

(19)



(11)

EP 4 567 235 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
11.06.2025 Bulletin 2025/24

(51) International Patent Classification (IPC):
E05D 15/40^(2006.01) E05F 1/10^(2006.01)

(21) Application number: **24218104.8**

(52) Cooperative Patent Classification (CPC):
E05F 1/1058; E05D 15/406; E05F 1/1075;
E05Y 2201/499; E05Y 2201/624; E05Y 2900/152

(22) Date of filing: **06.12.2024**

(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:
GE KH MA MD TN

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(30) Priority: **08.12.2023 DK PA202370605**

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(54) A LIFTING DEVICE FOR A ROOF WINDOW

(57) A lifting device (10) for a roof window (100), comprising a lifting arm (14) adapted to be inserted between a primary frame (1) of the roof window (100) and an at least one secondary frame (2, 3) of the roof window, the lifting arm (14) having a first end (14a) rotatably connected with a sledge (30) adapted to be slidably connected with the primary frame (1) in a sledge guide (16) and a second end (14b) adapted to be rota-

tably connected with the at least one secondary frame (3), 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 (L), wherein the forces exerted by the lifting arm (14) onto the central plane (P) are balanced.

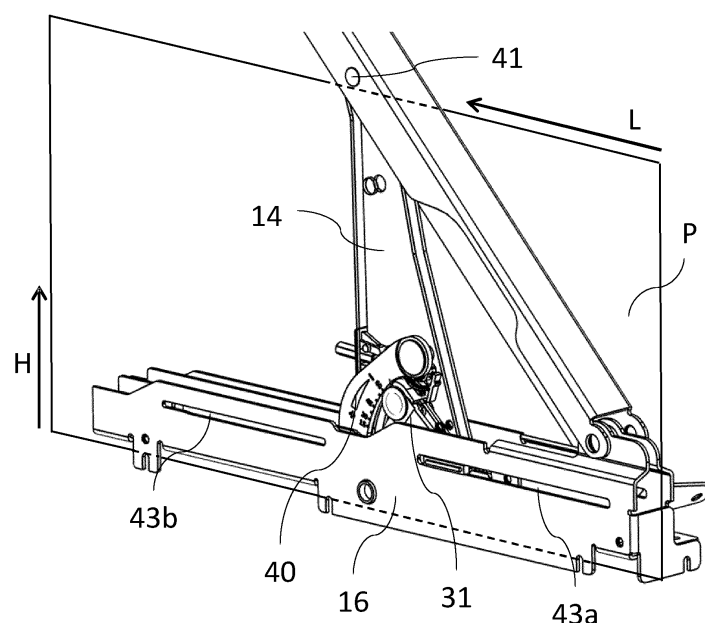


Fig. 8

EP 4 567 235 A1

Description

Technical Field

[0001] The present invention relates to a lifting device for a roof window with a lifting arm adapted to be inserted between a primary frame of the roof window and a secondary frame of the roof window, the lifting arm having a first end rotatably connected to a sledge adapted to be slidably connected with the primary frame in a sledge guide and a second end adapted to be rotatably connected to the secondary frame, the lifting device furthermore comprising a spring assembly configured to be coupled to the sledge, the lifting device further comprising a push arm having a first end rotatably connected to the sledge guide and a second end rotatably connected to the lifting arm, the lifting arm and the sledge guide extending along a length direction defining a central plane, the central plane extending along the length direction and a height direction being perpendicular to the length direction.

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 secondary frame, or 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] Furthermore, the opening of a roof window and the force required to operate the window is affected by the inclination of the roof in which the window is installed.

[0005] 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 a spring can retain the top-hinged frame in equilibrium in a desired opening position.

[0006] 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.

[0007] Another example of a lifting device is disclosed in Applicant's 4 390 030 A1.

[0008] EP 4 215 706 A1 discloses another example of a support system for windows.

[0009] 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 improvement.

Summary of Invention

[0010] With this background it is an object of the present invention to provide a lifting device for a roof window with an improved stability while allowing the desired movement pattern and ease of operability.

[0011] This is achieved with a lifting device of the kind mentioned in the introduction, which is further characterised in that the lifting arm comprises a first lifting arm and a second lifting arm arranged symmetrically with respect to the central plane, and that the forces exerted by the lifting arm onto the central plane are balanced.

[0012] This arrangement provides for an advantageous load distribution within the lifting device. The forces resulting from the weight of the movable components of the roof window are aligned with respect to the central plane. This ensures minimal torque on the individual parts of the lifting device and stabilizes the lifting device and the roof window in general.

[0013] The feature that the lifting arm comprises a first lifting arm and a second lifting arm arranged symmetrically with respect to the central plane increases the balance and stability of the lifting device. It may further ease the assembly of the lifting device.

[0014] The arrangement of arms and interconnections of arms with a sledge in a sledge guide provides a comfortable and balanced operation of the roof window in which it is installed.

[0015] Compared to EP 2 245 242 B1 the disclosure provides a lifting device with increased balance and stability.

[0016] In an embodiment, the lifting arm is adapted to be connected to a sash forming a secondary frame of the roof window. Typically, the sash is the heaviest component of a roof window, since the sash carries the window-pane, the weight of which has increased during recent years due to the ever-increasing quest for improvement

of insulation.

[0017] In a further embodiment, the push arm comprises a first push arm and a second push arm positioned on opposite sides of the lifting arm and positioned symmetrically with respect to the central plane. This may increase the balance and stability of the lifting device. It may further ease the assembling of the lifting device. The push arm may be connected to the sledge guide via a rivet and to the lifting arm via a rivet. This provides a stable and simple connection between the push arm and the lifting arm, thus resulting in a lower cost of manufacturing. The push arm may comprise a curved portion. By having a push arm with a curved portion, a larger area on the lifting arm is free to be coupled to the sledge.

[0018] In a still further embodiment, the lifting device further comprises a sledge arm connected at a first end to the lifting arm and at a second end to the sledge. The sledge arm may provide a link between the lifting arm and the sledge. As such, the lifting arm is rotatably connected to the first end of the sledge arm, and the sledge is rotatably fixed the second end of the sledge arm. Thereby, the lifting arm will rotate about the sledge arm connection during opening and closing of the roof window. The sledge arm has the advantage of increasing the mobility of the lifting arm relative to the sledge because it acts as a link connection between the sledge and the lifting arm. The sledge arm is preferably connected to the lifting arm at a point proximate the first end of the lifting arm.

[0019] In a further development of the still further embodiment, the sledge arm comprises a first sledge arm and a second sledge arm arranged symmetrically with respect to the central plane. This may increase the balance and stability of the lifting device. It may further ease the assembling of the lifting device. The first and second sledge arm may be positioned between a first and second lifting arm. Alternatively, the first and second sledge arm may be positioned on opposite sides of the lifting arm.

[0020] In yet another embodiment, the lifting device further comprises an adjustment system, the adjustment system comprising an adjustment screw arranged in an opening of the lifting arm and extending along the central plane, wherein the sledge arm is rotatably connected to the lifting arm via the adjustment screw. In an embodiment, the adjustment system provides a mechanism for adjusting the balance between the weight of the pane-carrying sash of the roof window with the force provided by the spring assembly. When the lifting device is used as intended, the weight of the pane-carrying sash is at least partially carried by the lifting arm when the roof window is in an open position. The lifting arm is arranged such that the weight of the pane-carrying sash acts as a pulling force on the spring in the spring assembly. The stretched spring provides a spring force towards the equilibrium position of the spring which forces the pane-carrying sash towards an open position. The weight carried by the lifting arm depends on the roof inclination of the roof in which the roof window is installed. The balance between

the spring force and the force from the weight of pane-carrying sash acting on the lifting arm may therefore change when the roof inclination is changed. The adjustment system is arranged to adjust the balance between the force exerted by the lifting arm on the pane-carrying sash and the weight of the pane-carrying sash. The adjustment system is arranged such that the opening angle of the roof window is not substantially affected during adjustment of the adjustment system. That means that the adjustment to a different roof inclination is possible without affecting the opening angle of the roof window. The adjustment system may be adjusted to balance roof window for roof inclinations in the range of 15 - 60°.

[0021] The adjustment screw may act as a connecting link between one or more elements of the roof window, where one element is the lifting arm, allowing the connected elements to be moved relative to each other when the adjustment screw is adjusted. Generally, the adjustment screw comprises an adjustment screw shaft, an adjustment screw wheel, and an adjustment screw top. In general, the adjustment screw is constrained by the opening of the adjustment arm. In preferred embodiments, the adjustment screw is connected to the lifting arm via the adjustment screw top and the adjustment screw is thereby stationary relative to the lifting arm when the adjustment screw is adjusted.

[0022] One or more elements of the roof window may be connected to the adjustment screw shaft. The position of the one or more elements on the adjustment screw shaft is arranged to be adjusted when the adjustment screw is manipulated. The adjustment screw wheel is arranged to be manipulated by an external force such as the force from a screw bit in order to rotate the adjustment screw. By adjustment of the adjustment screw, the one or more elements connected to the adjustment screw shaft is arranged to be moved relative to the lifting arm. This arrangement changes the balance between the weight of the pane-carrying frame and the force exerted by the lifting arm on the pane-carrying frame from the pull of the spring assembly.

[0023] The lifting arm may be adapted to be attached to the secondary frame by a rivet. This may provide a stable and simple connection between the lifting arm and the secondary frame, thus resulting in a lower cost of manufacturing.

[0024] The lifting device may further comprise an adjustment arm rotatably connected at a first end to the adjustment screw and rotatably connected at a second end to the lifting arm.

[0025] The adjustment arm may be connected to the adjustment screw comprised in the adjustment system. Even more preferably, the adjustment arm is connected to the adjustment screw shaft. As previously described, the adjustment screw is preferably connected to the lifting arm through an adjustment screw top, and one or more elements are connected to the adjustment screw shaft. The adjustment screw is arranged in an opening of the

lifting arm, and the forces acting on the adjustment screw may drive the adjustment screw towards a surface of the lifting arm resulting in the adjustment system and the lifting arm colliding causing unwanted friction and tear on the system and on the sledge. Alternatively, and/or additionally, the forces acting on the adjustment screw may cause a strain on the adjustment screw causing unwanted wear and tear on the system.

[0026] The adjustment arm may reduce the friction in the adjustment system, by acting as a constraint on the adjustment screw. By the second end of the adjustment arm being rotatably fixed to the lifting arm and the first end rotatably fixed to the adjustment screw, the adjustment screw is constrained to move in the arch provided by rotating the adjustment arm around its connection point with the adjustment arm. The opening of the lifting arm in which the adjustment screw is arranged, is shaped according to the adjustment arm such that the second end of the adjustment arm travels along this opening.

[0027] In an embodiment, the adjustment arm comprises a first adjustment arm and a second adjustment arm arranged symmetrically with respect to the central plane (P). This may increase the balance and stability of the lifting device. It may further ease the assembling of the lifting device. The adjustment arm may additionally and/or alternatively extend along the central plane. This may increase the balance and stability of the lifting device. It may further ease the assembly of the lifting device.

[0028] The sledge may comprise at least two runners, each runner being slidably connected to a track in the sledge guide.

[0029] The runners may provide a stable connection between the sledge and the sledge guide that allows the sledge to slide in the sledge guide at low friction. The track may comprise a straight portion and/or a curved portion.

[0030] The at least two runners may comprise a front runner configured to slide in a front track towards a first end of the sledge guide and a back runner configured to slide in a back track positioned towards a second end of the sledge guide.

[0031] The combination of a front runner and a back runner may provide a balanced support of the sledge in the sledge guide. The front runner may comprise a first front runner and a second front runner positioned on opposite sides of the lifting arm. This may provide an open space between the first and second front runner allowing the first end of the lifting arm to be coupled to the sledge in proximity of the front runner.

[0032] Other presently preferred embodiments and further advantages will be apparent from the subsequent detailed description and drawings.

Brief Description of Drawings

[0033] 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 view of a roof window in an embodiment of the invention, seen from an exterior side.

Fig. 1C is a side view of a roof window in an embodiment of the invention, with the sash in an open position.

Fig. 2A is a side view of a lifting device for a roof window in an embodiment according to the invention in an open position.

Fig. 2B is a side view of a lifting device for a roof window in an embodiment according to the invention in a closed position.

Fig. 3A is a perspective exploded view of a connection between an adjustment screw, an adjustment bushing, and an adjustment arm in an embodiment according to the invention.

Fig. 3B is a perspective exploded view of a connection between an adjustment screw arranged in an opening of a lifting arm in an embodiment according to the invention.

Fig. 3C is a perspective exploded view of a connection between a sledge arm, adjustment system, and a lifting arm in an embodiment according to the invention.

Fig. 4A is a side view of a lifting arm connected with a sledge arm through an adjustment system in a default position.

Fig. 4B is a side view of the lifting arm of Fig. 4A wherein the sledge arm is rotated relative to the lifting arm.

Fig. 4C is a side view of the lifting arm of Fig. 4A and 4B wherein the adjustment system is adjusted thereby changing the connection point between the adjustment system and the sledge arm.

Fig. 5 is a perspective exploded view of a connection between the lifting arm and the sledge arm.

Fig. 6 is a perspective view of an assembly comprising the lifting arm, the sledge arm, the adjustment arm and the adjustment system in an embodiment according to the invention.

Fig. 7 is a perspective view of a lifting device shown before installed in a sledge connected with a sledge guide in an embodiment according to the invention.

Fig. 8 is a perspective view of a lifting device for a roof window in an embodiment according to the invention showing a central plane P.

Fig. 9 is a front view of a lifting device for a roof window in an embodiment according to the invention showing the central plane P and the symmetrical arrangement of the lifting arm, sledge arm, and adjustment arm, in an embodiment according to the invention.

Fig. 10A is a close-up of a side view of an adjustment screw arranged in an opening of the lifting arm in an embodiment according to the invention.

Fig. 10B shows the embodiment of Fig. 10A in which a tool is inserted to provide an external force on the adjustment system.

Fig. 10C shows the embodiment of Figs. 10A and 10B in which the tool acts on the adjustment screw wheel.

Fig. 10D shows the embodiment of Figs. 10A-10C in which an external force is provided by means of rotating the external tool thereby adjusting the adjustment screw.

Fig. 10E shows the embodiment of Figs. 10A-10D in which the position of the sledge arm on adjustment screw has been changed by means of adjustment of the adjustment screw, thereby changing an angle between the sledge arm and the lifting arm.

Fig. 11A - 11B show the changing angle between the sledge arm and the lifting arm when the adjustment screw is adjusted.

Fig. 12 is a close-up of a bottom perspective view of an adjustment system in an embodiment according to the invention.

Description of Embodiments

[0034] In the following, embodiments of a 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. An interior side faces towards the interior of the building where the window is installed, while an exterior side faces on the opposite direction towards the exterior of the building.

[0035] Reference numerals refer to similar elements across various embodiments and figures described herein.

[0036] Referring initially to Figs 1A and 1B, a roof window 100 is shown. The roof window 100 is intended to be installed in or on an inclined roof surface (not shown).

[0037] The roof window 100 comprises a primary frame 1, a secondary frame which in the following will be referred to as a sash 2 but which could also include an intermediate frame connected partly to the primary frame 1, partly to a separate, glass-carrying unit functioning as a sash, and a pane 4.

[0038] Generally, the roof window comprises a windowpane comprising at least two layers of glass, preferably at least three layers of glass. The window may comprise an Insulating Glazing Unit (IGU).

[0039] 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.

[0040] The pane 4 comprises a number of edge portions generally associated to members of the sash 2. 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.

[0041] 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.

[0042] 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 at the top of the roof window 100. It is however conceivable to apply some principles of the presented concepts for roof windows on different types of windows having other opening patterns.

[0043] Further details shown in Fig. 1A include an operating assembly 5, here shown as a handle. Other operating assemblies may be present as well.

[0044] Also shown in Fig. 1B 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.

[0045] An insulating frame 7 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.

[0046] Referring to Fig. 1C, the roof window 100 is shown in a top-hung configuration. The roof window is top-hung, i.e., hinged at the top, by means of a hinge assembly (not shown) connecting the primary frame with the secondary frame.

[0047] 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.

[0048] To assist the user in opening the sash 2, a lifting device 10 is provided as will be described in the following. Referring now also to Fig. 2A, the lifting device 10 comprises a lifting arm 14 inserted between the primary frame 1 and the at least one secondary frame, here the sash 2. The lifting device 10 furthermore comprises a spring assembly 20 configured to be coupled to a sledge 30, and a push arm 40.

[0049] In Fig. 2A an embodiment of the lifting device 10 is shown from a side view with one side of the sledge guide 16 removed thereby showing the sledge 30 in connection with the spring assembly 20. The lifting arm 14 is inserted between the primary frame 1 and the sash 2 such that the lifting arm 14 has a first end 14a in connection with the sledge 30 and a second end 14b connected to the sash 2.

[0050] The lifting arm 14 is connected to the sledge guide 16 via the push arm 40. The push arm 40 has a first end 40a rotatably connected to the sledge guide 16 and a second end 40b rotatably connected to the lifting arm 14, in the embodiment shown by means of a first rivet 42i and a second rivet 42ii as shown in more detail Fig. 5.

[0051] The sledge 30 is attached to the spring assembly 20 which is arranged to exert a force on the sledge 30 in a condition of use of the roof window 100. The sledge 30 may be uncoupled from the spring assembly 20, as shown in Fig. 2B. 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. 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 21 attached to a spring comprised in the spring assembly 20. Such a coupling may for example be realized by the sledge 30 comprising a coupling plate 32 for coupling the sledge 30 to the spring assembly 20. Opening the roof window results in the sledge 30 engaging with the hook 21 and once the roof window is subsequently closed, the sledge 30 will slide in a direction away from the spring assembly 20 towards the top hinge of the roof window 100 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.

[0052] The pulling force of the spring assembly 20 and the weight of the movable parts of the roof window 100 are preferably balanced such that the sash 2 of the roof window 100 can be positioned in an open position without

forcing it to close due to its own weight or forcing it to open further due to the pulling force applied by the spring of the spring assembly 20. This balance is affected by the inclination of the roof that the roof window is installed in. The spring in the spring assembly 20 may be adjusted to balance the roof window to a specific roof inclination. If the roof window is installed on a roof with a roof inclination different than the intended inclination, the spring force acting on the sledge 30 will not be balanced to the weight of the movable parts of the roof 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 may be difficult for the user to operate and potentially hazardous.

[0053] To easily adjust the roof window 100 according to roof inclination, an adjustment system 50 may be used. The adjustment system 50 may be used to adjust the roof window for roof inclinations in the range of 15 - 60°.

[0054] An embodiment of the adjustment system 50 is shown in greater detail in Figs. 3A - 4C. The adjustment system 50 is connected to an adjustment arm 52 which in turn is connected to the other components of the lifting device 10 as will be described in further detail below.

[0055] Fig. 3A shows an adjustment screw 53 with an adjustment screw shaft 53i, an adjustment screw wheel 53ii, and an adjustment screw top 53iii. In the embodiment shown, the adjustment arm 52 is a two-part component comprising a first adjustment arm 521 and a second adjustment arm 522 and is coupled to an adjustment bushing 54.

[0056] Fig. 3B shows the assembly of Fig. 3A in connection with the lifting arm 14 which is here formed to comprise a first lifting arm 141 and a second lifting arm 142. The first lifting arm 141 and the second lifting arm 142 are connected to each other by one or more lifting arm rivets 57. In Fig. 3B, the adjustment system 50 comprising the adjustment screw 53 is shown as being accommodated between the first lifting arm 141 and the second lifting arm 142 and in an opening 15. The adjustment arm 52 has a first end 52a connected to the adjustment system 50 via the adjustment bushing 54. A second end of the adjustment arm 52b is rotatably connected to the lifting arm 14 allowing the adjustment arm 52 to travel along a path in the opening 15 of the lifting arm. In the embodiment shown, the opening 15 of the lifting arm is arch-shaped but could in principle have any shape allowing suitable movement. The adjustment screw wheel 53ii is accommodated in a separate opening 17 in the lifting arm 14. Preferably the adjustment screw is connected to the lifting arm 14 via the adjustment screw top.

[0057] Fig. 3C shows a sledge arm 31 with a first end 31a rotatably connected to the lifting arm 14 and a second end 31b rotatably connected to the sledge 30, not shown in Fig. 3C. The sledge arm 31 is connected to the adjustment bushing 54. In the embodiment shown, the sledge arm 31 is a two-part component as will be described

below.

[0058] Thus, the adjustment arm 52 is arranged in the lifting arm 14 between the first lifting arm 141 and second lifting arm 142, and the sledge arm 31 is arranged on the outside of the lifting arm 14.

[0059] Figs 4A - 4C show the assembly of the lifting arm 14 and the sledge arm 31 from Figs 3A - 3C. Fig. 4B shows how a second end 31b of the sledge arm 31 is arranged to rotate around the adjustment bushing 54 and Fig. 4C shows how a first end 31a of the sledge arm 31 is arranged to move along the adjustment screw shaft 53i upon adjustment of the adjustment screw 53.

[0060] Fig. 5 shows a push arm 40 with a first end 40a configured for being attached to the sledge guide (not shown) and a second end 40b being rotatably connected to the lifting arm 14. In Fig. 5, the push arm comprises a first push arm 401 and a second push arm 402 arranged on opposite sides of the lifting arm 14. The lifting arm 14 is rotatably connected to the sash 2 (not shown) by means of a rivet 41. The connection between the lifting arm 14 and the sash 2 is shown in Figs. 8 and 10D-10E.

[0061] The assembly of the lifting arm 14, the push arm 40, the adjustment system 50, the adjustment arm 52, and the sledge arm 31 according to one embodiment of the invention, is shown in Fig. 6.

[0062] Referring now to Fig. 7, an embodiment of the sledge 30 and the push arm 40 being arranged in the sledge guide 16 is shown. The sledge in Fig. 7 has a first front runner 701 and a second front runner 702 arranged to be slidably connected to a front track 43a located on each side of the sledge guide 16, and a back runner 71 arranged to be slidably connected to a back track 43b located on each side of the sledge guide 16. The first and second front runners 701, 702 comprised in a front runner 70 are in this embodiment shown as two separate runners, but may in other embodiments be coupled to form a single front runner 70.

[0063] Fig. 8 shows a lifting device 10 according to the invention with the lifting arm 14 inserted between the primary frame 1 and the sash 2. The sledge guide 16 extends along a length axis in a length direction L. When the window is in a closed position the lifting arm 14 also extends in the length direction L. A height axis extends in a height direction H perpendicular to the length direction L. The height axis extends perpendicularly to the pane of the roof window when the lifting device is installed in the roof window. The length axis and the height axis define a central plane P.

[0064] Generally, the lifting arm 14 of the embodiment shown comprises a first lifting arm 141 and a second lifting arm 142 arranged symmetrically with respect to the central plane P. Forming at least the lifting arm 14 as a two-part component so that the forces exerted by the lifting arm 14 onto the central plane P are balanced provides for an advantageous load distribution within the lifting device 10. That is, the forces resulting from the weight of the movable components of the roof window 100 are aligned with respect to the central plane P.

[0065] The push arm 40 comprises a first push arm 401 and a second push arm 402 arranged symmetrically with respect to the central plane P. The sledge arm 31 comprises a first sledge arm 311 and a second sledge arm 312 arranged symmetrically with respect to the central plane P. Finally, the adjustment arm 52 comprises a first adjustment arm 521 and a second adjustment arm 522 arranged symmetrically with respect to the central P and extending along the central plane P, while the adjustment screw 53 extends in the central plane P. The symmetrical arrangement of the lifting device components provides a lifting device where forces from the pane and other movable components of the roof window are aligned with respect to the central plane P. This ensures minimal torque on the individual parts of the lifting device and stabilizes the lifting device and the roof window in general.

[0066] Turning now to Figs. 10A-10E embodiments comprising an adjustment system 50 according to the disclosure are shown. The adjustment system 50 is shown comprising an adjustment screw 53 provided within the contours of the lifting arm 14 such as to be accessible via an opening in the lifting arm 14 as will be described below.

[0067] Fig. 10B shows how the adjustment system is adjusted by applying an external force. In this embodiment the external force is applied via a screw bit 60 to the adjustment screw wheel 53ii. In the embodiments shown in Figs. 10A-10C the lifting arm 14 is arranged to receive a screw bit 60 through an opening in the lifting arm 14. In the embodiment shown, the opening is provided as a space between the first lifting arm 141 and the second lifting arm 142 such that the screw bit 60 may be inserted from the back of the lifting arm 14. As such, the adjustment system 50 is most easily adjusted when the roof window 100 is in an open position. The opening for such a screw bit may alternatively and/or additionally be arranged on another side such as the front or on one or both sides of the lifting arm, for instance via the opening 15 described in the above. By having an opening on the side of the lifting arm 14 it is possible to adjust the adjustment system 50 in both the open and closed positions of the roof window.

[0068] In Figs. 10D and 10E it is shown how adjusting the adjustment system 50 changes the position of the first end 31a of the sledge arm 31 relative to the lifting arm 14 by moving along the adjustment screw 53, thereby changing the force balance between pulling force from the spring assembly 20 and the weight of the window, making it possible to adjust the roof window 100 for different roof inclinations. The first end 31a of the sledge arm 31 is therefore shown having two different positions relative to the lifting arm 14 corresponding to adjustment to two different roof inclinations.

[0069] Figs. 11A and 11B show a zoomed-in detailed view of the adjustment shown in Figs. 10D and 10E where it is clearly shown that the sledge arm 31 and the lifting arm 14 are connected to form a first angle α_1 between each other, and that the first angle α_1 formed between the

sledge arm 31 and the lifting arm 14 is configured to be changed to a second angle α_2 when the adjustment system 50 is adjusted. In the embodiment shown, this is carried out by adjusting the position of the first end 31a of the sledge arm 31 by means of the adjustment system 50. The first angle α_1 may be considered as an outset angle or pre-defined angle, typically forming part of factory settings in a condition of supply of the lifting device 10.

[0070] Fig. 12 shows a close-up bottom perspective view of the adjustment system, where it is clearly shown that the push arm 40 comprises indications for adjustment to different roof inclinations. In this embodiment, the indications are numerical values, ranging from 15 to 60, corresponding to respective degrees. These values indicate and correspond to the desired roof inclination that the user should adjust the lifting device 50. By moving the position of the first end of the sledge arm 31 on the adjustment screw 53 to a specific numerical value, the user is able to adjust the lifting device of the roof window to the desired roof inclination. In the embodiment shown in Figs 11A, 11B and 12, the numerical values shown on the push arm are 15, 30, 45 and 60 corresponding to roof inclinations of 15, 30, 45 and 60 degrees. Furthermore, a marking indicating the ascending or descending order of the numerical values is included in the embodiment shown. In alternative embodiments, higher or lower values of roof inclinations than those indicated in the embodiments shown may be achieved.

List of reference numerals

[0071]

1 primary frame
2 secondary frame / sash

4 pane
4i interior pane surface
4e exterior pane surface
5 operating assembly

7 insulating frame

10 lifting device

14 lifting arm
14a first end of lifting arm
14b second end of lifting arm
15 opening of lifting arm
16 sledge guide
17 separate opening

20 spring assembly
21 hook

30 sledge
31 sledge arm

31a first end of sledge arm
31b second end of sledge arm
32 coupling plate

5 40 push arm
40a first end of push arm
40b second end of push arm

41 rivet
10 42i first rivet
42ii second rivet
43a front track
43b back track

15 50 adjustment system

52 adjustment arm
52a first end of adjustment arm
52b second end of adjustment arm
20 53 adjustment screw
53i adjustment screw shaft
53ii adjustment screw wheel
53iii adjustment screw top
54 bushing

25 57 lifting arm rivet

60 screw bit

30 70 front runner
71 back runner

100 roof window

35 141 first lifting arm
142 second lifting arm

311 first sledge arm
312 second sledge arm
40
401 first push arm
402 second push arm

521 first adjustment arm
45 522 second adjustment arm

701 first front runner
702 second front runner
P central plane
50 L length direction
H height direction
 α_1 first angle
 α_2 second angle

55 Claims

1. A lifting device (10) for a roof window (100), comprising

a lifting arm (14) adapted to be inserted between a primary frame (1) of the roof window (100) and an at least one secondary frame (2) of the roof window, the lifting arm (14) having a first end (14a) rotatably connected to a sledge (30) adapted to be slidably connected with the primary frame (1) in a sledge guide (16) and a second end (14b) adapted to be rotatably connected to the secondary frame (2), the lifting device (10) furthermore comprising a spring assembly (20) configured to be coupled to the sledge (30),

the lifting device (10) further comprising a push arm (40) having a first end (40a) rotatably connected to the sledge guide (16) and a second end (40b) rotatably connected to the lifting arm (14),

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 (L),

characterised in that

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), and that the forces exerted by the lifting arm (14) onto the central plane (P) are balanced.

2. A lifting device (10) according to claim 1, wherein the lifting arm (14) is adapted to be connected to a sash (2) forming a secondary frame of the roof window (1).
3. A lifting device (10) according to any one of claim 1, wherein the push arm (40) comprises a first push arm (401) and a second push arm (402) positioned on opposite sides of the lifting arm (14) and positioned symmetrically with respect to the central plane (P).
4. A lifting device (10) according to any one of the preceding claims, wherein the lifting device (10) further comprises a sledge arm (31) connected at a first end (31a) to the lifting arm (14) and at a second end (31b) to the sledge (30).
5. A lifting device (10) according to claim 4, wherein the sledge arm (31) comprises a first sledge arm (311) and a second sledge arm (312) arranged symmetrically with respect to the central plane (P).
6. A lifting device (10) according to any of the preceding claims, wherein the lifting device (10) further comprises an adjustment system (50), the adjustment system (50) comprising an adjustment screw (51) arranged in an opening of the lifting arm (14) and extending along the central plane (P), and wherein the sledge arm (31) is rotatably connected to the

lifting arm (14) via the adjustment screw (51).

7. A lifting device (10) according to claim 6, wherein the lifting device (10) further comprises an adjustment arm (52) rotatably connected at a first end (52a) to the adjustment screw (51) and rotatably connected at a second end (52b) to the lifting arm (14).
8. A lifting device (10) according to claim 7, wherein the adjustment arm (52) comprises a first adjustment arm (521) and a second adjustment arm (522) arranged symmetrically with respect to the central plane (P).
9. A lifting device (10) according to any one of claims 7 and 8, wherein the adjustment arm (52) extends along the central plane (P).
10. A lifting device (10) according to any one of the preceding claims, wherein the sledge (30) comprises at least two runners (70, 71), each runner being slidably connected to a track (43a, 43b) in the sledge guide (16).
11. A lifting device (10) according to claim 10, wherein the at least two runners (70, 71) comprise a front runner (70) configured to slide in a first track (43a) positioned towards a first end of the sledge guide (16) and a back runner (71) configured to slide in a second track (43b) positioned towards a second end of the sledge guide (16).

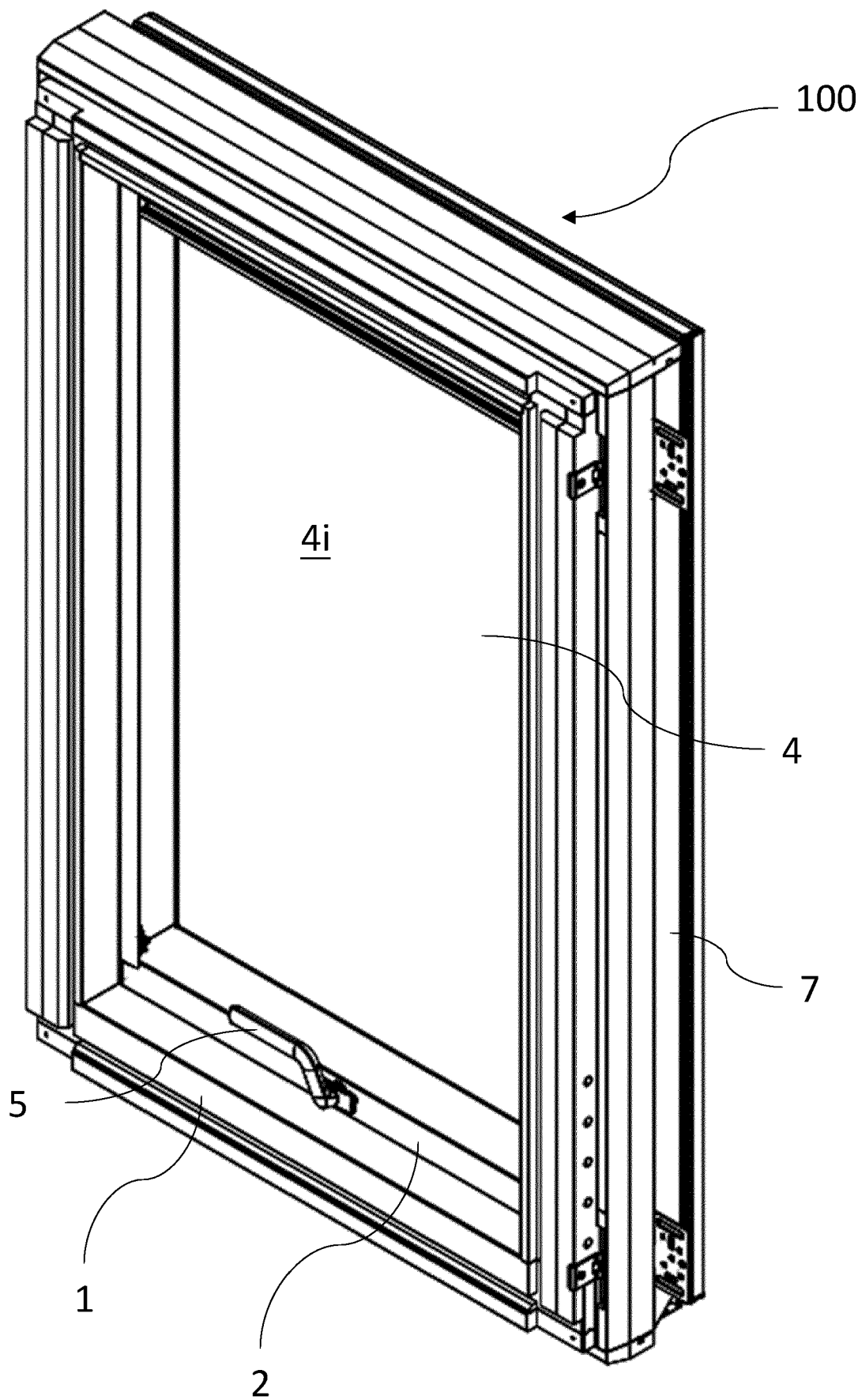


Fig. 1A

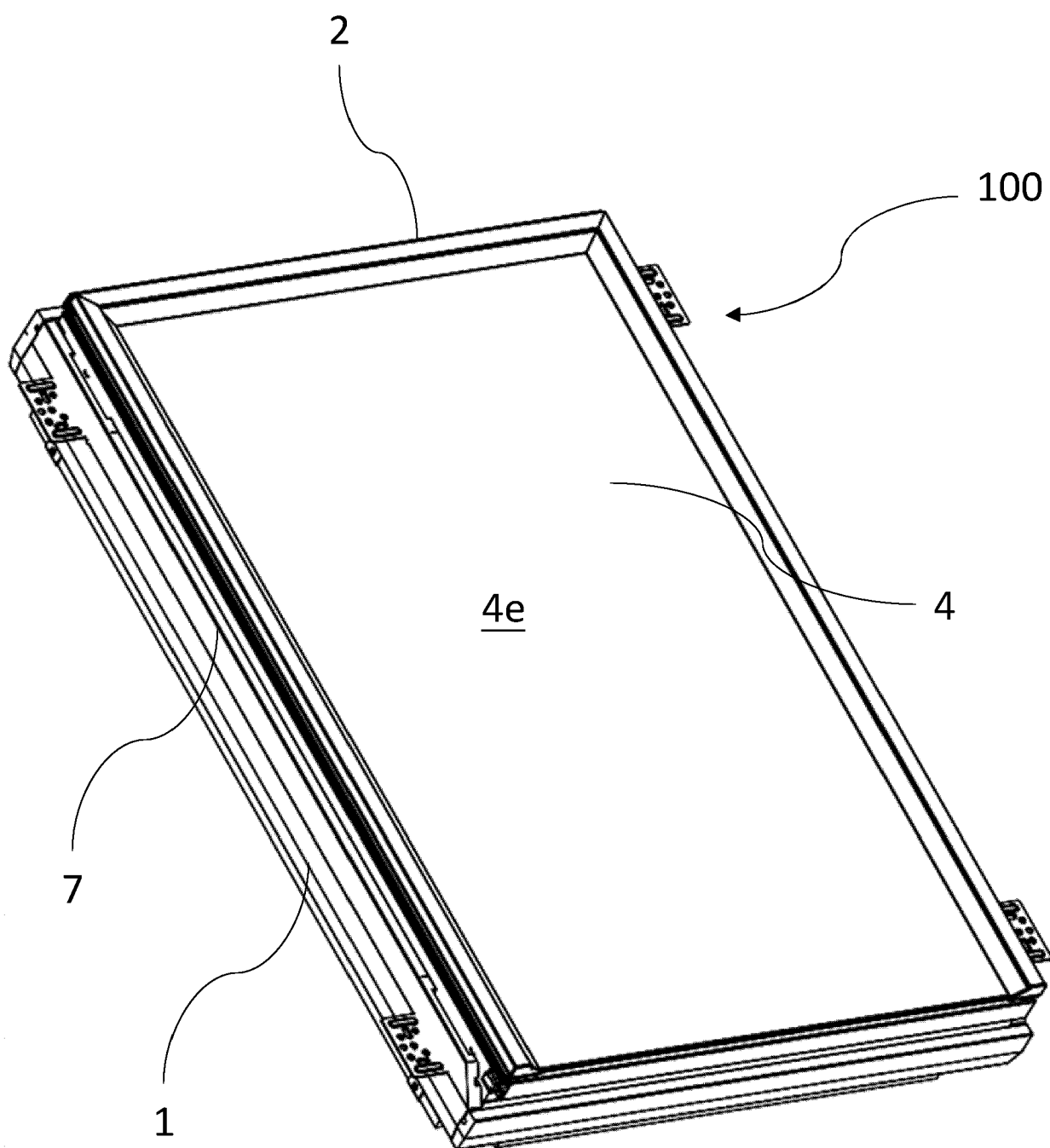


Fig. 1B

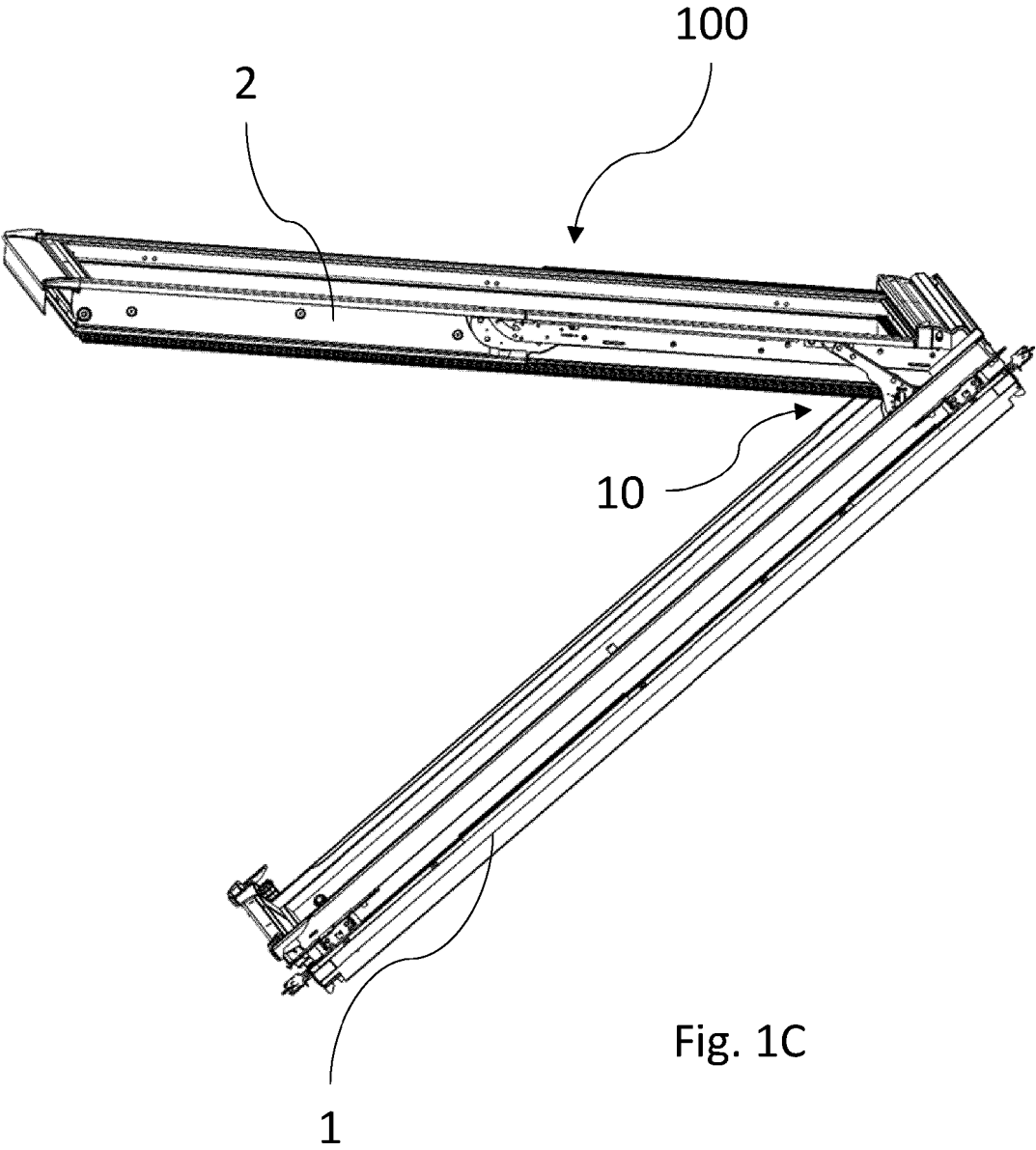


Fig. 1C

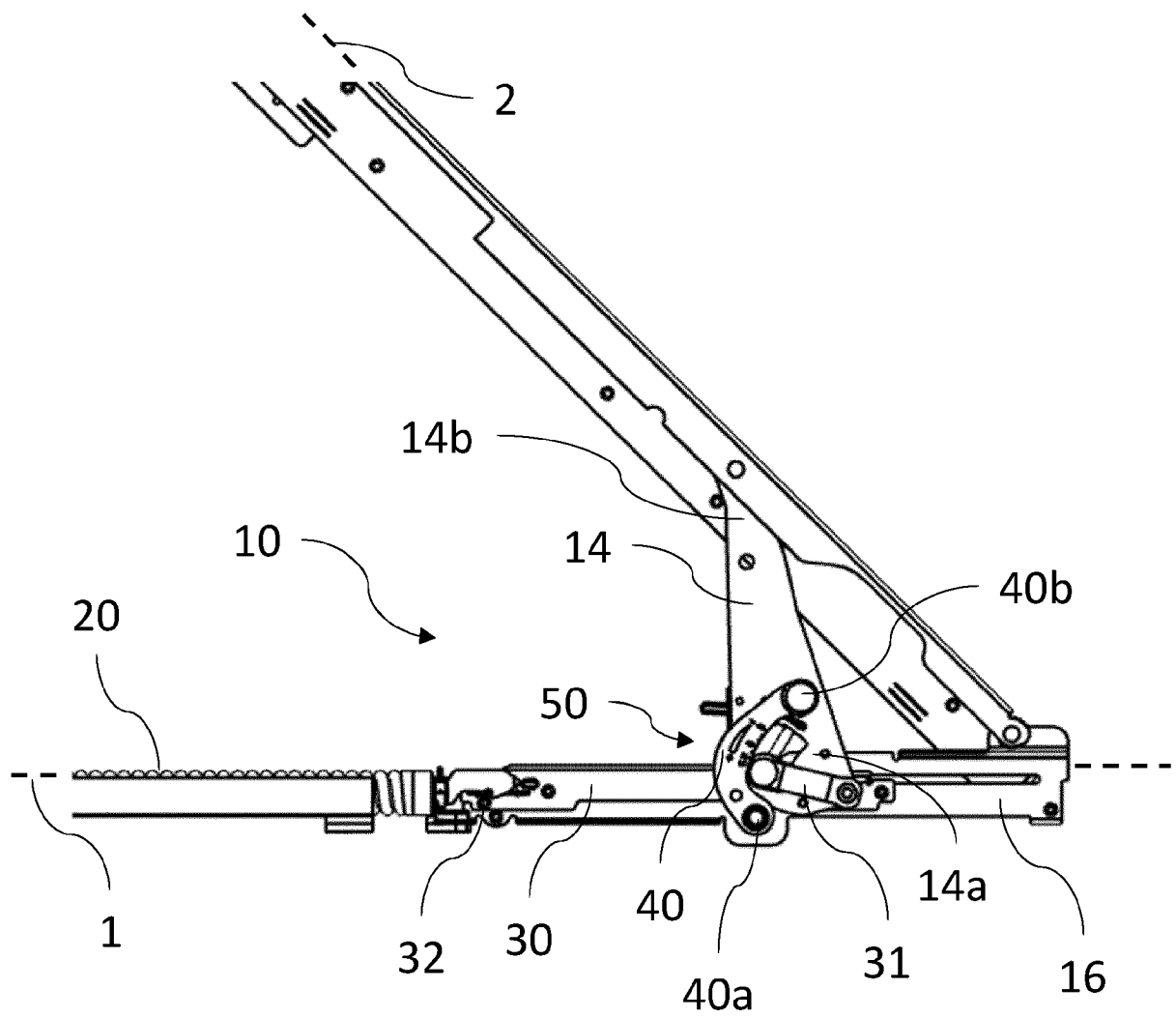


Fig. 2A

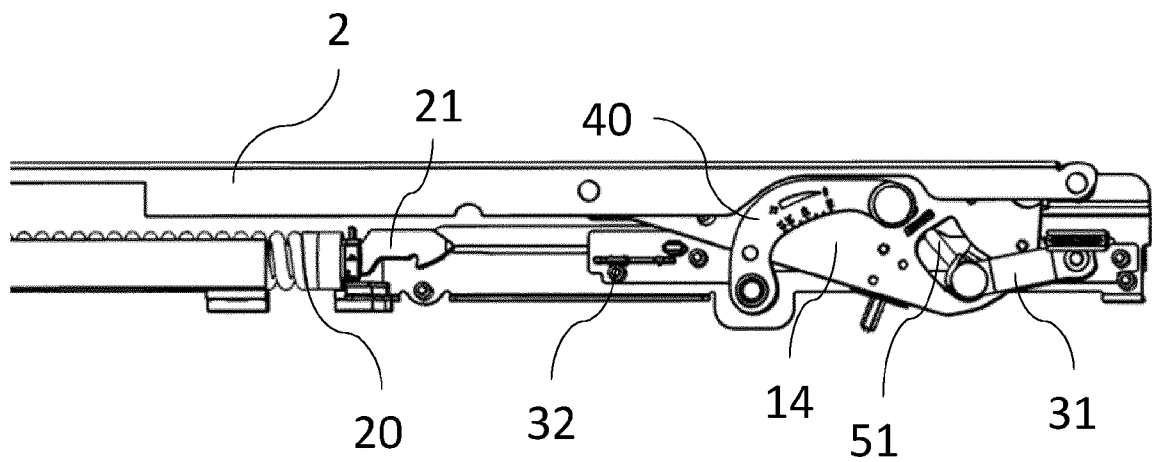
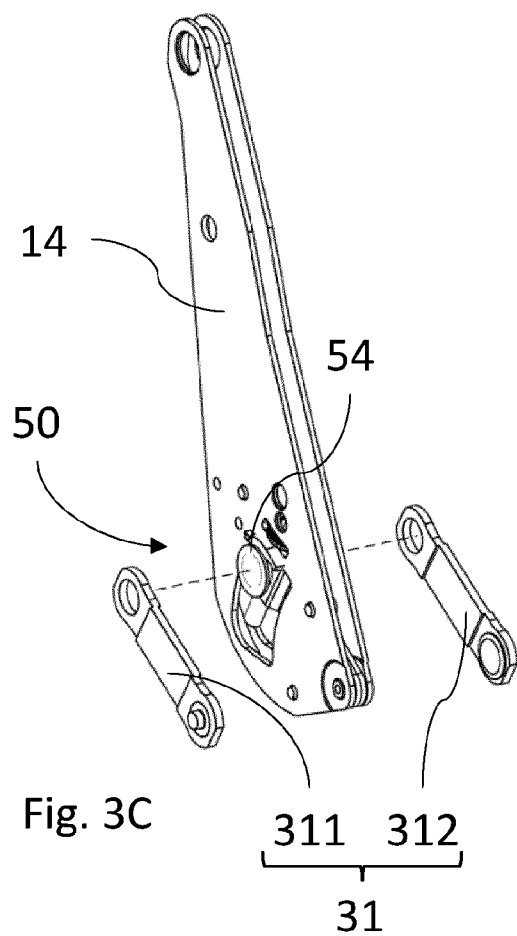
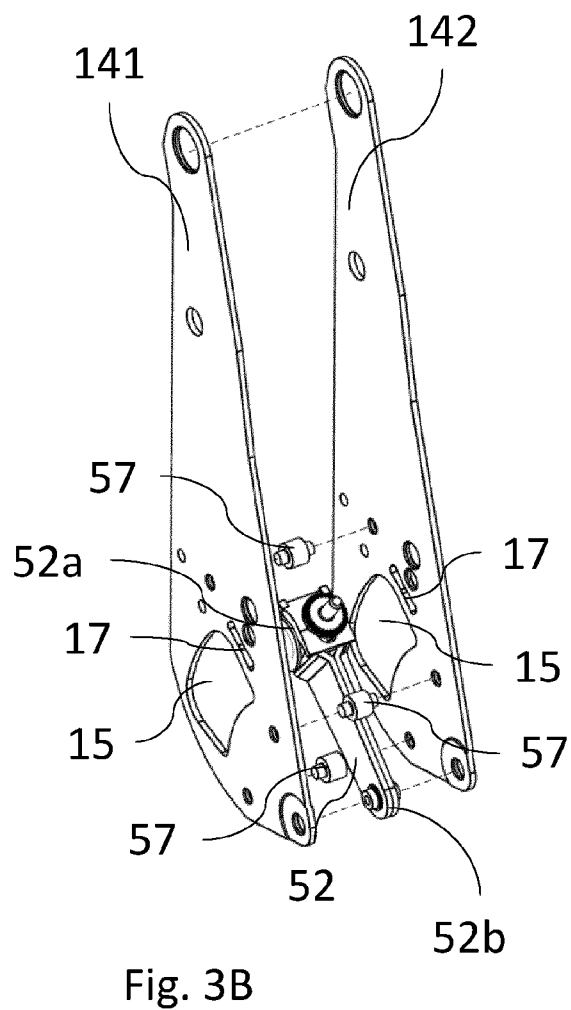
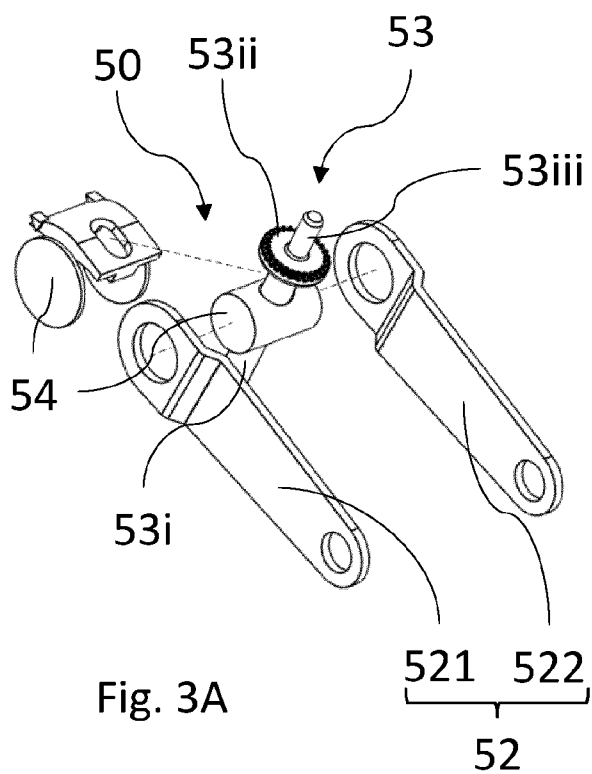


Fig. 2B



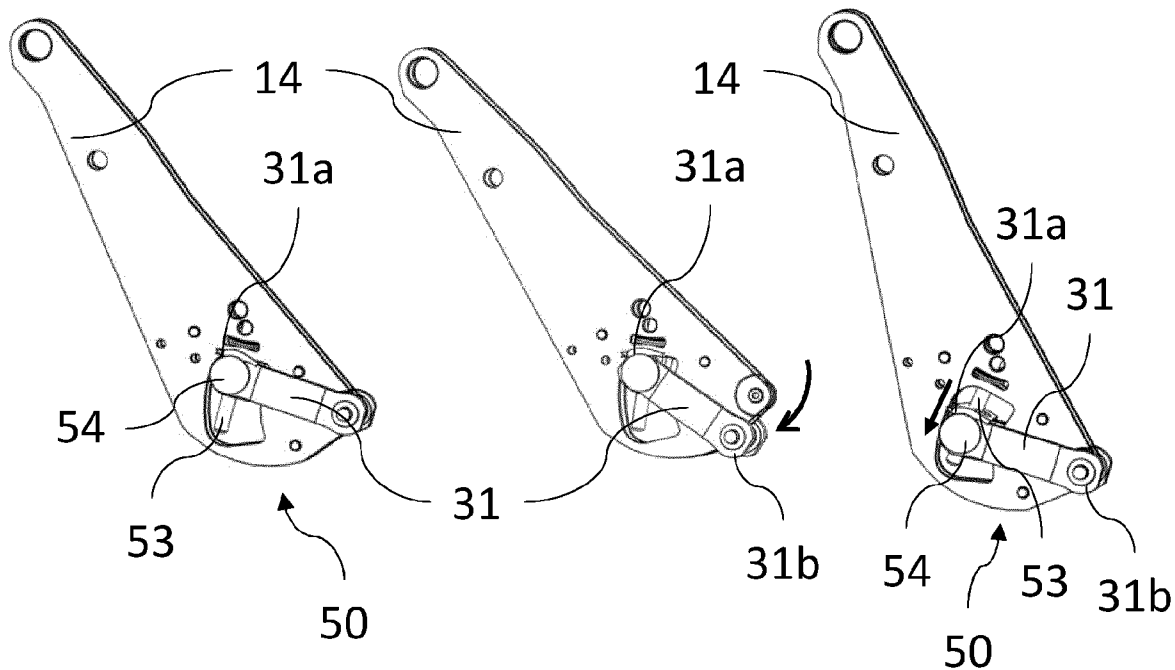


Fig. 4A

Fig. 4B

Fig. 4C

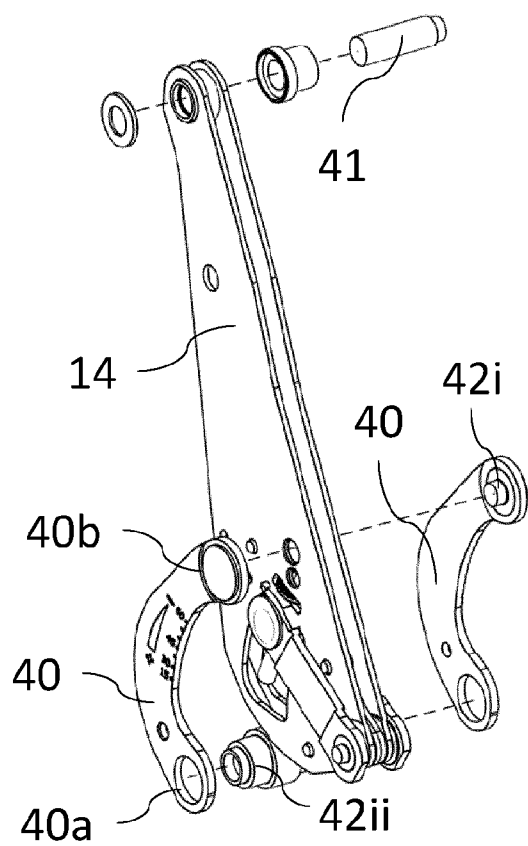


Fig. 5

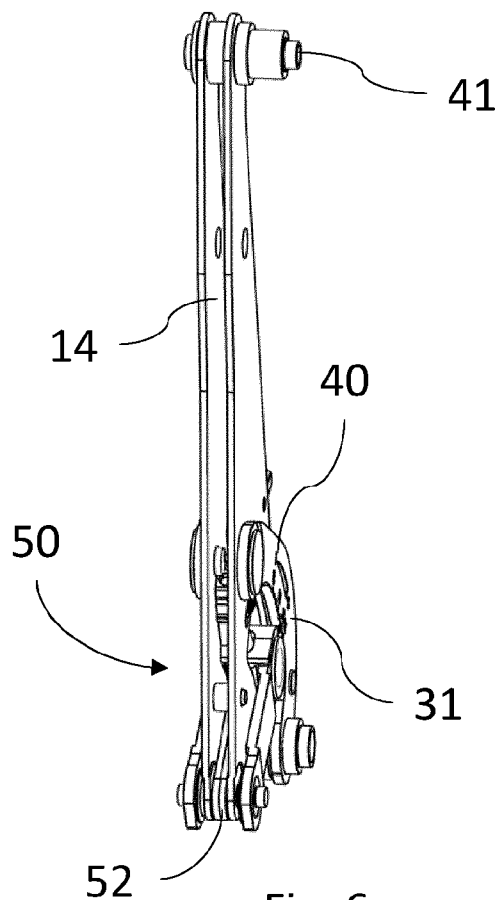


Fig. 6

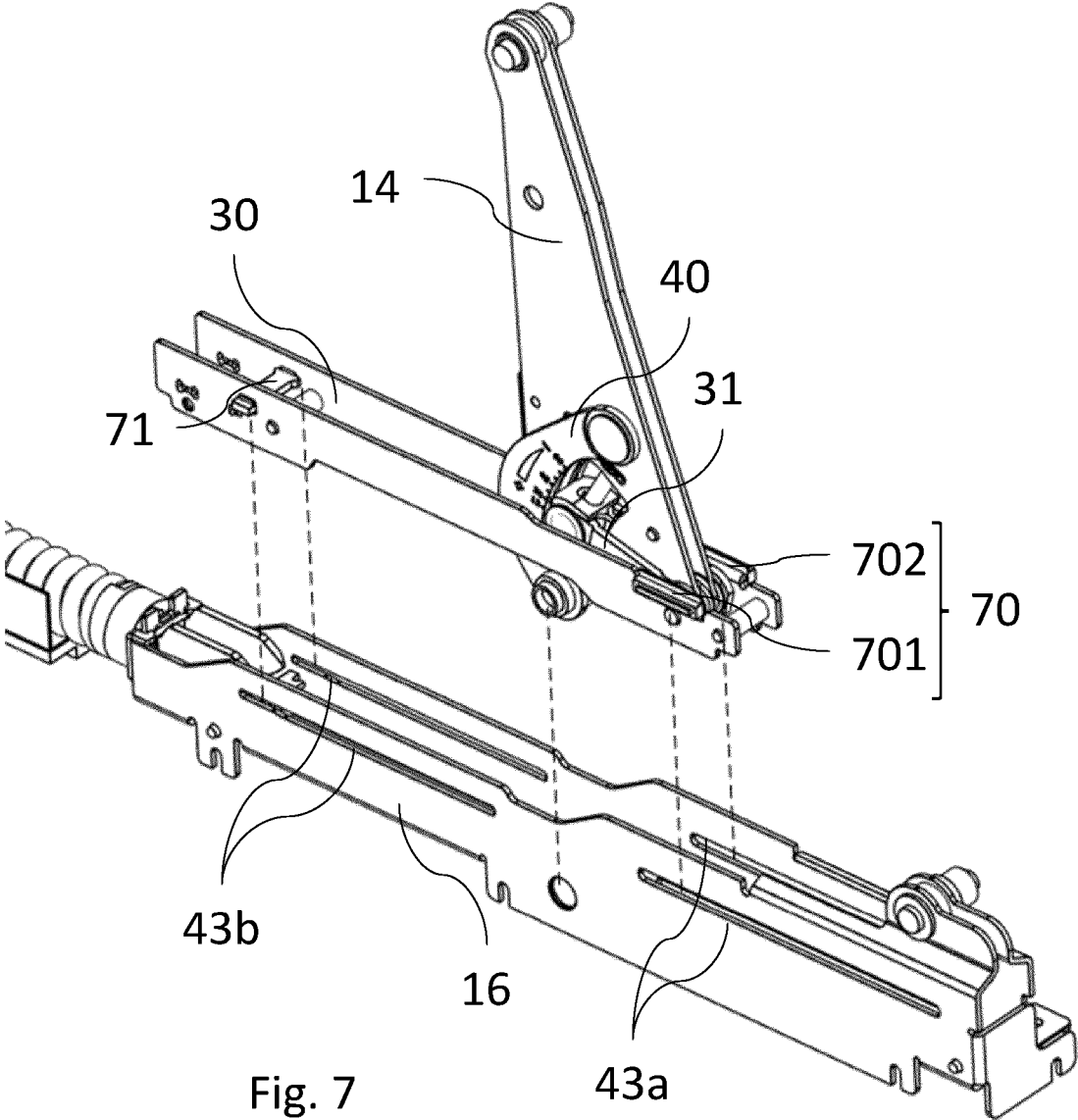


Fig. 7

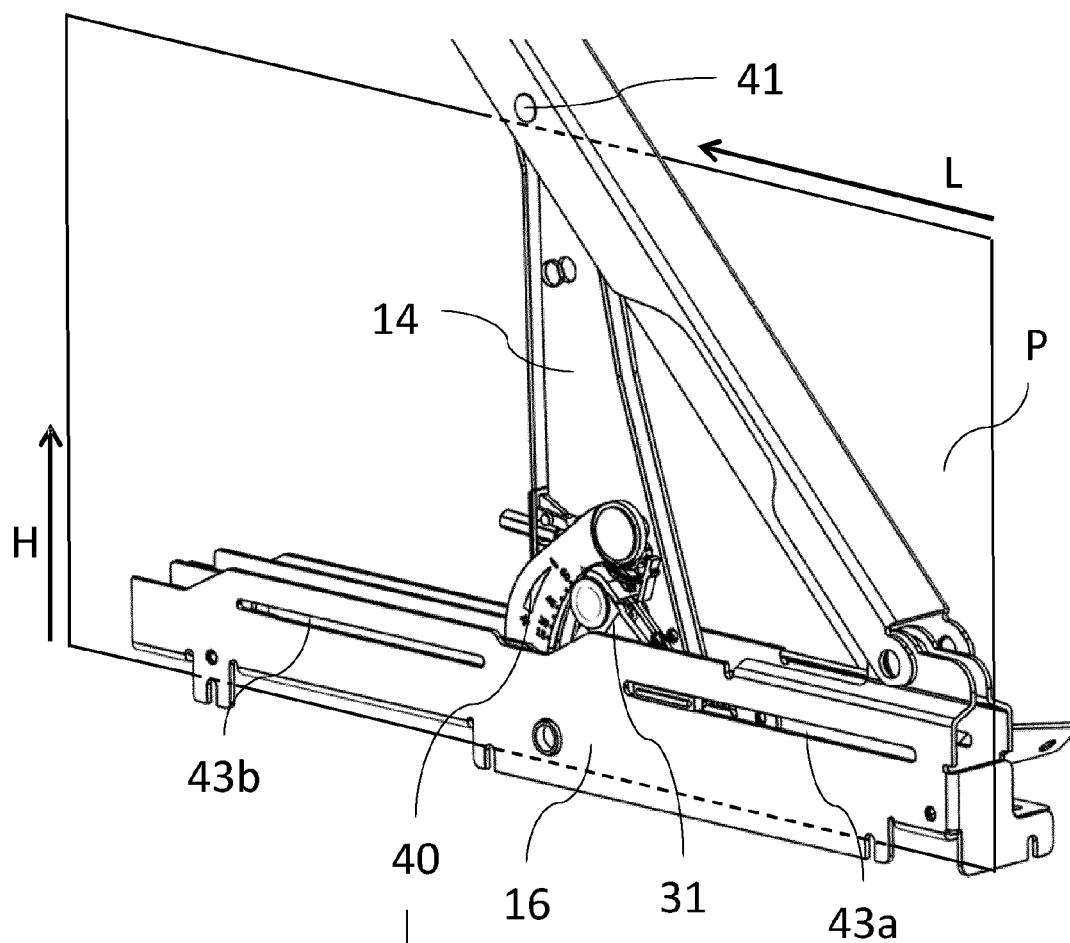


Fig. 8

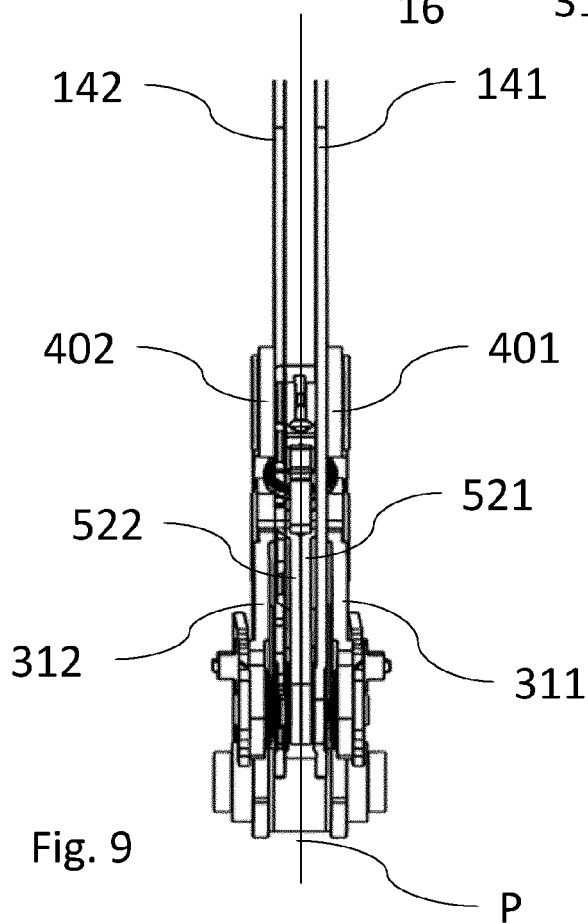
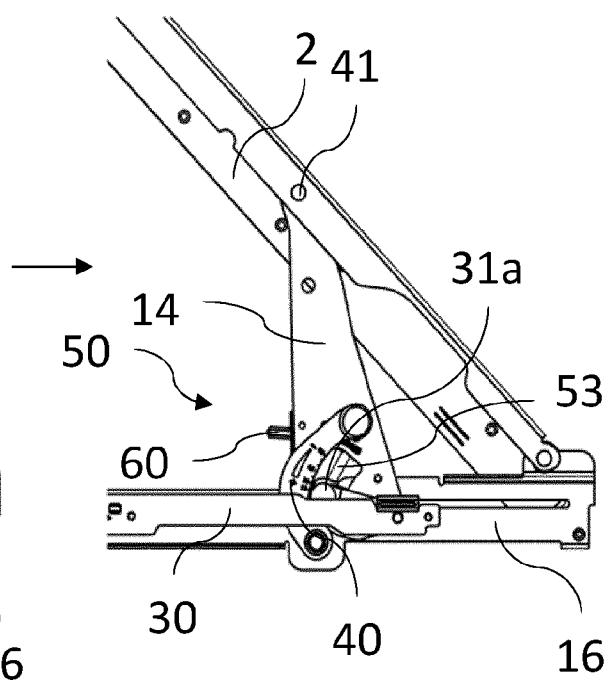
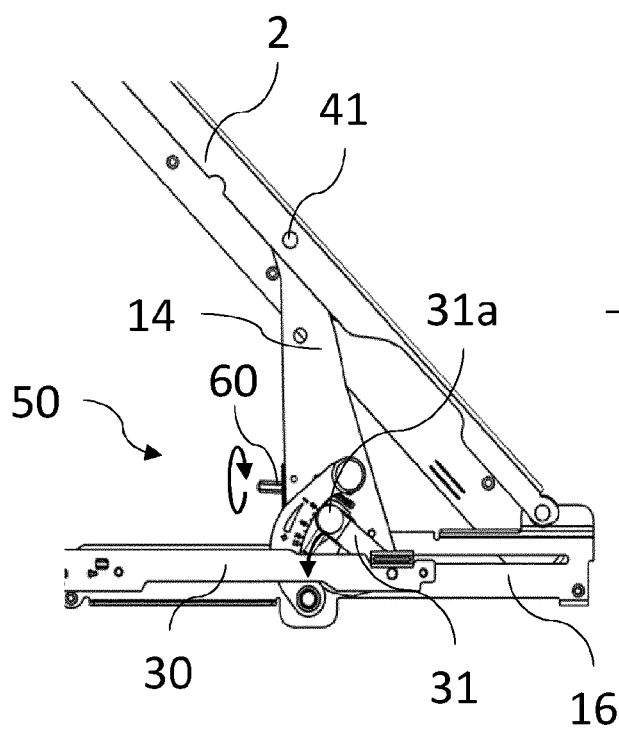
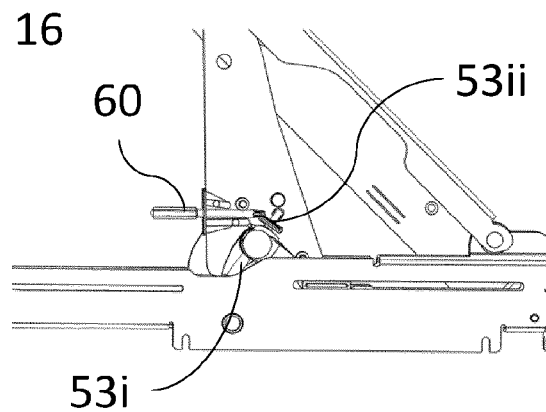
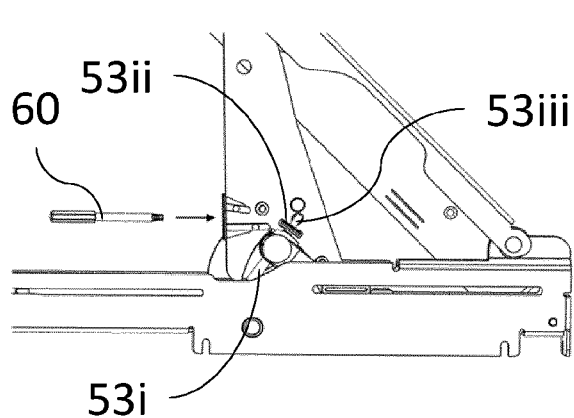
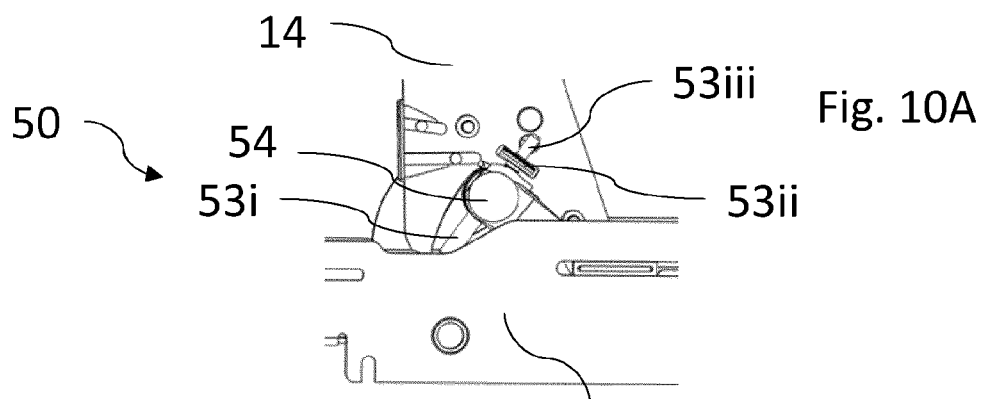
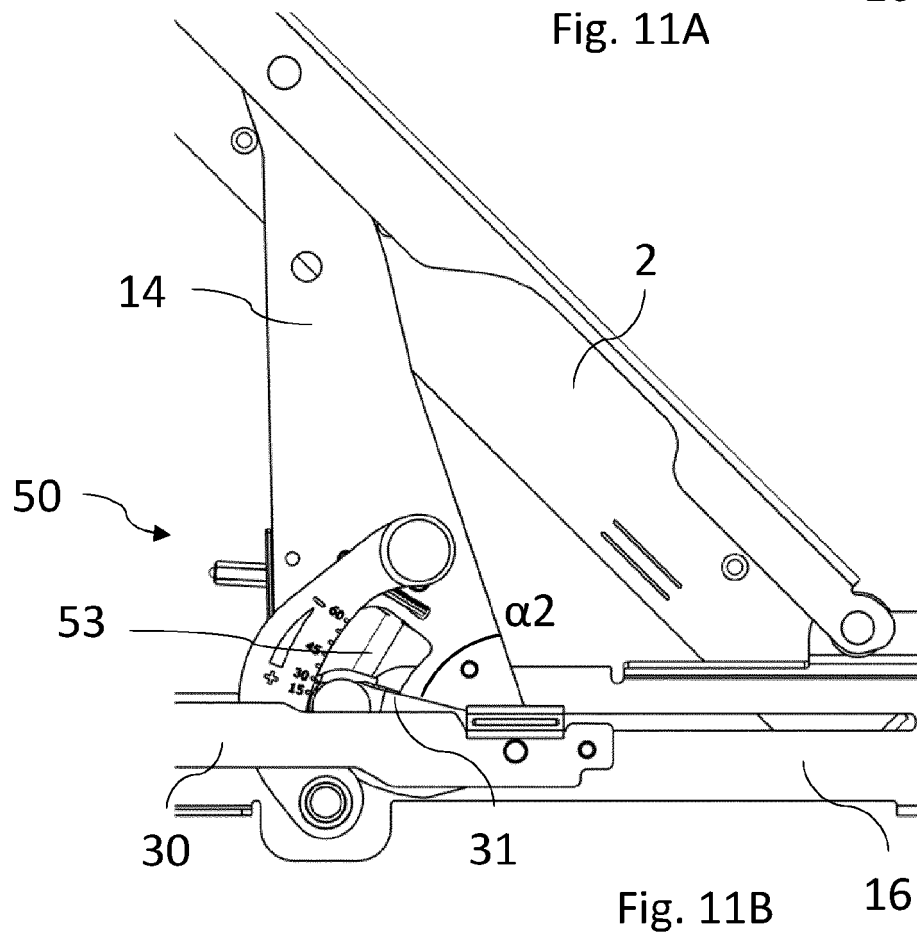
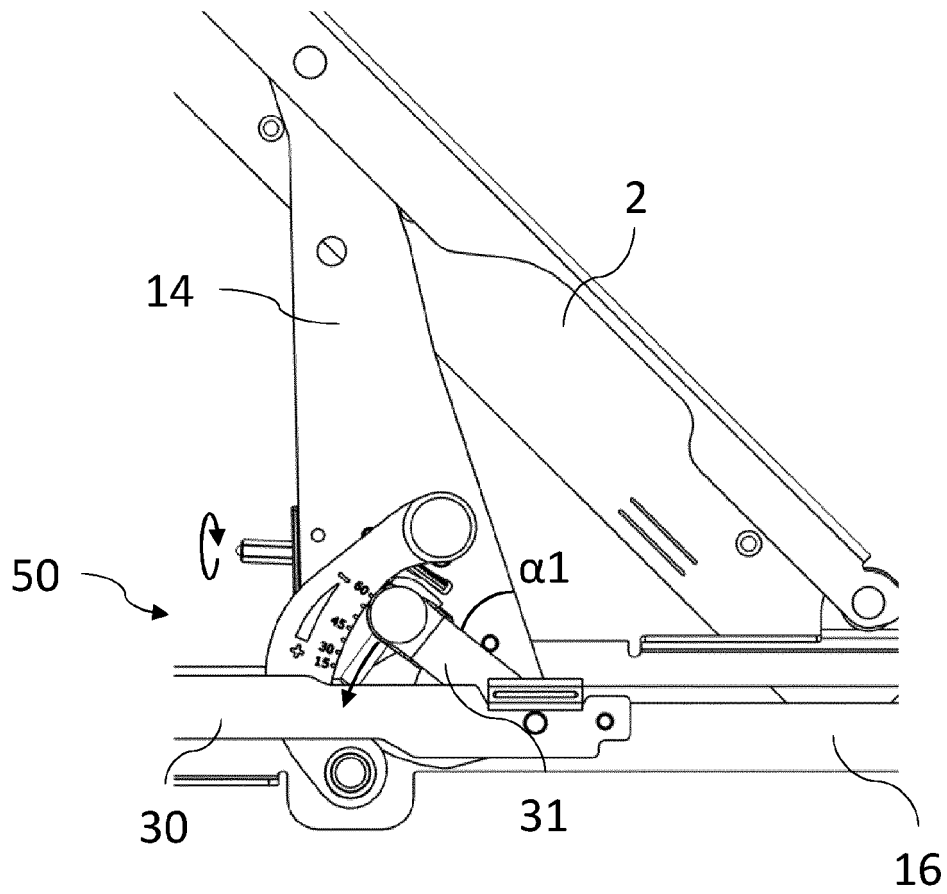


Fig. 9





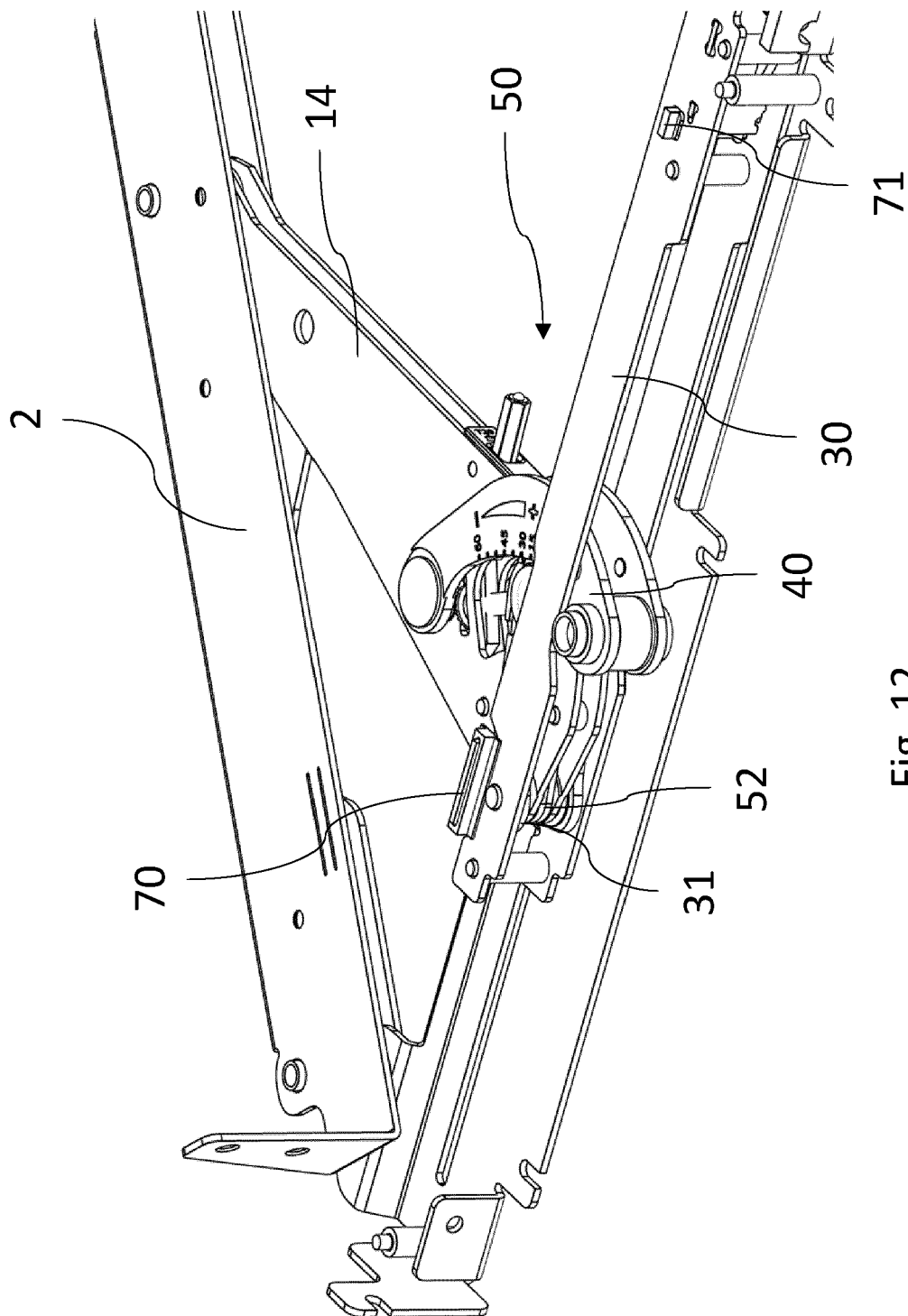


Fig. 12



EUROPEAN SEARCH REPORT

Application Number

EP 24 21 8104

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		3 April 2025	Mund, André
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