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(54) **CHAIN ACTUATOR PARTICULARLY FOR FRAME AND WINDOW CLOSURE SYSTEMS**

(57) The invention relates to a chain actuator (10) particularly for frame and window closing systems, comprising:

- a box-shaped body (11), with a mainly longitudinal extension;
- an operating lever (12) pivotably mounted by means of pivoting means (13) at one end (11a) of the box-shaped body (11);
- a rigid push-and-pull chain (14);
- a gearmotor unit (15) configured for the movement of the rigid chain (14), said gearmotor unit (15) being positioned in a first internal compartment (16) of said box-shaped body (11);
- a second internal compartment (17) of said box-shaped body (11), configured to accommodate said rigid chain (14) in the folded-up non-operative arrangement;
- a through-opening (18) for the passage of said rigid chain (14), said through-opening (18) being defined on said box-shaped body (11);
- a gas spring (19) fastened at a first end (19a) thereof to said operating lever (12) by means of a first hinge (21) and, at the second opposite end (19b), to said box-shaped body (11) by means of a second hinge (22).

A first distance (L10) between said through-opening (18) and said pivoting means (13) is smaller than a second distance (L20) between said second hinge (22) of

said second end (19b) of said gas spring (19) and said pivoting means (13).

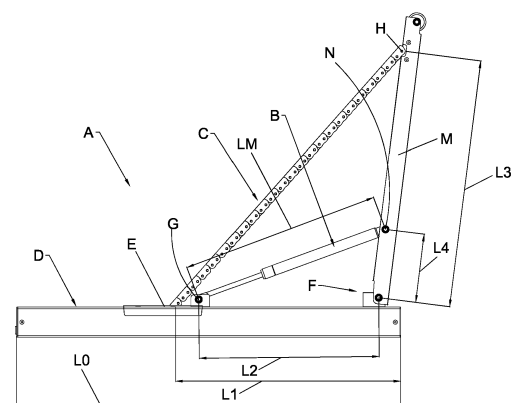


Fig.1

Description

Technical sector

[0001] The present invention relates to a chain actuator particularly for frame and window closing systems.

Prior art

[0002] Nowadays, actuators for window units called "chain actuators" are known.

[0003] In the sector relating to the manufacture of window units, chain actuators are especially used for actuating window units intended to be placed in positions which are difficult to access, as in the case, for example, of skylights.

[0004] A type of chain actuator which is increasingly more widespread is a chain actuator which comprises:

- a longitudinally extending box-shaped body, which is normally fixed to an upright or to the upper cross-piece of a window unit;
- an operating lever which is pivotably mounted by means of pivoting means at one end of said box-shaped body, where said operating lever is usually configured to move the window which is hinged with the frame;
- a rigid pull-and-push chain, which is configured to assume an operative, pushing or pulling, extended arrangement outside the box-shaped body or a non-operative folded-up arrangement inside the box-shaped body; the rigid chain is positioned and configured so as to exert a pushing or pulling force on the operating lever; the rigid chain is fastened at a first end thereof to the operating lever at a fastening point and, at a second opposite end, is fastened inside the box-shaped body;
- a gearmotor unit configured for the movement of said rigid chain, said gearmotor unit being positioned in a first internal compartment of the box-shaped body;
- a second internal compartment of the box-shaped body, configured to accommodate the rigid chain in the folded-up non-operative arrangement;
- a through-opening for the passage of the rigid chain, said through-opening being defined on the said box-shaped body;
- an auxiliary gas spring, which auxiliary gas spring is fastened at a first hinge thereof to the operating lever by means of a first hinge, and at the second opposite end to the box-shaped body by means of a second hinge.

[0005] The gas spring helps maintain the position acquired by the operating lever with respect to the box-shaped body, opposing any stressing forces resulting from the window should it in turn be stressed, for example, by the wind.

[0006] It is in fact known that the so-called "rigid chain"

is a chain which has links which are connected together and shaped so as to rotate relative to each other about a hinging axis, through a small angle, namely each link is shaped so as to have an end-of-rotation portion which prevents a following link hinged therewith from rotating in a direction, for example an anti-clockwise direction, beyond a certain predefined angle.

[0007] In this way, as the chain gradually extends outside of the box-shaped body, each of the links rests on the following link emerging from the box-shaped body, so as to be able to mutually support each other and assume a stable aligned configuration, namely "rigid chain" configuration, which allows the said chain to operate with a thrusting force, for example so as to support the weight of a window and keep it in an open position with respect to a frame.

[0008] Such a chain actuator is configured to extend or retract the chain so that the at least partial extension of the chain is followed by a rotation of the window away from the frame, and the retraction of the chain instead performs a rotation of the window towards the frame.

[0009] Chain actuators with an auxiliary gas spring, although known and widespread, have a number of aspects which are subject to improvement.

[0010] A first aspect is associated with the fact that the gas spring must be able to exert a pulling force on the operating lever, when the window is open, so as to keep the links of the rigid chain pressed, namely compressed, against each other also in windy weather conditions and at the same time must have a size such as not to exceed the dimensions which are normally acceptable for chain actuators of the known type.

[0011] An example of a chain actuator of the known type is schematically shown in Figure 1 and is indicated there overall by the letter A.

[0012] During adaptation to the dimensions of the gas spring B, the rigid chain C is normally positioned so that:

- the distance L1 between the through-opening E on the box-shaped body D, from which the rigid chain C emerges, and the pivoting means F is greater than the distance L2 between the hinge G on the box-shaped body D of the gas spring B and said pivoting means F;
- and the distance L3 between the point H where said rigid chain C is fastened to said operating lever M and the pivoting means F is greater than the distance L4 between the hinge N of the gas spring B with the lever M and the pivoting means F.

[0013] With this relative arrangement of the rigid chain C and the gas spring B, in order to perform rotation of the operating lever N with respect to the box-shaped body D such as to cause the opening of a window with respect to the frame through 90°, it is necessary to have a relatively long rigid chain C, i.e. one which is composed of a relatively large number of links.

[0014] L0 denotes the overall length of the box-shaped

body D in the direction of longitudinal extension of the said box-shaped body D.

[0015] A long rigid chain means that, in addition to the corresponding costs which are proportional to the length of the rigid chain itself, the longitudinal dimension of the box-shaped body must also be determined in relation to the length of the rigid chain, since the chain in the collapsed non-operative arrangement is housed inside an internal compartment of the box-shaped body, the length of which may not be less than half the length of the rigid chain in the completely extended condition when the links are arranged along two essentially parallel rows inside the box-shaped body, or the length of which may not be less than one third of the length of the rigid chain when the links are arranged along three essentially parallel rows inside the box-shaped body.

[0016] Therefore, inside the box-shaped body of the chain actuator, for the same dimensions of the motor, gearmotor and other electrical power supply components, the compartment containing the rigid chain, and therefore the box-shaped body as a whole, is all the longer, and therefore bulkier, the longer the rigid chain.

[0017] A second drawback resulting from the length of the rigid chain is the operating speed of the chain actuator: the further away the through-opening E is situated from the pivoting means F the greater is the distance which the first link of the rigid chain C must travel in order to bring the operating lever M into the desired angular arrangement.

Summary of the invention

[0018] The technical problem posed and solved by the present invention is therefore that of providing a chain actuator particularly for frame and window closing systems which is able to overcome the drawbacks mentioned with reference to the prior art.

[0019] An important object of the present invention is to provide a chain actuator, the longitudinal dimension of which is smaller compared to the prior art, for the same components arranged inside the box-shaped body of the said chain actuator.

[0020] Another object of the present invention is to provide a chain actuator which is able to speed up the opening and closing actions compared to similar chain actuators of the known type.

[0021] Yet another object of the present invention is to provide a chain actuator which has a lower cost compared to similar chain actuators of the known type. Another object of the invention is to provide a chain actuator which is simple to use in the manner of that which is known.

[0022] The aforementioned task and the objects are solved by a chain actuator particularly for frame and window closing systems according to claim 1. Preferred characteristic features of the present invention are the subject of the dependent claims.

Brief description of the figures

[0023] Reference will be made to the figures of the attached drawings in which:

- Figure 1 shows a plan view of a chain actuator of the known type;
- Figure 2 shows a plan view of a chain actuator according to the invention;
- Figure 3 shows a perspective view of a chain actuator according to the invention;
- Figure 4 shows a perspective cut-away view of the chain actuator according to the invention, in an open arrangement;
- Figure 5 shows a perspective cut-away view of the chain actuator according to the invention, in a closed arrangement;
- Figure 6 shows a side view of the chain actuator according to the invention, in an open arrangement;
- Figure 7 shows a cross-sectional view of the actuator according to the invention.

[0024] The thicknesses and curvatures shown in the figures mentioned above must be understood as being purely exemplary and are generally on a larger scale and not necessarily shown in proportion.

Detailed description of preferred embodiments

[0025] Below an embodiment of the invention will be described with reference to the figures mentioned above.

[0026] Similar components are indicated in the various figures by the same reference number.

[0027] In the detailed description which follows, embodiments and variants in addition to those embodiments and variants already considered in the same description will be described only with regard to their differences from that already illustrated.

[0028] Furthermore, the various embodiments and variants described below may be combined, where compatible.

[0029] With reference to the aforementioned figures, an embodiment of a chain actuator, particularly for frame and window closing systems, according to the invention is denoted overall by the number 10.

[0030] Such a chain actuator 10 comprises:

- a box-shaped body 11, with a mainly longitudinal extension;
- an operating lever 12 pivotably mounted by means of pivoting means 13 at one end 11a of the box-shaped body 11;
- a rigid pull-and-push chain 14, which is configured to assume an operative extended arrangement outside the box-shaped body 11 or a non-operative folded-up arrangement inside the box-shaped body 11; said rigid chain 14 is positioned and configured so as to exert a pushing or pulling force on the operating

lever 12; the rigid chain 14 is fastened at a first end 14a thereof to the operating lever 12 at a fastening point 20 and, at the second opposite end 14b, is fastened inside the box-shaped body 11;

- a gearmotor unit 15 configured for the movement of said rigid chain 14, said gearmotor unit 15 being positioned in a first internal compartment 16 of the box-shaped body 11;
- a second internal compartment 17 of the box-shaped body 11, configured to accommodate the rigid chain 14 in the folded-up non-operative arrangement, as shown by way of example in Figure 5;
- a through-opening 18 for the passage of the rigid chain 14, said through-opening 18 being defined on the box-shaped body 11;
- a gas spring; said gas spring 19 is used as an auxiliary element for helping maintain the position acquired by the operating lever with respect to the box-shaped body, opposing any stressing forces resulting from the window should it in turn be stressed, for example, by the wind; the gas spring 19 is fastened at a first end 19a thereof to the operating lever 12 by means of a first hinge 21; the auxiliary gas spring 19 is fastened at the second opposite end 19b to the box-shaped body 11 by means of a second hinge 22.

[0031] The particular feature of the chain actuator 10 according to the invention lies in the fact that a first distance L10 between the through-opening 18 and the pivoting means 13 is smaller than a second distance L20 between the second hinge 22 of the second end 19b of the auxiliary gas spring 10 and said pivoting means 13.

[0032] The point of the through-opening 18 to be taken into consideration for the measurement of the first distance L10 is a middle point of the longitudinal dimension of the through-opening 18.

[0033] Preferably, but not exclusively, a third distance L30 between the point where the rigid chain 14 is fastened to the operating lever 12 and the pivoting means 13 is greater than a fourth distance L40 between the first end 19a of the gas spring 19 and the pivoting means 13.

[0034] The pivoting means 13 comprise, in the present example of embodiment, a projecting body 25 fixed to the box-shaped body 11, and a lever pin 26.

[0035] The projecting body 25 consists for example of a parallelepiped block, for example made of metallic material.

[0036] The point of the pivoting means 13 to be taken into consideration for measurement of the first distance L10 is the axis of the lever pin 26.

[0037] The operating lever 12 comprises a fork-shaped hinging end 12a configured for rotatable coupling with the projecting body 25 by means of the lever pin 26. The rigid chain 14 and the gas spring 19 are arranged so as to operate side-by-side between the box-shaped body 11 and the operating lever 12.

[0038] In particular, as schematically shown in Figure 6, the rigid chain 14 is arranged so as to operate in a first

operating plane P1 and the gas spring 19 is arranged so as to operate in a second operating plane P2 parallel to the first operating plane P1.

[0039] The operating lever 12 has a longitudinal recess 28 for the gas spring 19 in the shortened rest arrangement. In other words, the longitudinal recess 28 is configured to accommodate the gas spring 19 in the shortened rest arrangement.

[0040] The shortened rest arrangement occurs when the rigid chain 14 is in the folded-up non-operative arrangement.

[0041] Said longitudinal recess 28 is defined along a first lateral portion 29 of the operating lever 12.

[0042] The fastening point 20 of the rigid chain 14 is positioned on the second opposite lateral portion 30 of the operating lever 12.

[0043] The two lateral portions 29 and 30 are obviously arranged alongside and adjacent in a transverse direction with respect to a direction parallel to the operating planes P1 and P2. In other words, the two lateral portions 29 and 30 correspond to the two opposite sides of the operating lever 12 in the main direction of the extension of the latter, as is clearly visible in Figure 6.

[0044] The rigid chain 14 comprises, or is composed of, in a known manner, a plurality of links 41, or link elements, or segments, which are arranged in series between a head segment 42, connected to the operating lever 12, and a tail segment 44. The head segment 42 and the tail segment 44 constitute, therefore, the end segments of the rigid chain 40.

[0045] In particular, each link of the plurality of links 41 has a direction of extension S and is connected to at least one further adjacent, neighbouring or adjoining link of the plurality of links 41, 42 and 44 so as to rotate with respect to the latter reversibly about a hinge axis C, shown by way of example in Figure 7, in a jamming direction or in a winding direction so that its direction of extension S is oriented respectively between a jamming angle, or jamming arrangement, and a winding angle or winding arrangement. In other words, each link of the plurality of links 41, 42 and 44 is associated rotatably with a further link so as to be able to rotate with respect to the latter about a hinge axis C, the latter being shown by way of example in Figure 7, in a jamming direction or in an opposite winding direction. In this way, each segment of the plurality of segments 41 may be arranged, with respect to the further segment with which it is rotatably associated, so as to orient its direction of extension S between a jamming angle and a winding angle.

[0046] Therefore, the winding direction may be the direction of the rotation about the hinge axis C, which allows a link 41 to orient its direction of extension S at the winding angle. Vice versa, the winding direction may be the direction of the rotation about the hinge axis C, which allows one link of the plurality of links 41 to orient its direction of extension S at the jamming angle.

[0047] In general, the respective directions of extension S are schematically shown in broken lines in Figure

5.

[0048] At the jamming angle each link of the plurality of segments 41, in particular of each of the links situated between the head link 42 and the links 41 engaged by the gearmotor unit 15, has its direction of extension S substantially parallel to the direction of extension S of the further segment so as to exert a stressing force along an operating direction D and move the operating lever 12 with respect to the box-shaped body 11.

[0049] The operating direction D is graphically indicated by way of example in Figure 4. When the links 41, 42 of the rigid chain 12 are at the jamming angle, the rigid chain 12 has a sufficient rigidity to exert a stressing force on the operating lever 12 along said operating direction D.

[0050] Said operating direction D therefore represents a stressing direction, such as a pulling or pushing force, along which the rigid chain 12 operates the operating lever 12.

[0051] The plane in which the jamming angle and the winding angle lie are defined, or lie, is the first operating plane P1 of the rigid chain 12.

[0052] The gearmotor unit 15 comprises an electric motor 45 designed to transfer the driving torque to an output gear 46 connected directly to or coaxially with a pinion 47 configured to mesh with the rigid chain 12.

[0053] The pinion 47 is positioned so as to rotate in the first operating plane P1, i.e. with its axis of rotation perpendicular to the first operating plane P1.

[0054] In particular, the first operating plane P1 does not coincide with the longitudinal median plane PM of the box-shaped body 11, as shown in Figure 7.

[0055] Namely, the first operating plane P1 is laterally displaced with respect to the median plane PM.

[0056] The second operating plane P2, of the auxiliary gas spring 10, is laterally displaced with respect to the median plane PM, on the opposite to the side where the first operating plane P1 is defined.

[0057] The through-opening 18 is defined in a cover 50 which is fixed over an open assembly window 51 on the box-shaped body 11.

[0058] The chain actuator 10 according to the invention, owing to the displaced position of the rigid chain 14 and the gas spring 19, is able to fulfil the aforementioned task and objects.

[0059] In particular, with L00 indicating the length of the box-shaped body 11 in the direction of longitudinal extension of the same box-shaped body 11, as can be clearly seen by comparing Figures 1 and 2, for the same length LM of the gas spring B and 19, respectively, for the same length of the box-shaped body L0 and L00, and for the same position of the points where the gas spring is fastened to the box-shaped body and the operating lever, by arranging the rigid chain 14 and the gas spring 19 so that they operate in operating planes P1 and P2 which are parallel, but separate, it is possible to use a rigid chain 14 which is shorter than a rigid chain C of the prior art, and it is therefore possible to use a box-shaped body 11 which is shorter than a box-shaped body D, with

the same cross-section, of the prior art.

[0060] The chain actuator 10 according to the present invention therefore provides several significant advantages.

5 **[0061]** In particular, with the present invention a chain actuator has been provided where the longitudinal dimension is smaller compared to the prior art, for the same components arranged inside the box-shaped body of the said chain actuator and for the same auxiliary gas spring.

10 **[0062]** Furthermore, with the invention a chain actuator has been provided where it is possible to use a gas spring with larger dimensions compared to the similar solutions of the prior art, with a consequent increase in the thrusting force produced by the said gas spring, something which cannot be realized with the known solutions; said advantage is possible precisely because of the particular configuration of the actuator according to the present invention in which the gas spring is arranged alongside the rigid chain since it does not "intersect" the operating lever.

20 **[0063]** Basically, with this invention there is the possibility of increasing the second distance L20 and/or the fourth distance L40 by displacing the pushing point towards the end of the operating lever 12 and therefore into a more advantageous condition since situated further away from the hinging means 13; this can be achieved also for the same force of the gas spring.

25 **[0064]** According to a variation of embodiment of the chain actuator according to the invention, not shown for simpler illustration, the fourth distance L40 is greater than or the same as the third distance L30; namely the pushing point of the rigid chain on the operating lever is located at the same distance or at a smaller distance from the hinging means of the operating lever than the pushing/pulling point of the gas spring on the operating lever.

30 **[0065]** Furthermore, the present invention provides a chain actuator which has a faster opening and closing action compared to similar chain actuators of the known type, owing to the smaller length of the rigid chain.

35 **[0066]** Furthermore, the present invention provides a chain actuator which has a lower cost compared to similar chain actuators of the known type, owing to the significant reduction in the number of links of the rigid chain.

40 **[0067]** Last but not least, the invention provides a chain actuator which is simple to use, in the same manner as that which is known.

45 **[0068]** The present invention has been described hitherto with reference to preferred embodiments thereof. It is to be understood that other embodiments relating to the same inventive idea may exist, all of these falling within the scope of protection of the claims which are illustrated hereinbelow.

Claims

55 1. Chain actuator (10) particularly for frame and window closing systems, comprising:

- a box-shaped body (11), with a mainly longitudinal extension,
 - an operating lever (12) pivotably mounted by means of pivoting means (13) at one end (11a) of said box-shaped body (11),
 - a rigid push-and-pull chain (14), configured to assume an operative, pushing or pulling, extended arrangement outside said box-shaped body (11) or a non-operative folded-up arrangement inside said box-shaped body (11), said rigid chain (14) being positioned and configured in such a way as to exert a push or pull on said operating lever (12), said rigid chain (14) being fastened at a first end (14a) thereof to said operating lever (12) at a fastening point (20), and at the second opposite end (14b) being fastened inside said box-shaped body (11),
 - a gearmotor unit (15) configured for the movement of said rigid chain (14), said gearmotor unit (15) being positioned in a first internal compartment (16) of said box-shaped body (11),
 - a second internal compartment (17) of said box-shaped body (11), configured to accommodate said rigid chain (14) in the folded-up non-operative arrangement,
 - a through-opening (18) for the passage of said rigid chain (14), said through-opening (18) being defined on said box-shaped body (11),
 - a gas spring (19), said gas spring (19) being fastened at a first end (19a) thereof to said operating lever (12) by means of a first hinge (21), said gas spring (19) being fastened at the second opposite end (19b) to said box-shaped body (11) by means of a second hinge (22),

characterized in that a first distance (L10) between said through-opening (18) and said pivoting means (13) is smaller than a second distance (L20) between said second hinge (22) of said second end (19b) of said gas spring (19) and said pivoting means (13).

2. Chain actuator according to claim 1, **characterized in that** a third distance (L30) between said fastening point (20) of said rigid chain (14) on said operating lever (12) and said pivoting means (13) is greater than a fourth distance (L40) between said first end (19a) of said gas spring (19) and said pivoting means (13).
3. Chain actuator according to claim 1 or 2, **characterized in that** said pivoting means (13) comprise a projecting body (25) fixed to said box-shaped body (11), and a lever pin (26), said operating lever (12) comprising a fork-shaped hinging end (12a) configured for rotatable coupling with said projecting body (25) by means of said lever pin (26).
4. Chain actuator according to one or more of the pre-

ceding claims, **characterized in that** said rigid chain (14) and said gas spring (19) are arranged to operate side-by-side between the box-shaped body (11) and the operating lever (12).

5. Chain actuator according to one or more of the preceding claims, **characterized in that** said rigid chain (14) is arranged so as to operate in a first operating plane (P1) and said gas spring (19) is arranged so as to operate in a second operating plane (P2) parallel to said first operating plane (P1).
6. Chain actuator according to one or more of the preceding claims, **characterized in that** said operating lever (12) has a longitudinal recess (28) for said gas spring (19) in the shortened rest arrangement.
7. Chain actuator according to the preceding claim, **characterized in that** said longitudinal recess (28) is defined along a first lateral portion (29) of said operating lever (12).
8. Chain actuator according to the preceding claim, **characterized in that** said fastening point (20) of said rigid chain (14) is positioned on a second opposite lateral portion (30) of said operating lever (12).
9. Chain actuator according to one or more of the preceding claims, **characterized in that** said first operating plane (P1) does not coincide with the longitudinal median plane (PM) of the box-shaped body (11).
10. Chain actuator according to the preceding claim, **characterized in that** said first operating plane (P1) is laterally displaced with respect to said median plane (PM), said second operating plane (P2), of said gas spring (19), being laterally displaced with respect to the median plane (PM), on the opposite side to the side where said first operating plane (P1) is defined.

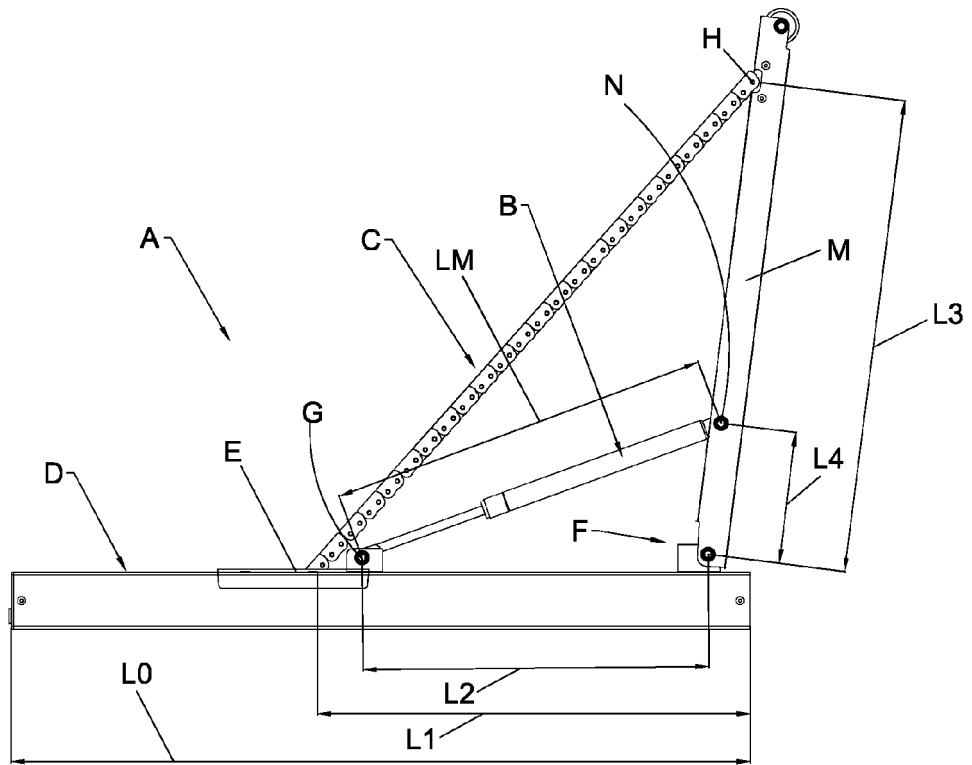


Fig.1

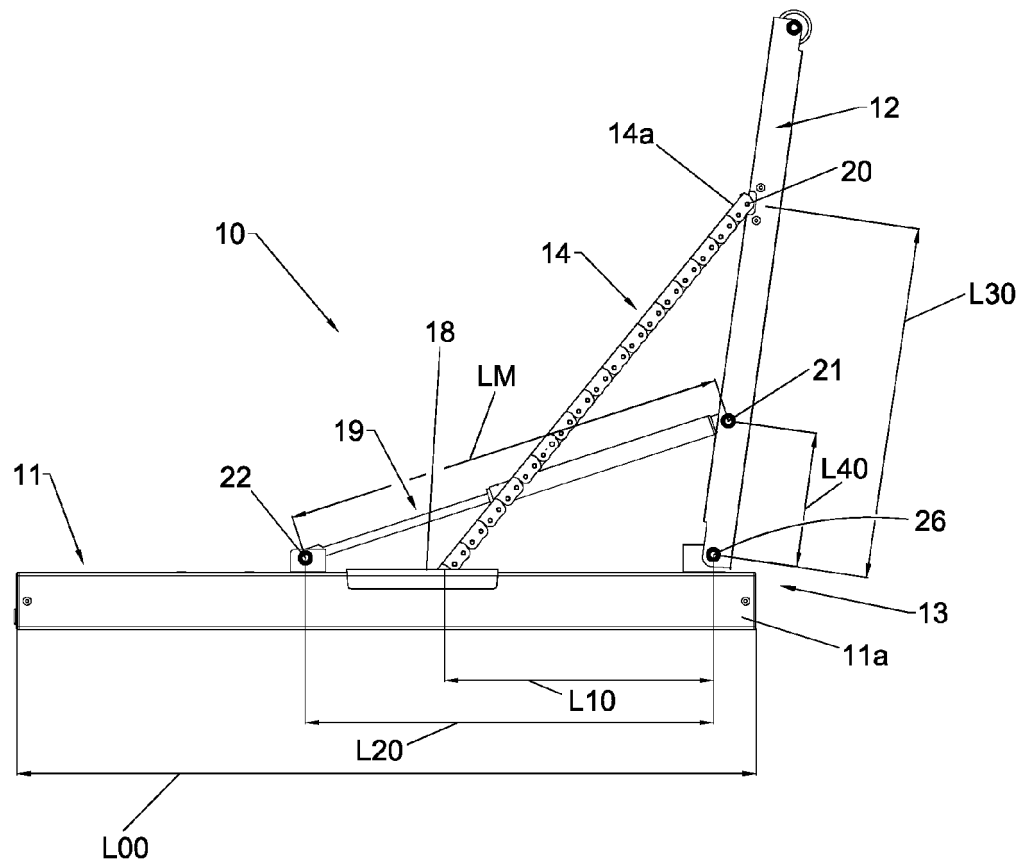


Fig.2

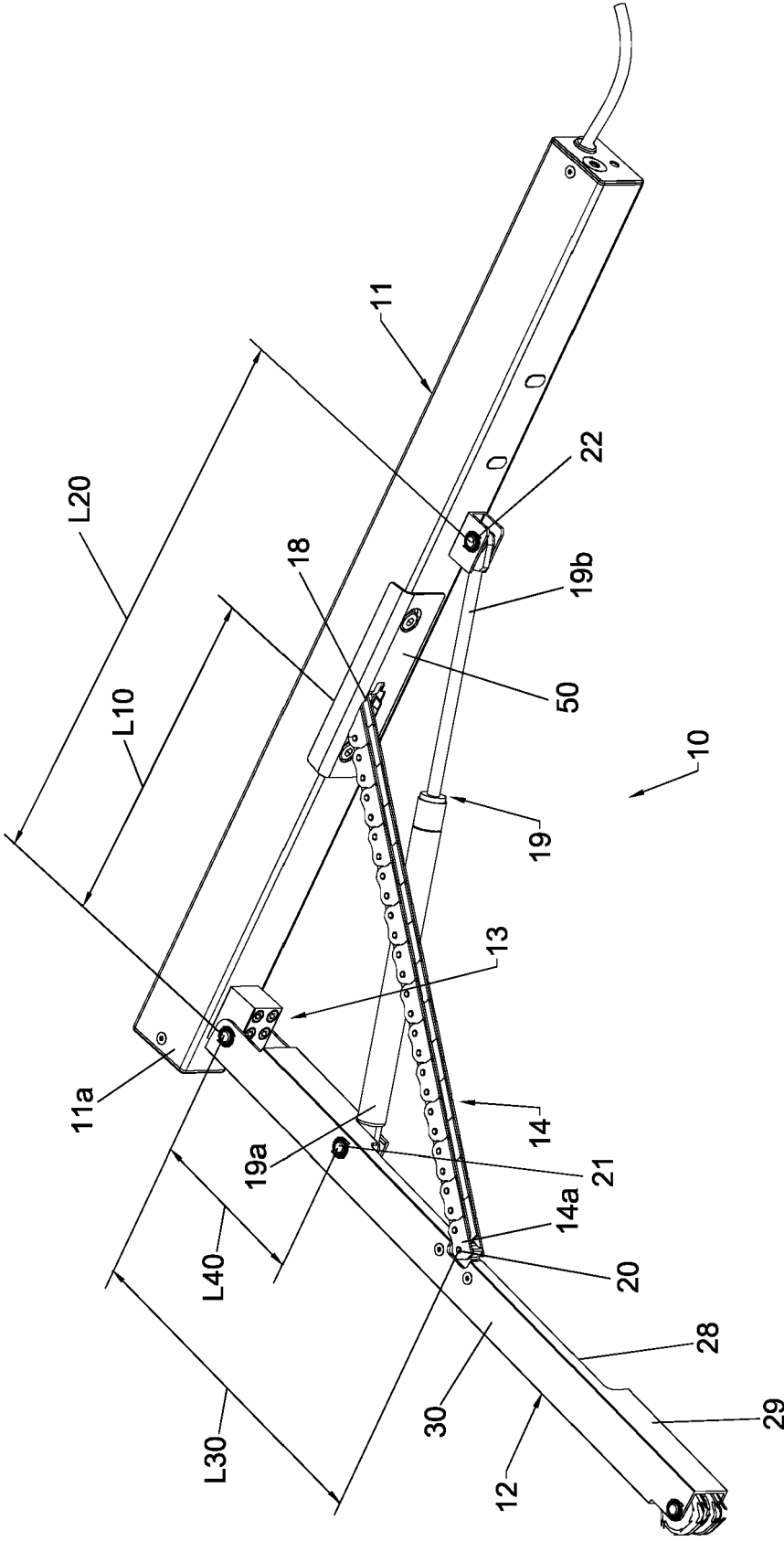


Fig.3

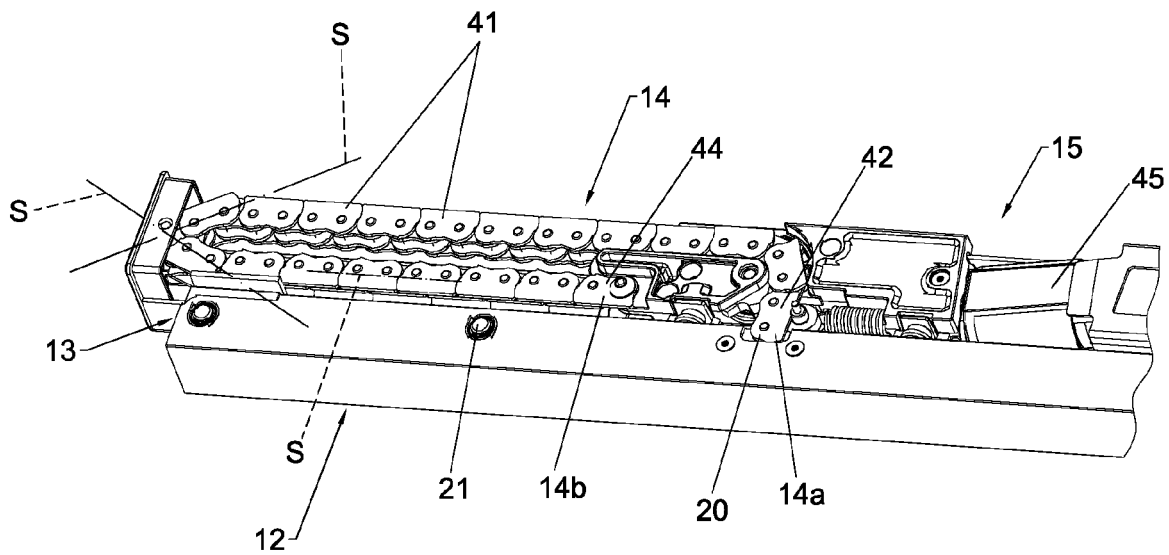
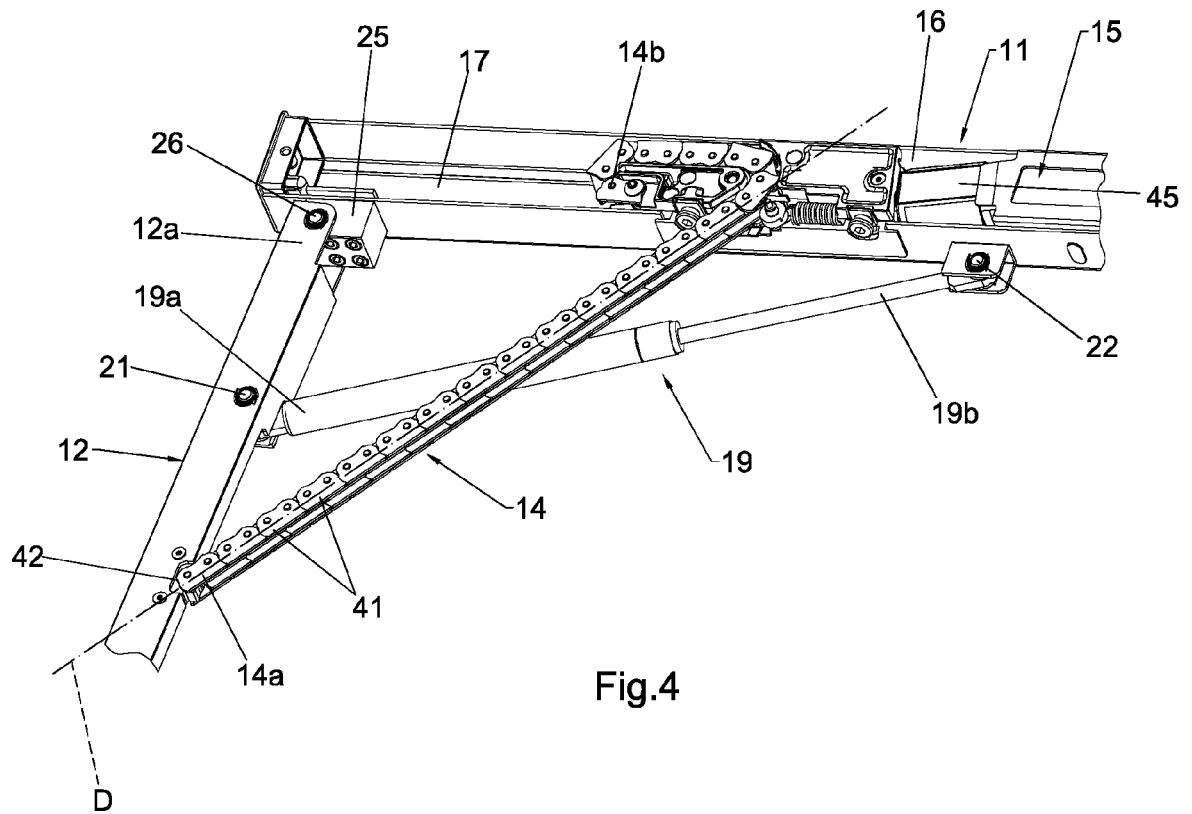


Fig.5

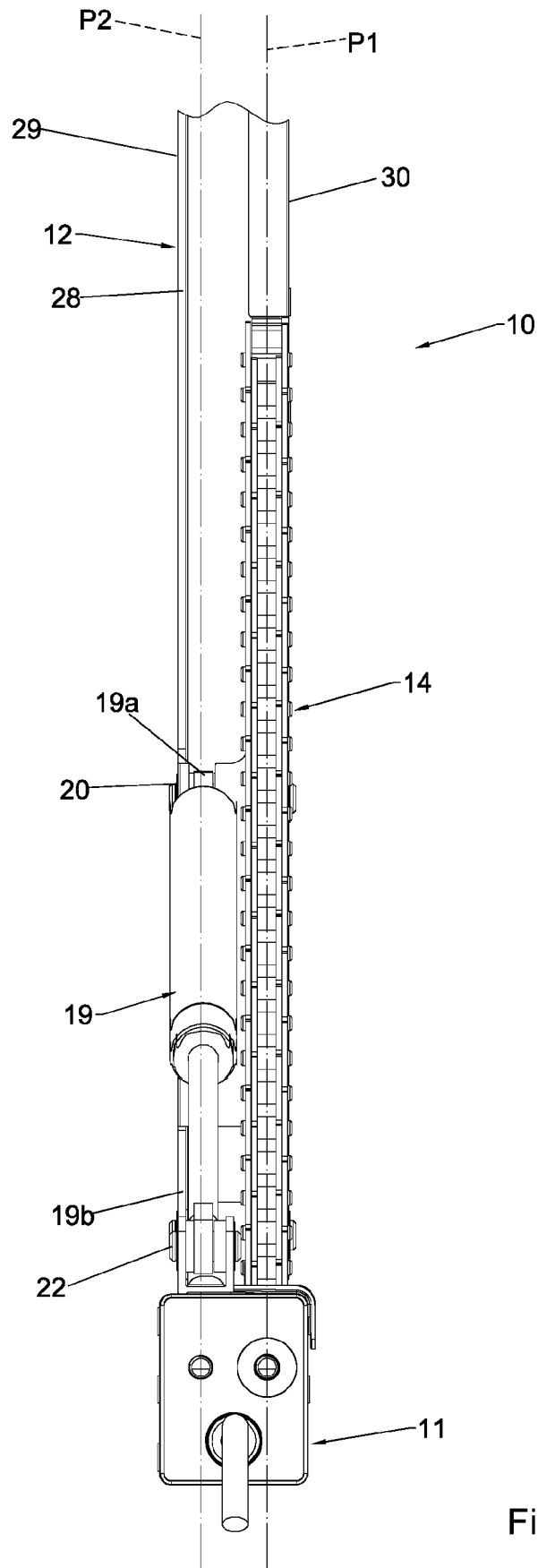


Fig.6

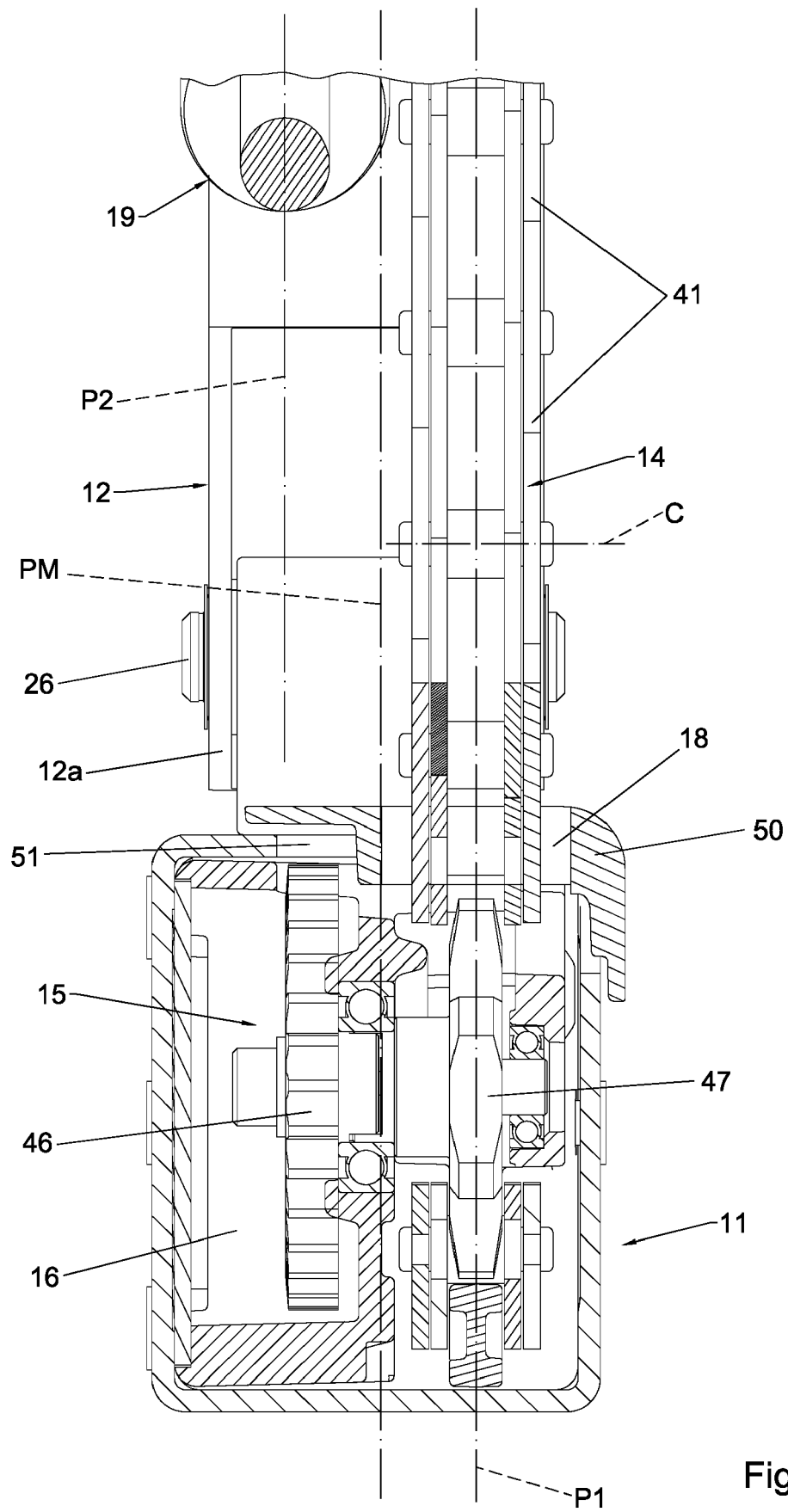


Fig.7



EUROPEAN SEARCH REPORT

Application Number

EP 24 16 7834

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	CN 113 107 302 A (HUANG WEN) 13 July 2021 (2021-07-13) * the whole document * -----	1-10	INV. E05F11/06 E05F15/619 E05F5/02
A	CN 105 756 461 A (NANTONG SUCHITC CONSTRUCTION ENG CO LTD) 13 July 2016 (2016-07-13) * the whole document * -----	1-10	
A	EP 3 505 712 A1 (VKR HOLDING AS [DK]) 3 July 2019 (2019-07-03) * the whole document * -----	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			E05F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 6 September 2024	Examiner Viethen, Lorenz
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	

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

EP 24 16 7834

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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06 - 09 - 2024

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