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(54) A PIVOT HINGE HAVING IMPROVED FRICTIONAL PROPERTIES

(57) The hinge is intended for use in a pivotal window with a frame and a sash connected to the frame by providing a pivoting movement for the window about a hinge axis. A first hinge part (1) to be secured on the frame and including a first base plate (2), a braking device with a leaf spring (15), and control means in the form of an arc shaped, preferably circular-arc shaped, guide (7); and a second hinge part (3) to be secured on the sash and including a second base plate (4) and an engagement set with a slide bar (8) and a guide pin (10). The arc shaped guide (7) cooperates with the engagement set, the slide bar (8) being adapted to fit in the guide (7) and being rotationally mounted on the second base plate (4), the guide pin (10) being mounted on the second base plate (4), and the leaf spring (15) is, during at least a part of the pivoting movement, in a frictional engagement with at least one element of the engagement set of the second hinge part (3). The guide pin (10) comprises a tensioning projection (10a) and an adjoining convex side (10c).

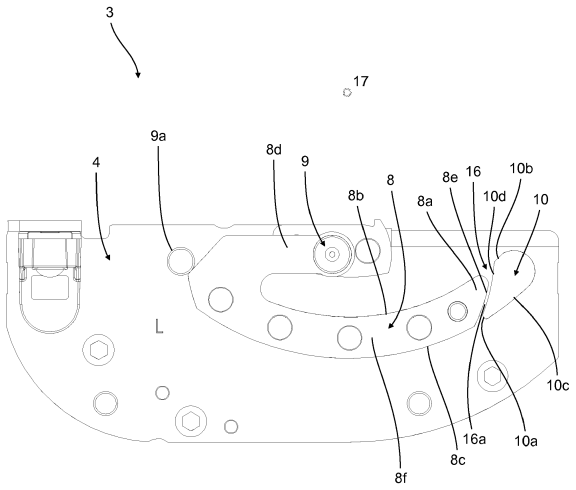

Fig. 4

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Description

Technical Field

[0001] The present invention relates to a hinge for a pivotal window with a frame and a sash connected to the frame at a hinge axis. The hinge provides a pivoting movement for the window and comprises a first hinge part to be secured on the frame. The first hinge part includes a first base plate, a braking device with a leaf spring, and control means in the form of an arc shaped, preferably circular-arc shaped, guide. The hinge further comprises a second hinge part to be secured on the sash. The second hinge part includes a second base plate and an engagement set with a slide bar and a guide pin. The arc shaped, preferably circular-arc shaped, guide cooperates with the engagement set. The slide bar is adapted to fit in the guide and is rotationally mounted on the second base plate. The guide pin is mounted on the second base plate. The leaf spring is, during at least a part of the pivoting movement, in a frictional engagement with at least one element of the engagement set of the second hinge part.

Background Art

[0002] Such a hinge is known in the art and used for a pivotal window, e.g. a roof window installed in an inclined roof surface, to provide a pivoting movement, i.e. the sash turning about a hinge axis at a distance from the top and bottom member, alternatively the side members, of the sash and of the frame. The hinge comprises two extreme positions, between which one, a plurality or a continuum of intermediate positions is defined. The extreme positions include a position in which the pivotal window is closed and a position in which the window sash and thus the second hinge part is turned outside at a maximum in relation to the closing position.

[0003] In both extreme and intermediate positions of the window it is desirable to have the window remain in the set position, such that the window does not unintentionally pivot by internal or external forces after setting the position of the window. Internal forces may for instance be the weight of the window, and external forces may for instance be wind loading. Prevention of unintentional pivoting caused by internal forces can be achieved by providing enough friction in the hinge to overcome the pivotal moment of the window, i.e. the opening and the closing moment, for the range of desired intermediate positions. The opening and closing moment of the window depend among others on the roof angle and the type of window. However, it has been discovered that for some intermediate positions of prior art pivotal windows the hinge friction cannot overcome the pivotal moment and as such these intermediate positions are unstable. It has been found that this problem is especially the case for a window mounted in a low roof angle and in an intermediate position with a large opening angle. Another drawback of the prior art hinges is that the hinges tend to deteriorate, in part due to the guide pin scraping on the leaf spring, thus reducing the hinge friction and exacerbating the problem of providing enough friction.

[0004] EP1612352A1, WO 85/02646 and WO 99/28581 are examples of prior art devices which have proven to function well. However, as the general tendency of an increased weight of in particular the pane to increase the thermal properties there is an ongoing demand for devices having even further improved operational properties.

Summary of Invention

[0005] On this background it is an object of the present invention to provide a pivot hinge which has improved friction characteristics such that more intermediate positions of the window are stable while already stable intermediate positions remain stable. It is a further object to provide pivot hinge which has reduced tendency to deteriorate.

[0006] These and further objects are achieved by a hinge of the kind mentioned in the introduction and which is furthermore characterised in that the guide pin comprises a tensioning projection and an adjoining convex side. In this manner, the guide pin, potentially the convex side of the guide pin, is able to remain in a frictional engagement with the leaf spring during the pivoting movement of the window. This has the advantage that during the entry of the guide pin and the slide bar into the guide, i.e. when closing the window from a large opening angle, the leaf spring will remain stressed and as such provide sufficient friction. Additionally, the slide bar avoids experiencing a stress spike when entering the guide and engaging the leaf spring due to the guide pin already having pre-stressed the leaf spring before the slide bar engages the leaf spring. This has the advantage that the deterioration rate of the hinge is reduced.

[0007] In some embodiments, the tensioning projection of the guide pin may, during at least a part of the pivoting movement, be positioned to face the slide bar, potentially a leading end of the slide bar. Additionally or alternatively, the tensioning projection of the guide pin may form a tip end of the guide pin. Additionally or alternatively, the tensioning projection may form a trailing portion of the guide pin during the closing movement of the window. An advantage of providing the hinge in this way, may be that a larger surface area is in frictional engagement with the leaf spring during the part of the pivoting movement since the adjoining convex side extends further.

[0008] In some embodiments, the leaf spring may, during at least a part of the pivoting movement, be in a frictional engagement with the convex side of the guide pin and/or the tensioning projection of the guide pin. This may provide the advantage that a relatively large surface is used for the frictional engagement and thus stress spikes during the pivoting movement of the window may

be reduced.

[0009] In some embodiments, the guide pin may comprise a nose, potentially positioned on an opposite side of the guide pin relative to the tensioning projection. The nose may extend at the concave side of the guide pin. A side of the nose may be integral and/or continuous with the concave side of the guide pin. The nose may comprise a side adjacent to the concave side of the guide pin and may form an integral and/or continuous surface, which may be configured to press against a side, potentially a concave side, of the guide opposite the leaf spring during at least a part of the pivoting movement of the window. In this way, the concave side of the guide pin may extend further, so that a larger surface area is pressed against the side of the guide which may have the advantage that stress concentration on the concave side of the guide pin is reduced. In some embodiments, a distance between the tensioning projection of the guide pin and the slide bar along a tangential direction of a convex side of the guide, when the window is in the closed position, is less than 10 mm, preferably less than 5 mm, more preferably less than 2 mm. It is understood that the distance is measured along a tangential direction of a convex side of the guide wherein the curvature of the convex side of the guide is extended towards the guide pin. If the guide is circular arc shaped the distance is measured along the circular arc of the convex side of the guide. By reducing said distance, the pre-tensioning of the spring leaf is increased and thus the friction characteristics of the hinge is improved while the deterioration rate is reduced.

[0010] In some embodiments, the slide bar and the guide pin defining a gap when the window is in a closed position. The gap comprises a central section which has substantially parallel edges. The distance between these edges is preferably less than 5 mm, more preferably less than 3 mm, or even more preferably less than 2 mm. The gap may comprise boundary sections at each end of the gap with the central section located in between the boundary sections. This has the advantage that the guide pin has increased stiffness due to filling the available space within tolerance limits which increases the amount of friction that the guide pin can provide.

[0011] In some embodiments, the guide pin comprises a circular arc shaped surface with a centre of curvature substantially located at, preferably coinciding with, the rotational axis of the slide bar. This has the advantage that the guide pin has increased stiffness due to filling the available space within tolerance limits which increases the amount of friction that the guide pin can provide.

[0012] In a presently preferred embodiment, the leaf spring includes at least one elbow portion. The elbow portion defines an angle or discontinuity between the extent of two adjacent portions of the leaf spring. The elbow portion, adjacent portions or both may, during at least a part of the pivoting movement, be in a frictional engagement with at least one element of the engagement set of the second hinge part. It is understood that the braking device is arranged such that the elbow portion of the leaf spring is pointing away from the hinge axis. This provides the advantage that the friction characteristics of the hinge may be configured during various intermediate positions of the window and as such friction may be increased for some intermediate positions.

[0013] In some embodiments, the leaf spring further includes a plurality of portions; a first end portion connected to a first curved portion connected by the elbow portion to a second curved portion connected to a second end portion, wherein the first end portion being adapted to connect to a first pin of the first hinge part, and wherein the second end portion being adapted to connect to a second pin of the first hinge part. The first curved portion and the second curved portion are preferably circular arc shaped. This has the advantage that the leaf spring can be configured to desired levels of friction at various intermediate positions of the window, such that friction is increased as desired at intermediate positions.

[0014] In some embodiments, the leaf spring is adapted to abut a third pin of the first hinge part during at least part of the pivotal movement of the window. This has the advantage of allowing the leaf spring to further stiffen and thus provide additional friction at certain intermediate positions.

[0015] In some embodiments, the centre of curvature of the first curved portion is different from the centre of curvature of the second curved portion. This has the advantage that the curved portions can be configured to provide the desired friction at various intermediate positions of the window, such that friction is increased as desired at intermediate positions.

[0016] In some embodiments, the first and/or the second curved portion of the leaf spring, in particular the curvature thereof, is/are adapted such that the leaf spring is in a frictional engagement during the pivotal movement of the window.

[0017] In some embodiments, the radius of curvature of the first curved portion is at least 70 mm. It has been found that a first curved portion with a curvature in this interval provides the desired friction.

[0018] In some embodiments, the radius of curvature of the second curved portion is in the interval of 80 - 160 mm, preferably in the interval of 100 - 140 mm, more preferably in the interval of 110 - 130. It has been found that a second curved portion with a curvature in these intervals provides the desired friction.

[0019] In some embodiments, the guide pin is non-rotatably mounted to the second base plate such that the guide pin is not allowed to rotate in relation to the second base plate. This has the advantage that the orientation of the guide pin is known throughout the pivoting movement of the hinge such that the friction caused by the guide pin can be configured accurately.

[0020] In some embodiments, the guide pin has a droplet shaped cross section in a cross-sectional plane normal to the hinge axis.

[0021] In some embodiments, the guide pin comprises

a coating, in particular a polyolefin coating, adapted to reduce the wear of the frictional engagement.

[0022] In this disclosure, the term "circular arc" is understood to constitute a part of the circumference of a circle. The term "circular arc shaped" is understood to constitute the shape or outline of an element when viewed from a cross-sectional plane normal to the hinge axis.

Brief Description of Drawings

[0023] In the following the invention will be described in more detail with reference to the drawings, in which

Fig. 1 shows an exploded perspective view of a frame hinge part;
Fig. 2 shows a perspective view of a frame hinge part;
Fig. 3 shows a perspective view of a sash hinge part;
Fig. 4 shows a side view of a sash hinge part;
Fig. 5 shows a cross-sectional view of a hinge according to the invention;
Fig. 6 shows a cross-sectional view of a hinge at an intermediate position;
Fig. 7a shows a perspective view of a leaf spring;
Fig. 7b shows a side view of a leaf spring;
Fig. 8a shows a perspective view of a first embodiment of a guide pin;
Fig. 8b shows a side view of the first embodiment of the guide pin shown in Fig. 8a;
Fig. 9a shows a perspective view of a second embodiment of a guide pin;
Fig. 9b shows a side view of the second embodiment of the guide pin shown in Fig. 9a;
Fig. 10 shows a hinge moment of a prior art hinge as a function of open angle;
Fig. 11 shows a hinge moment of a hinge according to the invention as a function of open angle;
Fig. 12 shows a hinge moment of a prior art hinge as a function of open angle;
Fig. 13 shows a hinge moment of a hinge according to the invention, incorporating only a new guide pin and an existing leaf spring, as a function of open angle;

Description of Embodiments

[0024] Referring first to Figs 1 to 6, a general overview of the components of a hinge according to the invention will first be given.

[0025] In a manner known *per* se, the hinge is configured to be installed in a pivotal window with a frame and a sash connected to the frame. The hinge is configured to provide a pivoting movement for the window in that the sash is able to turn relative to the frame about a hinge axis represented by reference numeral 17 in Figs 4 to 6.

[0026] The hinge comprises a first hinge part 1 to be secured on the frame and including a first base plate 2, a braking device with a leaf spring 15, and control means in the form of an arc shaped, preferably circular-arc shaped, guide 7, and a second hinge part 3 to be secured on the sash and including a second base plate 4 and an engagement set with a slide bar 8 and a guide pin 10. As shown, the guide 7 is defined in a plate piece 6 of the first hinge part 1 and comprises a convex side or wall and a concave side or wall. Opposite the guide 7, a recess 14 is formed in the plate piece 6. As in traditional hinges, the slide bar has a concave side 8b, a convex side 8c and a hinge end 8d connected to a hinge pin 9 mounted on the second base plate 4. Finally, a stop pin 9a is provided on the base plate 4 as in traditional hinges. As a feature according to the invention, the slide bar is here provided with a leading end 8a with a surface 8e to be accommodated by a gap surface 10d of the guide pin 10 to be described in further detail below.

[0027] During operation, the arc shaped guide 7 cooperates with the engagement set, the slide bar 8 being adapted to fit in the guide 7 and being rotationally mounted on the second base plate 4, the guide pin 10 being mounted on the second base plate 4.

[0028] The leaf spring 15 is, during at least a part of the pivoting movement, in a frictional engagement with at least one element of the engagement set of the second hinge part 3. Which part depends on the actual position of the element in question.

[0029] As shown in particular in Fig. 6 and referring now also to Figs 7a-7b and 8a-8b, respectively, the leaf spring 15 includes at least one elbow portion 15c and the guide pin 10 comprises a tensioning projection 10a. In the embodiment shown, the guide pin 10 has a cross section shaped as a droplet, in which the tensioning projection 10a is associated with a concave side 10b and a convex side 10c opposite the gap surface 10d. The material of the guide pin 10 is chosen to provide the frictional and wearability properties aimed at, and is typically made of steel. One specific material that has proven to function well is the commercially available VN 24.H20005.96. The leaf spring may be provided according to the EN 10270-1 standard and is typically made of steel.

[0030] In a closed position of the window, corresponding to the position shown in Fig. 5, there is a slight distance between the tensioning projection 10a of the guide pin 10 and the slide bar 8 along a tangential direction of the convex side of the guide 7. The distance may be chosen according to the specific field of application of the hinge; typically, the distance is less than 10 mm. preferably less than 5 mm, more preferably less than 2 mm.

[0031] Furthermore, and referring still to the closed position of the window, the slide bar 8 and the guide pin 10 define a gap 16 comprising a central section 16a having substantially parallel edges and preferably a width less than 5 mm, more preferably less than 3 mm, even more preferably less than 2 mm.

[0032] The form of the guide pin may in principle be chosen in any suitable manner. In the embodiment shown and presently preferred, the guide pin 10 comprises a circular arc shaped surface with a centre of cur-

vature substantially located at, preferably coinciding with, the rotational axis of the slide bar 8.

[0033] Turning now to the leaf spring 15 and referring specifically to Figs. 1 and 7a-7b, it is presently preferred that the leaf spring 15 includes a plurality of portions. These portions include a first end portion 15a connected to a first curved portion 15b connected by the elbow portion 15c to a second curved portion 15d connected to a second end portion 15e. The first end portion 15a is adapted to connect to a first pin 5a of the first hinge part 1, and the second end portion 15e is adapted to connect to a second pin 5b of the first hinge part 1. The first curved portion 15b and the second curved portion 15d are preferably circular arc shaped.

[0034] Furthermore, the leaf spring 15 is in the embodiment shown adapted to abut a third pin 5c of the first hinge part 1 during at least part of the pivotal movement of the window.

[0035] The second end portion 15e is adapted to connect to a second pin 5b of the first hinge part 1 in an operation position and in an assembly position, the operation position being the position of the pin when the window is in a mounted state, and the assembly position being a position where the connection and/or disconnection of the first end portion 15a to the second pin 5b is allowed.

[0036] The specific shape of the leaf spring 15 along the path from one end to the other will typically be chosen according to the requirements to the hinge in accordance with factors such as the size and weight of the components of the window, most importantly the weight of the pane and the sash. In the preferred embodiment shown and described herein, the centre of curvature of the first curved portion 15b is different from the centre of curvature of the second curved portion 15d.

[0037] Correspondingly, the radius of curvature of the second curved portion 15d is in the interval of 80 - 160 mm, preferably in the interval of 100 - 140 mm, more preferably in the interval of 110 - 130 mm.

[0038] Regarding the radius of curvature of the first curved portion 15b, this may in principle be chosen in any suitable manner, ranging from a radius of curvature smaller than the second curved portion 15d up to substantially straight. Preferably, the radius of curvature is larger than 70 mm, for instance 74 mm.

[0039] The connection between the guide pin and the base plate may in principle be carried out in any suitable manner. In the preferred embodiment, the guide pin 10 is nonrotatably fixed to the second base plate 4 such that the guide pin 10 is not allowed to rotate in relation to the second base plate 4. Specifically, this is carried out by means of the oblong mounting projection 10e protruding from a side of the body 10f of the guide pin 10 but other ways of ensuring the nonrotatability is conceivable as well.

[0040] In the above specification describes a first embodiment of the guide pin 10 as shown in Figs. 2-6 and 8a-8b. Turning to a second embodiment of the guide 10 as shown in Figs. 9a-9b. The second embodiment of the guide pin 10 corresponds to the first embodiment except in that, this second embodiment of the guide pin 10 includes a nose 10g positioned on an opposite side of the guide pin 10 relative to the tensioning projection 10a. The nose 10g comprises a side adjacent to the concave side 10b of the guide pin 10 and forms an integral and continuous surface, which is configured to press against a side of the guide 7 opposite the leaf spring 15 during at least a part of the pivoting movement of the window. The nose 10g extends less than the body 10f of the guide pin 10 in a direction of the hinge axis so that the nose fits in a spacing between the plate piece 6 and the first base plate 2 when the hinge is in the closed position.

[0041] Figs. 10 to 13 are graphs showing computer simulated curves for the hinge moments in Nm relative to the opening angle degree are shown for various roof inclinations. The dashed and the dotted lines respectively indicate the hinge moment in the closing direction and in the opening direction. The solid lines indicate the sash moment when a roof window is installed at various different roof angles. The hinge friction in the closing direction should be greater than the sash moment, while the hinge friction in the opening direction should be lower than the sash moment. As seen in Fig. 10, for opening angles above about 35 degrees when the roof angle is below 45 degrees, the hinge friction in the closing direction drops below the sash moment which causes the window to close.

[0042] Fig. 11 shows the improvement in hinge friction when incorporating a hinge according to the invention in a roof window with the sash moment characteristics as shown in Fig. 10. The hinge friction in the closing direction no longer sharply drops and stays above the sash moment for the indicated roof angles. In addition, the difference between hinge friction in the opening direction and the sash moment for all indicated opening angles has also increased.

[0043] Fig. 12 shows a different prior art window than in Fig. 10 and thus the curves are somewhat different. In this case the hinge friction in the closing direction drops below the sash moment at around 25 degrees, while the hinge friction in the opening direction is above the sash moment at 90 degrees for all opening angles between 0 degrees to 45 degrees.

[0044] Fig. 13 shows the improvement in hinge friction when incorporating a hinge according to the invention in a roof window with the sash moment characteristics as shown in Fig. 12, where the hinge incorporates only a new guide pin and an existing leaf spring. The hinge friction in the closing direction now stays above the sash moment at 15 degrees for all opening angles. In addition, the negative moment of the hinge friction in the opening direction is increased such that it falls below the sash moment at a 90 degree roof angle at an opening angle of about 30 degrees. It should be understood that a new guide pin provides the desired friction, while the combination of a guide pin and a leaf spring according to the

invention may provide additional friction.

[0045] It should be noted that the above description of preferred embodiments serves only as an example, and that a person skilled in the art will know that numerous variations are possible without deviating from the scope of the claims.

List of Reference Numerals

[0046]

1	first hinge part
2	first base plate
3	second hinge part
4	second base plate
5a	first pin
5b	second pin
5c	third pin
6	plate piece
7	guide
8	slide bar
8a	leading end
8b	concave side
8c	convex side
8d	hinge end
8e	surface
9	hinge pin
9a	stop pin
10	guide pin
10a	tensioning projection
10b	concave side
10c	convex side
10d	gap surface
10e	mounting projection
10f	body
10g	nose
14	recess
15	leaf spring
15a	first end portion
15b	first curved portion
15c	elbow portion
15d	second curved portion
15e	second end portion
16	gap
16a	central section
17	hinge axis

Claims

1. A hinge for a pivotal window with a frame and a sash connected to the frame, the hinge providing a pivoting movement for the window about a hinge axis (17) and comprising;
a first hinge part (1) to be secured on the frame and including a first base plate (2), a braking device with a leaf spring (15), and control means in the form of an arc shaped, preferably circular-arc shaped, guide (7);
a second hinge part (3) to be secured on the sash and including a second base plate (4) and an engagement set with a slide bar (8) and a guide pin (10), wherein the arc shaped, preferably circular-arc shaped, guide (7) cooperates with the engagement set, the slide bar (8) being adapted to fit in the guide (7) and being rotationally mounted on the second base plate (4), the guide pin (10) being mounted on the second base plate (4),
wherein the leaf spring (15) is, during at least a part of the pivoting movement, in a frictional engagement with at least one element of the engagement set of the second hinge part (3),
characterised in that the guide pin (10) comprises a tensioning projection (10a) and an adjoining convex side (10c).

2. A hinge according to claim 1, wherein the tensioning projection (10a) of the guide pin (10) is positioned to face the slide bar (8) during at least a part of the pivoting movement.

3. A hinge according to any one of the preceding claims, wherein the guide pin (10) comprises a concave side positioned opposite the convex side (10c) and configured to be in a frictional engagement with a side of the guide (7) opposite the leaf spring (15), wherein the guide pin (10) further comprises a nose (10g) positioned adjacently to the concave side and opposite the tensioning projection (10a).

4. A hinge according to according to any one of the preceding claims, wherein, in a closed position of the window, a distance between the tensioning projection (10a) of the guide pin (10) and the slide bar (8) along a tangential direction of a convex side of the guide (7) being less than 10 mm, preferably less than 5 mm, more preferably less than 2 mm.

5. A hinge according to any one of the preceding claims, wherein, in a closed position of the window, the slide bar (8) and the guide pin (10) defining a gap (16) comprising a central section (16a) having substantially parallel edges and preferably a width less than 5 mm, more preferably less than 3 mm, even more preferably less than 2 mm.

6. A hinge according to any one of the preceding claims, wherein the guide pin (10) comprises a circular arc shaped surface with a centre of curvature substantially located at, preferably coinciding with, the rotational axis of the slide bar (8).

7. A hinge according to any one of the preceding claims, wherein the leaf spring (15) includes at least one elbow portion (15c).

8. A hinge according to any one of the preceding claims, wherein the leaf spring (15) includes a plurality of portions; a first end portion (15a) connected to a first curved portion (15b) connected by the elbow portion (15c) to a second curved portion (15d) connected to a second end portion (15e), wherein the first end portion (15a) being adapted to connect to a first pin (5a) of the first hinge part (1), and wherein the second end portion (15e) being adapted to connect to a second pin (5b) of the first hinge part (1), and wherein the first curved portion (15b) and the second curved portion (15d) are preferably circular arc shaped.

9. A hinge according to claim 7, wherein the leaf spring (15) is adapted to abut a third pin (5c) of the first hinge part (1) during at least part of the pivotal movement of the window.

10. A hinge according to any one of claims 7 and 8, wherein the second end portion (15e) is adapted to connect to the second pin (5b) of the first hinge part (1) in an operation position and in an assembly position, the operation position being the position of the pin when the window is in a mounted state, and the assembly position being a position where the connection and/or disconnection of the first end portion (15a) to the second pin (5b) is allowed.

11. A hinge according to any one of claims 7 to 9, wherein the centre of curvature of the first curved portion (15b) is different from the centre of curvature of the second curved portion (15d).

12. A hinge according to any one of claims 7 to 10, wherein the radius of curvature of the first curved portion (15b) is at least 70 mm.

13. A hinge according to any one of claims 7 to 11, wherein the radius of curvature of the second curved portion (15d) is in the interval of 80 - 160 mm, preferably in the interval of 100 - 140 mm, more preferably in the interval of 110 - 130 mm.

14. A hinge according to any of the preceding claims, wherein the guide pin (10) is nonrotatably fixed to the second base plate (4) such that the guide pin (10) is not allowed to rotate in relation to the second base plate (4).

15. A hinge according to any one of the preceding claims, wherein the guide pin (10) has a droplet shaped cross section in a cross-sectional plane normal to the hinge axis.

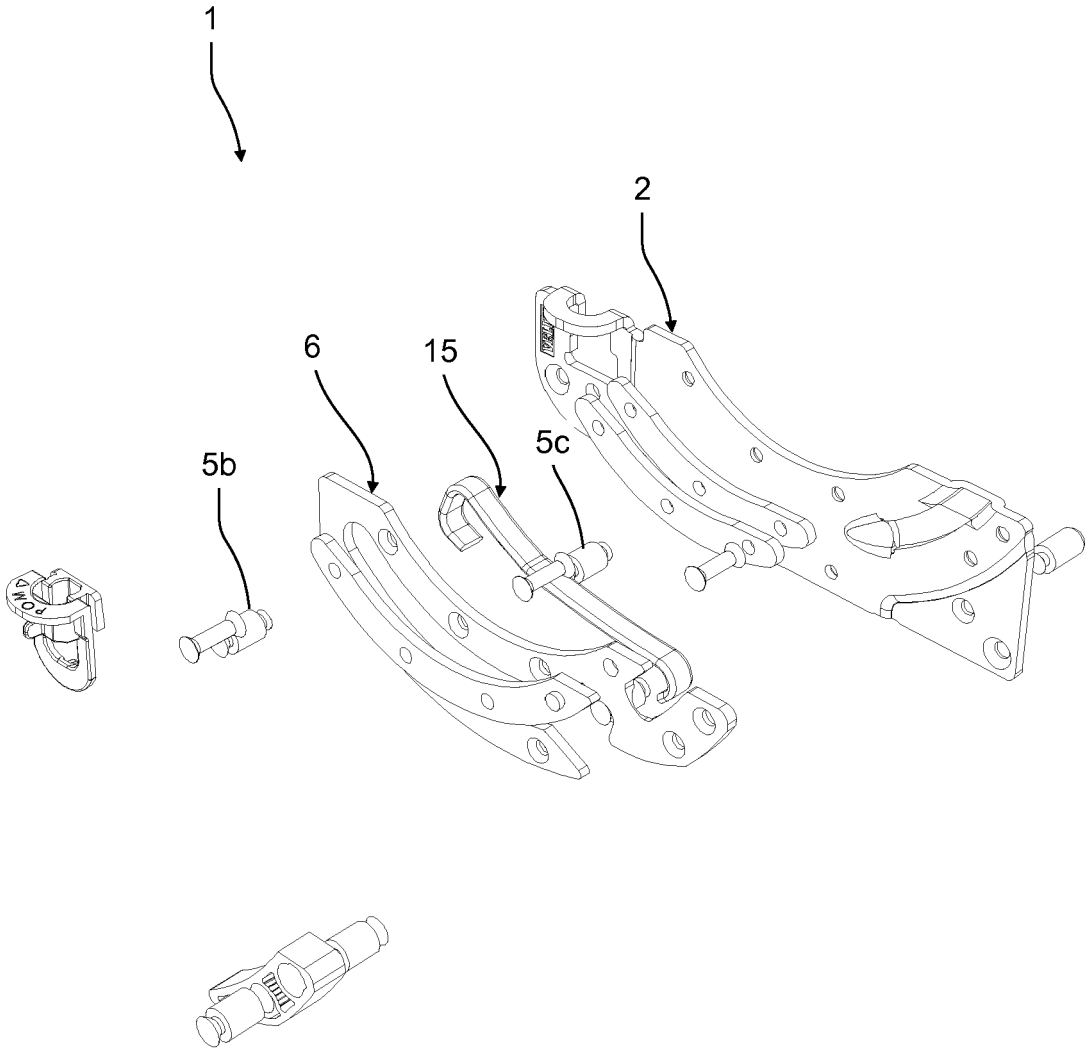


Fig. 1

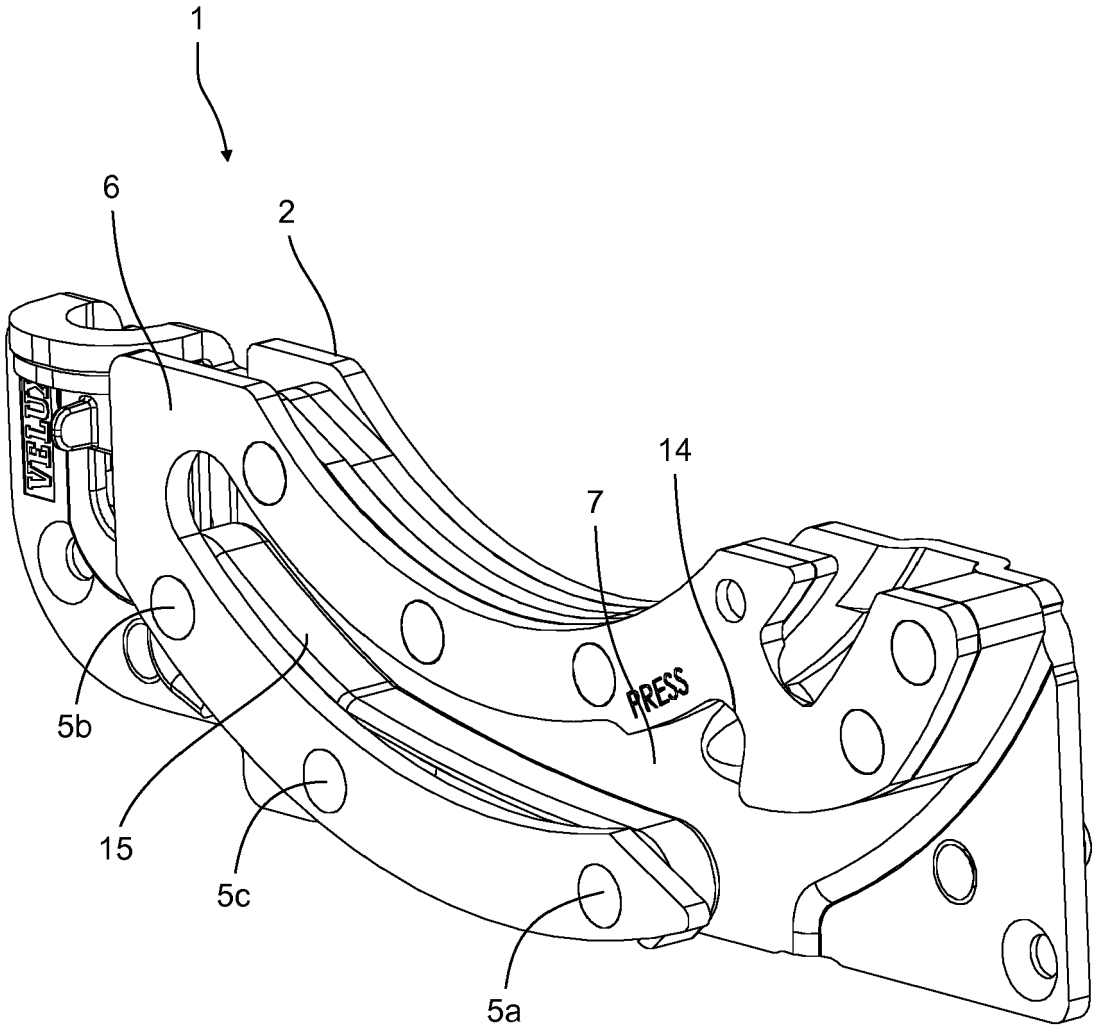


Fig. 2

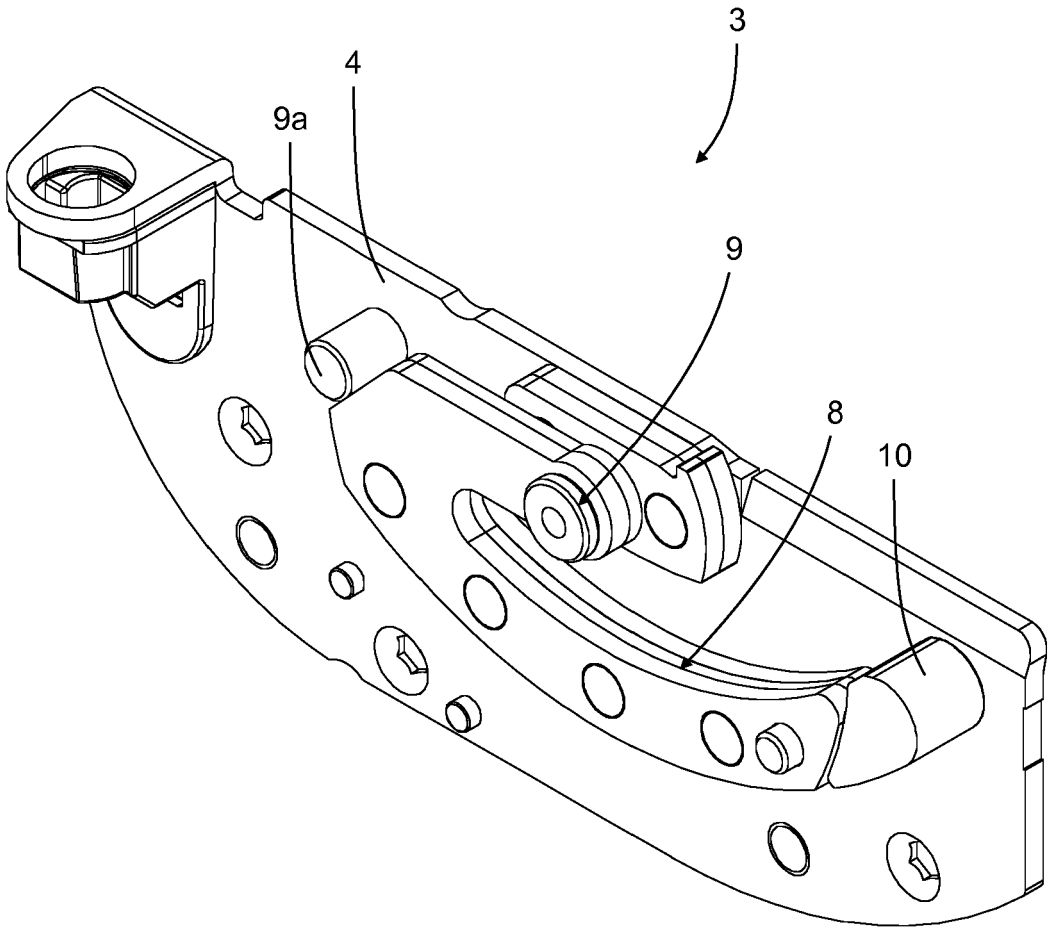


Fig. 3

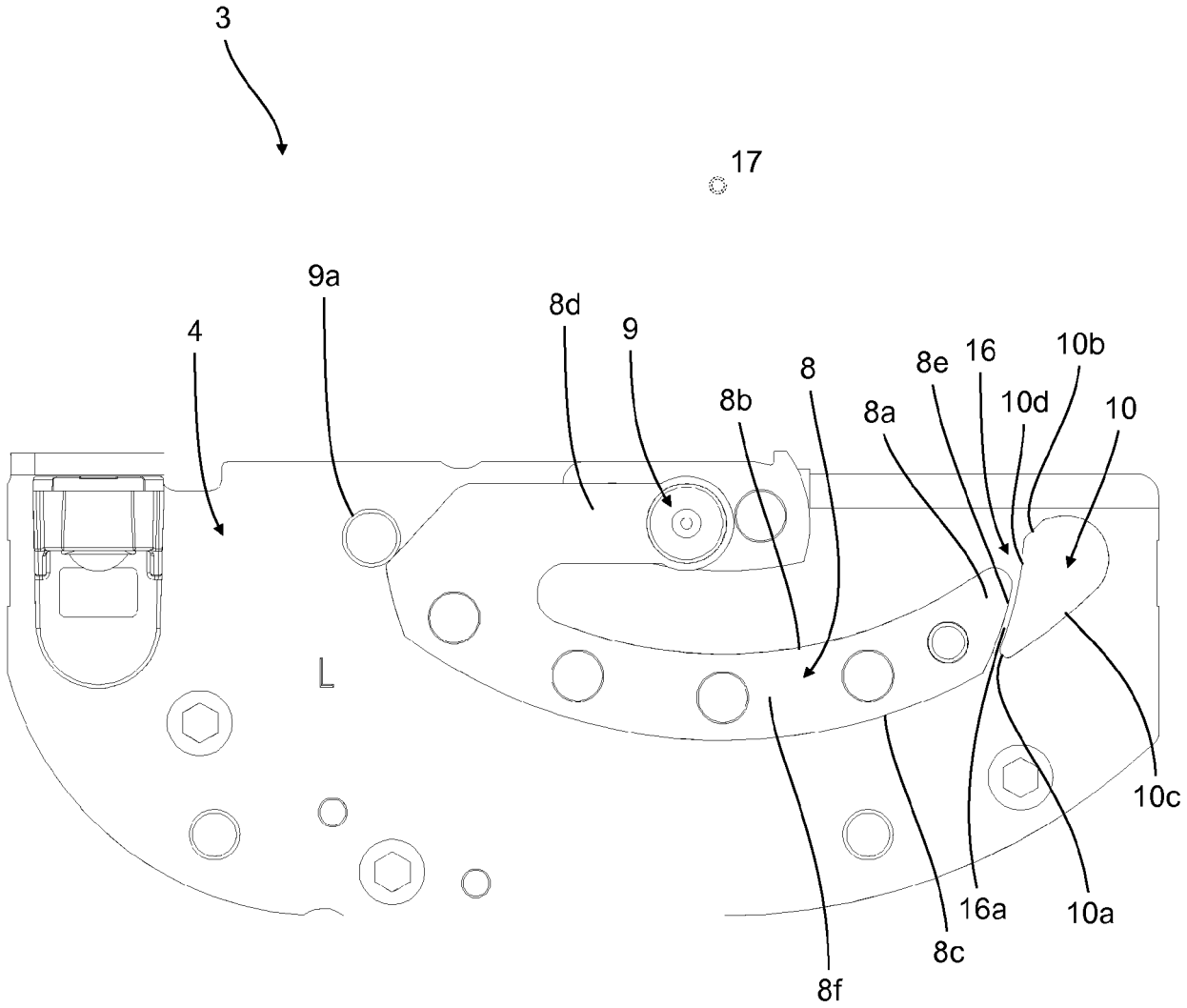


Fig. 4

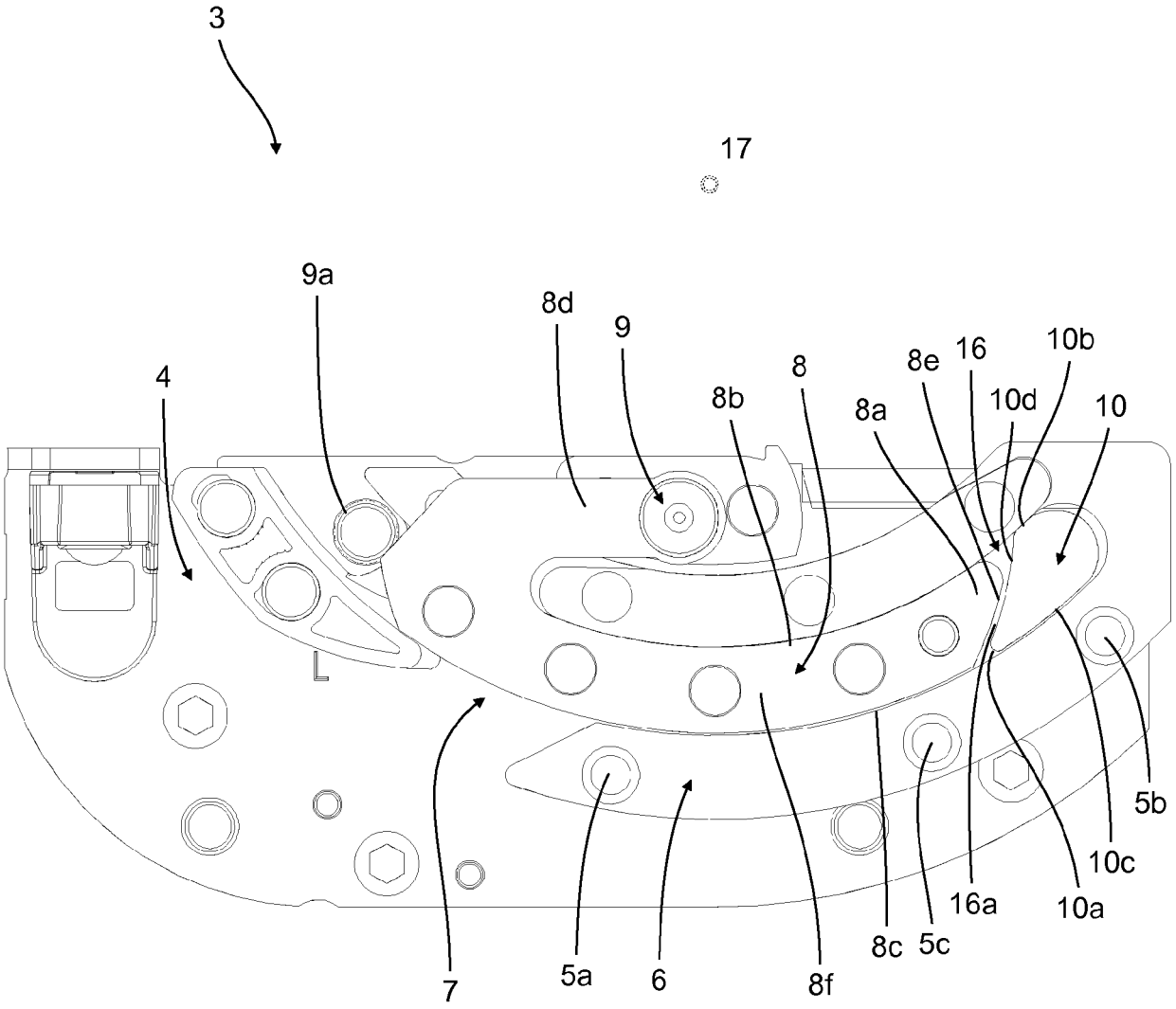


Fig. 5

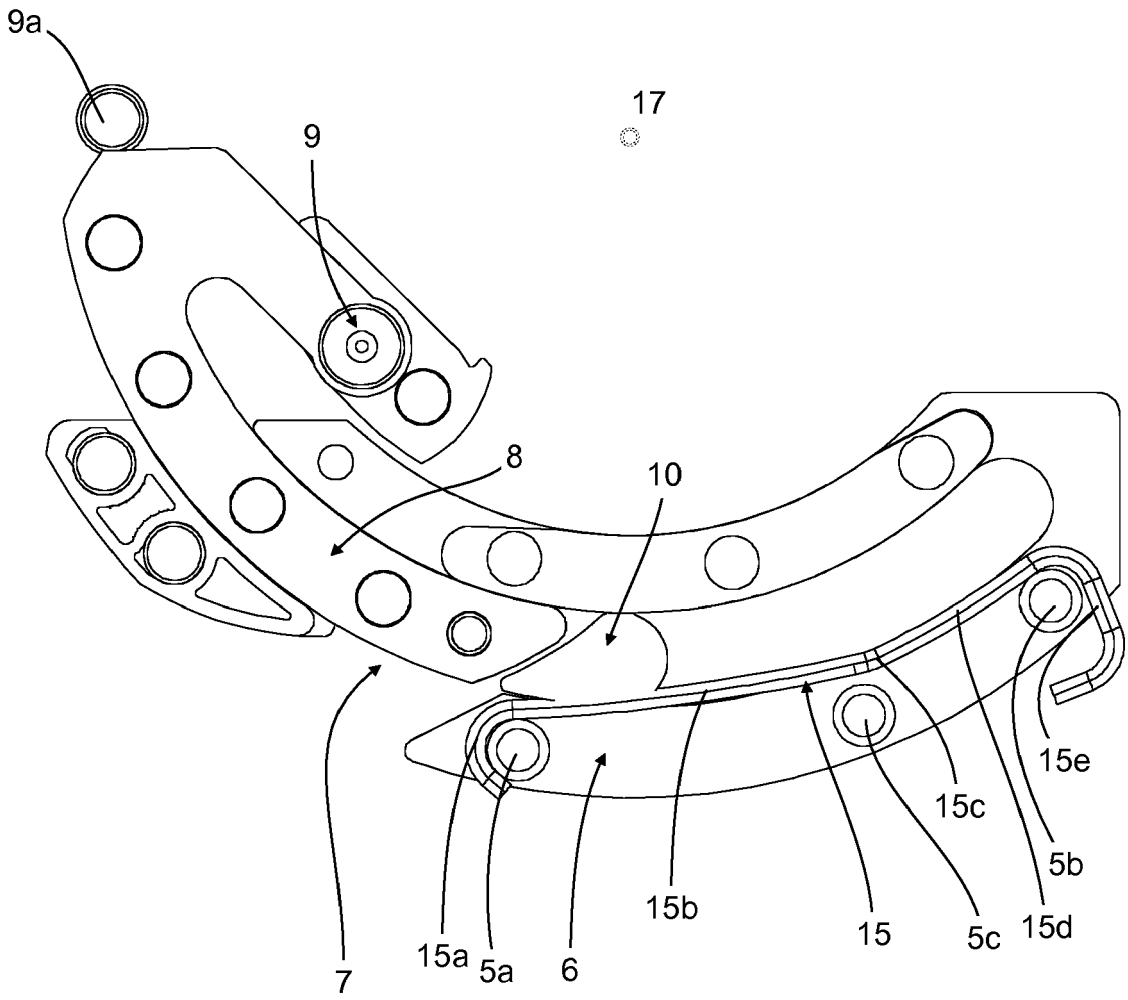


Fig. 6

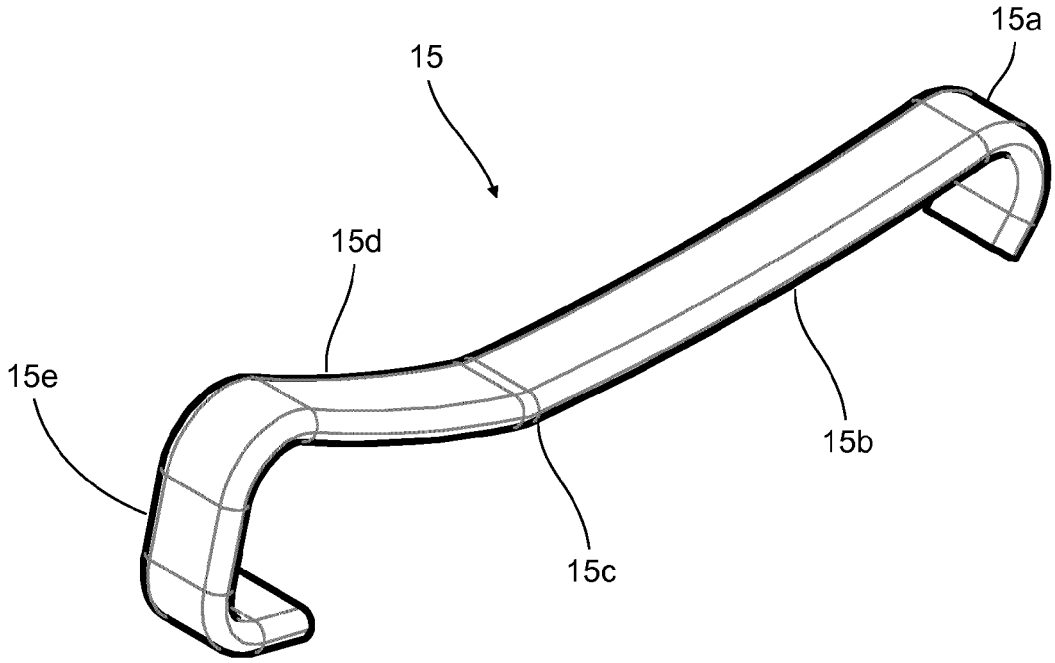


Fig. 7a

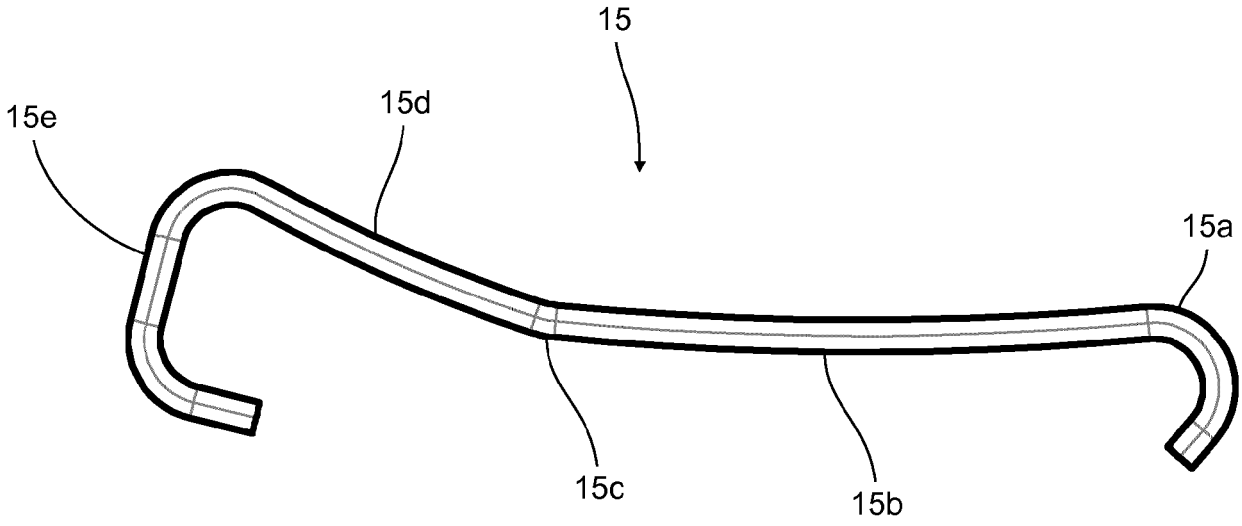


Fig. 7b

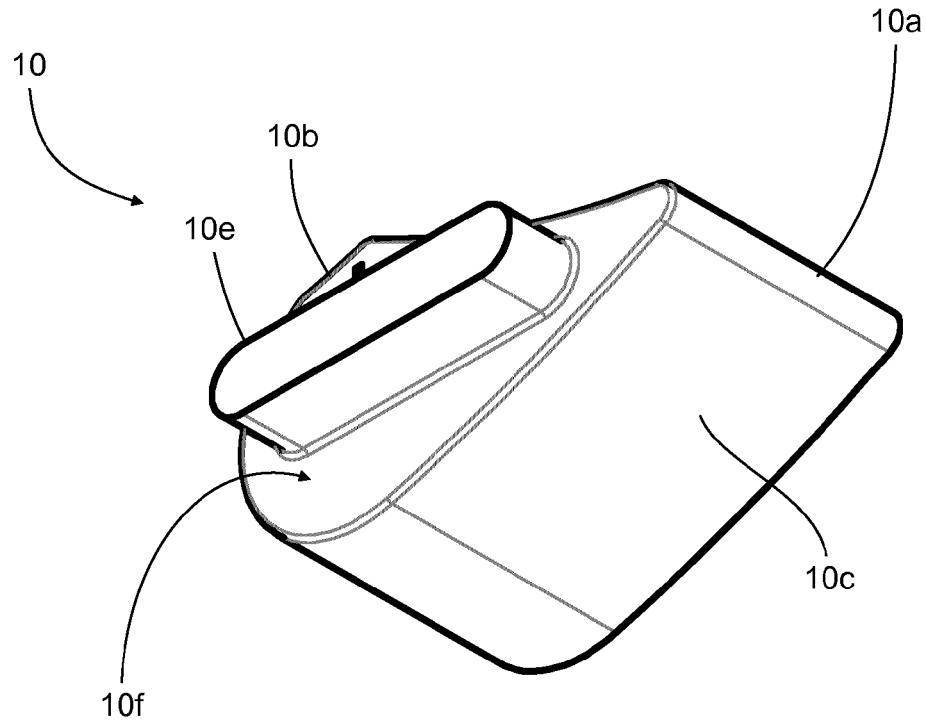


Fig. 8a

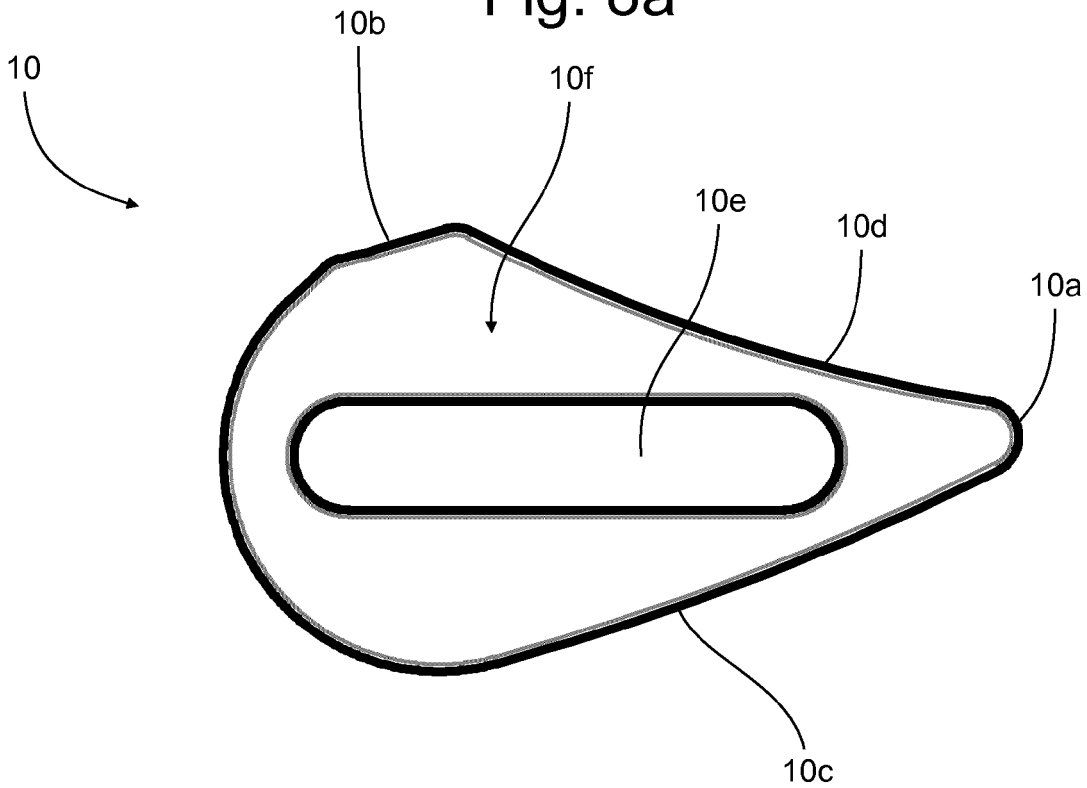


Fig. 8b

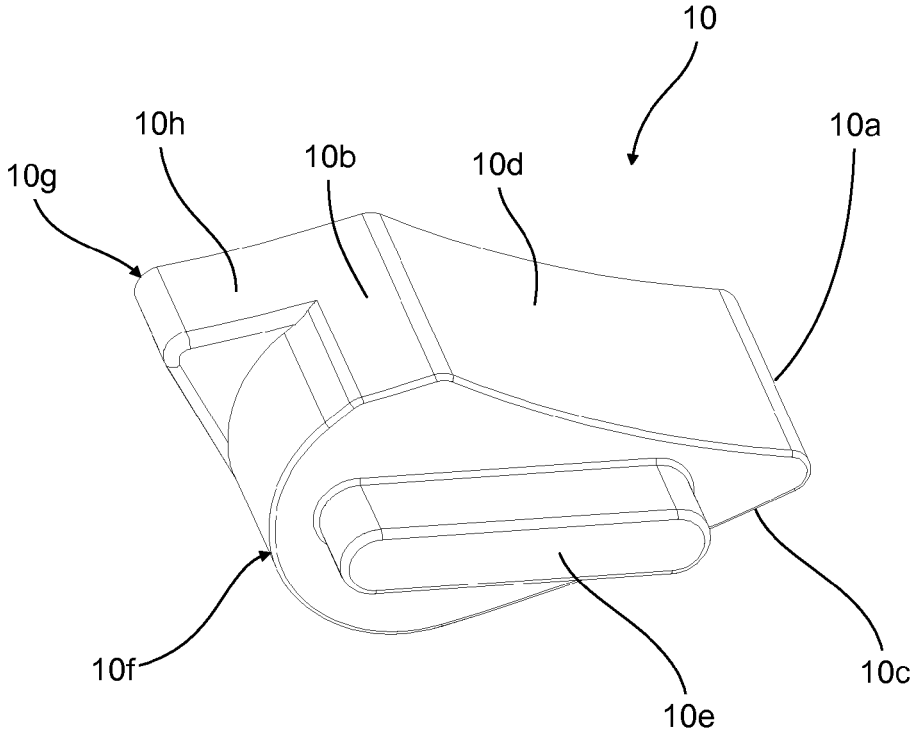
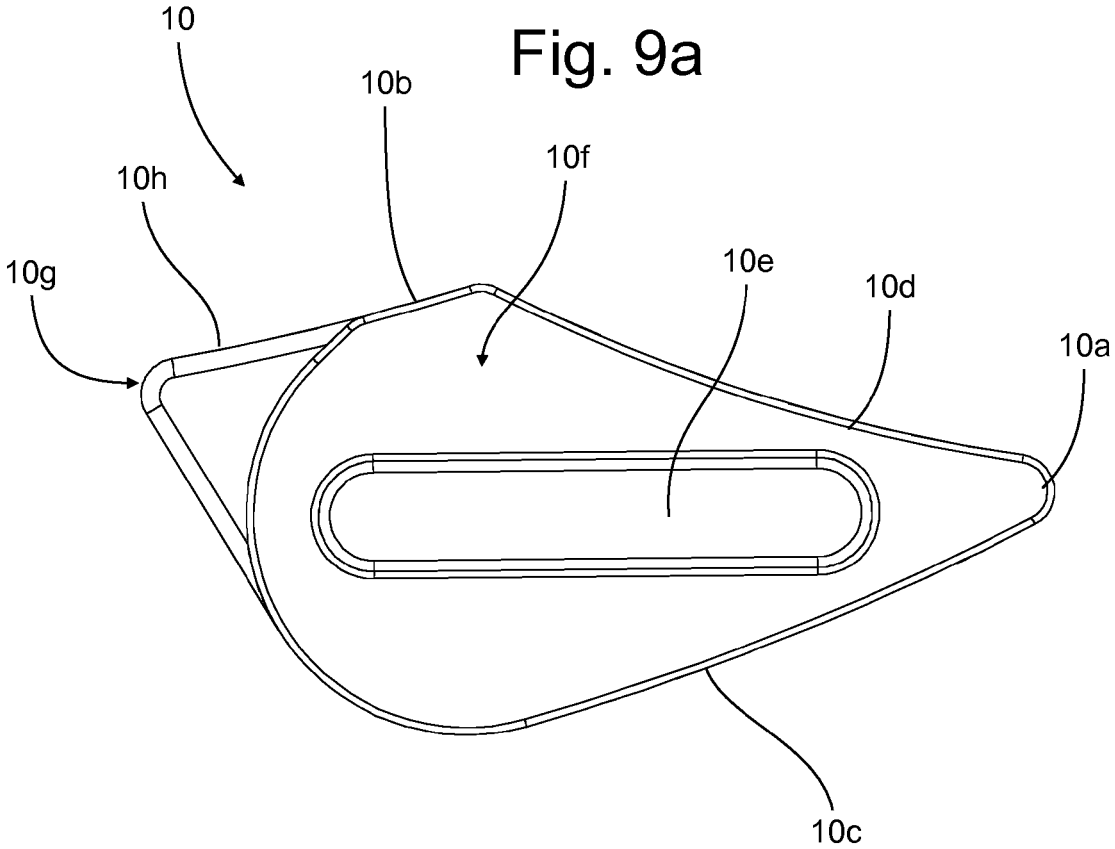

10
10h
10b
10d
10a
10g
10f
10e
10c

Fig. 9a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10b
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10g
10e
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10a
10c

Fig. 9b

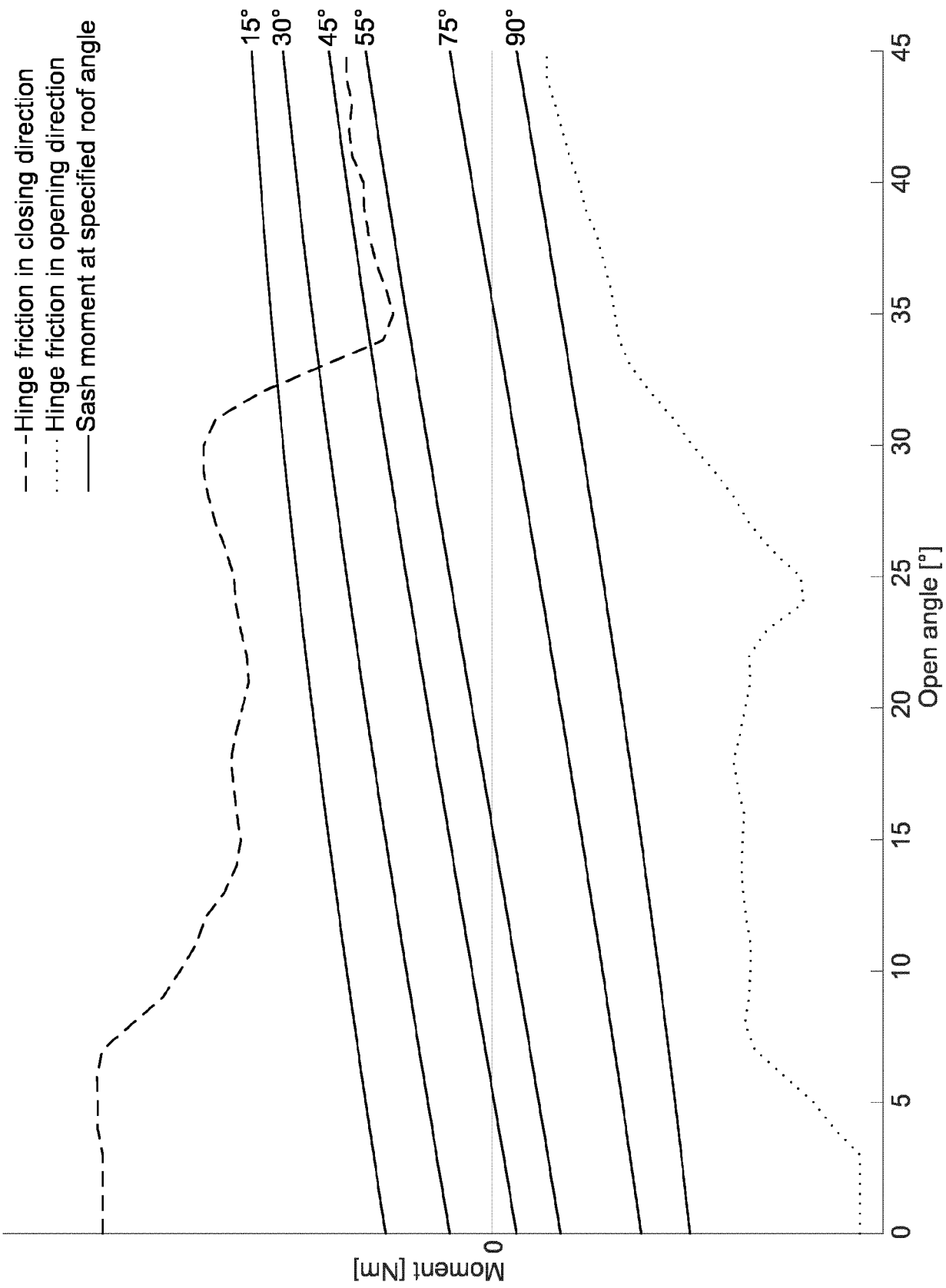
Hinge friction in closing direction
Hinge friction in opening direction
Sash moment at specified roof angle
15°
30°
45°
55°
75°
90°
Moment [Nm]
0
0
5
10
15
20
25
30
35
40
45
Open angle [°]

Fig. 10

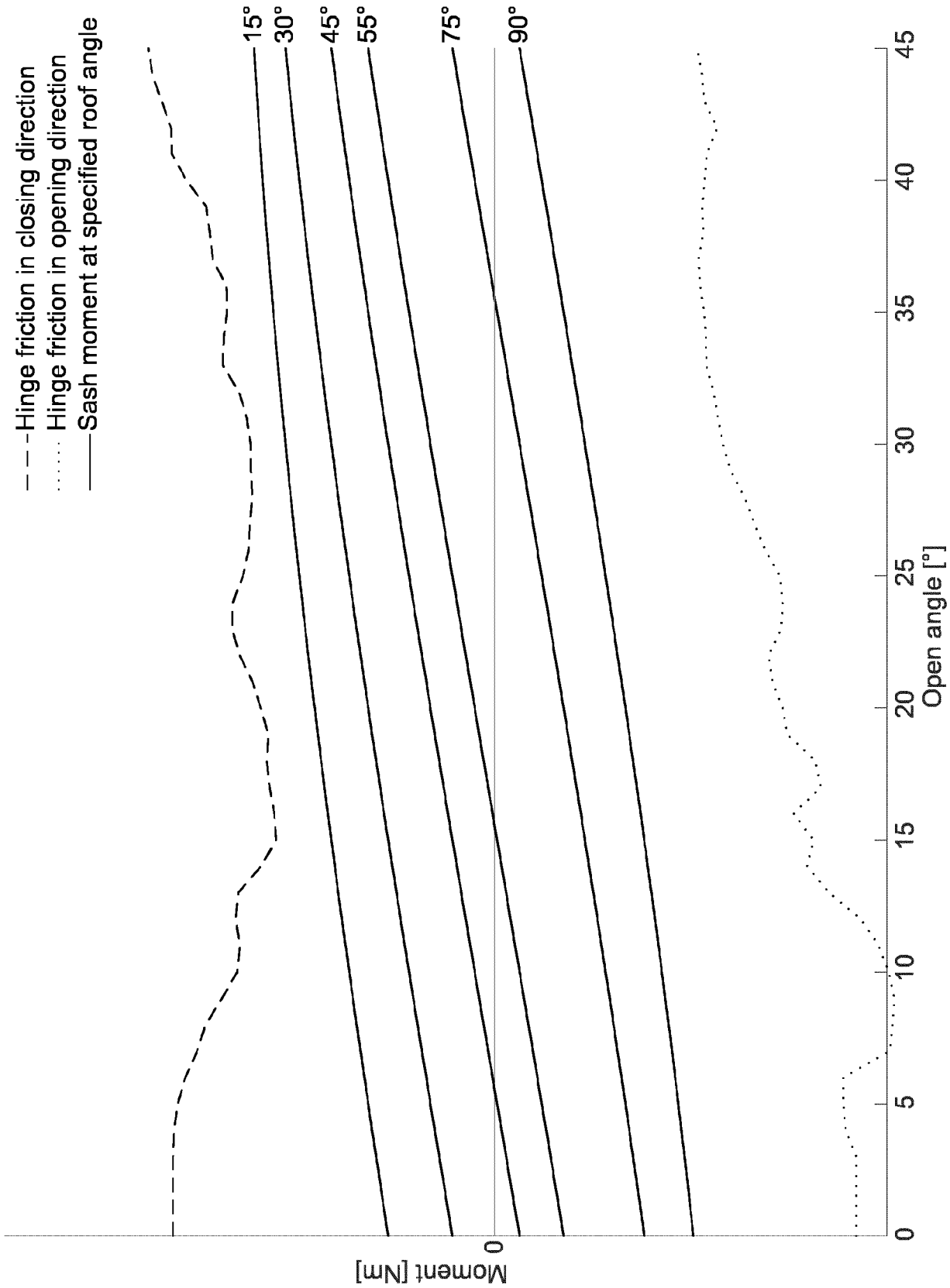
Hinge friction in closing direction
Hinge friction in opening direction
Sash moment at specified roof angle
15°
30°
45°
55°
75°
90°
Moment [Nm]
0
0
5
10
15
20
25
30
35
40
45
Open angle [°]

Fig. 11

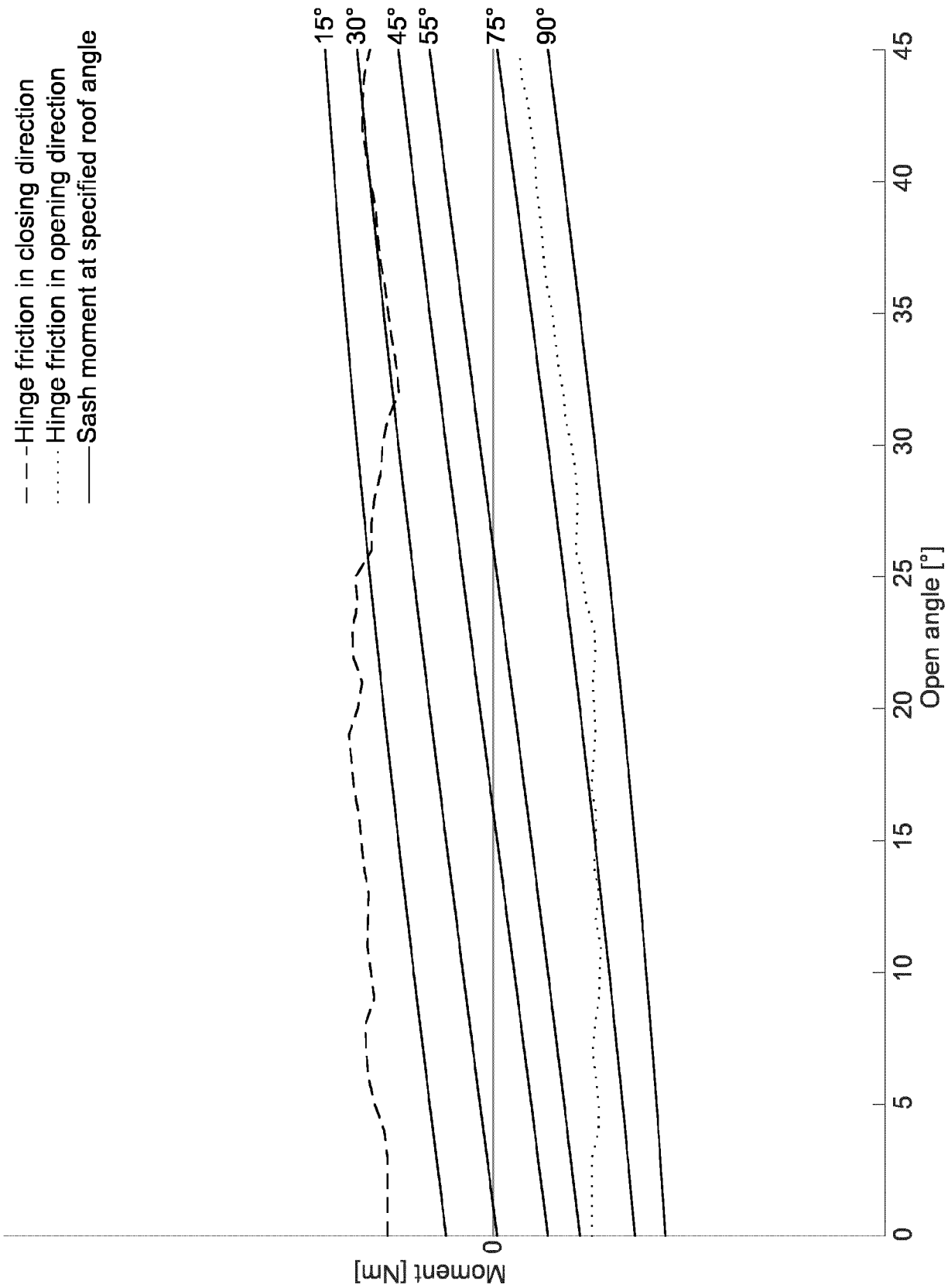
Hinge friction in closing direction
Hinge friction in opening direction
Sash moment at specified roof angle
15°
30°
45°
55°
75°
90°
0
5
10
15
20
25
30
35
40
45
Open angle [°]
0
Moment [Nm]

Fig. 12

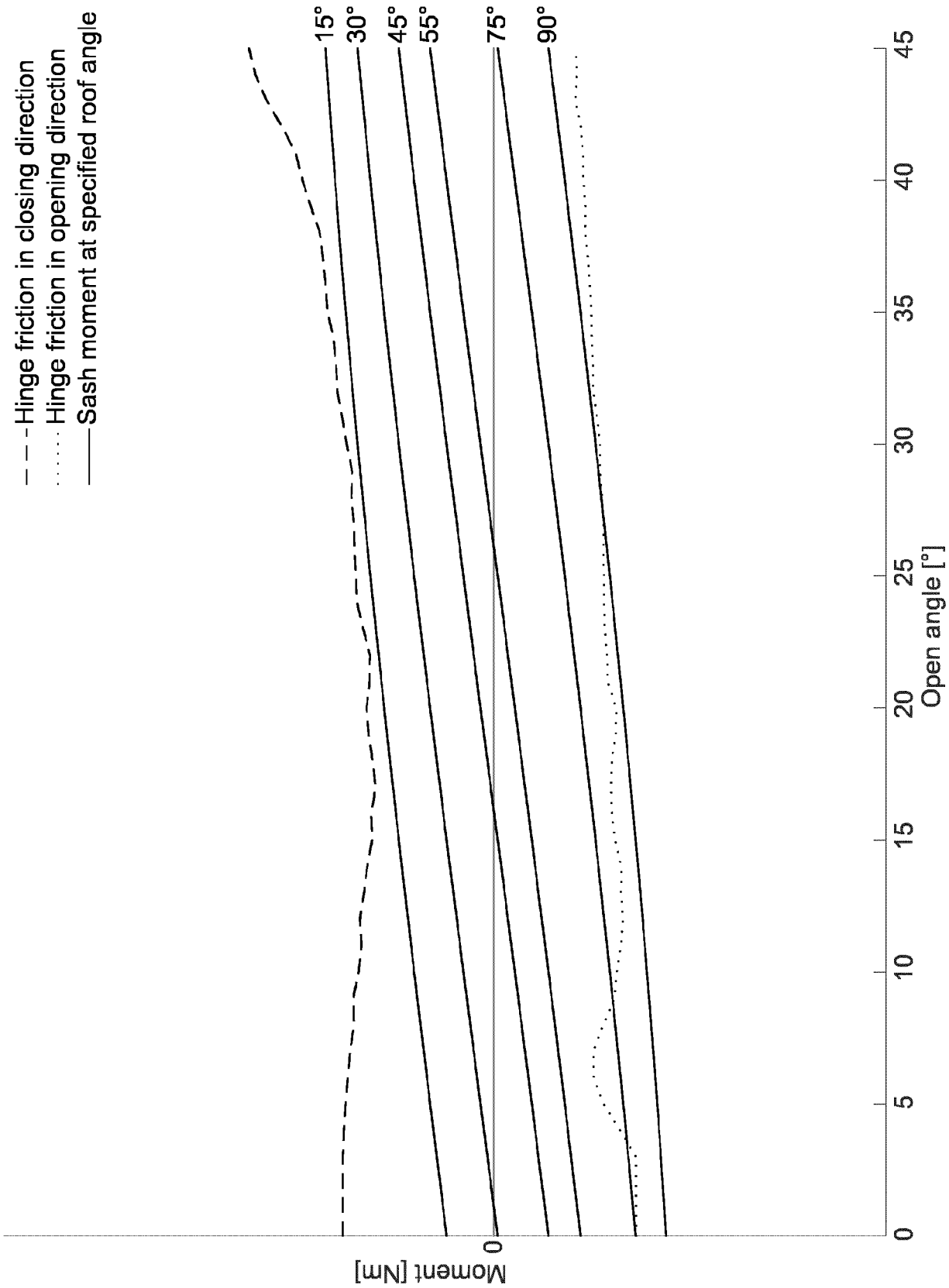
Hinge friction in closing direction
Hinge friction in opening direction
Sash moment at specified roof angle
15°
30°
45°
55°
75°
90°
0
Moment [Nm]
0
5
10
15
20
25
30
35
40
45
Open angle [°]

Fig. 13

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EUROPEAN SEARCH REPORT

Application Number
EP 18 20 7522

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Place of search	Date of completion of the search	Examiner
The Hague	11 March 2019	Rémondot, Xavier

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