(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 904 628 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.11.2021 Bulletin 2021/44

(51) Int Cl.:
E05F 15/619 *(2015.01)*

(21) Application number: **20172284.0**

(22) Date of filing: **30.04.2020**

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **VKR Holding A/S**
2970 Hørsholm (DK)

(72) Inventor: **AABOE, Thorbjørn**
2970 Hørsholm (DK)

(74) Representative: **Nordic Patent Service A/S**
Bredgade 30
1260 Copenhagen K (DK)

(54) WINDOW COMPRISING A PUSH PULL CHAIN ACTUATOR

(57) A window with at least one push pull chain actuator. An end connector with an extending finger transfers the load force and straightens the chain. A pull force is transferred elsewhere through the end connector. This force transfer in combination with a forward bending chain allows a longer chain stroke and higher chain capacity which enable slimmer window profiles. Further windows with chains having straight parallel chain sides are also disclosed.

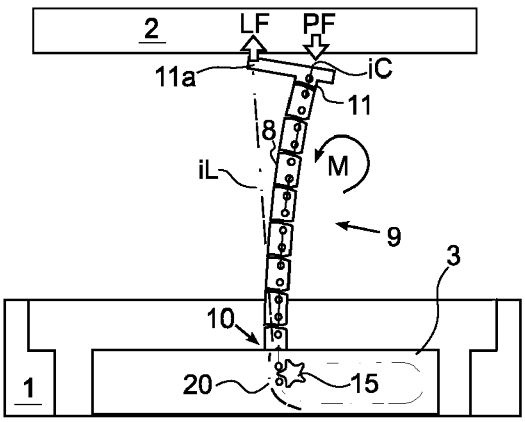

Fig. 4

EP 3 904 628 A1

Description

TECHNICAL FIELD

[0001] The disclosure relates to a building window comprising a sash and a frame adapted for receiving the sash. The sash is configured to open by means of a push pull chain actuator.

BACKGROUND

[0002] Chain actuators are popular because the push pull chain is stiff when extended but at the same time the chain can fold one way and wind up to be stored less visible for example along a window side. Chain actuators are compact and generally enable good application into windows.

[0003] Usually the push pull chain obtains stiff stability by bending beyond a straight line. A further benefit is that this also allows the chain to follow the opening radius of the window wing like shown in US20110302843. Such chain following the radius of the wing is not part of the present invention.

[0004] Prior art has suggested chain end connectors with springs and chain ends with offset connection. One example is shown in DE29514179U1 where fig. 1 shows a push pull chain having the extended position angle alfa of 90 degrees or more.

[0005] DE202012001762U1 also shows a push pull chain (fig 11a) which loads the chain by an inclined chain end connector fig 10b (43).

[0006] DE102016203452 also shows a chain bending back beyond a straight line to obtain stability.

SUMMARY

[0007] In the present disclosure by chain is understood a push pull chain which has a stiff configuration and a folded configuration.

It is an object to provide a window having an improved chain actuator with increased load and/or stroke.

Also it is an object to better utilize the chain capacity to allow smaller dimensions of the actuator. Because the chain actuator size affects the size of the window profiles in applications where the actuator is hidden in the window. Also it is an object to better utilize the chain capacity for applications in roof windows, where the chain must carry some of the window weight and the chain actuator must be oversized to accommodate heavy snow loads.

[0008] 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.

[0009] According to a first aspect, there is provided a window comprising a frame and a movable sash,

at least one chain configured to open and close the sash,

the chain has a chain back where chain links engage to form a stiff chain,

the stiff chain does not bend back past a straight line for stiffness, rather in an unloaded state the stiff chain bends forward,

the chain has an end connector with a finger portion which applies a one way load force at an imaginary vector line located behind a stiff chain center line,

and the chain end connector applies a pull force elsewhere than the imaginary vector line.

Hereby the window actuator chain is favorably stabilized which enables smaller dimensions and/or larger stroke. Furthermore, the end of the chain is easily connected to the sash of the window during install/assembly.

[0010] In a possible implementation of the first aspect, the finger portion extends away from and beyond the chain back and/or beyond a chain exit.

Hereby the load force is transferred such that the chain is stable.

[0011] In a further possible implementation of the first aspect, the imaginary vector line does not intersect the chain center line.

Hereby the chain does not risk sudden decrease of the load capacity.

[0012] In a further possible implementation of the first aspect, the chain end connector applies an increasing moment which increases with increased load force.

[0013] Hereby the chain capacity is increased compared to other stabilizing solutions such as a spring, which merely generates a constant moment.

[0014] In a further possible implementation of the first aspect, the chain end connector does not apply an increasing moment when pulling with a pull force.

Hereby the chain may pull without the stabilizing effect is reversed into a destabilizing effect.

[0015] In a further possible implementation of the first aspect, the pull force is substantially applied at the chain center line.

Hereby a neutral pull force is provided which does not destabilize the chain when pulling or under fluctuating loads.

[0016] In a further possible implementation of the first aspect, the pull force is more towards the front of the chain than the load force which is more to the back of the chain. Hereby the chain is stabilized under load without the pulling forces destabilize the chain. For example, a wind draft can change the direction from load to pull instantly.

[0017] In a further possible implementation of the first aspect, the extended chain sides are substantially straight and parallel.

Hereby both sides of the chain are loaded equally and the chain capacity is enhanced to allow larger load and/or stoke. For a tilting window this may require the chain actuator and the chain end connector is hinged.

[0018] In a further possible implementation of the first aspect, the finger portion and/or the start of the imaginary vector line extend behind the chain back by at least twice the amount which the chain bends forward in the unloaded stiff state.

Hereby the chain obtains stability and enhanced load capacity. Also the chain remains stable if impacted, which may otherwise cause the chain to collapse.

[0019] In a further possible implementation of the first aspect, the unloaded chain bends forward relative to a straight line at least 3mm, such as at least 6mm.
Hereby it is ensured the chain does not bend backwards past a straight line.

[0020] In a further possible implementation of the first aspect, the end connector is connected the to a bracket by means of one or more elongated openings which allow a defined displacement in the chain stroke direction whereby the pull force is transferred only.
Hereby it is possible to separate the position of the load force and the pull force. As a bonus the elongated openings also function as a bracket allowing the end connector to tilt and keep the chain sides parallel.

[0021] In a further possible implementation of the first aspect, where in a loaded state the stiff chain bends forward. Hereby the chain does not bend past a straight line when stiff but bends the opposite way. And with increased load the chain deforms towards a straight line and gains increased capacity.

[0022] In a further possible implementation of the first aspect, comprises an actuator from which extends the chain with the end connector and
wherein the actuator and the end connector are pivotably hinged to the frame and sash respectively.
Hereby the chain sides can remain straight and parallel and divide the load equally on both chain sides for increased capacity.

[0023] In a further possible implementation of the first aspect, the actuator is hidden inside the sash or inside the frame or in a cavity between the sash and frame.
Hereby the actuator is architecturally pleasing and well protected from the climate and burglars. In such configurations it is usually favorable the dimensions of the actuator are small.

[0024] In a further possible implementation of the first aspect, the window is a roof window and the chain supports at least part of the sash weight.
Hereby the high load capacity allows a roof window which can withstand a possible snow load. A further benefit is that the chain is stable under changing load conditions due to different roof angles and possible window addons such as roller shutters.

[0025] This and other aspects will be apparent from the embodiments described below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] 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. 1 shows a perspective view of a window.

Fig. 2 shows the interior of a push pull chain actuator.

Fig. 3a shows the front of a push pull chain.

Fig. 3b shows the back of a push pull chain.

Fig. 3c shows the side of the chain unloaded and according to scale.

Fig. 4 is an exaggerated model figure of an extended chain.

Fig. 5 shows the push pull chain end connector.

Fig. 6a shows a tilting window in an open position.

Fig. 6b shows a parallel displacement window in an open position.

DETAILED DESCRIPTION

[0027] Fig. 1 shows a window comprising a moving sash 2 and a frame 1 adapted for receiving the sash 2. The sash 2 is hinged to rotate about an axis or the hinges can provide a combined rotation and displacement or a parallel displacement etc. At least one push pull chain actuator is configured to open and close the sash. The chain actuator has an extending chain 9 and the actuator housing is connected to the frame and the chain end is connected to the sash. A vice versa arrangement is also possible. In examples the chain actuator housing is hidden in the window frame or hidden in the window sash or hidden in a cavity between the sash and frame. The chain actuator provides a pull force PF when retracting the chain 9 and pulling a window member. The chain actuator provides a load force LF when extending the chain 9 and pushing on a window member.

[0028] Fig. 2 shows the interior of a push pull chain actuator also known as a thrust chain because it can transmit a push force i.e. load force LF.
The chain actuator has a housing and the chain extends and retracts through an opening in the housing. The chain extends substantially perpendicular to the elongated housing. The chain actuator bends the chain when the chain is stored for example in two or more layers. The chain 9 extends substantially perpendicular to the stored layer(s) direction. This provides a compact solution which is advantageous. The chain actuator housing may be hinged to the window so the housing can tilt 12 during the opening movement.
The chain is driven by an electric motor 13. A reduction gear 14 comprising a worm and/or multiple gears drive the final sprocket gear 15 which engages the chain. A chain guide 20 (not shown in fig. 2) guides the chain towards the exit where the chain becomes stable. However different gear configurations may be used and the chain actuator does not need a sprocket to push the chain, but can also use a spindle etc.

The chain 9 has a back 8 where links engage to carry a push load. In this example the chain back 8 has a closed back where the links use the width of the chain for engagement. Other chain designs are also possible. The extending end 11 of the chain 9 is connected to a window member.

Chain Definition:

[0029] Fig. 3a shows the chain front and fig 3b shows the chain back and fig. 3c shows a similar chain from the side and according to scale in an unloaded state.

The chain 9 comprises links 4 joined by pins 6 which allow rotation in a chain plane P. And the pin 6 rotation axis is perpendicular to the chain plane.

The chain 9 has a chain front 5 with links 4 which allows bending forwards.

The chain 9 has a back 8 with links 4 which engage to form a stiff chain with limited bending backwards.

The chain has sides 7a,7b which extend between the chain front 5 and the chain back 8.

A chain center line extends through an imaginary line iC crossing through the pins 6 of the stiff chain and hereafter called center line iC.

[0030] Fig. 3b shows an example of a chain with an open back i.e. a see through back. Here both the inner and outer links 4 engage on each chain side 7a,7b. So the total push load is distributed among four chain links.

[0031] This example also shows the chain 9 is straight in the plane P. In other words the chain sides 7a,7b are substantially straight and parallel. Hereby the load is divided evenly on both sides of the chain and this allows a better capacity rating. And possibly a larger opening stroke and/or smaller dimensions of the actuator and window.

[0032] Fig. 3c shows a different chain with a little different link design. However the overall function is the same as previous figures. The chain here is unloaded and according to scale. And it is visible that the chain 9 is not completely straight. Nor does the chain bend back past a straight line. Fig. 3c shows the chain 9 bends forward. In one example the chain is 25cm long and at the middle D it bends substantially 5mm. In general terms the chain forward bending is curved with a height of 1-10mm, such as 3-8mm at the middle (vertex) for a 25cm chain. In more general terms the chain bends forward at the middle D by 1% to 4% of the chain stroke in the unloaded state. By forward bending chain is understood, that the chain engaging links 4 form an angle of less than 180 degrees around the chain pins 6.

A roof window for example can load the chain with 130Kg and this naturally makes the chain deform a little under load. By employing a forward bent chain 9 together with an end connector 11 (explained later) a stabilizing effect can be obtained which allows larger capacity and/or stroke.

[0033] Fig. 4 shows an exaggerated bending figure to explain the forces. The push pull chain 9 has engaged the back links 8 and is stiff and extended. The chain 9 bends forward and has an end connector 11 at the extended chain end. The end connector 11 applies a load force (LF) at an imaginary vector line iL located behind the stiff chain 9. Naturally the load can be applied at a surface or at multiple locations or at a single location. But the resulting load force LF vector is at the imaginary vector line iL. The end connector may for example be L or T shaped as explained later. To ensure the stabilizing effect the imaginary vector line iL does not intersect the forward bent chain 9 center line iC. The chain center line iC substantially meets the imaginary vector line iL at the chain actuator exit 10 where the chain links exit and achieve the stable and stiff chain configuration. The chain exit 10 is where the chain guide 20 terminates and where the chain 9 achieves stiffness and exits the housing.

The chain 9 deforms under heavy load. And a regular chain which bends beyond a straight line to obtain stiffness will gradually loose capacity with increased deformation. The current chain however bends forward in an unloaded stiff state. And the current chain will become more straight under load and gain load capacity.

The end connector 11 transfers the load force LF and pull force PF differently, meaning the load force LF automatically increases a moment M which maintains the chain stable with increased load. On the other hand the pull force PF acts at a different position where a more neutral pull can be provided.

Generally, if the pull was located at the same position as the load, then the forward 5 bent chain 9 would be urged towards possible collapse and failure. So the chain 9 end connector 11 transfers the pull force PF elsewhere than the imaginary vector line iL. In one example the pull force PF acts substantially at the chain 9 center line iC. In one example the pull force PF acts closer to the chain center line iC than to the imaginary vector line iL. Generally, all these effects are fulfilled by the end connector 11 described next.

[0034] Fig. 5 shows the push pull chain 9 with an end connector 11 provided at the extending chain end. And the figure illustrates the chain rotates about 90° to the front 5 in the stored configuration. The end connector 11 is connected to the last chain link. The end connector 11 extends along the direction from the back side 8 of the chain to the front side 5 of the chain. An engagement surface 11b located at the top of the end connector 11 and it transfers the load force LF only from a window member or from a bracket 16 on a window member. The end connector 11 with a finger portion 11a applies a one way load force LF at an imaginary vector line iL located behind the stiff chain center line iC. The pull force PF is transferred elsewhere from the load force LF. The end connector 11 extends into a finger portion 11a in the direction of the back side 8 of the chain. The finger portion 11a extends in the chain plane P. The finger portion 11a extends such that the load force LF is provided behind the chain back 8. The finger portion 11a is offset from the chain exit 10 in the chain backwards 8 direction. The finger portion 11a extends opposite of the forward bent chain 9. The load force LF which is applied at the finger portion 11a is transferred through an imaginary vector line iL located behind the stiff chain back 8. The finger portion 11a and the start of the imaginary vector line iL extend behind the chain back 8 by at least twice the amount, which the chain 9 bends forward in the unloaded stiff configuration. Understood so that if the stiff unloaded chain bends forward by 5mm, then the finger portion 11a and the start of the imaginary vector line iL extends at least 10mm behind the chain back 8.

The imaginary vector line iL extends from the finger portion 11a to the chain exit 10. At the chain exit 10 the imaginary vector line iL substantially meets the chain back. The imaginary vector line iL may move from the finger portion 11a along the engagement surface 11b when the chain deforms under heavy load, so figure 4 does not illustrate a permanent situation. The engagement surface 11b is inclined so the finger portion 11a is towards the top and/or so that the finger portion 11a is the point of load engagement. This ensures the load force LF is applied at the finger potion 11a. The finger portion 11a generally prevents the chain 9 from bending forwards. The end connector 11 has a threaded hole 11c and a fastener 17. The threaded hole 11c is substantially located at the chain center line iC. The fastener 17 transfers the pull force PF. A bracket 16 is located at a window member. The bracket 16 has elongated openings 18,19 which connect with the fastener 17. The elongated opening 18,19 are elongated in the chain stroke direction and the top of the openings 18,19 will never contact the fastener 17. The surface 11b will contact the bracket 16 before the fastener 17. Hereby it is ensured, that the fastener transfers a pull force (PF) only. Further the openings 18,19 also allow a pivoting movement so the chain sides 7a,7b can remain straight and parallel. Alternatively the openings 18,19 and the fastener 17 could be swapped, so the end connector 11 would have an elongated hole and the bracket 16 could have a thread for the fastener 17. Also the fastener 17 could be a pin or a hook suitable to pull.

Generally the shape of the end connector 11 can be different. The end connector may be L or Y or T shaped or be formed from a rod or a special chain link etc. This particular end connector 11 and bracket 16 design example is simply chosen to favor quick assembly in the window.

[0035] Fig. 6a shows a further enhanced embodiment with a window configuration with the chain actuator 3. The actuator 3 is hinged at an axis 12. And the chain end connector 11 is also hinged at a parallel axis 11. Hereby the chain 9 is neutral straight in the sideway 7a,7b direction and the chain remains in the straight chain plane P. And the opening sash radius r does not require the chain to bend sideways 7a,7b. Due to the hinged chain end connector 11 and the hinged actuator 3 the chain is straight and parallel in the sideway direction 7a,7b and an even further enhanced chain capacity and/or chain stroke is provided. The window has hinges which hold the sash 2 in the frame 1 and the actuator 3 hinged axis 12 and chain end connector axis 11 are located opposite to the window hinges. Generally the hinged actuator 3 axis 12 and chain end connector 11 axis are parallel with the window sash/frame side where the actuator is located. Fig. 6b shows a further enhanced embodiment with a window configuration where multiple chain actuators 3 open the window by parallel displacement (the frame 1 and sash 2 remain parallel). Due to the parallel displacement the chain is straight in the sideway direction 7a,7b and an even further enhanced chain capacity and/or chain stroke is provided. Windows with parallel displacement do not require the actuator or chain to be hinged. Fig. 6a and 6b show the actuator 3 at the frame 1, but the actuator can also be switched to the sash 2 instead.

[0036] The inventors have realized maximizing the chain capacity allows for a more compact and slimmer design which has a synergistic effect on the overall window profile design and/or roof window design. Also enhancing the chain stability allows for larger opening stroke and larger window openings. Further the lifetime of the chain is increased due to wear on the chain links being counteracted by the chain stabilizing effect.

Further roof windows benefit due to varying roof angles and load conditions such as push pull situations which occur. Another benefit is a reduced need for window load balancing by counterweights or springs etc. so the springs / counterweights do not need adjustment or entirely may be omitted. The same applies when a retrofit shutter or snow adds weight to a window.

[0037] 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, and the indefinite article "a" or "an" does not exclude a plurality. The end connector 11 may be from multiple separate parts. For example the pull force (PL) and load force (LF) can be managed by separate parts. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage.

[0038] The reference signs used in the claims shall not be construed as limiting the scope.

Claims

1. A window comprising a frame (1) and a movable sash (2), at least one chain (9) configured to open and close the sash (2),
   the chain (9) has a chain back (8) where chain links (4) engage to, when in a loaded state, form a stiff chain having a stiff chain center line (iC),

the chain (9) furthermore being configured such that, when in an unloaded state, the chain (9) does not bend back past the straight stiff chain center line (iC) and past the chain back (8), but rather bends forward past a chain front (5),
the chain (9) has an end connector (11) with a finger portion (11a) which applies a one way load force (LF) on the sash (2) or the frame (1) at an imaginary vector line (iL) located past the stiff chain center line (iC) and past the chain back (8),
and the chain end connector (11) applies a pull force (PF) on the sash (2) or the frame (1) elsewhere than at the imaginary vector line (iL).

2. The window according to claim 1, where the finger portion (11a) extends away from and past the chain back (8) and/or past a chain exit (10), the chain exit (10) being arranged at the frame (1).

3. The window according to any one of the previous claims, where the imaginary vector line (iL) does not intersect the chain center line (iC).

4. The window according to any one of the previous claims, where the chain end connector (11) applies a moment (M) onto the chain (9) which increases with increased load force (LF) .

5. The window according to any one of the previous claims, where the chain (end connector (11) does not apply an increasing moment (M) onto the chain (9) when pulling with a pull force (PF).

6. The window according to any one of the previous claims, wherein the pull force (PF) is substantially applied at the chain center line (iC).

7. The window according to any one of the previous claims, where the pull force (PF) is applied closer to the chain front (5) than the load force (LF), the load force (LF) being applied closer to the chain back (8).

8. The window according to any one of the previous claims, where extended chain sides (7a,7b) are substantially straight and parallel.

9. The window according to any one of the previous claims, wherein the finger portion (11a) and/or a start of the imaginary vector line (iL) extend past the chain back (8) by at least twice the amount by which the chain (9) bends forward in the unloaded state.

10. The window according to any one of the previous claims, wherein the unloaded chain center line (iC) bends forward relative to the straight line by at least 3mm, such as at least 6mm.

11. The window according to any one of the previous claims, wherein the end connector (11) is connected to a bracket (16) by means of one or more elongated openings (18,19) which allow a defined displacement in the chain stroke direction whereby only the pull force (PL) is transferred.

12. The window according to any one of the previous claims where in a loaded state the stiff chain (9) bends forward.

13. The window according to any one of the previous claims, comprising an actuator (3) from which the chain (9) with the end connector (11) extends and wherein the actuator (3) and the end connector (11) are pivotably hinged to the frame and sash respectively.

14. The window according to any one of the previous claims, wherein the actuator (3) is hidden inside the sash (2) or inside the frame (1) or in a cavity between the sash (2) and frame (1).

15. The window according to any one of the previous claims, wherein the window is a roof window and the chain (9) supports at least part of the sash (2) weight.

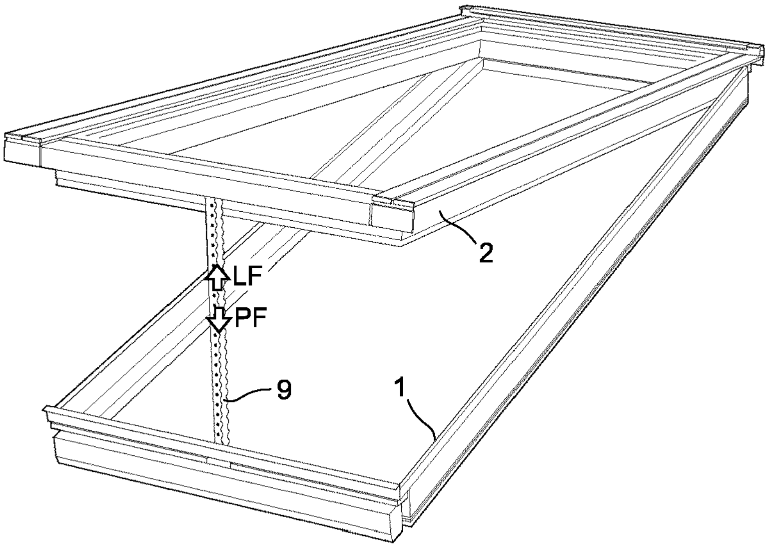

Fig. 1

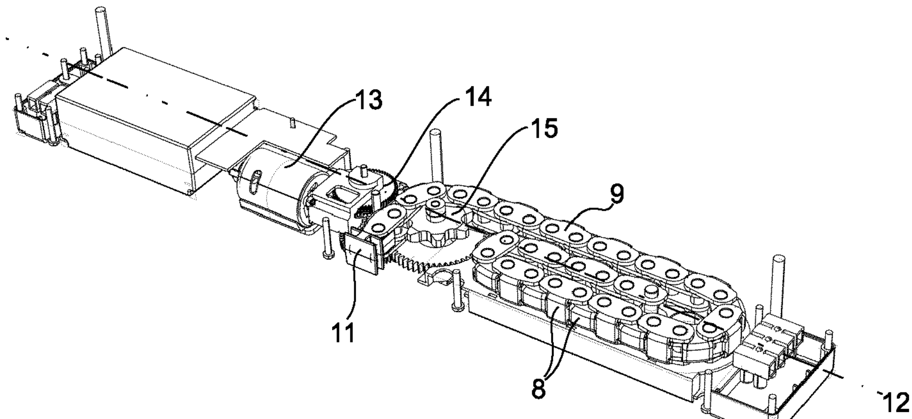

Fig. 2

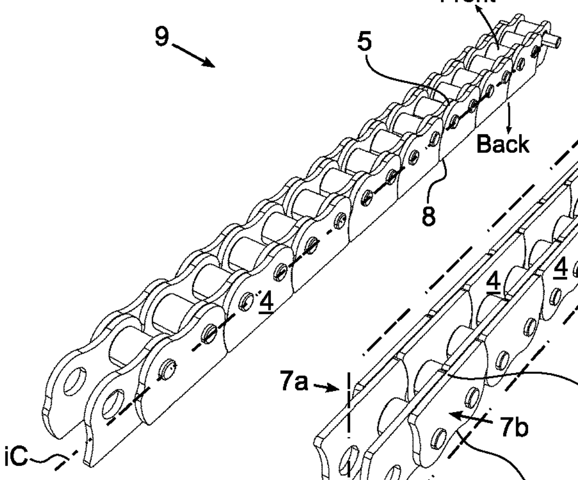

Fig. 3a

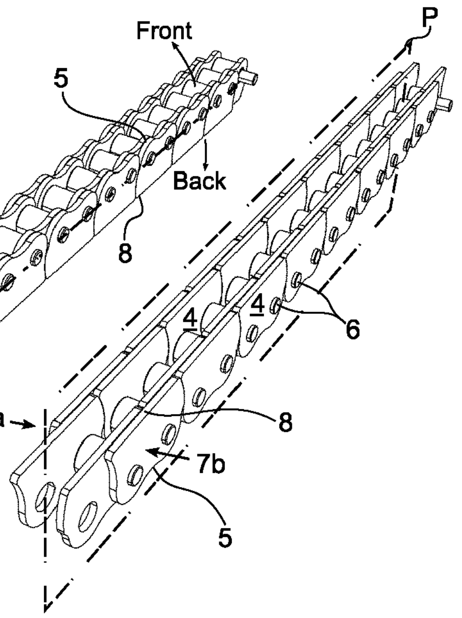

Fig. 3b

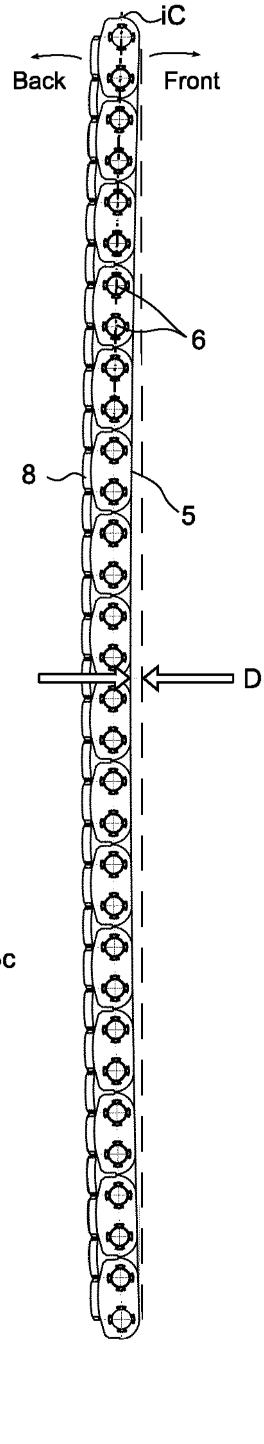

Fig. 3c

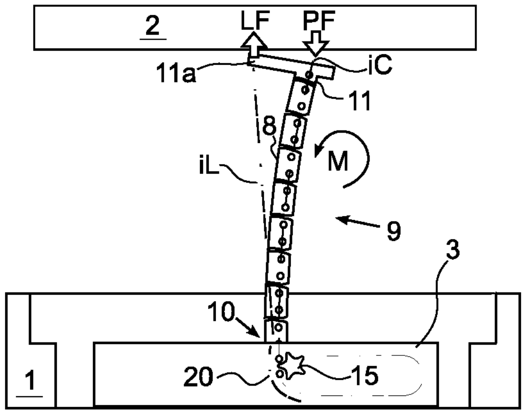
2
LF
PF
11a
iC
11
8
M
iL
9
3
10
1
20
15

Fig. 4

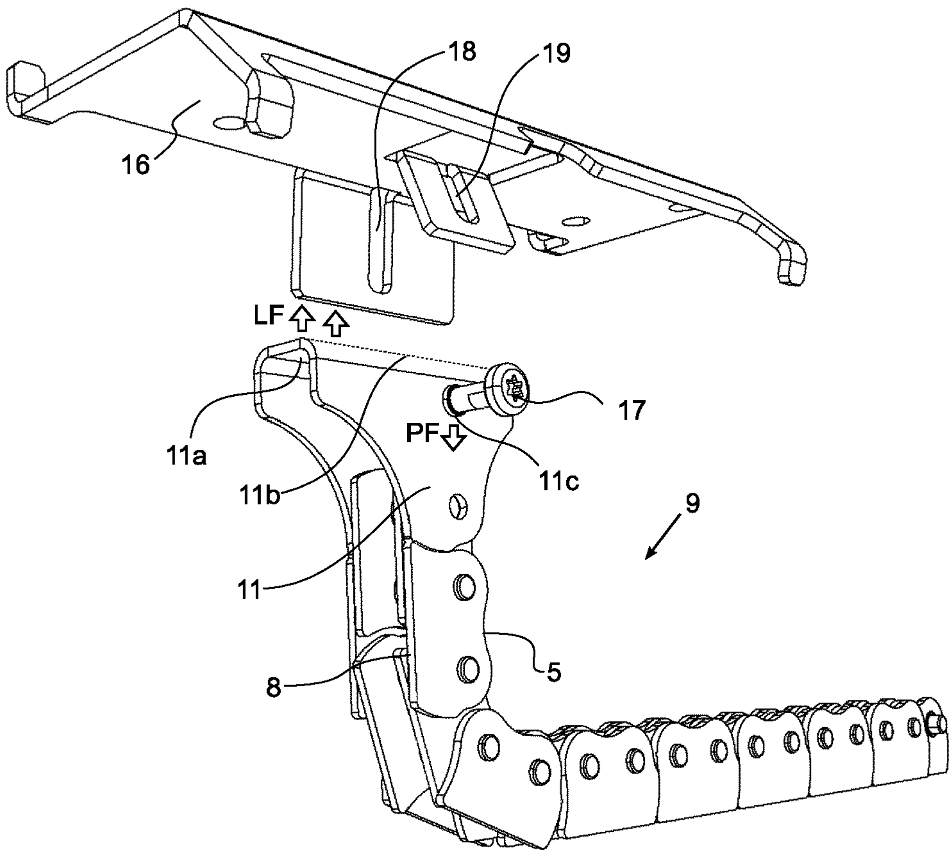
18
19
16
LF
17
11a
PF
11c
11b
9
11
5
8

Fig. 5

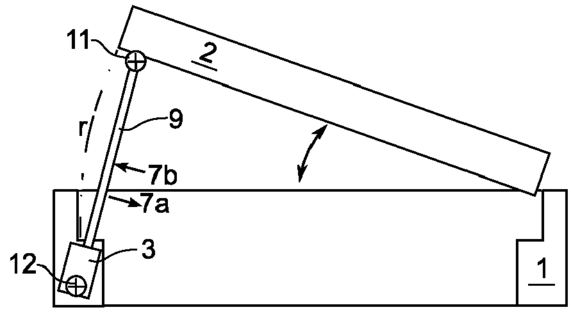

Fig. 6a

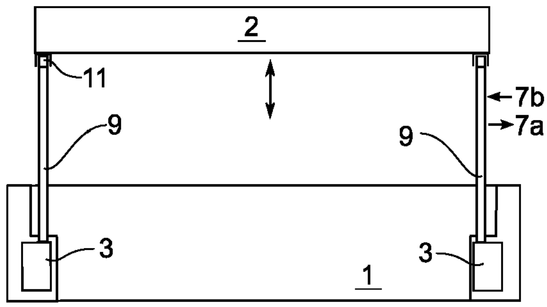

Fig. 6b

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 17 2284

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
E	EP 3 647 521 A1 (VKR HOLDING AS [DK]) 6 May 2020 (2020-05-06) * paragraphs [0029] - [0041]; figures 1-3c * -----	1-8,11, 14,15	INV. E05F15/619
A	DE 298 16 102 U1 (D & H MECHATRONIC DINGFELDER & [DE]) 17 December 1998 (1998-12-17) * page 2, line 21 - page 3, line 13; figures 1-3 * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

E05F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	30 September 2020	Klemke, Beate

CATEGORY OF CITED DOCUMENTS

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

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

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 17 2284

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

30-09-2020

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 3647521	A1	06-05-2020	NONE	
DE 29816102	U1	17-12-1998	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- US 20110302843 A **[0003]**
- DE 29514179 U1 **[0004]**
- DE 202012001762 U1 **[0005]**
- DE 102016203452 **[0006]**