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(54) **ROOF WINDOW COMPRISING A PRE-STRESSED CHAIN ACTUATOR**

(57) A roof window comprising a sash (1) and a frame (2) adapted for receiving the sash (1), and at least one actuator (4) comprising a push-pull chain (5) and a bracket (6). The actuator (4) pivots the sash (1) against a load (L) of the sash (1). The push-pull chain (5) bends freely in a first direction (D1) and only to a limited extent in a second opposite direction (D2). The bracket (6) provides a support point (S) for supporting the load (L) of the sash (1), the support point (S) being laterally offset so that the load (L) of the sash (1) urges the push-pull chain (5) to bend in the second opposite direction (D2). A connection pin (8) extends through an oblong first opening (9) in the bracket (6) and secures the push-pull chain (5) to the sash (1) and/or the suspension arm (3). The connection pin (8) moves in the oblong first opening (9) in the direction of the longitudinal extent of the oblong first opening (9) which is aligned with the longitudinal extent of the push-pull chain (5).

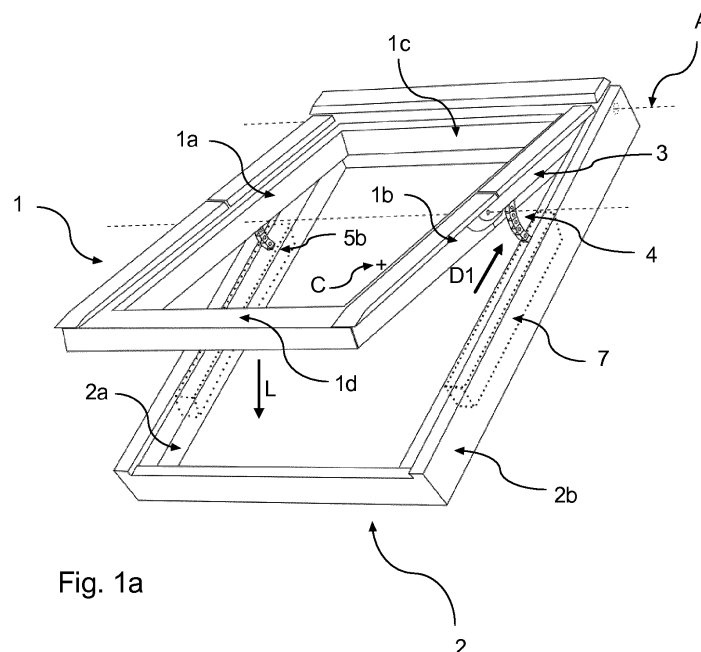


Fig. 1a

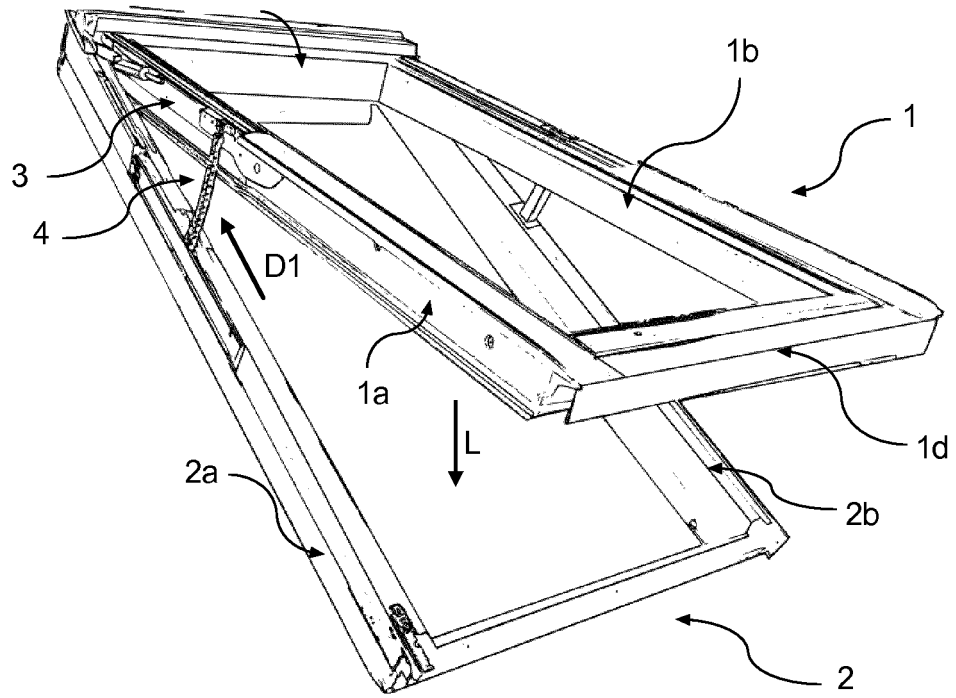


Fig. 1b

Description

TECHNICAL FIELD

[0001] The disclosure relates to a roof window comprising a sash and a frame adapted for receiving the sash. The sash is optionally suspended from the frame by means of suspension arms, and the sash is configured to pivot around a pivot axis by means of an actuator so as to open the sash towards an outer side of the window.

BACKGROUND

[0002] Conventional roof windows are both difficult to install as well as move between open and closed positions due to their location on top of a building.

[0003] It is known in prior art to provide roof windows with electrically operated actuators, allowing one or several roof windows to be moved between open and closed positions by means of remote control, see e.g. WO 02/31304 A1. The use of electrically operated actuators furthermore allows automatic operation for indoor temperature regulation or automatic closing of an open window due to changing weather conditions.

[0004] The push-pull chain of an electrically operated actuator can be collapsed and wound together when subjected to force extending in a first direction perpendicular to the longitudinal extension of the push-pull chain, while reaching and maintaining a straight configuration, or a slightly arched configuration, when being subjected to force extending in an opposite second direction. When the push-pull chain is in the straight or slightly arched configuration, the push-pull chain is stable enough to carry the weight of the sash and subsequently be used to push the sash open or hold it in an open position.

[0005] One disadvantage with such a push-pull chain actuator is that the push-pull chain can accidentally fold together due to undesired force being applied onto the chain in the first direction. DE 298 16 102 U1 provides a solution where the push-pull chain is stabilized against such undesired force by offsetting the point at which load is applied onto the push-pull chain by the sash, such that a counteracting force is generated which helps to maintain the push-pull chain in the straight or slightly arched configuration.

[0006] However, such a solution does not prevent accidental collapse completely. For example, a gust of wind may lift the sash upwards. The offset point of load, shown in DE 298 16 102 U1, would in this case induce a collapsing movement since the offset point of load will be pivoted around an end of the push-pull chain, partially in the first direction, and effectively force the push-pull chain to straighten or bend in the first direction. As the additional load provided by the gust of wind disappears, the load applied by, e.g., the weight of the sash onto the unstable or possibly even bent and semi-collapsed push-pull chain will cause the sash to pivot uncontrollably downwards into the frame.

[0007] Furthermore, such a push-pull chain actuator has to be individually adapted to fit the specific dimensions of the roof window, since the radius of the push-pull chain determines the size of the window sash.

SUMMARY

[0008] It is an object to provide a roof window having improved chain actuator stability and flexibility.

[0009] The foregoing and other objects are achieved by the features of the independent claim. Further implementation forms are apparent from the dependent claims, the description, and the figures.

[0010] According to a first aspect, there is provided a roof window comprising a sash and a frame adapted for receiving the sash, the sash being configured to pivot around a pivot axis so as to open the sash towards an outer side of the window, the sash optionally being suspended from the frame by means of suspension arms, each optional suspension arm extending at least partially between the sash and the frame, the roof window further comprising at least one actuator adapted for pivoting the sash in relation to the frame against a load of the sash, the load mainly being caused by the weight of the sash, the actuator comprising a push-pull chain and a bracket, the bracket being rigidly connected to a first end of the push-pull chain, a second end of the push-pull chain being received in an actuator housing connected to the frame, the push-pull chain being adapted for bending freely in a first direction, past a configuration in which the push-pull chain forms a straight line, and only to a limited extent past the straight line configuration in a second opposite direction, the bracket providing a support point for supporting the load of the sash, the support point being laterally offset from the longitudinal extent of the push-pull chain so that the load of the sash urges the push-pull chain to bend in the second opposite direction, a connection pin connecting the bracket to at least one of the sash and the suspension arm, the connection pin extending through an oblong first opening in the bracket for securing the push-pull chain to one of the sash and the suspension arm whilst allowing the connection pin to move in the oblong first opening in the direction of the longitudinal extent of the oblong first opening, the longitudinal extent of the oblong first opening being aligned with the longitudinal extent of the push-pull chain.

[0011] This solution provides a roof window having an actuator which is stabilized by a stabilizing force, generated by the load of the sash, and which assists in preventing accidental collapse of the push-pull chain of the actuator. Furthermore, an end of the actuator is easily connected to the sash of the roof window after the frame and subsequently the sash have been installed in the roof.

[0012] In a possible implementation form of the first aspect, the support point is laterally offset from the longitudinal extent of the push-pull chain in the first direction, allowing the push-pull chain to be stabilized when in an

end position arched past its straight line configuration in the second opposite direction, which facilitates an actuator which can be used with sashes having different dimensions.

[0013] In a further possible implementation form of the first aspect, the push-pull chain comprises a plurality of coupled links, wherein a last link at the first end of the push-pull chain forms the bracket, allowing the main part of the actuator, including a part of the bracket, to be at least partially collapsed or wound together within the housing.

[0014] In a further possible implementation form of the first aspect, the bracket comprises a second opening adapted for receiving a pre-loading pin, the pre-loading pin extending through the second opening and connecting the bracket to one of the sash and the suspension arm, the load of the sash urging the push-pull chain to bend in the second opposite direction by the pre-loading pin applying the load of the sash onto the bracket. This allows the pre-load applied onto the push-pull chain, and induced by the load of the sash, to be progressive and change in response to a change in the load of the sash.

[0015] In a further possible implementation form of the first aspect, a center axis of the connection pin and a center axis of the pre-loading pin extend parallel with each other and substantially parallel with the pivot axis, allowing the bracket to be pivoted without inducing collapse of the push-pull chain.

[0016] In a further possible implementation form of the first aspect, an open end of the second opening allows the pre-loading pin to at least partially exit the second opening, in a direction parallel with the longitudinal extent of the oblong first opening, if the load applied by the sash is reduced or reversed, preventing collapse of the push-pull chain should the sash be lifted upwards by e.g. wind.

[0017] In a further possible implementation form of the first aspect, the roof window comprises a connecting plate, connected to at least one of the sash and the suspension arm, the connecting plate comprising connection openings aligned with the oblong first opening and the second opening, the connection pin and the pre-loading pin extending through the connection openings of the connecting plate, allowing a simple yet stable connection between actuator and sash.

[0018] In a further possible implementation form of the first aspect, the bracket comprises first and second parallel bracket plates, an oblong first opening in the first bracket plate being aligned with an oblong first opening in the second bracket plate, and a second opening in the first bracket plate being aligned with a second opening in the second bracket plate, the bracket at least partially enclosing the connecting plate such that the first and second bracket plates extend on opposite sides of the connecting plate, facilitating an actuator which distributes force evenly upon the connection pin, the pre-loading pin and, hence, the sash.

[0019] In a further possible implementation form of the first aspect, the actuator comprises locking means en-

gaging the connection pin, the locking means being configured for preventing the connection pin from being removed from the oblong first opening. This solution provides an actuator one end of which is easily connected to the sash of the roof window after the frame, and subsequently the sash, have been installed in the roof. The actuator is connected to the sash from the inside of the building, i.e. an inner side of the window, or, should the sash be in an open position, from the exterior of the building, i.e. the outer side of the window. After installation, however, the connection between sash and actuator can no longer be accessed from the exterior when the window is closed, even after having removed any outer cladding.

[0020] In a further possible implementation form of the first aspect, the connection pin comprises a first pin end and a second pin end, the second pin end comprising an enlarged portion too large to pass through the oblong first opening, the first pin end engaging the locking means, the locking means and the first pin end being arranged in a recess within the sash side member or between the suspension arm and the sash, the second pin end being arranged between the frame and the sash or between the frame and the suspension arm. This solution facilitates use of the actuator in a window where the sash is suspended directly from the frame without the use of suspension arms and provides the locking means at a location which is unreachable from the exterior of the building when the sash is closed, as well as a simple and reliable way of interlocking components without, e.g., having to rely on moving parts.

[0021] In a further possible implementation form of the first aspect, the locking means is releasable and comprises at least one of a threaded nut, a spring, a clip, a slider, and a pin, all being reliable and easy-to-operate mechanical solutions for interlocking components.

[0022] In a further possible implementation form of the first aspect, the actuator further comprises a protective casing adapted for enclosing the locking means and the first pin end, further obstructing access to the locking means from the exterior as well as providing protection against external influence such as ingress of dirt, weather conditions, or unintentional mechanical forces such as bending forces.

[0023] In a further possible implementation form of the first aspect, the casing comprises two casing halves, one casing half comprising an access opening allowing access to the locking means such that the locking means can be released from the connection pin, allowing the actuator to be released from the sash, facilitating a secure solution which still allows for simple connection of the actuator to the sash.

[0024] In a further possible implementation form of the first aspect, the actuator further comprises chain support means, connected to at least one of the sash and the frame, adapted for providing a stabilizing force onto the push-pull chain perpendicularly to the longitudinal extension of the push-pull chain, the stabilizing force urging the push-pull chain to bend in the second opposite direc-

tion.

[0025] In a further possible implementation form of the first aspect, the roof window is a top-hung roof window comprising one actuator, the actuator being arranged adjacent a frame bottom member.

[0026] In a further possible implementation form of the first aspect, the roof window is a center-pivoted roof window or a top-hung roof window comprising two actuators, each actuator being arranged adjacent one frame side member.

[0027] This and other aspects will be apparent from the embodiments described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] In the following detailed portion of the present disclosure, the aspects, embodiments and implementations will be explained in more detail with reference to the example embodiments shown in the drawings, in which:

Fig. 1a shows a schematic perspective view of a roof window in accordance with one embodiment of the present invention;

Fig. 1b shows a schematic perspective view of a roof window in accordance with a further embodiment of the present invention;

Fig. 2 shows a perspective side view of a suspension arm and a thereto connected actuator in accordance with one embodiment of the present invention;

Figs. 3a and 3b show sectional perspective front and rear views of the suspension arm and the actuator shown in Fig. 2;

Fig. 3c shows a partially exploded bottom view of the suspension arm and the actuator section shown in Figs. 3a and 3b;

Figs. 4a and 4b show perspective front and rear views of a section of the actuator shown in Figs. 3a to 3c;

Fig. 4c shows an exploded front view of the actuator section shown in Figs. 4a and 4b;

Fig. 5a shows a sectional perspective view of the suspension arm and the actuator shown in Fig. 2;

Fig. 5b shows a partially exploded view of the suspension arm and the actuator shown in Fig. 5a;

Fig. 6a shows a perspective front view of the suspension arm and the actuator shown in Figs. 5a and 5b;

Fig. 6b shows a perspective rear view of the suspension arm and the actuator shown in Fig. 6a.

DETAILED DESCRIPTION

[0029] Figs. 1a and 1b show a roof window comprising a sash 1 and a frame 2 adapted for receiving the sash 1, the sash 1 being configured to pivot around a pivot axis A so as to open the sash towards an outer side of the window, i.e. towards the exterior of a building. The sash 1 comprises two sash side members 1a, 1b connected to a top sash member 1c and a bottom sash member 1d. The sash 1 may be suspended directly from the frame 2 or, optionally, suspended from the frame 2 by means of suspension arms 3. Each optional suspension arm 3 extends at least partially between a sash side member 1a, 1b and an adjacent frame side member 2a, 2b.

[0030] At least one actuator 4 is provided to pivot the sash 1 between a closed position and several open positions in relation to the frame 2, open positions being shown in Figs. 1a and 1b. The actuator 4 may furthermore be adapted for securing the sash 1 in the closed position.

[0031] In one embodiment, the actuator 4 is adapted for pivoting the sash 1 in relation to the frame 2 against a load L of the sash 1, the load L mainly being caused by the weight of the sash 1. In part, the load L may also be attributed to external conditions such as e.g. snow resting on the sash or wind.

[0032] As shown in more detail in Figs. 2 and 4a, the actuator 4 comprises a push-pull chain 5 and a bracket 6, the bracket 6 being rigidly connected to a first end 5a of the push-pull chain. A second end 5b of the push-pull chain is received in an actuator housing 7 connected to the frame 2, as shown schematically in Fig. 1a. As the sash 1 is closed, the push-pull chain 5 is withdrawn, completely or almost completely, into the actuator housing 7 by an electrical motor (not shown). The push-pull chain 5 is maintained in the withdrawn position by means of the motor or any other suitable locking means, such that the sash 1 is maintained in the closed position until the actuator 4 is activated in order to move the sash 1 to an open position.

[0033] The push-pull chain 5 comprises a plurality of coupled links 13, as shown in Fig. 2. In one embodiment, the last link 13a at the first end 5a of the push-pull chain forms the bracket 6. In a further embodiment, the bracket 6 is a separate component connected to the last link 13a of the push-pull chain 5.

[0034] The push-pull chain 5 bends freely in a first direction D1, at least partially towards the pivot axis A, past a configuration in which the push-pull chain forms a straight line 5c, shown in Fig. 2, such that at least the main part of the push-pull chain 6 can be collapsed and wound together. The push-pull chain 5 can bend only to a limited extent past the straight line 5c configuration in a second opposite direction D2, allowing the push-pull chain 5 to form an arc.

[0035] The bracket 6 provides at least one support

point S for supporting the load L of the sash 1, as shown in Figs. 4a to 4c. The support point S is laterally offset from the longitudinal extent of the push-pull chain 5 so that the load L of the sash 1 urges the push-pull chain 5 to bend in the second opposite direction D2.

[0036] A connection pin 8, in one embodiment being releasable, connects the bracket 6 to at least one of the sash 1 and the suspension arm 3, preferably one of the side sash members 1a, 1b and/or the suspension arms 3, as shown in Figs. 5a and 5b as well as 6a and 6b. The connection pin 8 has a first pin end 8a and a second pin end 8b as shown in Figs. 3a to 3c.

[0037] The connection pin 8 extends through an oblong first opening 9 in the bracket 6 for securing the push-pull chain 5 to one of the sash 1 and the suspension arm 3. The connection pin 8 is allowed to move in the oblong first opening 9 in the direction of the longitudinal extent of the oblong first opening 9, the longitudinal extent of the oblong first opening 9 being aligned with the longitudinal extent of the push-pull chain 5.

[0038] In one embodiment, the bracket 6 comprises a second opening 17 adapted for receiving a pre-loading pin 18, the pre-loading pin 18 extending through the second opening 17 and connecting the bracket 6 to one of the sash 1 and the suspension arm 3. The second opening 17 is essentially a U-shaped recess having an open end 17a, facing away from the push-pull chain 5, allowing the pre-loading pin 18 to exit the second opening 17 in one direction. The pre-loading pin 18 extends through the second opening 17 and connects the bracket 6 to the sash 1 rigidly. The load L of the sash 1 urges the push-pull chain 5 to bend in the second opposite direction D2 by the pre-loading pin 18 applying the load L of the sash 1 onto the bracket 6.

[0039] The center axis CA of the connection pin 8 and the center axis CA2 of the pre-loading pin 18 extend parallel with each other and substantially parallel with the pivot axis A.

[0040] The open end 17a of the second opening 17 allows the pre-loading pin 18 to at least partially exit the second opening 17, in a direction parallel with the longitudinal extent of the oblong first opening 9, if the load L applied by the sash 1 is reduced or reversed.

[0041] The releasable connection pin 8 extends in a direction substantially parallel with the pivot axis A, through the first opening 9 and through at least one of a fourth opening 10 in the sash side member 1a, 1b and a third opening 11 in the suspension arm 3. As the releasable connection pin 8 connects the bracket 6 to the side sash member 1a, 1b and/or the suspension arm 3, the first pin end 8a is arranged closer to the center C of the sash than the second pin end 8b.

[0042] The actuator further comprises locking means 12 engaging the connection pin 8, the locking means 12 being configured for preventing the connection pin 8 from being removed from the oblong first opening 9. The locking means 12, shown in Figs. 4b and 4c, engage the first pin end 8a such that the releasable connection pin 8 is

prevented from being removed from the fourth opening 10 and/or the third opening 11. The locking means 12 comprises at least one of a threaded nut, a spring, a clip, a slider, and a pin.

[0043] The first pin end 8a is configured for engaging the locking means 12 by means of a section having a reduced diameter arranged at the first pin end 8a, as shown in Fig. 3c, or, as in a further embodiment, by means of a throughgoing channel 14 which extends perpendicular to the center axis CA of the releasable connection pin 8, and which receives a part of the locking means 12 such as, e.g., one leg of a spring as shown in Fig. 4b.

[0044] In one embodiment, the releasable connection pin 8 extends through the fourth opening 10 of the sash side member 1a, 1b, and the first pin end 8a and the locking means 12 are arranged in a recess within the sash side member 1a, 1b. The recess extends from the inner surface of the sash, i.e. from the surface closest to the center C of the sash 1, in a direction towards the frame side member 2a, 2b. The second pin end 8b is arranged between the frame side member 2a, 2b and the sash side member 1a, 1b. The releasable connection pin 8 extends, in other words, through the first opening 9 and the fourth opening 10.

[0045] If the window also comprises suspension arms 3, the second pin end 8b may be arranged either between the frame side member 2a, 2b and the suspension arm 3, or between the suspension arm 3 and the sash side member 1a, 1b. If the second pin end 8b is arranged between the frame side member 2a, 2b and the suspension arm 3, the releasable connection pin 8 also extends through the third opening 11 of the suspension arm 3, i.e. the releasable connection pin 8 extends through the first opening 9, the third opening 11, and the fourth opening 10.

[0046] In one embodiment, the releasable connection pin 8 extends through the third opening 11 of the suspension arm 3, and the first pin end 8a and the locking means 12 are arranged between the suspension arm 3 and the sash side member 1a, 1b. The second pin end 8b is arranged between the frame side member 2a, 2b and the suspension arm 3. The releasable connection pin 8 extends, in other words, through the first opening 9 and the third opening 11.

[0047] In one embodiment, the second pin end 8b comprises an enlarged portion too large to pass through the oblong first 9 and second 10 openings or the first 9 and third 11 openings, or even the first 9, second 10, and third 11 openings, such that the releasable connection pin 8 can only be withdrawn from the openings in one direction, i.e. in the direction extending from the first pin end 8a to the second pin end 8b. The first pin end 8a receives a part of the locking means 12, which prevents the releasable connection pin 8 from being withdrawn from the openings 9, 10, 11 in the direction extending from the first pin end 8a to the second pin end 8b. The locking means 12 has to be released from the first pin

end 8a, from the interior of the building in order to be able to withdraw the releasable connection pin 8 from the openings 9, 10, 11.

[0048] As shown in Figs. 3a to 3c, 5a to 5b, and 6a to 6b, the suspension arm 3 may comprise a ledge 3a extending parallel with the center axis of the third opening 11, such that the ledge 3a at least partially covers any existing gap between the suspension arm 3 and the sash side member 1a, 1b. The ledge effectively covers the interior space of the suspension arm such that any components at least partially surrounded by the suspension arm can only be accessed from the interior of the building, i.e. from an inner side of the window.

[0049] Furthermore, the actuator 4 may comprise a protective casing 15 adapted for enclosing the locking means 12 and the first pin end 8a. The casing 15 comprises two casing halves interlocking with each other such that a void is formed between the casing halves, the void accommodating the locking means 12 and preferably the first pin end 8a. One casing half comprises an access opening 15a which allows access to the locking means 12, from the interior of the building, such that the locking means 12 can be released from the releasable connection pin 8. Correspondingly, the other casing half comprises an opening allowing the releasable connection pin 8 to pass through and enter the void formed by the two casing halves.

[0050] In one embodiment, shown in Figs. 3a to 3c, each suspension arm 3 has an upside-down U-shaped cross-section enclosing the locking means 12 and the casing 15. The two parallel legs of the U-shape are of different heights, the shorter leg extending the open end of the U-shape. The open end of the U-shape is at least partially directed towards the closest frame side member 2a, 2b, i.e. the frame side member 2a, 2b arranged adjacent the suspension arm 3 when the window is in the closed position. The locking means 12, arranged such that it is enclosed by the U-shaped suspension arm 3, is accessible through a wall opening 16 in a wall 3b of the U-shaped cross-section. The wall 3b extends adjacent the sash side member 1a, 1b, and essentially perpendicular to the ledge 3a. The wall 3b corresponds to the longer of the two parallel legs of the U-shape.

[0051] In one embodiment, the roof window further comprises a connecting plate 19 connected to at least one of the sash 1 and the suspension arm 3. The connecting plate 19 comprises connection openings 20 aligned with the oblong first opening 9 and the second opening 17, such that the connection pin 8 and the pre-loading pin 18 may extend through the connection openings 20.

[0052] The bracket 6 may comprise first and second parallel bracket plates 6a, 6b, arranged such that the oblong first opening 9 in the first bracket plate 6a is aligned with the oblong first opening 9 in the second bracket plate 6b, and the second opening 17 in the first bracket plate 6a is aligned with the second opening 17 in the second bracket plate 6b. The bracket 6 encloses

the connecting plate 19 at least partially such that the first and second bracket plates 6a, 6b extend on opposite sides of the connecting plate 19.

[0053] In one embodiment, the actuator 4 further comprises chain support means 21, connected to at least one of the sash 1 and the frame 2. The chain support means 21 provide a stabilizing force F onto the push-pull chain 5 perpendicularly to the longitudinal extension of the push-pull chain 5, such that the stabilizing force F urges the push-pull chain to bend in the second opposite direction D2, as shown in Fig. 2.

[0054] In one embodiment, the roof window is a top-hung roof window comprising one actuator 4, the actuator 4 being arranged adjacent a frame bottom member 2d.

[0055] In a further embodiment, the roof window is a center-pivoted roof window or a top-hung roof window comprising two actuators 4, each actuator 4 being arranged adjacent one frame side member 2a, 2b.

[0056] The present roof window has several benefits. For example, it enables large opening angles. Another benefit is having a large load capacity which remains stable with changing roof angles and during high load conditions (any push-pull situations which occur). A further benefit is that the push-pull chains can be placed substantially out of sight at the sides of the window, allowing the window to have a slenderer appearance and providing a better view. Additionally, the need for window load balancing by springs is reduced, such that the springs do not need adjustment or may be entirely omitted. Another benefit is that the push-pull chain actuator may keep the window closed without additional need for a window lock. Furthermore, the window installation process and the process of connecting the push-pull chain(s) is enhanced. Finally, the push-pull chain is burglar protected while still enabling service of the window.

[0057] The various aspects and implementations have been described in conjunction with various embodiments herein. However, other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed subject-matter, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0058] The reference signs used in the claims shall not be construed as limiting the scope.

Claims

1. A roof window comprising a sash (1) and a frame (2) adapted for receiving said sash (1), said sash (1) being configured to pivot around a pivot axis (A) so as to open said sash (1) towards an outer side of said window, said sash (1) optionally being suspend-

ed from said frame (2) by means of suspension arms (3), each optional suspension arm (3) extending at least partially between said sash (1) and said frame (2),

said roof window further comprising:

at least one actuator (4) adapted for pivoting said sash (1) in relation to said frame (2) against a load (L) of said sash (1), said load (L) mainly being caused by the weight of said sash (1), said actuator (4) comprising a push-pull chain (5) and a bracket (6), said bracket (6) being rigidly connected to a first end (5a) of said push-pull chain (5), a second end (5b) of said push-pull chain (5) being received in an actuator housing (7) connected to said frame (2), said push-pull chain (5) being adapted for bending freely in a first direction (D1), past a configuration in which said push-pull chain (5) forms a straight line (5c), and only to a limited extent past said straight line (5c) configuration in a second opposite direction (D2), said bracket (6) providing a support point (S) for supporting the load (L) of said sash (1), said support point (S) being laterally offset from the longitudinal extent of said push-pull chain (5) so that the load (L) of said sash (1) urges said push-pull chain (5) to bend in said second opposite direction (D2), a connection pin (8) connecting said bracket (6) to at least one of said sash (1) and said suspension arm (3), said connection pin (8) extending through an oblong first opening (9) in said bracket (6) for securing said push-pull chain (5) to one of said sash (1) and said suspension arm (3) whilst allowing said connection pin (8) to move in said oblong first opening (9) in the direction of the longitudinal extent of said oblong first opening (9), the longitudinal extent of said oblong first opening (9) being aligned with the longitudinal extent of said push-pull chain (5).

2. The roof window according to claim 1, wherein said support point (S) is laterally offset from the longitudinal extent of said push-pull chain (5) in said first direction (D1).
3. The roof window according to claim 1 or 2, wherein said push-pull chain (5) comprises a plurality of coupled links (13), wherein a last link (13a) at said first end (5a) of said push-pull chain (5) forms said bracket (6).
4. The roof window according to any one of the previous claims, wherein said bracket (6) comprises a second opening (17) adapted for receiving a pre-loading pin (18), said pre-loading pin (18) extending through said

second opening (17) and connecting said bracket (6) to one of said sash (1) and said suspension arm (3),

the load (L) of said sash (1) urging said push-pull chain (5) to bend in said second opposite direction (D2) by said pre-loading pin (18) applying the load (L) of said sash (1) onto said bracket (6).

5. The roof window according to claim 4, wherein a center axis (CA) of said connection pin (8) and a center axis (CA2) of said pre-loading pin (18) extend parallel with each other and substantially parallel with said pivot axis (A).
6. The roof window according to claim 4 or 5, wherein an open end (17a) of said second opening (17) allows said pre-loading pin (18) to at least partially exit said second opening (17), in a direction parallel with the longitudinal extent of said oblong first opening (9), if the load (L) applied by said sash (1) is reduced or reversed.
7. The roof window according to any one of claims 4 to 6, further comprising a connecting plate (19), connected to at least one of said sash (1) and said suspension arm (3), said connecting plate (19) comprising connection openings (20) aligned with said oblong first opening (9) and said second opening (17), said connection pin (8) and said pre-loading pin (18) extending through said connection openings (20) of said connecting plate (19).
8. The roof window according to any one of claims 4 to 7, wherein said bracket (6) comprises first and second parallel bracket plates (6a, 6b), an oblong first opening (9) in said first bracket plate (6a) being aligned with an oblong first opening (9) in said second bracket plate (6b), and a second opening (17) in said first bracket plate (6a) being aligned with a second opening (17) in said second bracket plate (6b), said bracket (6) at least partially enclosing said connecting plate (19) such that said first and second bracket plates (6a, 6b) extend on opposite sides of said connecting plate (19).
9. The roof window according to any one of the previous claims, wherein said actuator further comprises locking means (12) engaging said connection pin (8), said locking means (12) being configured for preventing said connection pin (8) from being removed from said oblong first opening (9).
10. The roof window according to claim 9, wherein said connection pin comprises a first pin end (8a) and a second pin end (8b), said second pin end (8b) comprising an enlarged portion too large to pass through said oblong first opening (9),

said first pin end (8a) engaging said locking means (12), said locking means (12) and said first pin end (8a) being arranged in a recess within said sash side member (1a, 1b) or between said suspension arm (3) and said sash (1),
 said second pin end (8b) being arranged between said frame (2) and said sash (1) or between said frame (2) and said suspension arm (3).

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11. The roof window according to claim 9 or 10, wherein said locking means (12) is releasable and comprises at least one of a threaded nut, a spring, a clip, a slider, and a pin. 10
12. The roof window according to claim 10 or 11, wherein said actuator (4) further comprises a protective casing (15) adapted for enclosing said locking means (12) and said first pin end (8a). 15
13. The roof window according to claim 12, wherein said casing (15) comprises two casing halves, one casing half comprising an access opening (15a) allowing access to said locking means (12) such that said locking means (12) can be released from said connection pin (8), allowing said actuator (4) to be released from said sash (1). 20
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14. The roof window according to any one of the previous claims, wherein said actuator (4) further comprises chain support means (21), connected to at least one of said sash (1) and said frame (2), adapted for providing a stabilizing force (F) onto said push-pull chain (5) perpendicularly to the longitudinal extension of said push-pull chain (5), said stabilizing force (F) urging said push-pull chain to bend in said second opposite direction (D2). 30
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15. The roof window according to any one of the previous claims, wherein said roof window is a top-hung roof window comprising one actuator (4), said actuator (4) being arranged adjacent a frame bottom member (2d). 40
16. The roof window according to any one of claims 1 to 14, wherein said roof window is a center-pivoted roof window or a top-hung roof window comprising two actuators (4), each actuator (4) being arranged adjacent one frame side member (2a, 2b). 45

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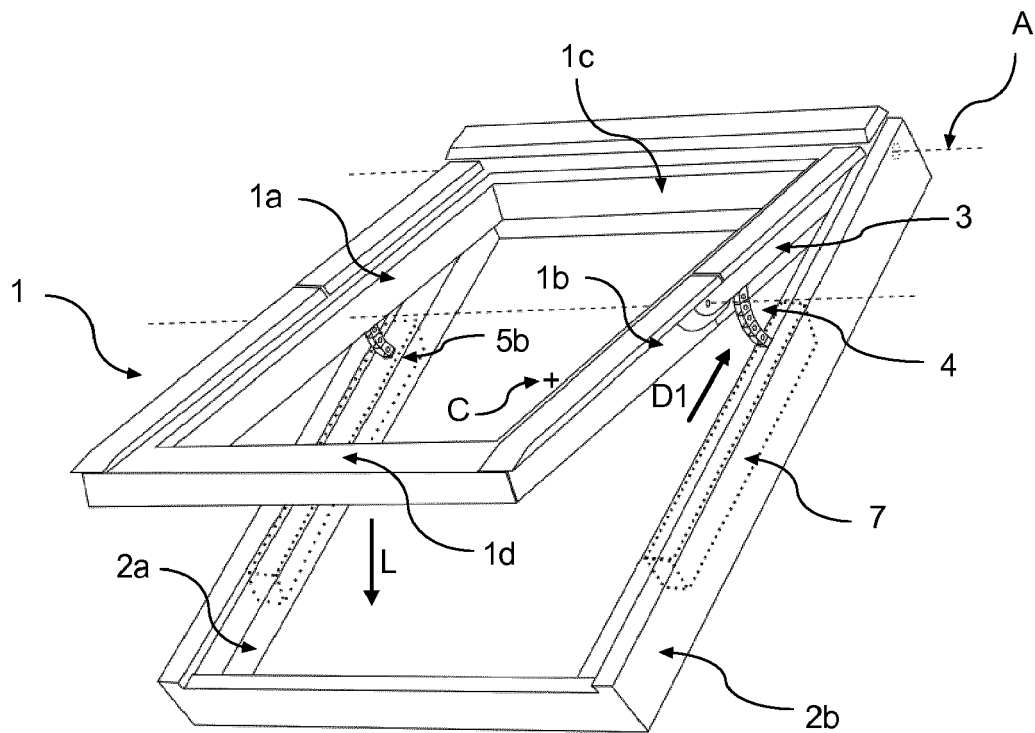


Fig. 1a

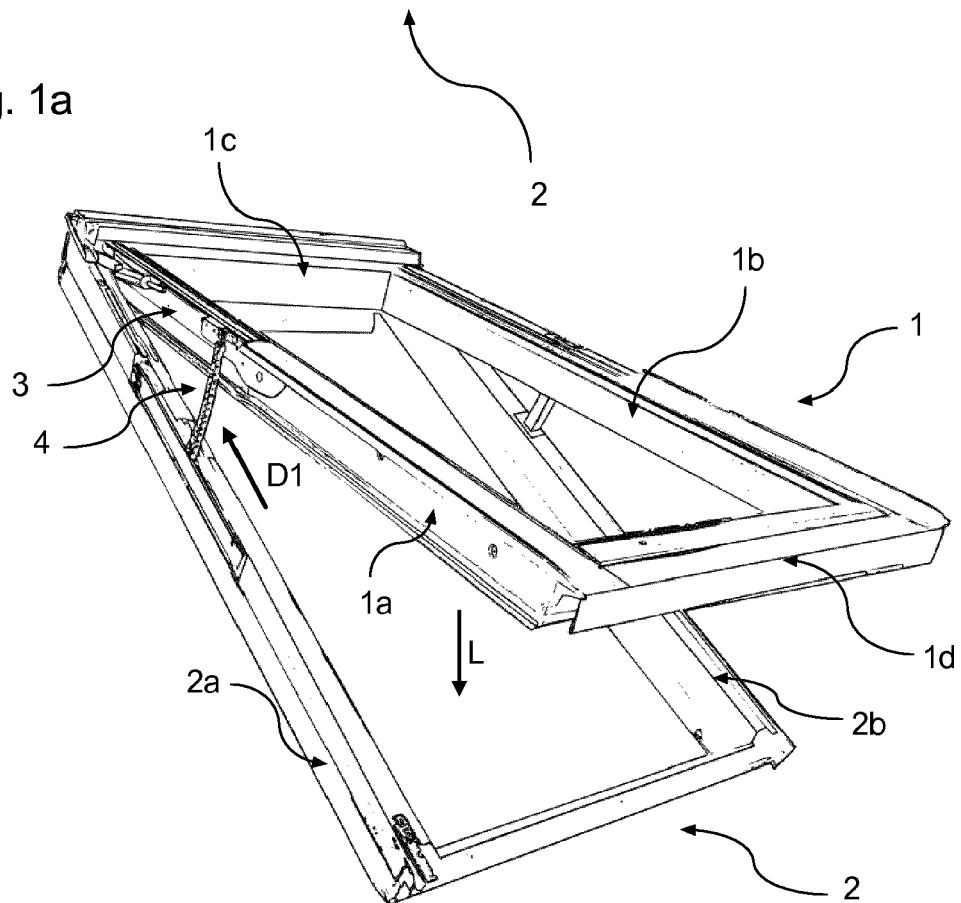
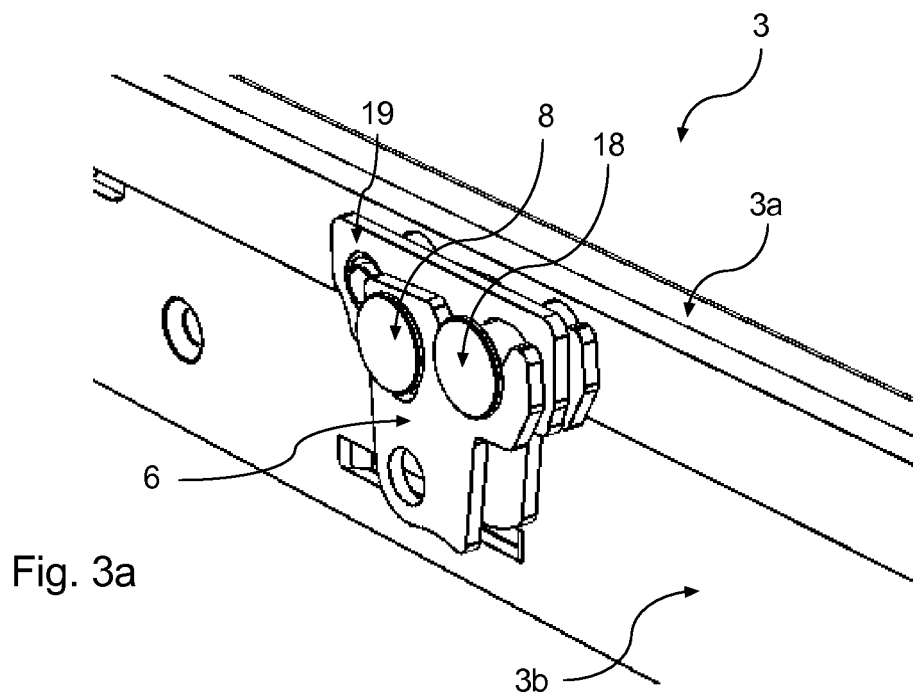
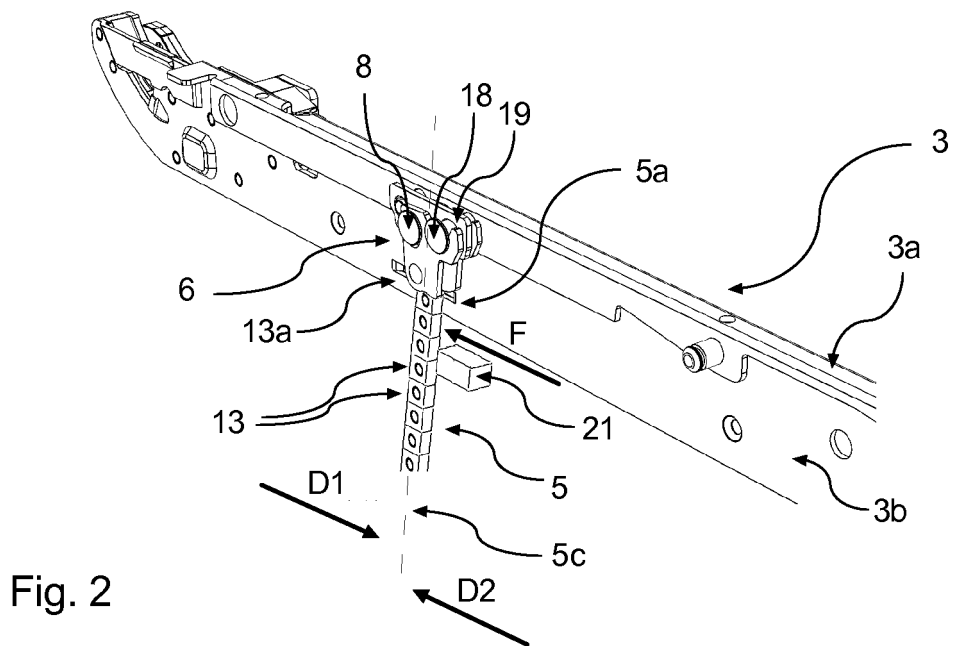


Fig. 1b



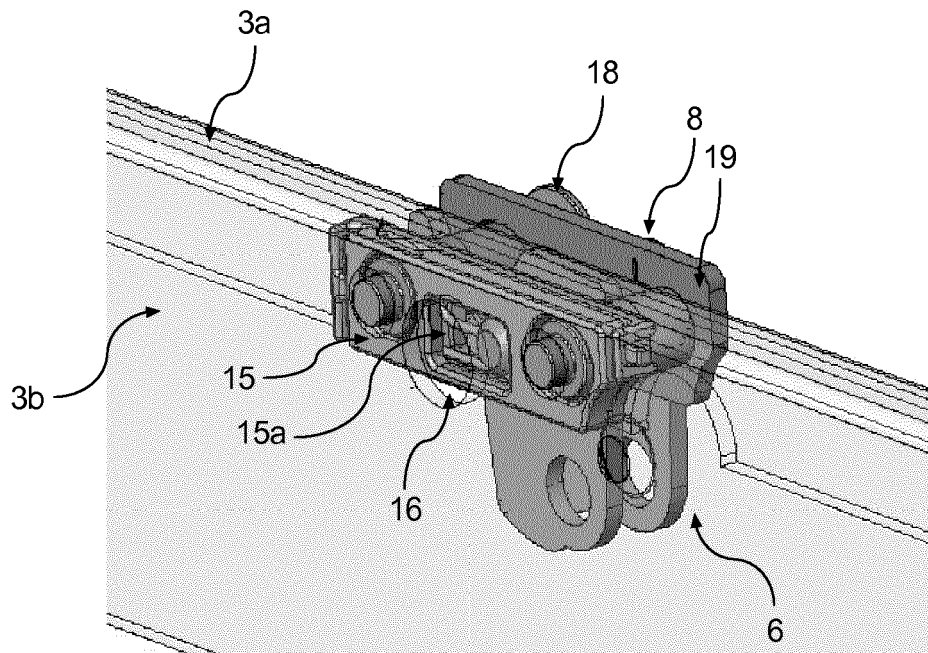


Fig. 3b

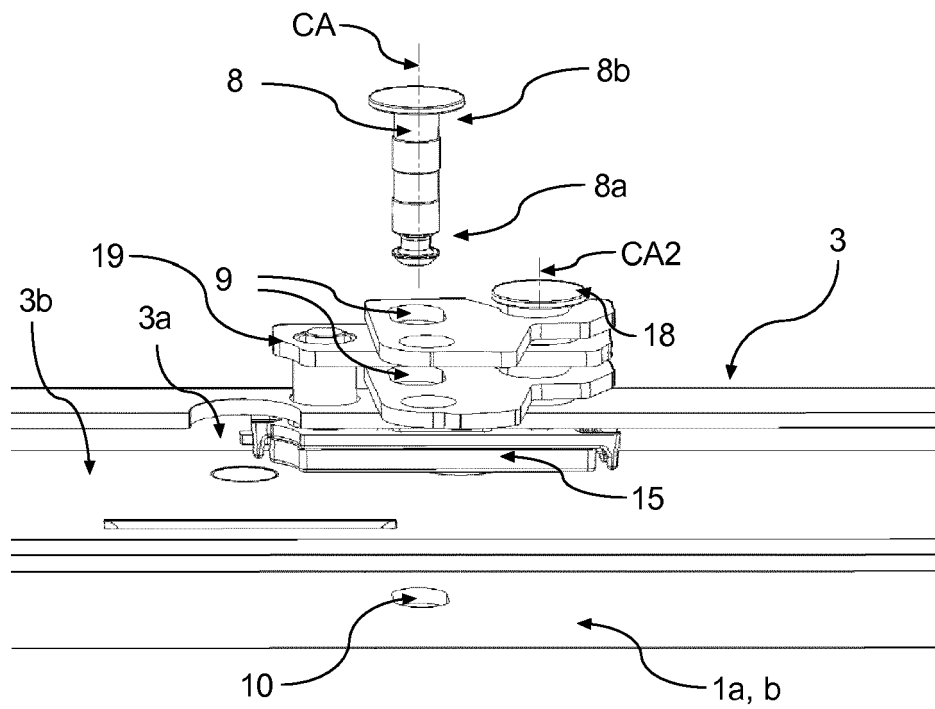


Fig. 3c

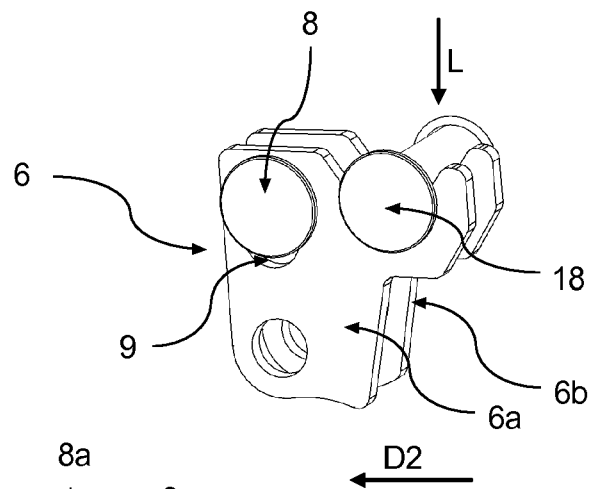


Fig. 4a

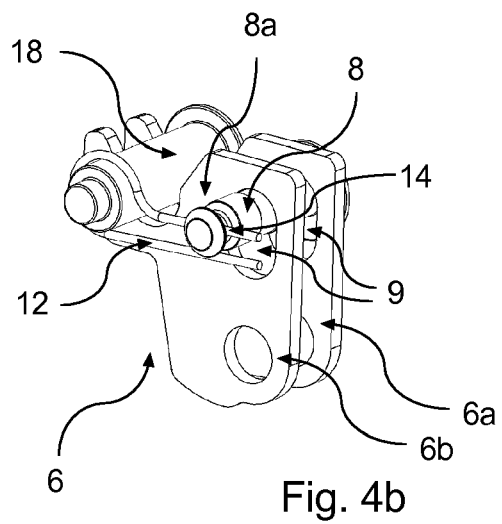


Fig. 4b

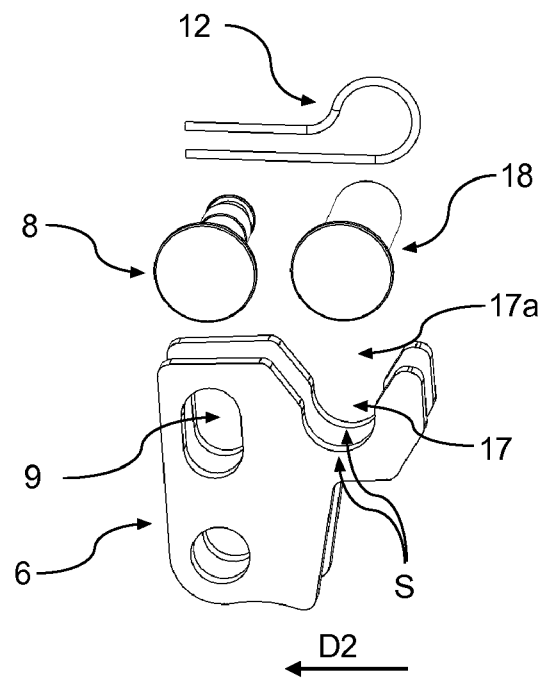
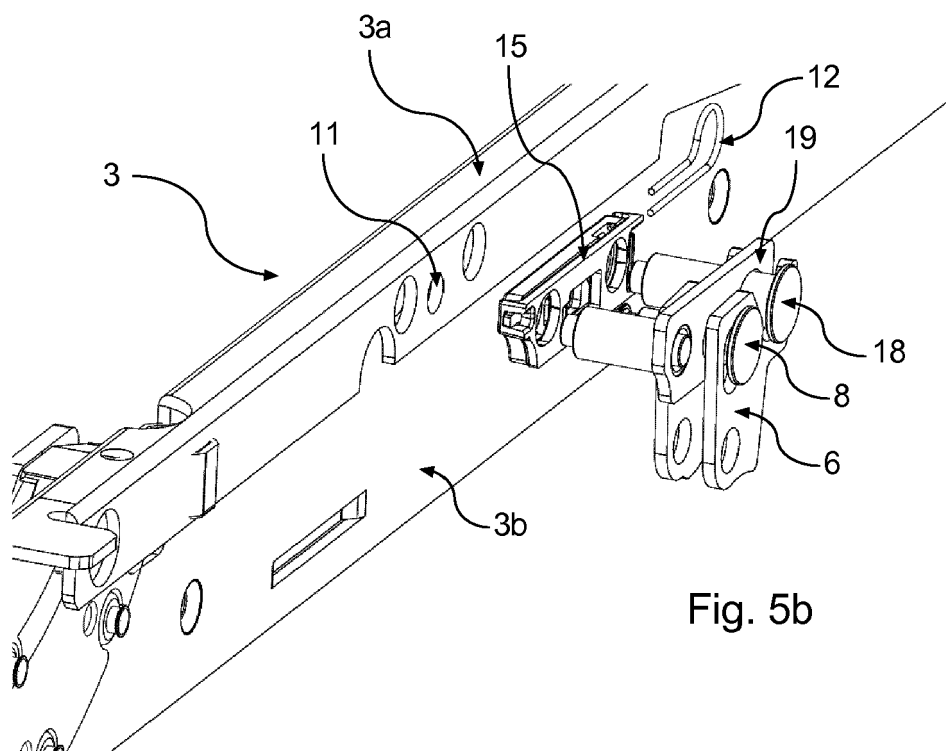
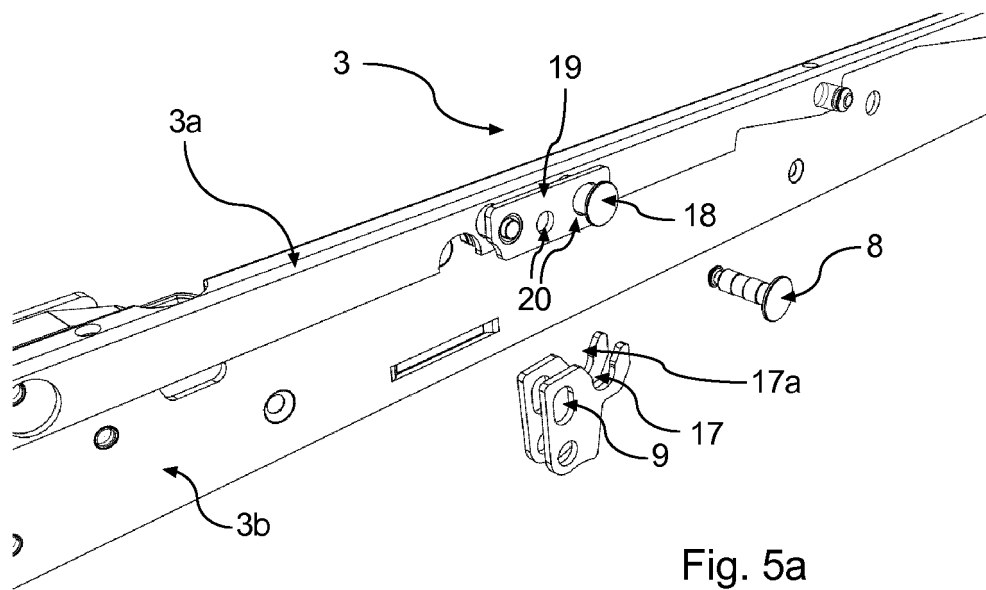
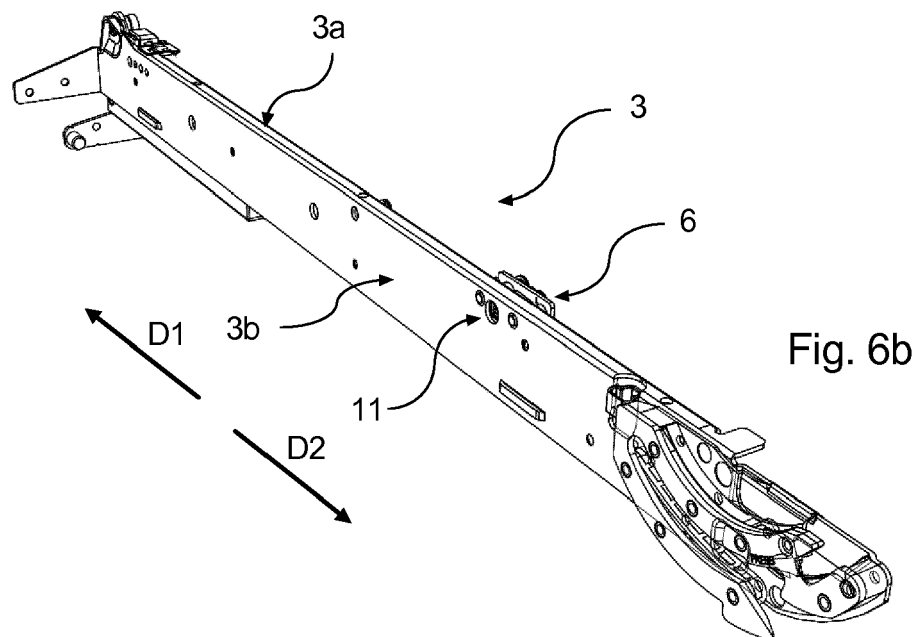
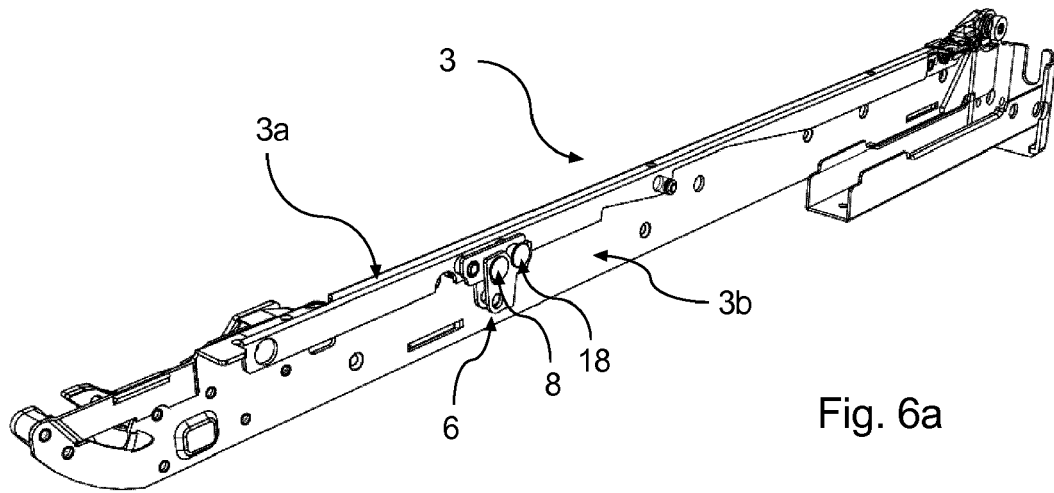


Fig. 4c







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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 27 February 2020	Examiner Rémondot, Xavier
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