minimum friction connected between the adjustment screw and the adjustment arm. As the adjustment arm is adjusted on the adjustment screw, the angle between the adjustment arm and the lifting arm changes. Simultaneously, the angle between the adjustment arm and the adjustment screw may change. The bushing provides a suitable mechanism that allows such a rotation.

[0053] The bushing may comprise a cylindrical or cyclical body engaging with the adjustment screw via a through hole. The through hole of the adjustment bushing may have an inner geometry to engage with an outer bushing of the adjustment screw. The adjustment bushing may further have at least one end part projecting from the body and configured to engage with a track or a slot on the sledge guide. This track or slot may be called engagement slot.

[0054] The adjustment system may further comprise a disc configured to be in connection with and/or adjacent to the second end of the adjustment arm. The disc may further be adjacent and/or connected to the adjustment bushing such that the disc encompasses the body of the adjustment bushing and the end part projects from the disc.

[0055] The sledge guide may further comprise the adjustment slot, wherein the adjustment system is configured to be accommodated in the adjustment slot.

[0056] In order for the adjustment arm to travel along the adjustment screw an adjustment slot may be provided in the sledge guide such that the adjustment bushing and the adjustment arm can be adjusted without colliding with the sledge guide. Additionally, such an adjustment slot may provide a way to visually inspect the adjustment level of the adjustment system by acting as a way to observe the adjustment screw, the adjustment bushing or the ad-

justment arm. Indications such as numerical values, letters or marks for the adjustment may be provided along the adjustment slot to indicate the position of the adjustment arm on the adjustment screw to the user according to the roof inclination. The adjustment slot may be linear. The adjustment slot may alternatively be slightly curved. The adjustment slot may run in direction that intersect with the direction of the sliding direction of the sledge. It may run in direction that is perpendicular to the sliding direction of the sledge.

[0057] The adjustment bushing may be configured to be engaged with the adjustment slot.

[0058] By fitting the adjustment bushing to the adjustment slot, the entire adjustment system is securely fixed in the sledge guide. The adjustment bushing will be restricted to travel along the length of the adjustment slot which results in the second end of the adjustment arm being locked to a position along the adjustment slot. Furthermore, by engaging the adjustment bushing with the adjustment slot, the adjustment bushing may be used as an indicator for where on the adjustment screw the adjustment arm is positioned.

[0059] The sledge guide may comprise an opening adapted to receive a mechanical tool such as a tip end of a drill bit fitted to the adjustment system. Such opening may be a through hole or a blind hole on the outer surface of the sledge guide. The mechanical tool may be any tool that can provide an adjustment of the adjustment system such that the second end of the adjustment arm is displaced related to the sledge guide through the adjustment system. The mechanical tool may be fitted to the adjustment screw of the adjustment system.

[0060] This may provide an easy adjustment method of the roof window that can be done with common tools available to a person installing a window. The opening may be provided in the sledge guide. The opening may be provided in the sledge guide in a position close to an end of the adjustment screw. There may be two or more openings in the sledge guide for receiving a mechanical tool fitted to the adjustment system. There may be such openings provided symmetrically on two sides of the sledge guide. This makes it possible to install the lifting device in more than one position and still being able to access the adjustment system in case one opening is blocked. It may be envisioned that the lifting device is provided in both sides of the roof window. In a case where the roof window has been installed in a roof of a building, the adjustment system may best be reached by the installer or user of the window through the opening of the window. In such a case the same lifting device may be used in both sides of the room window with equally easy access to the adjustment system in both lifting devices.

[0061] The sledge guide may comprise a first side and a second side being symmetrical with respect to the central plane, wherein the opening for insertion of the drill bit is comprised on each of the first and second sides of the sledge guide.

[0062] The provision of an opening 161 on each side

of the sledge guide allows the adjustability of the lifting device from both sides. That also allows the installation of a lifting device on either side of the roof window, thus providing a versatile and simple solution.

[0063] By sides, it is hereby commonly referred to the sides extending in a longitudinal direction. By ends, it is commonly referred to the ends extending in a width direction perpendicular to the longitudinal direction.

[0064] The sledge guide may further comprise openings such as holes adapted to receive screws for mounting the sledge guide onto the window frame.

[0065] The roof window may further comprise an insulating glazing unit. Two-layer or three-layer glass also known as insulating glazing units (IGUs) have better thermal properties than single layered glass but are usually heavier and more cumbersome to install and lift. Lifting devices are therefore beneficial to use in windows comprising IGUs.

[0066] The sledge may comprise a sledge wheel configured to roll on the sledge guide and/or a runner mounted on the sledge configured to cooperate and/or engage with the sledge guide.

[0067] A sledge wheel may allow steering of the sledge along the length of the sledge guide. The sledge wheel may be provided substantially next to the connection between the sledge and the lifting arm. The lifting arm may be connected to the sledge through the sledge wheel. By providing the sledge wheel close to the lifting arm, a greater stability of the sledge is achieved.

[0068] The sledge wheel may additionally add support for the sledge in the sledge guide. The sledge may additionally and/or alternatively be provided with one or more runners. The one or more runners mounted on the sledge may provide additional support for the sledge in the sledge guide. The runners may be made of a polymer. The runners may comprise glass fibre.

[0069] The runner may be configured to be connected to the first end of the lifting arm and be mounted on the sledge.

[0070] The sash wheel may have a diameter of approximately 30 mm. A sash wheel with a diameter of approximately 30 mm ensures that the sash wheel runs on the secondary frame in a stable manner. A sash wheel of approximately 30 mm in diameter also fits well in the lifting arm without colliding with other features. The lifting arm may be dimensioned accordingly. A sash wheel of approximately 20 mm in diameter may also be implemented.

[0071] A sash wheel of approximately 40 mm may be further implemented.

[0072] The sash wheel may have one or more cavities or apertures. The sash wheel may have a substantially round shape. The cavities may be positioned along the periphery of the round sash wheel and may be equally spaced with each other.

[0073] The sash wheel may be optimised with regards to weight, material usage and strength. Thus, a series of cavities may be provided in the sash wheel. Such cavities

may be provided through a topology optimization algorithm.

[0074] The sash wheel may be moulded. The sash wheel may be provided as a one-piece. Moulding the sash wheel provides an easy manufacturing of the wheel while allowing incorporation of cavities and serrations.

[0075] The sledge guide may be integrally formed as one piece, thus having an increased tensile strength.

[0076] Other presently preferred embodiments and further advantages will be apparent from the subsequent detailed description and drawings.

Brief Description of Drawings

[0077] In the following description, embodiments of the invention will be described with reference to the drawings, in which

Fig. 1A is a perspective view of a roof window in an embodiment of the invention, seen from an interior side;

Fig. 1B is perspective of the roof window of Fig. 1A, seen from an exterior side;

Fig. 1C is a perspective cross-sectional view of a roof window in another embodiment, with the sash in an open position.

Fig. 2 is a perspective view of a lifting device for a roof window in an embodiment according to the invention in a first operational condition.

Fig. 3A is a side view of a lifting device for a roof window in an embodiment according to the invention in a closed position of the window and with the sledge unattached to the spring assembly.

Fig. 3B is a side view of a lifting device for a roof window in an embodiment according to the invention in an open position of the window and with the sledge attached to the spring assembly.

Fig. 4 is a close-up perspective view of a lifting device for a roof window in an embodiment according to the invention showing the sash wheel mounted in a lifting arm and in connection with a wheel guide.

Fig. 5 is close-up perspective view of a lifting device for a roof window in another embodiment according to the invention showing the sash wheel mounted in a lifting arm and in connection with a wheel guide.

Fig. 6 is a close-up perspective view of a lifting device for a roof window in an embodiment according to the invention showing part of a sledge guide, an adjustment arm and lifting arm and how these are connected.

Fig. 7 is a close-up perspective view of a lifting device for a roof window in an embodiment according to the invention showing part of a sledge guide, an adjustment arm and lifting arm and how these are connected from another angle.

Fig. 8 is a close-up perspective view of a lifting device for a roof window in an embodiment according to the invention showing part of a sledge guide, an adjust-

ment arm and lifting arm and how these are connected from another angle.

Fig. 9 is a perspective view of a lifting device for a roof window in an embodiment according to the invention showing the central plane P.

Fig. 10 is a side view of a lifting device for a roof window in an embodiment according to the invention in one operational condition where the adjustment arm is adjusted at an angle α_1 in relation to the lifting arm.

Fig. 11 is a side view of a lifting device for a roof window in an embodiment according to the invention in another operational condition where the adjustment arm is adjusted to an angle α_2 in relation to the lifting arm by introducing a tip end of a mechanical tool such as a drill bit into an opening in the sledge guide, where the drill bit is fitted to an adjustment screw connected to the adjustment arm.

Fig. 12A shows a mechanical tool interacting with an adjustment system for a lifting device for a roof window in an embodiment according to the invention adjusted for a specific roof inclination.

Fig. 12B shows a mechanical tool interacting with an adjustment system for a lifting device for a roof window in an embodiment according to the invention adjusted for a roof inclination different from the one shown in Fig. 12A.

Description of Embodiments

[0078] In the following, embodiments of the lifting device and roof window will be described in further detail. When referring to the Figures, the terms up, down, upwards, downwards, top and bottom are taken relative to how the figures are displayed. A front view is taken from the hinge and viewing towards the window frame. A view from behind is therefore taken as viewed from the frame towards the hinge. A longitudinal direction is, if nothing else is mentioned, longitudinal along the length of a member. It is to be understood that the arrangement shown in a horizontal orientation is not the normal orientation as the window is installed on an inclined roof.

[0079] Referring initially to Figs 1A and 1B, a roof window 100 is shown. The roof window 100 is intended to be installed in an inclined roof surface (not shown).

[0080] The roof window 100 comprises a primary frame 1, a secondary frame such as a sash 2, and a pane 4. In the shown embodiment only one secondary frame is present; however, a further secondary frame in form of an intermediate frame may be provided, which is well-known from roof windows that are top-hinged during normal use but which pivot for cleaning. The primary frame 1 comprises a set of frame members including a top frame member, two side frame members and a bottom frame member. Correspondingly, the sash 2 comprises a set of sash members including a top sash member, two side sash members and a bottom sash member. While the primary frame 1 and sash 2 are described as rectangular

structures, some principles of the presented concepts may be applicable to other geometrical shapes as well.

[0081] The pane 4 comprises a number of edge portions generally associated to members of the sash 2 as will be described in further detail below. An exterior pane surface 4e defines a plane of the roof window 100 in an assembled condition of the roof window 100. The assembled condition of the roof window 100 is achieved when main components of the primary frame 1 and sash 2 have been assembled and the primary frame 1 and sash 2 are connected to each other, for instance in an installed position when the roof window 100 is ready for use. Correspondingly, an assembled condition of the sash 2 is achieved once main components of the sash 2 have been assembled, and an assembled condition of the primary frame 1 when main components of the primary frame 1 are assembled. The term "main components" is to be understood as encompassing primary parts of the roof window necessary to perform all operational functions, and not including accessories or auxiliary equipment.

[0082] An interior pane surface 4i faces the interior, typically a room of a building subjacent the roof surface in which the roof window 100 is installed.

[0083] In the embodiments shown, the sash 2 is openable relative to the primary frame 1, to obtain one or more open positions. In such open positions, the sash 2 and pane 4 are moved out of the plane of the roof window 1. As will be described in the following, the sash 2 is shown as being top hung, i.e. during normal use, the sash 2 is rotated about a substantially horizontal hinge axis at or near the top frame member and top sash member. It is however conceivable to apply some principles of the presented concepts for roof windows on different types of windows having other opening patterns, or being provided as fixed skylights.

[0084] Further details shown in Fig 1A include an operating assembly, here shown as a handle. Other operating assemblies may be present as well.

[0085] Also shown is a representative mounting bracket forming part of a plurality of mounting brackets forming a load-transferring connection between the roof window 100 and a surrounding roof structure (not shown). Such a roof structure may include rafters and battens, plywood or other construction materials.

[0086] An insulating frame is shown. Insulation by an insulating frame is optional and may be provided along only some of the frame members or as shown surrounding all four frame members.

[0087] Referring to Fig. 1C it is shown that the roof window 100 furthermore comprises a hinge assembly.

[0088] The hinge assembly is configured in such a way that it allows the sash 2 to be top hung in a first operational condition corresponding to normal use. That is, during normal use the sash 2 is rotated about a substantially horizontal first hinge axis at or near the top frame member and top sash member between a closed position and an open position.

[0089] Fig. 2 shows a lifting device 10 installed in a

roof window with a primary frame 1 and a sash 2. The lifting device is installed between the primary frame 1 and the sash 2 and comprises a sledge guide 16 fixed to the primary frame 1 and a lifting arm 14 with a first end 12 rotatably connected or fixed to a sledge 30 sliding in the sledge guide 16. At a second end 13 of the lifting arm 14, a sash wheel 40 is attached to the lifting arm 14. In Fig. 1 the connection between the sash 2 and the lifting arm 14 is shown as a sash wheel 40 attached to the lifting arm 14 by means of a wheel rivet 42. The sash wheel 40 is therefore in a rolling connection with the sash 2 by means of the sash wheel 40. Other means of attachment may be envisioned. In the embodiment shown in Fig. 2 the sash wheel 40 is configured to roll on a wheel guide 41. The wheel guide 41 acts as a rail for the sash wheel during opening and closing of the window. The wheel guide 41 also provides protection for the sash 2 as the sash wheel rolls on the sash 2 during opening and closing of the roof window. The lifting arm 14 is also attached to the sledge guide 16 through an adjustment arm 52. The adjustment arm 52 is at one end rotatably attached to lifting arm 14. In Fig. 2 the adjustment arm 52 is attached to the lifting arm 14 at a point approximately equally distanced between the first end 12 of the lifting arm 14 and the second end 13 of the lifting arm. The adjustment arm 52 can in other embodiments be rotatably attached to the lifting arm at a point closer towards the first end 12 of the lifting arm 14 or at a point closer towards the second end 13 of the lifting arm 14. In Fig. 2 the adjustment arm 52 is connected to the sledge guide 16 through an adjustment system 50, which will be described further below. The adjustment arm 52 may in other embodiments be rotatably attached to the sledge guide directly.

[0090] The sledge 30 is attached to a spring assembly 20 which is arranged to exert a force on the sledge 30. As detailed in Fig. 3A the sledge 30 may be uncoupled from the spring assembly 20. This may, as an example, be an advantage during installation of the roof window where a spring force acting on the sledge 30 may make it difficult to handle the roof window. In the cases where the lifting device is installed in the roof window according to its intended use, the sledge 30 and the spring assembly 20 are initially in an uncoupled state as shown in Fig. 3A. The spring assembly 20 and the sledge 30 are then coupled by opening the roof window resulting in the sledge 30 sliding towards a coupling device such as a hook attached to a spring comprised in the spring assembly 20. Opening the roof window results in the sledge 30 engaging with the hook and once the roof window is subsequently closed, the sledge 30 will slide back in a direction away from the spring assembly 20 and the spring now coupled to the sledge 30 will exert a pulling force on the sledge 30 and provide a resistance against the closing of the roof window. The pulling force of the spring and the weight of the roof window are preferably balanced such that the roof window can be positioned in an open position without closing due to its own weight or opening further due to the pull from the spring in the spring as-

sembly. This balance is also influenced by the inclination of the roof that the roof window is installed in. The spring in the spring assembly 30 may be adjusted to balance the roof window in a specific roof inclination. If the roof window is installed in a roof with a roof inclination different than the intended inclination, the spring force acting on the sledge will not be balanced to the weight of the window. In one example, the spring may exert too much force on the window thereby forcing the window to open further. In another example, the spring may be too weak, and the window will close due to its own weight. In both cases, the window is difficult for the user to operate and potentially hazardous. To easily adjust the roof window according to roof inclination, an adjustment system as shown in Figs. 2 - 3 and 6 - 11 may be used. In these embodiments, the adjustment system is installed to adjust the position of the second end of the adjustment arm 52 in the sledge guide 16. Alternatively, it may be envisioned that the adjustment system 50 is instead installed in the lifting arm 14 such that the first end of the adjustment arm is attached to the lifting arm 14 through an adjustment system and the second end of the adjustment arm is attached to the sledge guide. An adjustment rivet 57 - better shown in Fig. 3B - connects the lifting arm 14 to the adjustment arm 52 firmly, while enabling their rotational movement with respect to each other.

[0091] In Figs. 3A and 3B a sliding disc 43 on the lifting arm 14 is present. A further sliding disc may be arranged on the other side of the lifting arm 14 as well. The sliding disc reduces the distance to the sledge guide 16 and adds stability to the lifting arm as it travels from an open to a closed position or vice versa. Fig. 4 shows a sash wheel 40 in a wheel guide 41 where the wheel guide 41 is provided with longitudinal flanges projecting from both longitudinal edges of the wheel guide thereby forming a channel which the sash wheel 40 can move in. Fig. 5 shows an alternative embodiment of the lifting device 10 where the wheel guide 41 is configured as a plate. Generally, the second end of the lifting arm may also comprise flanges that surround the sash wheel or part of the sash wheel, as shown in Fig. 5.

[0092] Figs. 6 and 7 each shows a part of the lifting device with the lifting arm 14 extending upwards and away from the sledge 30. In these embodiments the lifting arm 14 comprises a first lifting arm 141 and a second lifting arm 142 with the two lifting arms 141, 142 arranged on opposite sides of the adjustment arm 52. The two lifting arms 141, 142 are preferably similarly shaped with both the sash wheel and adjustment arm arranged between the two lifting arms 141, 142.

[0093] The wheel rivet 42 displayed in Figs. 4 and 5 may be used as means to keep the two lifting arms 141, 142 fixed to each other. Other means may also be used to keep the two lifting arms 141, 142 fixed to each other. The two lifting arms 141, 142 may be fixed to each other through the attachment to the adjustment arm 52 and through the attachment to the sledge 30. Each of these means of fixing the two lifting arms to each other may be

used in combination or individually. As also depicted in Figs. 6 and 7, the adjustment arm 52 comprises a first adjustment arm 521 and a second adjustment arm 522.

[0094] Figs. 6 and 7 additionally show the adjustment system 50. Fig. 6 particularly shows an adjustment slot 55 with an adjustment bushing 54 engaged with the adjustment slot 55. In this embodiment the adjustment slot 55 is a linear slit -in the form of a track- on an outer part of the sledge guide 16 limiting the adjustment bushing 54 and thereby the adjustment arm 52 to travel in a linear direction in the adjustment slot 55. The adjustment slot 55 may alternatively be slightly curved such that the adjustment arm 52 travels in a semi-circle. The longitudinal direction of the adjustment slot 55 may additionally or alternatively be arranged in a direction substantially in parallel with the sliding direction of the sledge. The longitudinal direction of the adjustment slot 55 may in other embodiments travel in a direction that is perpendicular to the sliding direction of the sledge 30 in the sledge guide 16.

[0095] Fig. 7 shows a sledge guide rivet 58 for added stability of the lifting device 10. The sledge guide rivet 58 locks the two sides of the sledge guide to each other and simultaneously ensure that the adjustment system also shown in Fig. 7 is kept in place.

[0096] Fig. 8 shows a lifting device 10 for a roof window from a top perspective view. It is clearly shown that in this embodiment the first and the second adjustment arms 521, 522 are distanced and separated from each other at their attachment to the adjustment system 50, but are attached to each other at a point located close to their attachment to the adjustment system 50 and up until their attachment to the lifting arms 141, 142. Alternatively, the adjustment arms 521, 522 may each have a longer inclined portion and an attachment point closer to the attachment to the lifting arm.

[0097] Fig. 9 shows a perspective view of the lifting device in an open position, where a central plane P is illustrated. The imaginary central plane P extends in a longitudinal L direction and a height direction H and is defined as the plane where the respective forces exerted by the lifting arm and the adjustment arm are balanced. The height direction H is perpendicular to the length L direction. The two lifting arms 141, 142 are therefore symmetrically arranged with respect to the central plane P. In Fig. 9 the sledge guide is shown as extending along the length direction that defines the central plane P. The lifting device is shown in an open position and the lifting arm extends substantially in the height direction in this open position. When the lifting device 10 is in the closed position, such as shown in Fig. 3A, the lifting arm extends substantially along the length direction together with the sledge guide. Similarly, the two adjustment arms 521, 522 are symmetrically arranged with respect to the central plane P. The two lifting arms 141, 142 are positioned such that the forces exerted by the lifting arm 14 onto the central plane P are balanced. Furthermore, the sledge guide 16 is symmetrical with respect to the central plane

P. The lifting arm 14 comprises a first lifting arm 141 and a second lifting arm 142 arranged symmetrically with respect to the central plane P.

[0098] Figs. 10 and 11 show a lifting device from a side view. In Fig. 10, the adjustment arm 52 is adjusted such that its second end is in a position creating an angle α_1 between the lifting arm 14 and the adjustment arm when the window is in an open position.

[0099] In Fig. 11, the roof window is in the same open position as in Fig. 10 and the second end of the adjustment arm 52 is adjusted such that the angle between the adjustment arm 52 and the lifting arm 14 is an angle α_2 . In Fig. 11 it is also visualized how the adjustment arm 52 can be adjusted by means of a mechanical tool 60 such as a drill bit fitted and rotated into an opening 161 in the sledge guide 16 of the lifting device 10, also shown in Figs 3A, 3B. The adjustment arm 52 shown in Fig. 10 is arranged for a roof window installed in a roof with an inclination of approximately 65°, whereas the roof window shown in Fig. 11 is arranged for a roof window installed in a roof with an inclination of approximately 15°. By adjusting the adjustment arm 52 to a position in between these two extremes the forces can be balanced for roof inclinations varying in the range of 15° to 65°.

The adjustment system may also adjust the lifting device to operate smoothly in roof windows installed in lower or higher roof inclinations, such as 10° or 70°.

[0100] Figs. 12A - 12B show an example of how a mechanical tool and an adjustment system may interact. In Fig. 12A a mechanical tool 60 is shown to fit into the opening 161 in the sledge guide 16. The mechanical tool 60 has a drill bit fitted to the adjustment screw 53. Fig. 12A shows how an adjustment bushing 52 may be fitted onto the adjustment screw 52. Fig. 12A also shows how the adjustment bushing 52 is fitted to an adjustment slot 55. By turning the mechanical tool 60 in this embodiment shown as a drill bit, the adjustment screw 53 is turned. This results in the adjustment bushing 52 being moved along the length direction of the adjustment screw 53 and as well to move along in the adjustment slot. As can be seen from Fig. 12A, the adjustment slot 55 has indications showing what roof inclination the adjustment system 50 is adjusted for. In Fig. 12A the adjustment system 50 is adjusted to a roof inclination of approximately 15°. In Fig. 12B the adjustment system 50 is adjusted to a roof inclination of approximately 65°. In Fig. 12B it is shown how the adjustment arm 52 may be connected to the adjustment bushing 52.

[0101] The invention is not limited to the embodiments shown and described in the above, but various modifications and combinations may be carried out

List of reference numerals

[0102]

1 Primary frame

2	Secondary frame
4	Pane
4i	Interior pane surface
4e	Exterior pane surface
10	Lifting device
12	First end of lifting arm
13	Second end of lifting arm
14	Lifting arm
	141 First lifting arm
	142 Second lifting arm
16	Sledge guide
	161 opening
20	Spring assembly
30	Sledge
31	Sledge wheel
40	Sash wheel
41	Wheel guide
42	Wheel rivet
43	Sliding discs
50	Adjustment system
52	Adjustment arm
	521 First adjustment arm
	522 Second adjustment arm
53	Adjustment screw
54	Adjustment bushing
55	Adjustment slot
56	Adjustment base
57	Adjustment arm rivet
58	Sledge guide rivet
60	Mechanical tool
100	Roof window
P	Central plane
H	Height direction
L	Length direction
a1	Angle
α_2	Angle

Claims

1. A roof window (100), comprising

a stationary primary frame (1),
at least one secondary frame (2, 3), such as a sash (2) and/or an intermediate frame (3), and a lifting device (10) comprising a lifting arm (14) inserted between the primary frame (1) and the at least one secondary frame (2, 3), the lifting arm (14) having a first end (12) rotatably connected with a sledge (30) slidably connected with the primary frame (1) in a sledge guide (16) and a second end (14) rotatably connected with the at least one secondary frame (2, 3), the lifting device (10) further comprising a spring assembly (20) configured to be coupled to the sledge

(30),
wherein the lifting device (10) further comprises an adjustment arm (52) having a first end rotatably connected to the lifting arm (14) and a second end rotatably connected to the sledge guide (16),
the lifting arm (14) and the sledge guide (16) extending along a length direction (L) defining a central plane (P), the central plane (P) extending along the length direction (L) and a height direction (H) being perpendicular to the length direction,
wherein the forces exerted by the lifting arm (14) onto the central plane (P) are balanced.

2. A roof window (100) according to claim 1, wherein the sledge guide (16) is symmetrical with respect to the central plane (P).

3. A roof window (100) according to any one of the preceding claims, wherein the lifting arm (14) comprises a first lifting arm (141) and a second lifting arm (142) arranged symmetrically with respect to the central plane (P).

4. A roof window (100) according to any one of the preceding claims, wherein the adjustment arm (52) comprises a first adjustment arm (521) and a second adjustment arm (522) mounted to each other and arranged symmetrically with respect to the central plane (P).

5. A roof window (100) according to any of the preceding claims, wherein the sledge (30) comprises at least one runner (60) configured to facilitate operation of the sledge (30), the runner (60) being arranged symmetrically with respect to the central plane (P).

6. A roof window (100) according to any of the preceding claims, wherein the lifting device further comprises an adjustment system (50), the adjustment arm (52) being rotatably connected to the sledge guide (16) through the adjustment system (50).

7. A roof window (100) according to any of the preceding claims, wherein the adjustment arm (52) and the lifting arm (14) are connected at an angle (α_1), wherein the angle (α_1) assumes a second angle (α_2) by adjusting the position of the second end of the adjustment arm (52) by means of the adjustment system (50).

8. A roof window (100) according to any of the preceding claims, wherein the adjustment system (50) comprises an adjustment screw (53), the second end of the adjustment arm (52) being connected to the adjustment screw (53).

9. A roof window (100) according to claim 8, wherein the adjustment system (50) further comprises an adjustment bushing (54) arranged on the adjustment screw (53), the second end of the adjustment arm (52) being attached to the adjustment screw (53) through the adjustment bushing (54). 5
10. A roof window (100) according to claims 8 and 9 when dependent on claim 7, wherein the angle (α_1) assumes the second angle (α_2) when the adjustment screw (53) is being turned by use of an external force. 10
11. A roof window (100) according to any of the preceding claims, the lifting arm further comprising at least two sliding discs (43) arranged on opposite sides of the lifting arm (14) and symmetrically with respect to the plane (P). 15
12. A roof window (100) according to any of the preceding claims, wherein the sledge (30) comprises a sledge wheel (31) configured to roll on the sledge guide (16). 20
13. A roof window (100) according to any of the preceding claims, the sledge guide (16) being integrally formed. 25
14. A roof window (100) according to any of the preceding claims, wherein the sledge guide (16), the sledge (30), the lifting arm (14), the adjustment arm (52) and the adjustment system (50) are made of steel. 30
15. A roof window (100) according to any of the claims 8-14, wherein the sledge guide (16) comprises an opening for insertion of a tip end of a mechanical tool (60) such as a drill bit arranged to engage with the adjustment screw (53). 35
16. A roof window (100) according to claim 15, wherein the sledge guide comprises a first side and a second side being symmetrical with respect to the central plane (P), wherein the opening for insertion of the drill bit is comprised on each of the first and second sides of the sledge guide. 40
45
17. A roof window (100) according to claim 1, wherein the forces exerted by the adjustment arm (52) and/or the sledge guide (16) onto the central plane (P) are balanced. 50

55

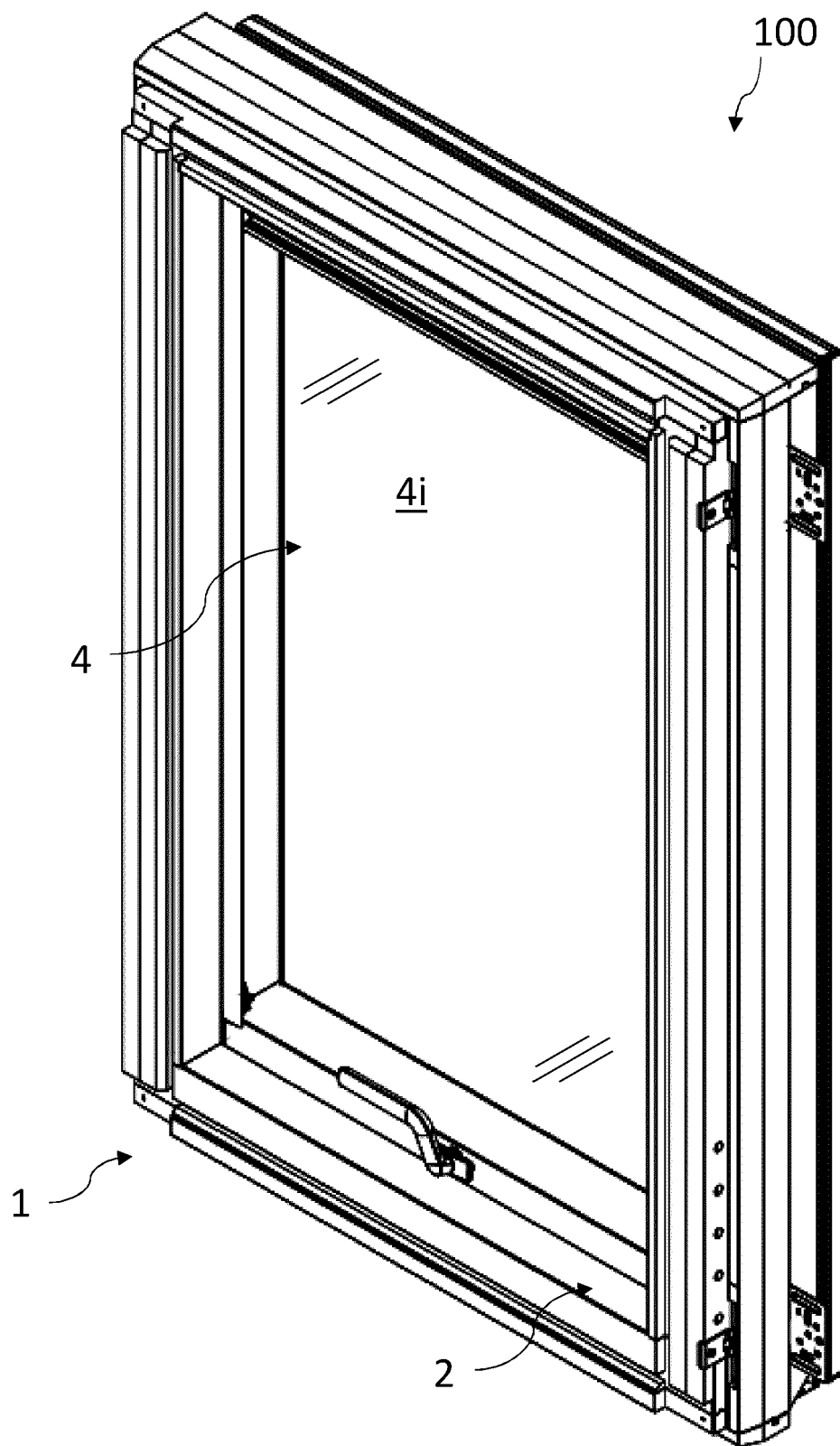


Fig. 1A

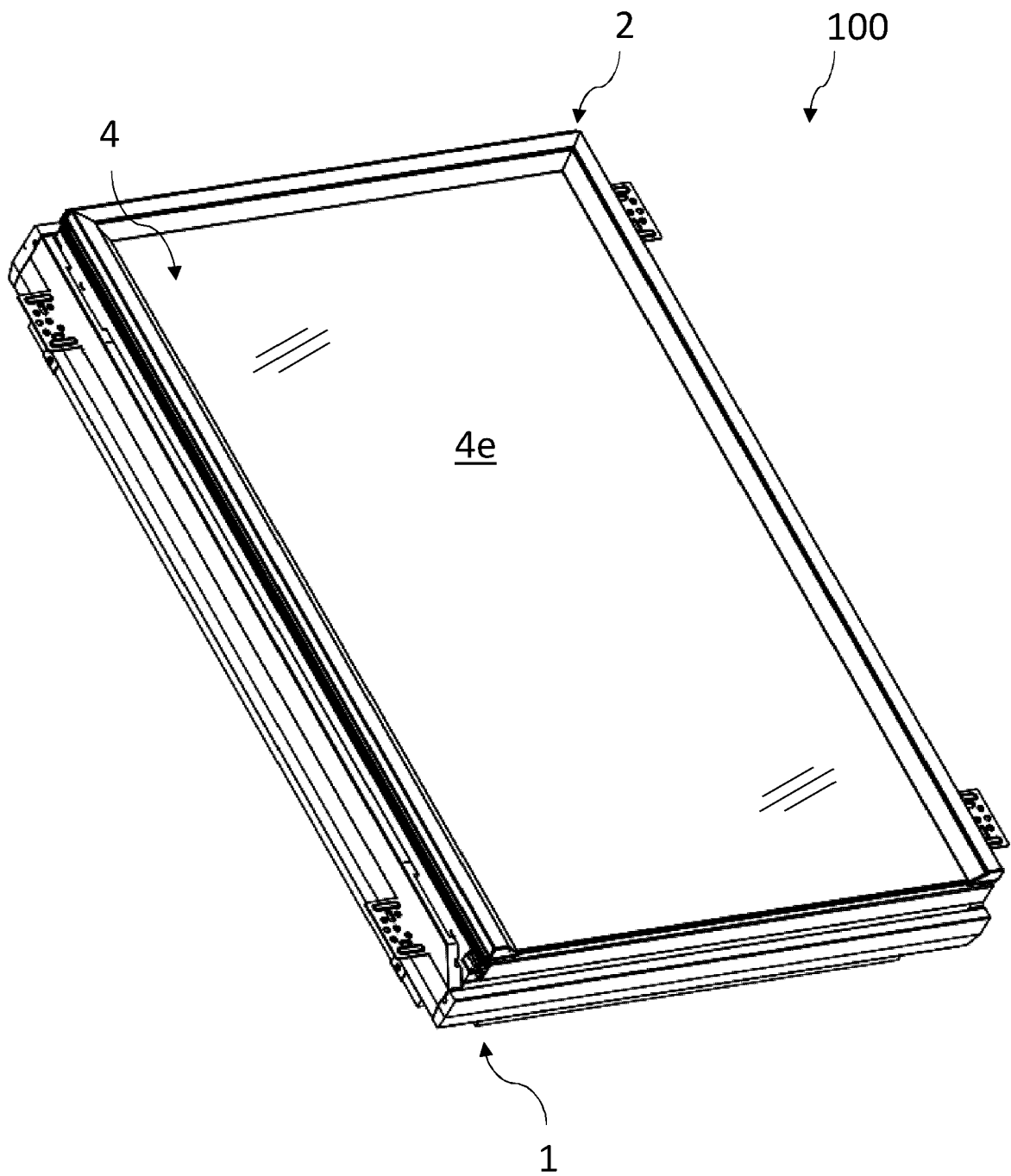


Fig. 1B

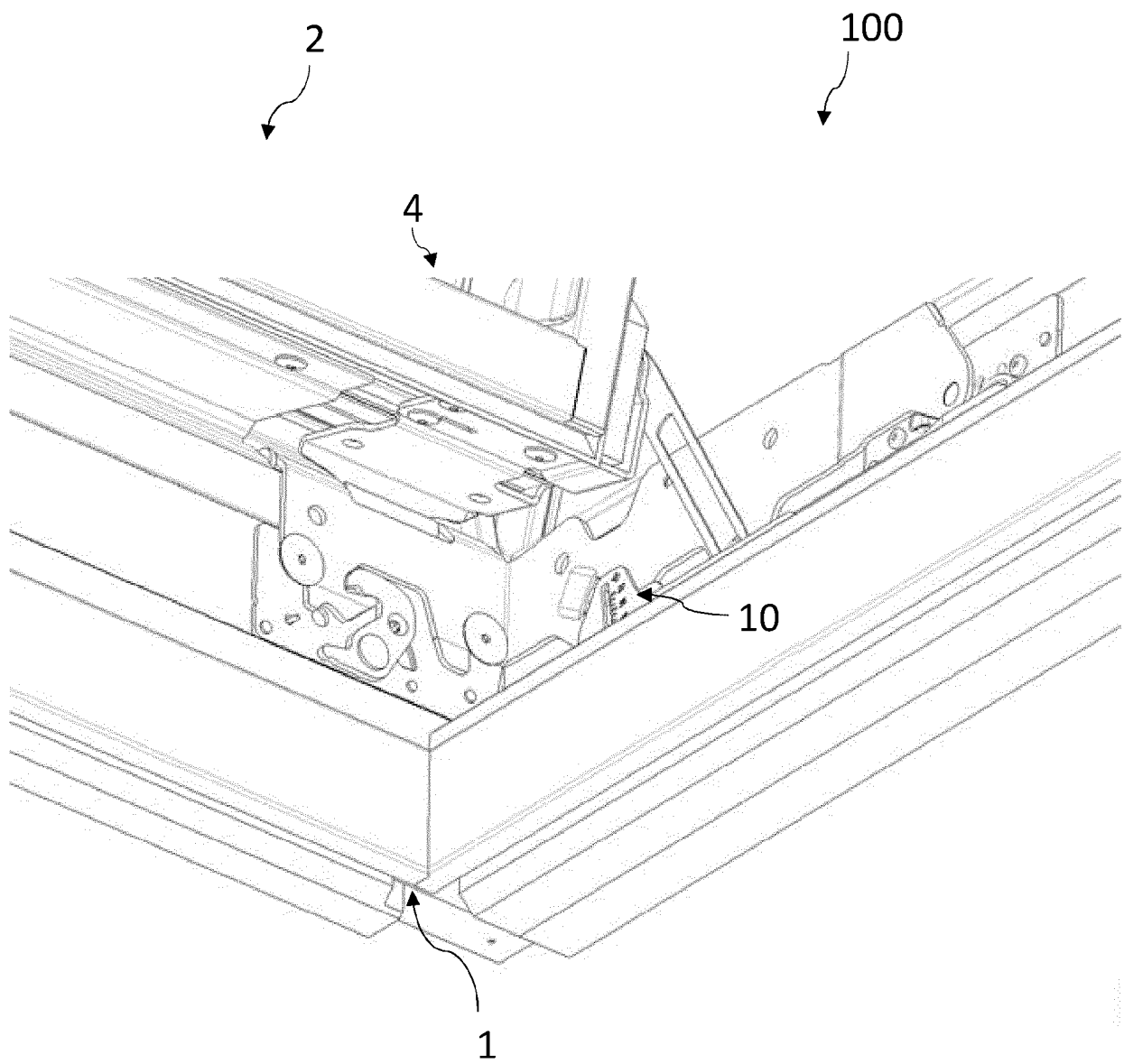


Fig. 1C

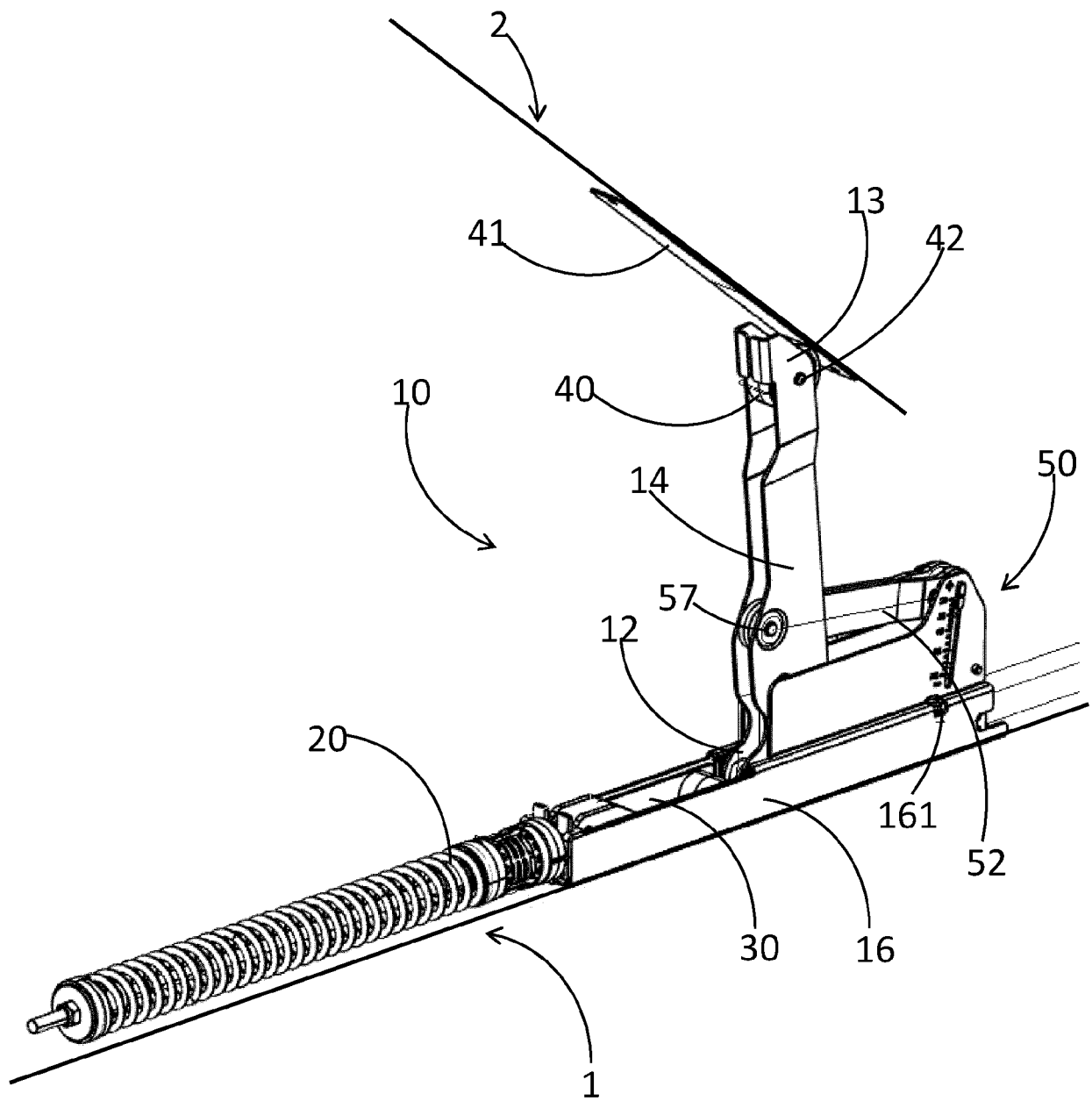
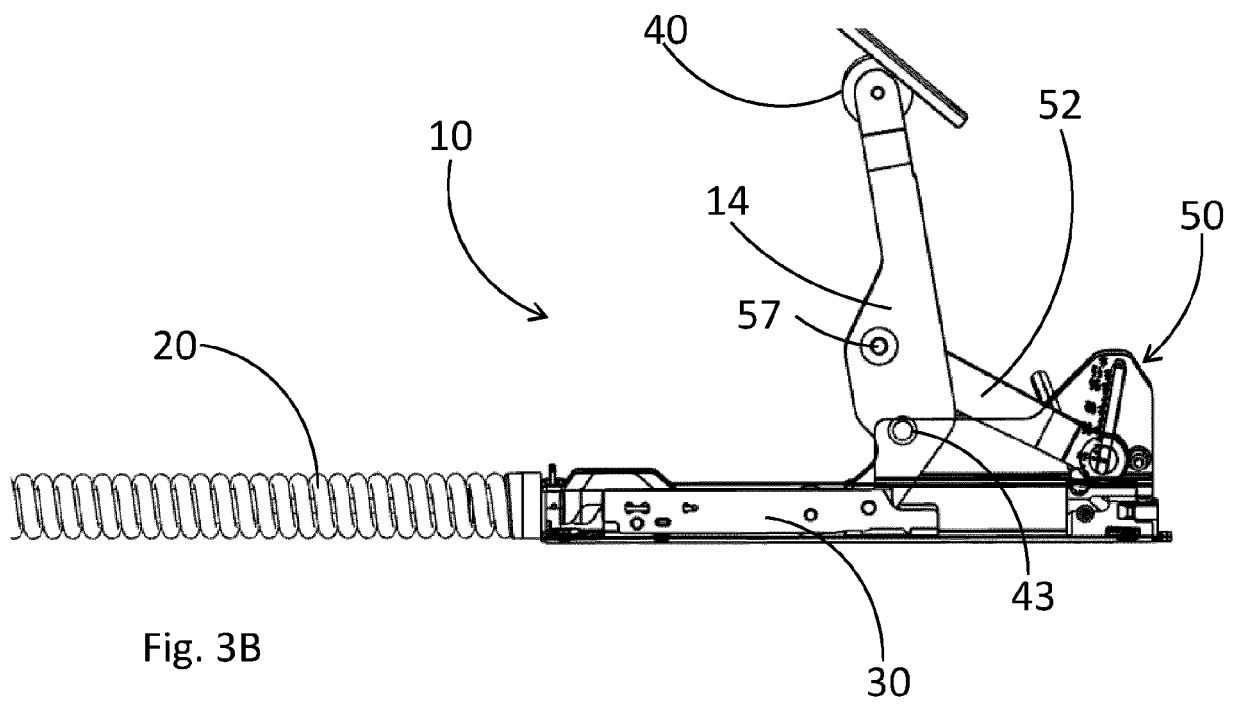
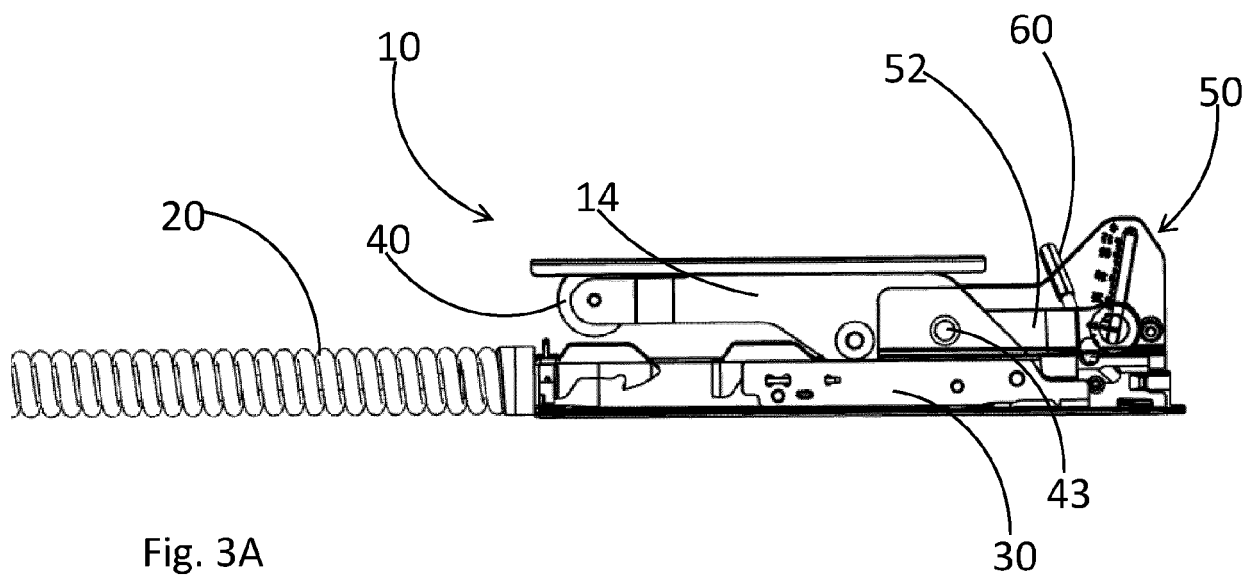
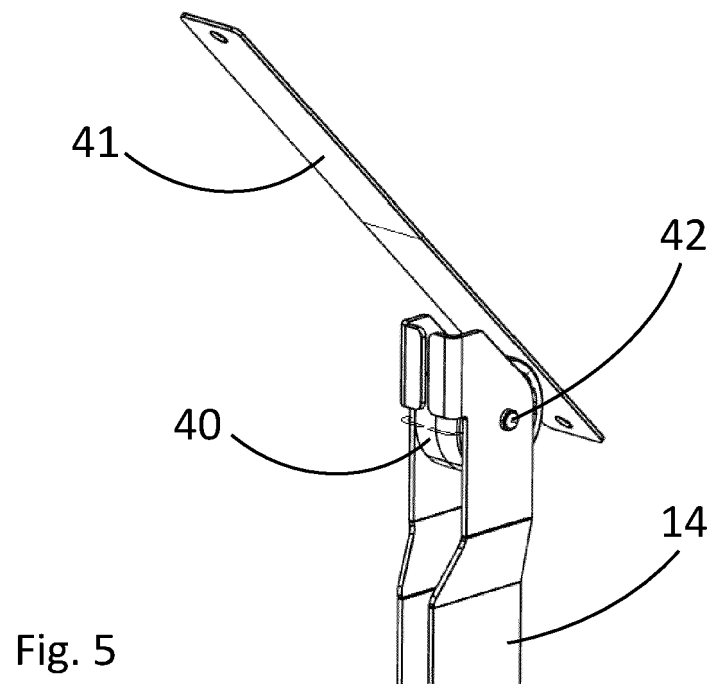
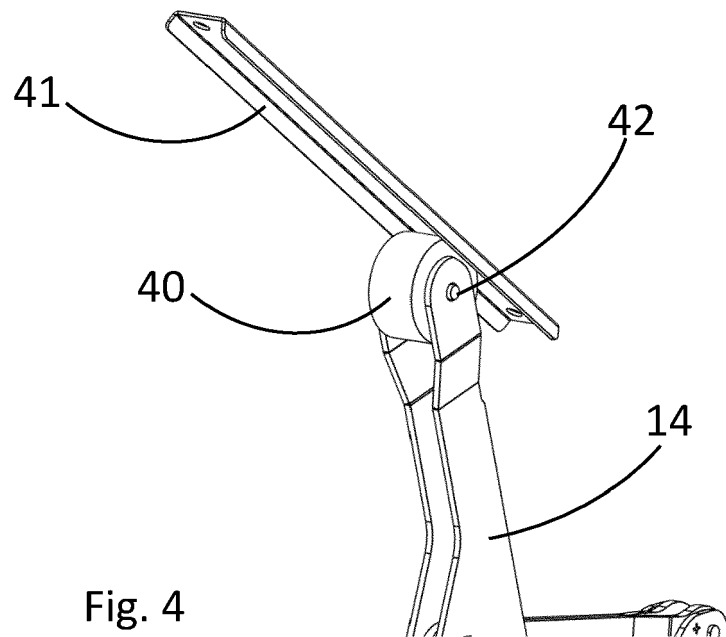
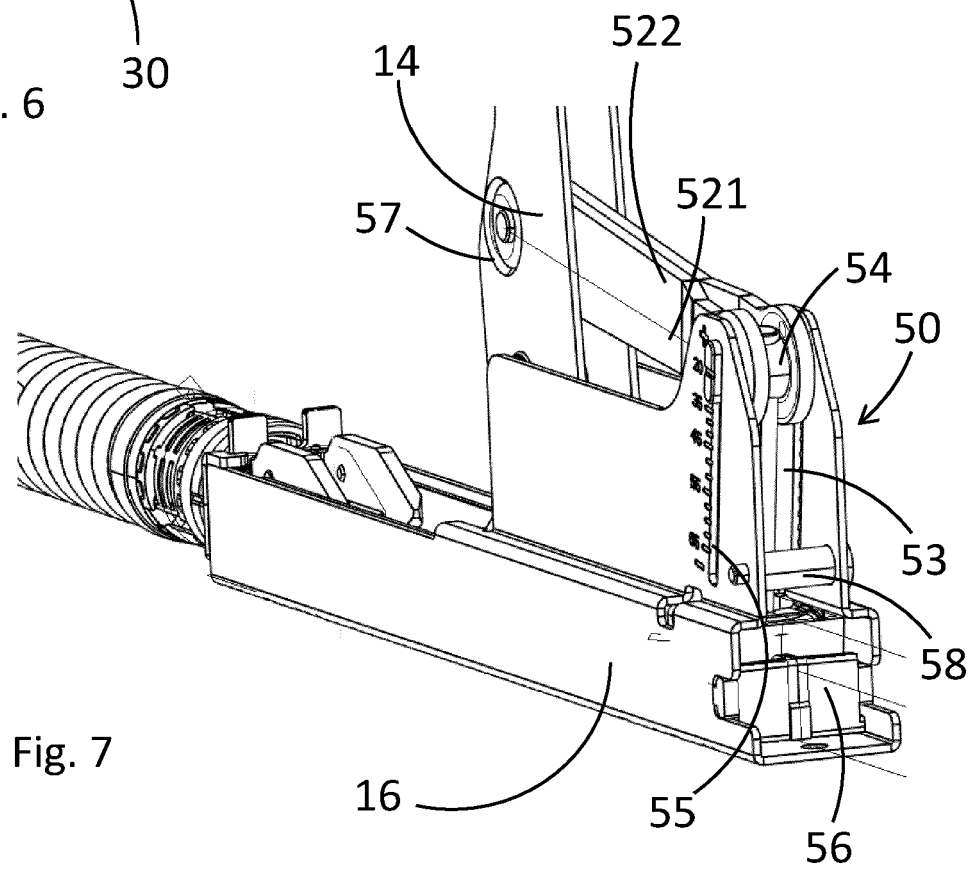
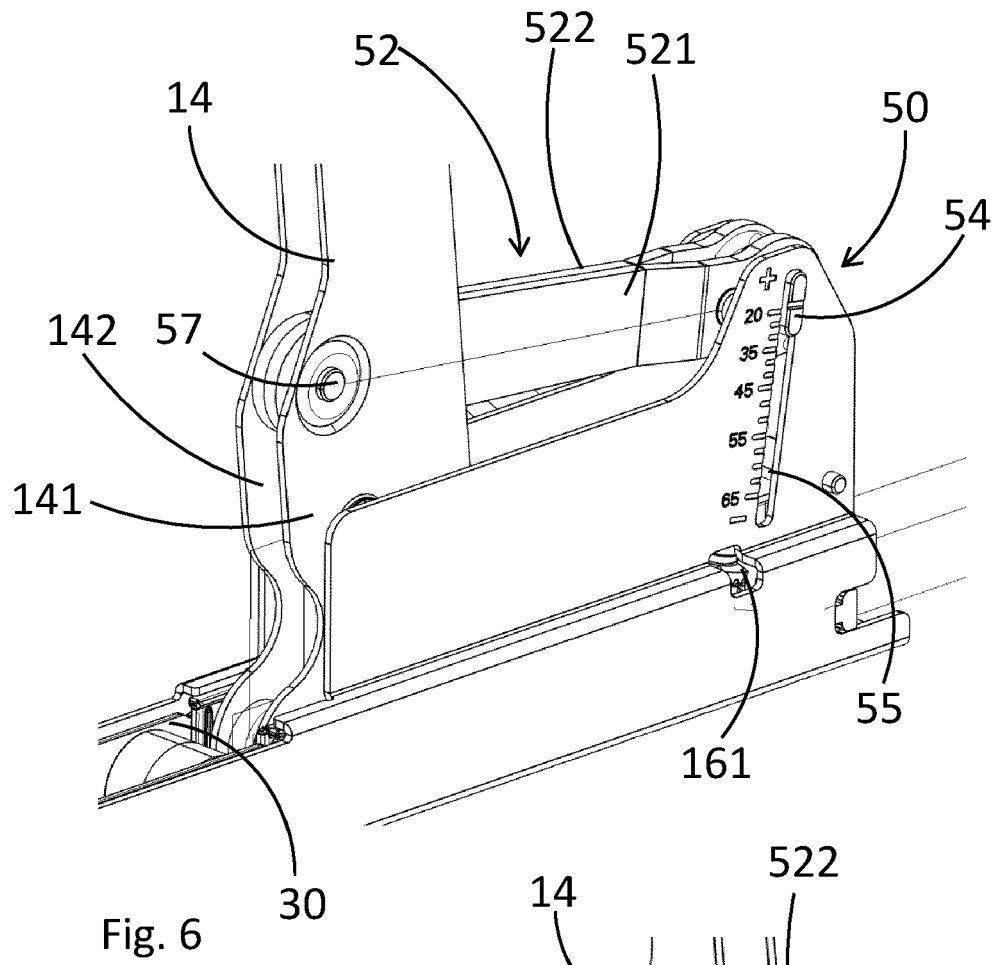
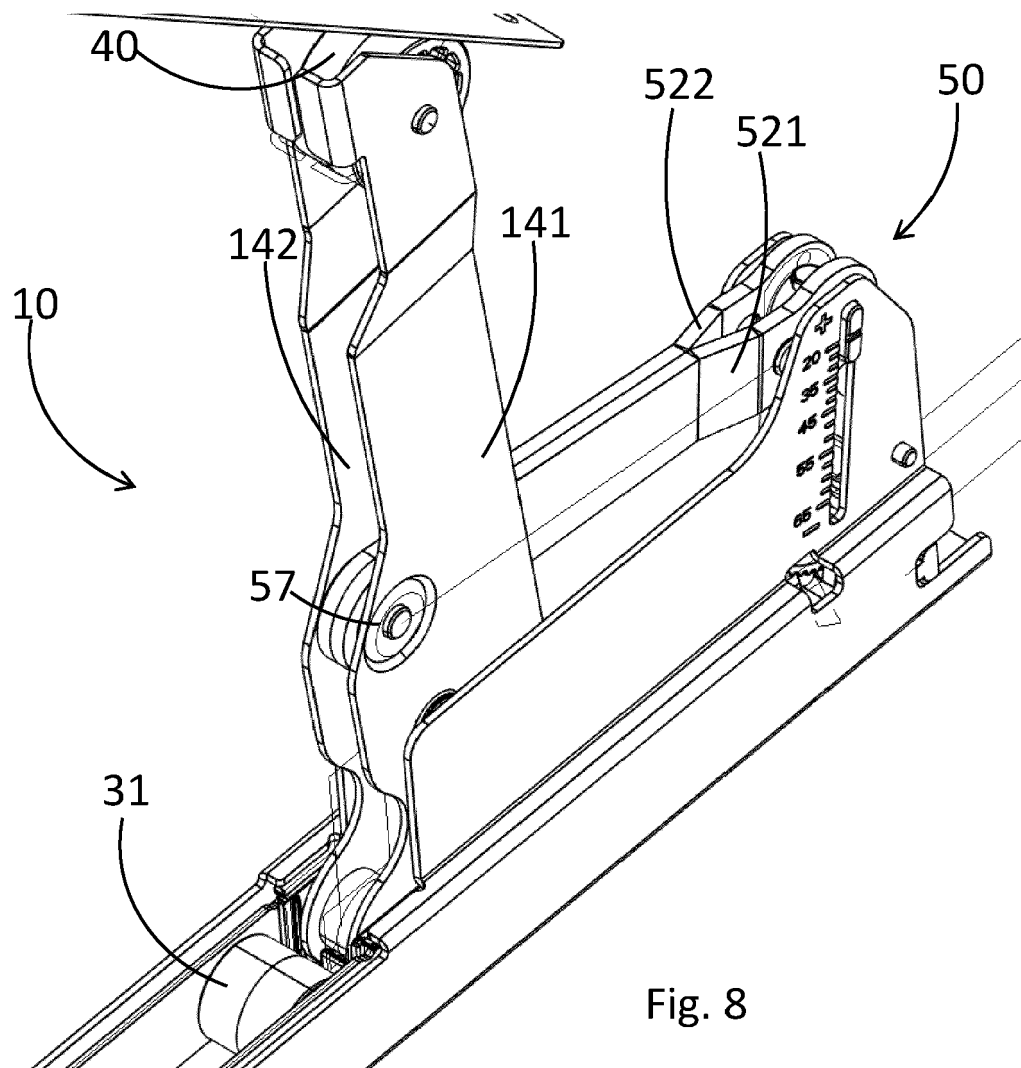


Fig. 2









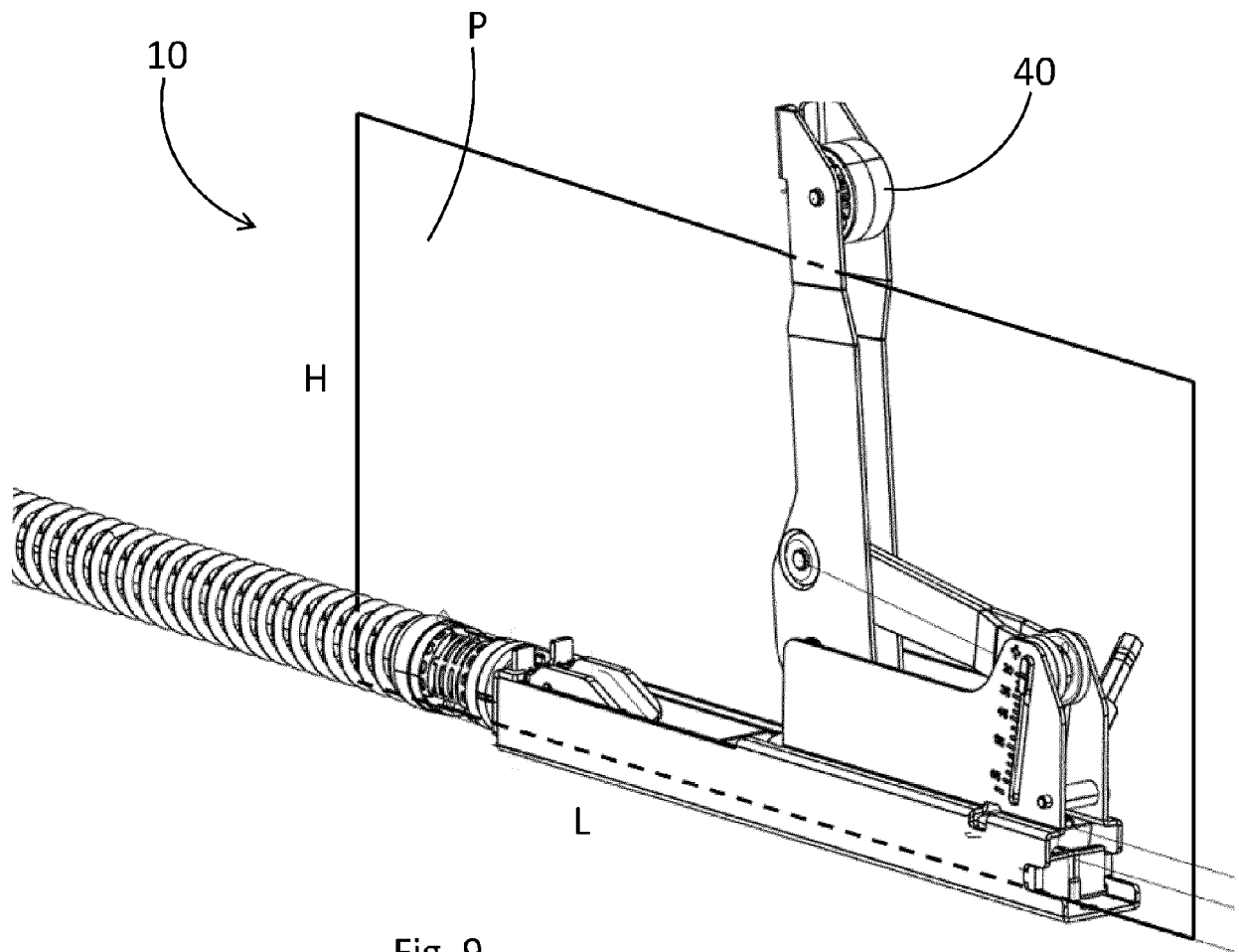
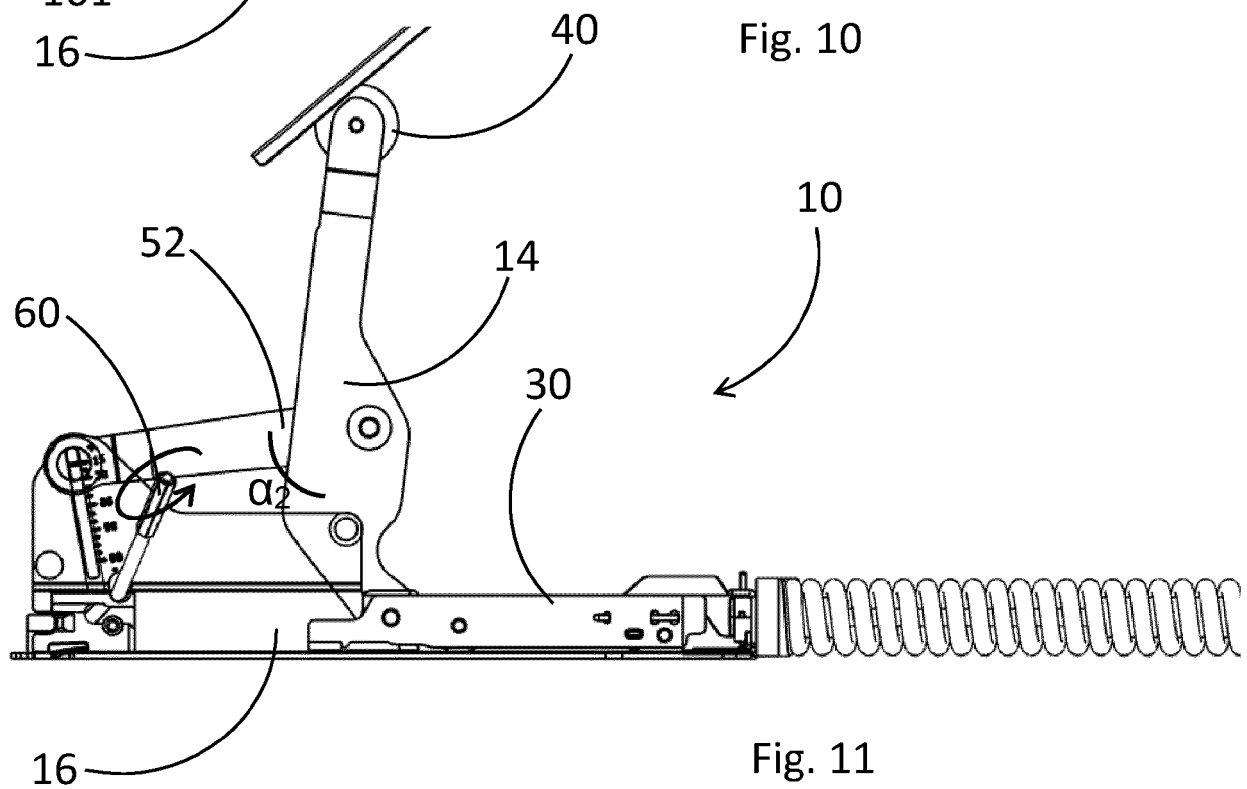
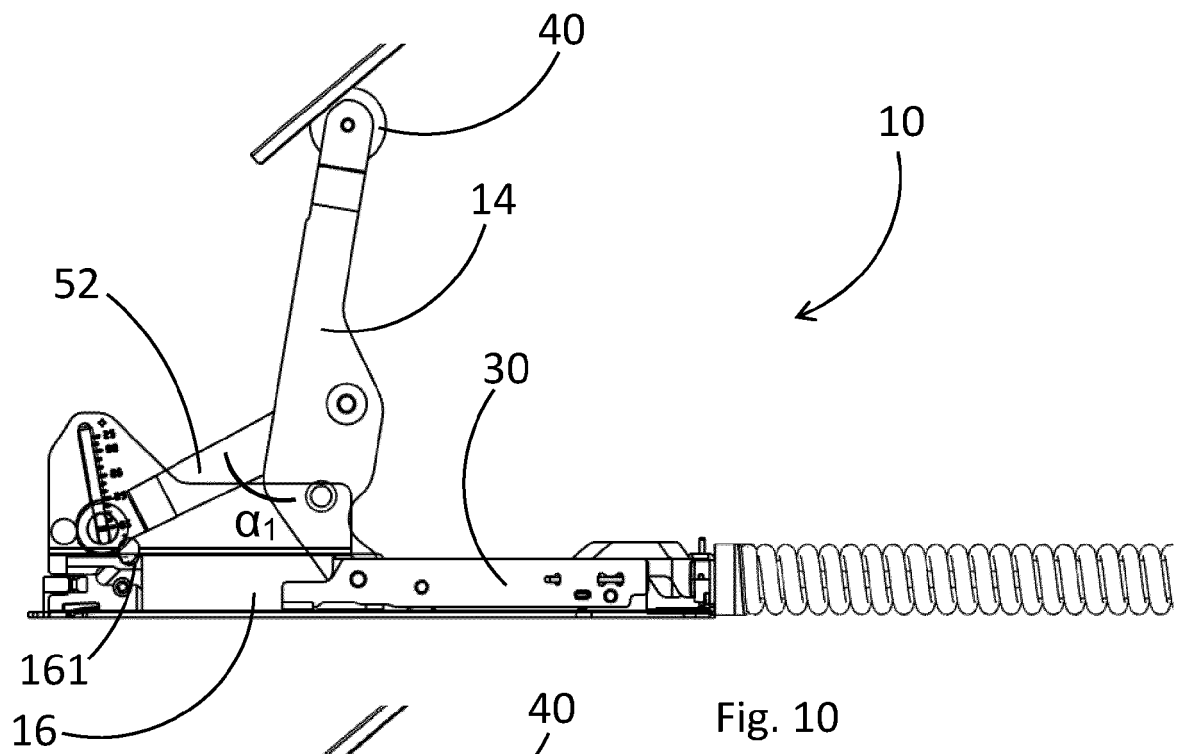


Fig. 9



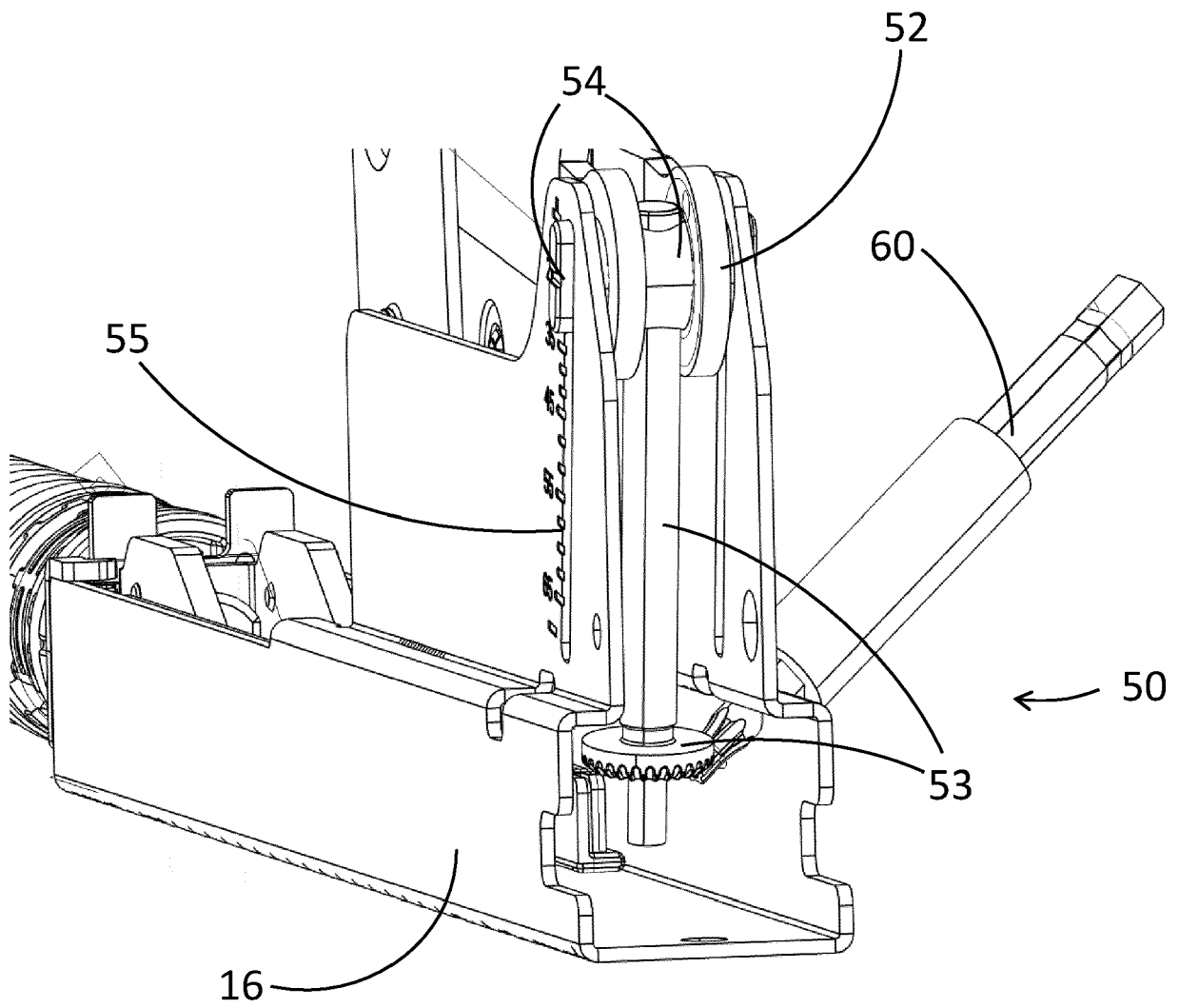


Fig. 12A

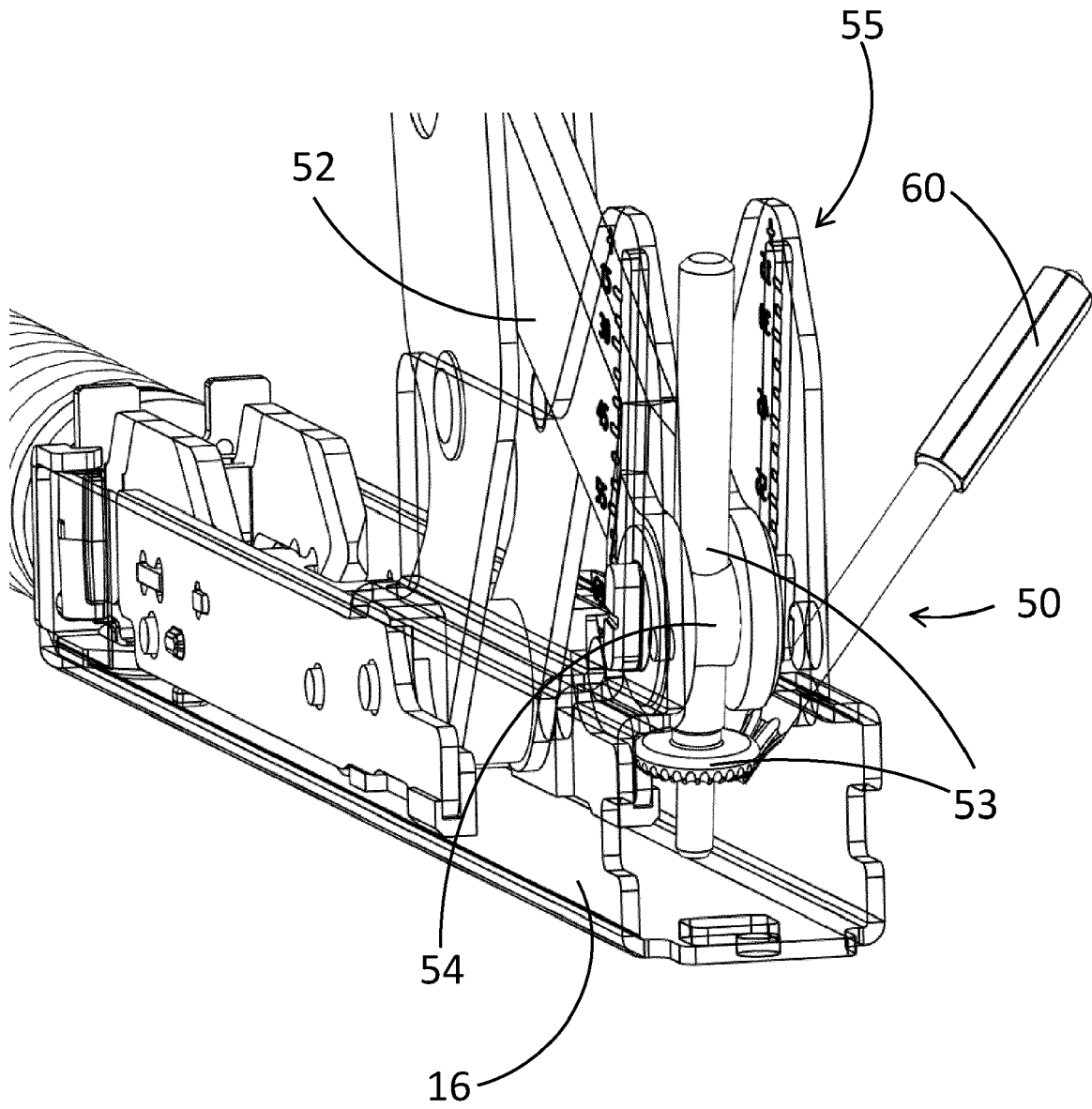


Fig. 12B



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 8122

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 95/16097 A1 (RASMUSSEN KANN IND AS [DK]; JENSEN JAN FAHLEN [DK] ET AL.) 15 June 1995 (1995-06-15)	1, 2, 13, 14, 17	INV. E05F1/10
A	* page 4, line 1 - line 7; figure 1 *	3-12, 15, 16	
X	EP 0 679 775 B1 (ROTO FRANK AG [DE]) 28 April 1999 (1999-04-28)	1, 13, 14, 17	
A	* figures 1, 2a, 6 *	3-12, 15, 16	
A	EP 3 045 636 A1 (SIEGENIA AUBI KG [DE]) 20 July 2016 (2016-07-20) * figures; page 6, line 8 - page 7, line 26 *	1-17	
A	WO 2019/101279 A1 (VKR HOLDING AS [DK]) 31 May 2019 (2019-05-31) * page 3, line 15 - page 4, line 7; figures 1, 2 *	1-17	
A	WO 99/28582 A1 (HARKINS PETER WILLIAM [AU]) 10 June 1999 (1999-06-10) * paragraphs [0030], [0055]; figure 1 *	1-17	TECHNICAL FIELDS SEARCHED (IPC) E05F
The present search report has been drawn up for all claims			

1

Place of search

The Hague

Date of completion of the search

22 April 2024

Examiner

Berote, Marc

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03:82 (P04C01)

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

EP 23 21 8122

5

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

22-04-2024

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9516097 A1	15-06-1995	AT E154411 T1	15-06-1997
		AU 1271695 A	27-06-1995
		CN 1137306 A	04-12-1996
		CZ 289954 B6	15-05-2002
		DE 69403814 T2	22-01-1998
		DK 138393 A	11-06-1995
		EP 0733146 A1	25-09-1996
		ES 2105881 T3	16-10-1997
		HU 219511 B	28-04-2001
		JP 3510259 B2	22-03-2004
		JP H09506401 A	24-06-1997
		PL 314871 A1	30-09-1996
		RU 2126481 C1	20-02-1999
		SK 71296 A3	09-04-1997
EP 0679775 B1	28-04-1999	US 5689916 A	25-11-1997
		WO 9516097 A1	15-06-1995
		AT E179479 T1	15-05-1999
		DE 9406891 U1	16-06-1994
		DK 0679775 T3	25-10-1999
		EP 0679775 A1	02-11-1995
		HU 215062 B	28-09-1998
		PL 308337 A1	30-10-1995
EP 3045636 A1	20-07-2016	SI 0679775 T1	31-08-1999
		US 5581941 A	10-12-1996
		DE 102015000453 A1	21-07-2016
WO 2019101279 A1	31-05-2019	EP 3045636 A1	20-07-2016
		CN 111373106 A	03-07-2020
		DK 201770887 A1	12-06-2019
		EP 3714116 A1	30-09-2020
		ES 2895371 T3	21-02-2022
		HU E056557 T2	28-02-2022
		PL 3714116 T3	31-01-2022
		WO 2019101279 A1	31-05-2019
WO 9928582 A1	10-06-1999	CA 2309276 A1	10-06-1999
		EP 1034350 A1	13-09-2000
		JP 2001525508 A	11-12-2001
		NZ 503977 A	26-04-2002
		US 6460294 B1	08-10-2002
		WO 9928582 A1	10-06-1999

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- WO 8910460 A [0003]
- EP 0733146 B1 [0003]
- EP 1873323 B1 [0003]
- EP 2762665 A2 [0003]
- WO 2019101281 A1 [0003] [0005]