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(54) CHAIN ACTUATOR FOR A WINDOW UNIT AND WINDOW UNIT INCLUDING SAID CHAIN ACTUATOR

(57) The present invention relates to a chain actuator (1) for a window unit. Said window unit (2) comprises a fixed part (21) and a movable part (22) which are connected together and mutually movable.

The chain actuator (1) comprises a frame (30) having a fixed portion (31) and a movable portion (32) apt to be coupled to the fixed part (21) and to the movable part (22), respectively.

The actuator (1) also comprises an articulated chain (40) connected to the fixed portion (31) and to the movable portion (32) so as to move the movable portion with respect to the fixed portion in order to operate the window unit (2). The articulated chain (40) is composed of a plurality of segments (41) arranged in series between a head segment (42), connected to the movable portion (32), and a tail segment. Each segment has a direction of extension (S) and is connected to at least one further segment in such a way as to rotate reversibly about a hinge axis (C) in a first jamming direction (α11) or a first winding direction (α12) so as to orient its direction of extension (S), between a jamming angle and a winding angle, respectively. In the jamming angle position each segment of the plurality of segments (41) has its direction of extension (S) substantially parallel to the direction of extension (S) of the further segment so as to exert a thrust along an operating direction (D) so as to move the fixed portion (31) and the movable portion (32) of the frame (30) with respect to each other.

The actuator (1) further comprises an actuation device (50) coupled to the fixed portion (31) and to the articulated chain (40) and able to be operated so as to extend said chain or retract it from/inside the fixed portion (31).

In particular, the movable part (32) comprises, in turn, a fixing element (35), apt to be fixed to the movable part (22) of the window unit (20), and a coupling element (34) associated with the fixing element (35) so as to be able to rotate with respect to the latter about a first axis of rotation (A) transverse to the operating direction (D).

The head segment (42) is connected to the coupling element (34) so as to rotate reversibly in a second jamming direction (α21) or in a second winding direction (α22) about a second axis of rotation (8), parallel to the hinge axis (C) and transverse to the first axis of rotation (A).

The articulated chain (40) and said coupling element (34) are mutually configured and coupled together so that a rotation of the plurality of segments (41) in the first jamming direction (α11) is followed by a rotation of the head segment (42) in the second jamming direction (α21) which is limited by an interference between the head segment (42) and the coupling element (34) thus defining an angular jamming position of the head segment (42).

EP 4 428 333 A1

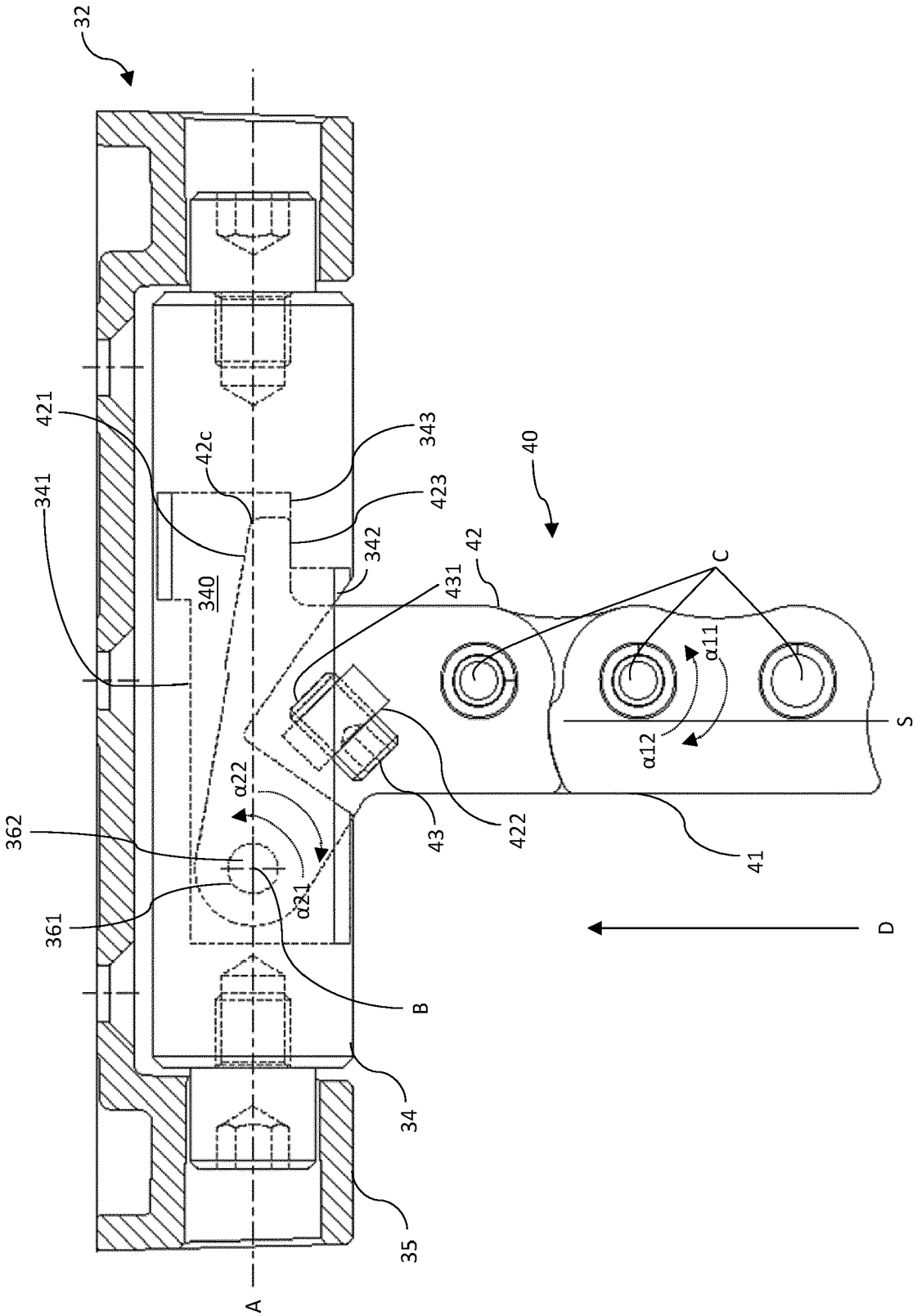

32
421
42c
343
341
423
342
340
431
42
40
C
α11
α12
S
α22
α21
362
361
43
422
41
D
B
34
35
A

Fig. 1

Description

TECHNICAL SECTOR

[0001] The present invention relates to an actuator for window units, in particular of the chain type, for opening and closing the movable part of the window unit to which it is connected. In addition, the present invention relates to a window unit comprising the aforementioned chain actuator.

PRIOR ART

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

[0003] Conventional chain actuators comprise a frame having a movable portion and a fixed portion, which can be associated with a movable part and a fixed part of a window unit, respectively. The chain actuators further comprise an articulated chain, associated with the movable portion and the fixed portion of the frame and an actuation device configured to extend or retract the articulated chain with respect to the frame so that, when installed, an at least partial extension of the articulated chain results in a movement of the movable part of the window unit away from the fixed part of the window unit, and a retraction of the articulated chain results, instead, in a movement of the movable part of the frame towards the latter. The actuation device is therefore configured to allow a bi-directional movement of the articulated chain, resulting in an open position or closed position of the movable part of the window unit being achieved.

[0004] In particular, the articulated chain is provided with a plurality of segments, i.e. link elements, or more simply links, which are connected together and shaped so as to be able to abut, when the articulated chain is extended, against each other so as to be able to support each other in turn in order to support the weight of the movable part of the window unit and therefore keep it open. In this way, the articulated chain, when it is extended with respect to the frame, has the necessary rigidity for transmitting to the movable part of the window unit the pushing force or pulling force needed to move the latter.

[0005] Generally, moreover, the articulated chain, when it is extended between the fixed part and the movable part of the window unit, tends to be arranged along an arched trajectory or curved trajectory having an extrados side on the chain winding side. The "concave" side is therefore the side for winding up the articulated chain. However, when the articulated chain is extended, it may happen that its links may be oriented in a random manner, with the risk of losing or interrupting the equilibrium condition. An orientation of the links different from that which they are configured to reach in the equilibrium condition may cause the collapse of the articulated chain onto itself, and therefore the sudden and undesirable closing of the movable part of the shutter. This situation may occur, for example, following strong gusts of wind or accidental impacts. Also, this situation may occur when the articulated chain is subject to a small load, namely a small weight of the movable part of the window unit, and a long travel path. In these conditions, it is possible that a pressure and friction sufficient to keep the links engaged and therefore ensure the equilibrium condition may not be exerted on the surfaces of the links.

[0006] At the same time, in order to preserve the stability and duration of the said articulated chain, it is necessary that it should not be made to flex or allowed to flex excessively, in order to prevent the yielding or deformation of the link elements. In fact, with an increase in the load, namely the weight of the movable part of the window unit and the travel path, the articulated chain could define a curvature which is so pronounced as to cause failure thereof.

SUMMARY OF THE INVENTION

[0007] The problem underlying the present invention is therefore to overcome the drawbacks of the conventional solutions by allowing the articulated chain to be kept in a stable equilibrium condition when extended between the fixed part and the movable part of the window unit. In other words, the problem posed and solved by the present invention is that of ensuring that the articulated chain is arranged between the fixed portion and the movable portion in such a way as to have the necessary rigidity for supporting the load applied to it.

[0008] The task of a chain actuator for a window unit and of a window unit comprising it is therefore that of solving this problem.

[0009] In connection with this task, one object of the present invention is therefore to ensure that the links which abut against each exert on each other a stress sufficient for ensuring a mutual engagement able to reach and maintain a stable equilibrium condition of the articulated chain.

[0010] A further object of the present invention is to ensure that a curved trajectory of the articulated chain portion extending between the fixed portion and the movable portion of the frame is maintained in the equilibrium condition.

[0011] A further object of the present invention is to ensure that the links, namely the segments, of the articulated chain which abut against each other when the articulated chain is extended in the operating plane exert against each other a suitable stress for ensuring mutual engagement able to reach and maintain an equilibrium condition, namely suitable spacing of the movable part with respect to the fixed part of the window unit with which, during use, the chain actuator is associated.

[0012] A further object of the invention is to propose a

chain actuator which is structurally simple and robust, can be easily manufactured and can also be easily installed without requiring specialist skills.

[0013] This task, as well as these and other objects which will emerge more clearly below are achieved by a chain actuator and a window unit which comprises it according to the attached independent claims.

[0014] Detailed characteristics of a chain actuator for a window unit and a window unit comprising it, according to the invention, are illustrated in the dependent claims.

[0015] Further characteristic features and advantages of the invention will emerge more clearly from the description of a preferred, but non-exclusive embodiment of a chain actuator device for a window unit and a window unit comprising it according to the invention, illustrated in an embodiment shown by way of a non-limiting example in the attached sets of drawings listed below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

- Figure 1 shows a partially sectioned view, from above, of a detail of a chain actuator according to the present invention in which the head segment is in a winding position;
- Figure 2 shows a partially sectioned view, from above, of a detail of a chain actuator according to the present invention in which the head segment is in a jamming position;
- Figure 3 shows a partially sectioned view, from above, of a detail of a chain actuator according to the present invention in which the head segment is in a jamming position different from that of Figure 2;
- Figure 4 shows an exploded view of a detail of a chain actuator according to the present invention;
- Figure 5 shows a perspective view of a detail of a chain actuator according to the present invention;
- Figure 6 shows a partially sectioned perspective view of a detail of a chain actuator according to the present invention in which the head segment is in a winding position;
- Figure 7 shows a partially sectioned perspective view of a detail of a chain actuator according to the present invention in which the head segment is in a jamming position;
- Figure 8 shows a side view of a chain actuator according to the present invention connected to a window unit in a closed position;
- Figure 9 shows a perspective view of a chain actuator according to the present invention connected to a window unit in an open position.

DETAILED DESCRIPTION

[0017] With particular reference to the attached figures, 1 denotes overall a chain actuator for a window unit.

[0018] The window unit 2 may comprise a fixed part 21, which can be installed on an infrastructure, and a movable part 22, connected to the fixed part 21, so as to be mutually movable. For example, the movable part 22 may comprise or consist of a shutter and the infrastructure may comprise or consist of a wall. In particular, the movable part 22 may be moved with respect to the fixed part 21 between an open position, namely spaced from the fixed part 21, and a closed position, namely arranged close to the fixed part 21.

[0019] In particular, the chain actuator 1 according to the present invention comprises a frame 30, namely a structural assembly, which has a fixed portion 31, apt to be coupled to the fixed part 21 of the window unit 2 or to the infrastructure, and a movable portion 32 apt to be coupled to the movable part 22 of the window unit 2.

[0020] The chain actuator 1 according to the present invention further comprises an articulated chain 40 connected to the movable portion 32 and to the fixed portion 31 of the frame 30 so as to move the movable portion 32 with respect to the fixed portion 31 so as to operate, namely move, the window unit 2 between an open position and a closed position. Consequently, the articulated chain 40 is configured to move the movable part 22 of the window unit 2 with respect to the fixed part 21 of the latter so that the movable part 22 may assume an open position or a closed position. The articulated chain 40 may therefore act as a movement member for the movable portion 32 of the frame 30 and therefore for the movable part 22 of the window unit 2.

[0021] The articulated chain 40 comprises or is composed of a plurality of segments 41, namely a plurality of links or link elements, arranged in series between a head segment 42, connected to the movable portion 32, and a tail segment (not shown). The head segment 42 and the tail segment, represent therefore end segments of the articulated chain 40.

[0022] In particular, each segment of the plurality of segments 41 has a direction of extension S and is connected to at least one further segment, namely to at least one adjacent, contiguous or adjoining segment, of the plurality of segments 41 so as to rotate with respect to the latter reversibly about at a hinge axis C in a first jamming direction $\alpha 11$ or in a first winding direction $\alpha 12$ so as to orient its direction of extension S respectively between a jamming angle, or jammed condition, and a winding angle, or winding condition. In other words, each segment of the plurality of segments 41 is associated with a further segment rotatably so as to be to rotate with respect to the latter about a hinge axis C, in a first jamming direction $\alpha 11$ or in a first winding direction $\alpha 12$, obviously opposite to said first jamming direction $\alpha 11$. 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. Therefore, the first winding direction $\alpha 12$ may be the direction of the rotation about the hinge axis C, which allows one segment of the plurality of segments 41 to

orient their direction of extension S into the winding angle position. Vice versa, the first winding direction α11 may be the direction of the rotation about the hinge axis C, which causes one segment of the plurality of segments 41 to orient its direction of extension S into the jamming angle position.

[0023] According to the present invention, in the jamming angle position, each segment of the plurality of segments 41, in particular each segment of those segments comprised between the head segment 42 and the segment or segments engaged by the actuation device (not shown), 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, so as to move mutually the fixed portion 31 and the movable portion 32 of the frame 30; in particular so as to move the movable portion 32 away from the fixed portion 31 in order to open the window unit 2. In other words, in the jamming angle position, the direction of extension S of each segment, in particular each segment of those segments comprised between the head segment 42 and the segment or segments engaged by the actuation device, is substantially aligned with the direction of extension S of the further segment so that the articulated chain 40 may exert a stressing force along the operating direction D. Namely when the segments of the articulated chain 40 are in the jamming angle position, the articulated chain 40 has sufficient rigidity to exert a stressing force on the movable portion 32 along the operating direction D. Said operating direction D therefore represents a direction of a stressing force, such as a pulling or pushing force, along which the articulated chain 40 acts on the movable portion 32 of the frame 30. The plane in which the jamming angle and the winding angle are defined, or lie, is the operating plane of the articulated chain 40. Preferably, the operating direction D lies in the operating plane.

[0024] The chain actuator 1 according to the present invention further comprises an actuation device coupled to the fixed portion 31 of the frame 30 and to the articulated chain 40. The actuation device can be operated so as to extend, or extract, the articulated chain 40 from the fixed portion 31 along the operating direction D or so as to retract, in particular wind up, the articulated chain 40 inside the fixed portion 31. Consequently, during use, the actuation device may be operated so as to move the articulated chain 40 bi-directionally with respect to the fixed portion 31, so as to exert a pushing or pulling force on the movable portion 32 so as to, respectively, move the latter away from or towards the fixed portion 31.

[0025] According to the present invention, the movable portion 32 may comprise a fixing element 35, apt to be fixed to the movable part 22 of the window unit 20, and a coupling element 34, associated with the fixing element 35 so as to be able to rotate with respect to the latter about a first axis of rotation A, transverse to the operating direction D. In connection with the present invention, the expression "transverse" is understood as meaning that the first axis of rotation A is substantially perpendicular to the operating direction D. Preferably, "substantially perpendicular to" is understood as meaning that the first axis of rotation A forms with the operating direction D an angle of not less than 75 degrees, even more preferably of not less than 88 degrees.

[0026] Furthermore, according to the present invention, the head segment 42 is connected to the coupling element 34 so as to be able to rotate reversibly in a second jamming direction α21 or in a second winding direction α22 about a second axis of rotation B, parallel to the hinge axis C and transverse to the first axis of rotation A. In other words, the axis of rotation B is parallel to the hinge axis C of each segment of the plurality of segments 41 and is therefore perpendicular to the operating plane of the articulated chain 40.

[0027] According to the present invention, the articulated chain 40 and the coupling element 34 are mutually configured and coupled together so that a rotation of the head segment 42 in the second jamming direction α21, into an angular jamming position of the head segment 42 defined by the interference or contact or abutment between the head segment 42 and the coupling element 34, is followed by a rotation of said plurality of segments 41 in the first jamming direction α11. The rotation of the head segment 42 in the second jamming direction α21 is therefore limited by its interference or contact or abutment with the coupling element. The angular jamming position represents therefore an angular end-of-travel position of rotation of the head segment 42 in the second jamming direction α21.

[0028] Since the amplitude of rotation in the second jamming direction α21 of the head segment 42 is predefined, insofar as limited upon reaching the jamming position and since the head segment 42 is connected rotatably to the further segments of the plurality of segments 41, consequently the amplitude of rotation about the hinge axis C of the other segments of the articulated chain 40 in the first jamming direction α11, in particular of the further segments comprised between the head segment 42 and the segment or segments engaged by the actuation device, is predefined. Therefore, by controlling reaching or maintaining of the jamming position it is possible to determine reaching or maintaining of the jamming angle of the further segments of the chain 40, especially those segments in the section comprised between the head section 42 and the actuation device. Consequently, reaching of the angular jamming position of the head segment 42 determines the jamming angle of the further segments 41 of the articulated chain 40; in particular of the further segments comprised between the head segment 42 and the segment or segments engaged by the actuation device.

[0029] According to the invention, therefore, the articulated chain 40, in particular the head segment 42, and the movable portion 32 are mutually configured and associated so as to introduce a rotation of each segment of the operating section, namely of the section of the ar-

ticulated chain 40 situated between the movable portion 32 and the actuation device, until the respective jamming angle is reached. Since, in the jamming angle position, the segments of the articulated chain 40 are able to exert the stressing force along the operating direction D, the articulated chain 40, in particular the head segment 42, and the movable portion 32 are mutually configured and associated so as to favour stable spacing of the movable portion 32 with respect to the fixed portion 31. This allows a stable distance to be maintained between the movable portion 32 and the fixed portion 31.

[0030] According to the invention, therefore, the head segment 42 in the angular jamming position determines the transfer of a thrusting force F onto the articulated chain 40 which forces the segments of the operating section into the jamming angle position. Owing to the aforementioned thrusting force, the segments of the section of the articulated chain 40 between the head section 42 and the at least one segment engaged by the actuation device may be forced to rotate about the respective hinge axis C in the first jamming direction $\alpha 11$ so as to reach the jamming angle position. The further segments of the articulated chain 40 are therefore forced to follow the rotation of the head segment 42 and reach their own jamming angle position. The section of the articulated chain 40 situated between the movable portion 32 and the actuation device may be defined as the operating section of the articulated chain 40 since the segments between the movable portion 32 and the actuation device are those which transmit the stressing force to the movable portion 32.

[0031] In addition, since the articulated chain 40, by means of the coupling element 34, is associated with the fixing element 35, the articulated chain 40 acquires a greater degree of freedom of movement with respect to the movable part 22 of the window unit 2 with which it is operationally associated. In particular, as the articulated chain 40 gradually extends from the fixed portion 31, and therefore along the operating direction D, the angle, i.e. the inclination, between the operating plane of the articulated chain 40 and the movable part 22 of the window unit may vary freely. In this way, as the articulated chain 40 is extracted with respect to the movable portion 32, the latter moves more freely with respect to the trajectory followed by the movable part 22 so as to limit the stresses which the articulated chain 40 could undergo in a direction transverse to the operating plane and to which it would be subject if it were unable to rotate freely with respect to the movable part 22 of the window unit. In short, the undesirable stresses acting on the articulated chain 40 are limited as a result.

[0032] According to the present invention, the winding angle and/or jamming angle may be preferably defined between the direction of extension S of a segment and the direction of extension of a further segment S connected to the latter.

[0033] According to a preferred aspect of the present invention, the thrusting force F which is applied onto the articulated chain 40 is such as to impart an arching moment M to the articulated chain 40. The thrusting force F determines or generates the aforementioned arching moment. Preferably, the arching moment M is apt to increase an arching of the operating section of the articulated chain 40 where, as described above, "operating section of the articulated chain 40" is understood as meaning the section of the articulated chain 40 comprised between the head segment 42 and the segment or segments engaged by the actuation device. The arching of the operating section of the articulated chain 40, namely an arrangement along an arched or C-shaped trajectory, occurs in the case where the segments of the articulated chain 40 and the operating conditions of the latter, in particular the load applied to the articulated chain 40 by the movable part 22 of the window unit 2, allow this.

[0034] More preferably, the segments of the section of the articulated chain 40 situated between the movable portion 32 and the actuation device are forced to be arranged along the arched trajectory in the operating plane of the articulated chain 40.

[0035] Preferably, the thrusting force F corresponds to the weight force of the movable part 22.

[0036] In connection with the present description, the expression "direction of extension S substantially parallel to the direction of extension S of the further segment" is understood as meaning that the direction of extension S of a segment does not diverge from the parallel arrangement with respect to the direction of extension S of a further segment. In other words, it is understood that the jamming angle of a segment corresponds to an angle of substantially 180° between the direction of extension S of the said segment and the direction of extension of a further segment connected to it. In other words, the aforementioned expression is understood as meaning that the operating section of the articulated chain 40 is arranged along a straight trajectory. Said straight trajectory therefore extends along the operating direction D.

[0037] Alternatively, the aforementioned expression means that the direction of extension S of one segment does not diverge from the direction of extension S of a further segment, namely a segment connected to it, by an angle greater than 2°, preferably not greater than 1°, even more preferably not greater than 0.8°, and at the most preferably not greater than 0.5°. In this case, the arching moment effectively may result in arching of the operating section of the articulated chain 40 in the operating plane. Namely the arching moment causes an arrangement of the operating section of the articulated chain 40 along an arched section in the operating plane.

[0038] According to this preferred aspect of the present invention, in the jamming angle position, the direction of extension S of each segment of the operating section may differ from the parallel arrangement with respect to D. More preferably, the segments of the operating section, namely the segments of the articulated chain 40 situated between the movable portion 32 and the actuation device, in the mutual jamming angle position may

define an arched trajectory, i.e. a C-shaped trajectory in the operating plane. In other words, when each segment of the articulated chain 40 between the movable portion 32 and the actuation device and in its jamming angle position, they may be arranged along a arched or C-shaped trajectory in the operating plane. The articulated chain 40 may therefore be configured to be arranged between the movable portion 32 and the actuation device along an arched or C-shaped trajectory in the operating plane. The arch-shaped trajectory defines a concave or extrados side and an opposite convex or intrados side.

[0039] According to this preferred aspect, the operating direction D may correspond to or coincide with the direction along which the chord of said arch-shaped trajectory is defined. According to a preferred aspect of the present invention, the operating direction D substantially corresponds to or coincides with the direction of extraction of the articulated chain 40 from the fixed portion 31. In other words, the articulated chain 40 being extracted from the fixed portion 31 follows substantially said operating direction D. Expressed in yet other words, the operating direction D and the direction along which the articulated chain 40 is configured to unwind between the fixed portion 31 and the movable portion 32.

[0040] According to a preferred aspect of the present invention, the head segment 42 is rotatable with respect to the coupling element 34 in the second jamming direction $\alpha 21$ between an angular winding position and the angular jamming position. The angular winding position therefore corresponds to an angular position for the start of the rotational movement of the head element 42 in the second jamming direction $\alpha 21$.

[0041] According to a preferred aspect, both the angular winding position and the angular jamming position are fixed positions of the head segment 42 with respect to the coupling element 34, "Fixed" is understood as meaning that these positions cannot be varied or adjusted, in particular with respect to each other, by a user. In other words, both the angular winding position and the angular jamming position are defined a priori during the design of the chain actuator 1.

[0042] Preferably, moreover, according to this preferred aspect of the present invention, each one of the head segment 42 and the coupling element 34 comprises a respective first interference surface 421, 341. In other words, the head segment 42 comprises a first interference surface 421 and the coupling element 34 comprises a first interference surface 341. In the angular jamming position, the first interference surface 421 of the head segment 42 comes up against, i.e. makes contact with or abuts against, the first interference surface 341 of the coupling element 34.

[0043] According to a different preferred aspect, the angular jamming position is adjustable continuously or discretely. In particular, the angular jamming position is adjustable or variable, continuously or discretely, with respect to the angular winding position. The amplitude of rotation of the head segment 42 between the angular jamming position and the angular winding position is therefore adjustable continuously or discretely. In other words, the angular distance between the angular winding position and the angular jamming position may be varied, adjusted or chosen by a user, such as a person responsible for installing or maintaining chain actuators for window units. In this way, the jamming angle of the remaining segments of the operating section of the articulated chain 40 may be varied consequently. As a result, it is possible to adjust the arching of the operating section of the articulated chain 40, namely it is possible to obtain a different degree of arching of the operating section of the articulated chain 40. For example, in the case of actuators with a limited travel movement and/or with a small load, in order to obtain a stable equilibrium condition, advantageously the head segment 42 of the articulated chain may perform an ample rotation in the second jamming direction $\alpha 21$ so as to orient consequently the segments of the operating section as much as possible along a trajectory which has a small radius of curvature and therefore is greatly curved. Vice versa, in the case of actuators with a significant travel movement of the articulated chain and/or with a heavy load, in order to obtain a stable equilibrium condition and avoid yielding of the articulated chain 40, advantageously the head segment 42 of the articulated chain may perform a small rotation in the second jamming direction $\alpha 21$, so as to orient consequently the segments of the operating section along a trajectory having a wide radius of curvature.

[0044] More preferably, the angular winding position is a fixed angular position of the head segment 42 with respect to the coupling element 34, while the angular jamming position is an angular position which is adjustable or variable continuously or discretely.

[0045] According to this preferred aspect of the present invention , the head segment 42 comprises a first interference surface 421. The coupling element 34 comprises, in turn, a first interference surface 341 and further comprises a second interference surface 342.

[0046] In addition, the head segment 42 comprises coupling means 422 and the actuator 1 comprises adjustment means 43 which are at least partially housed in the coupling means 422. The adjustment means 43 are configured to be moved between at least an extracted position, in which they protrude or project from the coupling means 422, and a retracted position.

[0047] The angular jamming position is determined, as required, by the interference between:

- the first interference surface 421 of the head segment 42 against the first interference surface 341 of the coupling element 34; or
- the adjustment means 43, in an extracted position, against the second interference surface 342 of the coupling element 34.

[0048] In other words, the angular jamming position may be adjusted, for example during installation of the

chain actuator 1, so that it is defined by the interference between the first interference surface 421 of the head segment 42 against the first interference surface 341 of the coupling element 34 or by the interference between the adjustment means 43, in an extracted position, against the second interference surface 342.

[0049] Preferably, moreover, the angular distance with respect to the winding position is greater in the case where the jamming position is defined by the interference between the first interference surface 421 of the head segment 42 against the first interference surface 341 of the coupling element 34 than in the case where the jamming position is defined by the interference between the adjustment means 43 in an extracted position, against the second interference surface 342.

[0050] Preferably, the extracted or retracted position of the adjustment means 43 is adjustable discretely or continuously.

[0051] Preferably, the adjustment means 43 comprise or consist of an adjustment screw, more preferably a screw with a threaded shank and flat head. In particular, the extracted position or retracted position coincides with the position of the flat head with respect to the coupling means 422. Preferably, moreover, the coupling means 422 comprise a coupling seat. The coupling seat may be configured as a hole or channel. In addition, the coupling seat may be surrounded by a counter-threaded surface apt to be coupled with the adjustment screw.

[0052] According to a preferred aspect of the present invention, each one of the head segment 42 and said coupling element 34 comprises an abutment surface 423, 343. Namely, the head segment 42 and the coupling element 34 comprises a respective abutment surface 423, 343. According to this aspect, moreover, in the angular winding position, the abutment surface 423 of the head segment 42 comes up against abutment surface 343 of the coupling element 34.

[0053] According to a preferred aspect of the present invention, the movable portion 32 may comprise connection means apt to connect together the coupling element 34 and the head segment 42. Preferably, moreover, said connection means comprise a hole 361 and a pin 362, inserted in the hole 361, which cooperate so as to define the second axis of rotation B. More preferably, the hole 361 is formed in the head segment 42, while the pin 362 is associated with or integral with the coupling element 34.

[0054] According to a preferred aspect of the present invention, the head segment 42 comprises at least one plate-like or substantially plate-like element. Preferably, moreover, each segment of the plurality of segments 41, except for the head segment 42, may comprise a first plate element and a second plate element arranged parallel to each other and connected together by a pair of pins. In this way, advantageously, the head segment 42 may be made by the same manufacturer as that of the further segments 41 of the articulated chain 40.

[0055] Alternatively, the head segment 42 comprises or consists of a single plate-like or substantially plate-like element. The first interference surface 421 is defined along the plate-like element. Preferably, also the abutment surface 423 is defined along the plate-like element.

[0056] More preferably, the head segment 42 comprises or consists of a pair of plate-like or substantially plate-like elements. Therefore, the head segment 42 comprises or consists of a first plate-like or substantially plate-like element 42a and a second plate-like or substantially plate-like element 42b. In this case, the first interference surface 421 is defined, i.e. formed, along the first and second plate-like elements 42a, 42b. Preferably, also the abutment surface 423 is defined along the first and second plate-like elements 42a, 42b.

[0057] The head segment 42 may be made by means of pressing and/or by means of mechanical machining operations.

[0058] According to a preferred aspect of the present invention, the hole 361 comprises a first hole and a second hole which are formed respectively in the first and second plate-like elements 42a, 42b so that they can be rotatably associated with the pin 362.

[0059] According to a preferred aspect of the present invention, the first and second plate-like elements 42a, 42b are spaced from each other. In other words, the first plate-like element 42a and the second plate-like element 42b define a recess between them. Preferably, the coupling seat is formed between in the recess defined between the first and second plate-like elements 42a, 42b.

[0060] According to a preferred aspect of the present invention, the coupling element 34 comprises an intermediate wall, which projects inside the seat 340. The second interference surface 342 is formed on said intermediate wall. If the head segment 42 comprises the first and second plate-like elements 42a, 42b, the intermediate wall is apt to be seated inside the recess defined between them. Preferably the second interference surface 342 forms an angle of between 25° and 65°, more preferably between 35° and 55° and even more preferably of about 45° with the operating direction D (in the first jamming direction $\alpha 11$).

[0061] According to a preferred aspect of the present invention, the head segment 42 comprises a tooth 42c. If the head segment 42 comprises the first plate-like element 42c and the second plate-like element 42b, the tooth 42c is formed on the first plate-like element 42c and the second plate-like element 42b. In other words, each one of the first plate-like element 42a and the second plate-like element 42b comprises a tooth 42c. The first interference surface 421 and the abutment surface 423 of the head segment 42 form part of or are formed along two opposite surfaces of the tooth 42c.

[0062] According to a preferred aspect of the present invention, the head segment 42, and more preferably each one of the first plate-like element 42a and the second plate-like element 42b, if present, comprises a first plate-like portion, hinged with a further segment of the plurality of segments 41, and a second plate-like portion

connected by means of the connection means to the coupling element 34. For example, the hole 36a is formed in the second plate-like portion. Preferably, the tooth 42c is formed in the first plate-like portion.

[0063] Preferably, the first plate-like portion and the second plate-like portion are integral with each other. Even more preferably, the first plate-like portion and the second plate-like portion form a substantially L-shaped body.

[0064] According to a preferred aspect of the present disclosure, the first plate-like portion extends mainly along the direction of extension S of the head segment 42. Preferably, the second plate-like portion extends along a direction substantially perpendicular to the direction of extension S. Preferably, the first plate-like portion is rotatably coupled to a further segment so as to be able to rotate about a hinge axis C.

[0065] According to a preferred aspect of the present invention, the coupling element 34 houses at least partly the head segment 42. Preferably, the coupling element 34 comprises a housing seat 340 and wherein said head segment 42 is at least partly housed inside the housing seat 340.

[0066] More preferably, the coupling element 34 also houses the connection means. According to a preferred aspect of the present invention, the coupling element 34 has a substantially box-shaped or substantially cylindrical shell-like form.

[0067] According to this aspect, moreover, preferably, the coupling element 34 comprises at least one side wall. The one or more side walls laterally surround the housing seat 340 of the coupling element 34 inside which the head segment 42 is at least partly housed. Preferably, the first interference surface 341 of the coupling element 34 is defined along a first portion of the side wall or a first side wall. Said side wall or first portion of the side wall is substantially perpendicular to the operating direction D. Preferably, the abutment surface 343 of the coupling element 34 is defined along a second portion of the side wall or of a second side wall, substantially opposite to or facing the first portion of the side wall or the first side wall.

[0068] Preferably, the coupling element 34 comprises at least one slot or slit through which a portion of the head segment 42 projects from the coupling element so as to be coupled with a further segment of the operating chain 40. If the head segment 42 comprises or consists of a pair of plate-like or substantially plate-like elements, more preferably, the coupling element 34 comprises a pair of slots or slits and each plate-like or substantially plate-like element protrudes from the coupling element 34 so as to be coupled with a further segment of the operating chain 40.

[0069] According to a preferred aspect of the present invention, the fixing element 35 is a bracket. More preferably the fixing element 35 is C-shaped and defines a central region suitable for receiving the coupling element 34.

[0070] According to a preferred aspect of the present invention, the operating direction D substantially corresponds to or coincides with the direction of extraction of the articulated chain 40 from the fixed portion 31. In other words, the articulated chain 40 being extracted from the fixed portion 31 follows substantially said operating direction D. Expressed in yet other words, the operating direction D is the direction along which the articulated chain 40 is configured to unwind between the fixed portion 31 and the movable portion 32.

[0071] According to a preferred aspect of the present invention, the sole rotation which is allowed for each segment of the plurality of segments 41 is that with respect to the hinge axis C. In other words, each segment of the plurality of segments 41 is configured to be able to rotate or swivel with respect to the further segment, namely an adjacent segment, only about the hinge axis C and between the jamming angle and the winding angle. Namely the articulated chain 40 is not configured to rotate about an axis which is parallel or contained in the operating plane. In this way, it is ensured that the articulated chain 40 has the necessary rigidity in the operating direction D for transmission of the stressing force in order to move the movable part 22, along a given trajectory, of the window unit 2 with respect to the fixed part 21 thereof.

[0072] According to a preferred aspect of the present invention, the fixed portion 31 is also connected rotatably to the fixed part 21 of the window unit 2. In particular, the fixed portion 31 is connected so as to be able to rotate with respect to the fixed part 21 about a third axis of rotation E parallel to the first axis of rotation A. In this way, the operating plane of the articulated chain 40 may rotate with respect to the movable part 22 and the fixed part 21 of the window unit. In this way, the stresses acting on the articulated chain 40 in a direction transverse to said operating plane are further limited.

[0073] According to a preferred aspect of the present invention, the segments of the articulated chain 40 may be connected together in an articulated manner in sequence between the head segment 42 and the tail segment. In other words, the segments of the plurality of segments 41 may be connected operationally in series with each other.

[0074] According to a preferred aspect of the present invention, each segment of the plurality of segments 41 is hinged with a further segment by means of a rotational connection element, such as a pin, which defines the aforementioned hinge axis C.

[0075] According to a preferred aspect of the present invention, the tail segment may be coupled to the fixed portion 31 and the latter may be configured to house inside it at least part of the articulated chain 40. Preferably, moreover, according to this aspect, the articulated chain 40 may be housed completely, except for the head segment 42, inside the fixed portion 31 of the frame 30 when the window unit 2 is in the closed position.

[0076] According to a preferred aspect of the present invention, the fixed portion 31 of the frame 30 is provided with a guided sliding channel for the articulated chain 40

which communicates with an environment outside the fixed portion 31 via an outlet opening or mouth. Expressed differently, the fixed portion 321 may also comprise a sliding channel along the articulated chain 40 inside the said fixed portion 31. More specifically, said sliding channel is configured to house internally the articulated chain 40, when it is retracted with respect to the frame 30, and to guide and cause it to project gradually from the aforementioned outlet opening or mouth as a result of the action of the actuation device.

[0077] According to a preferred aspect of the present invention, the actuation device may comprise a movement member which interacts with the articulated chain 30 so as to extend it from and retract it inside the fixed portion 31. In other words, the actuation device may comprise a movement member which engages with the articulated chain 40 so as to extract it or retract it relative to the fixed portion 31. Preferably, said movement member may be a toothed wheel.

[0078] Preferably, the movement member may be housed inside the fixed portion 31. According to a preferred aspect of the present invention, the actuation device may also comprise a motorized system for actuating the actuating member.

[0079] According to a preferred aspect of the present invention, each segment of the plurality of segments 41, except for the head segment 42, may comprise or consist of a connecting rod element.

[0080] According to a preferred aspect of the present invention, each segment of the plurality of segments 41, except for the head segment 42, may have a first end region and a second end region each pivotably mounted on or hinged with a respective second end region or first end region of the at least one further segment.

[0081] According to a preferred aspect of the present invention, each segment of the plurality of segments 41, except for the head segment 42, may comprise a first plate element and a second plate element arranged parallel to each other and connected together by a pair of pins. Each pin defines a hinge axis C about which a segment may rotate with respect to a further segment. The space between each pair of pins defines the pitch of the articulated chain 40 and can be engaged by the actuating member.

[0082] Preferably, the direction of extension S is a main direction of extension of each first plate element and second plate element.

[0083] Preferably, moreover, with reference to said direction of extension S, for each segment, except for the head segment 42, each first plate element and each second plate element is delimited by a pair of end surfaces and four side surfaces. "End surfaces" are understood as meaning the surfaces, situated opposite each other and defined in a plane tangential, preferably perpendicular, to the direction of extension S.

[0084] According to a preferred aspect of the present invention, when the segments situated between the head segment 42 and the at least one segment engaged or occupied by the actuating member are each located in the jamming angle position, the end surfaces of these segments face each other, namely abut or bear against each other. In other words, in the jamming angle position, each end surface is configured to mutually engage with an end surface of a preceding segment and/or a following segment.

[0085] Finally, the present invention also relates to a window unit which comprises a chain actuator 1 as described hitherto.

[0086] In particular, the fixed part 21 and the movable part 22 of this window unit 2 are interconnected by a chain actuator 1 as described hitherto.

[0087] According to a preferred aspect of the present invention, the fixed part 21 and the movable part 22 are hinged together along an opening and closing axis which is parallel to the first axis of rotation A.

[0088] According to a preferred aspect of the present invention, the window unit 2 may comprise a first end 23 and a second end 24, which are opposite to each other and wherein the fixed part 21 and the movable part 22 are hinged together at the first end 23. Preferably, the chain actuator 1 is associated with the first end 23 so as to allow rotation of the movable part 22 with respect to the fixed part 21 about the opening and closing axis of the said window unit 2. In this case the distance between the first end 23 and the second end 24 defines the radius of the arch-shaped circumferential trajectory which the movable part 21 describes between the opening position and closing position, and vice versa.

[0089] The invention thus devised may be subject to numerous modifications and variations, all of which fall within the scope of protection of the attached claims.

[0090] Moreover, all the details described above may be replaced by other technically equivalent elements.

[0091] Where the operational characteristics and the techniques mentioned are followed by reference numbers or symbols, these reference numbers or symbols have been assigned with the sole purpose of facilitating understanding of the description and the said claims and consequently they do not limit in any way the interpretation of each element which is identified, purely by way of example, by said reference numbers or symbols.

Claims

1. Chain actuator (1) for a window unit, wherein the window unit (2) comprises a fixed part (21), installable on an infrastructure, and a movable part (22), connected to said fixed part (21), so as to be mutually movable and wherein said chain actuator (1) comprises:

    - a frame (30) having a fixed portion (31) apt to be coupled to the fixed part (21) of the window unit (2) or to the infrastructure and a movable portion (32) apt to be coupled to the movable

part (22) of the window unit (2);
- an articulated chain (40) connected to said movable portion (32) and to said fixed portion (31) of frame (30) so as to move the movable portion (32) with respect to the fixed portion (31) in order to operate said window unit (2) between an open position and a closed position; and wherein said articulated chain (40) is composed of a plurality of segments (41) arranged in series between a head segment (42), connected to said movable portion (32), and a tail segment, wherein each segment of said plurality of segments (41) has a direction of extension (S) and is connected to at least one further segment of said plurality of segments (41) in such a way as to rotate with respect to the latter reversibly around a hinge axis (C) in a first jamming direction (α11) or in a first winding direction (α12) so as to orient its direction of extension (S) between a jamming angle and a winding angle, respectively, wherein in the jamming angle position each segment of said plurality of segments (41) has its own direction of extension (S) substantially parallel to the direction of extension (S) of the further segment in such a way as to exert a thrust along an operating direction (D), so as to move the movable portion (32) away from the fixed portion (31) of the frame (30) in order to open the window unit (2);
- an actuation device (50) coupled to the fixed portion (31) and to the articulated chain (40) and able to be operated so as to extend the articulated chain (40) from the fixed portion (31) or retract it inside the fixed portion (31);
wherein said movable portion (32) comprises:

- a fixing element (35), apt to be fixed to the movable part (22) of the window unit (20), and
- a coupling element (34) associated with said fixing element (35), so as to be able to rotate with respect of the latter about a first rotation axis (A), transverse to the operating direction (D),

and wherein the head segment (42) is connected to the coupling element (34) in such a way as to rotate reversibly in a second jamming direction (α21) or in a second winding direction (α22) about a second rotation axis (B), which is parallel to the hinge axis (C) and transverse to the first rotation axis (A);
wherein said articulated chain (40) and said coupling element (34) are mutually configured and coupled so that a rotation of the head segment (42) in the second jamming direction (α21) into an angular jamming position of the head segment (42) defined by the interference or abutment between the head segment (42) and the coupling element (34) is followed by a rotation of said plurality of segments (41) in the first jamming direction (α11).

2. Chain actuator (1) according to any one of the preceding claims, wherein said head segment (42) is rotatable with respect to said coupling element (34) in said second jamming direction (α21) between an angular winding position and said angular jamming position.

3. Chain actuator (1) according to claim 2, wherein said angular winding position and said angular jamming position are fixed or non-adjustable positions.

4. Chain actuator (1) according to claim 3, wherein each one of said head segment (42) and said coupling element (34) comprises a respective first interference surface (421, 341) and wherein in said angular jamming position said first interference surface (421) of said head segment (42) abuts against said first interference surface (341) of said coupling element (34).

5. Chain actuator (1) according to claim 3, wherein said angular jamming position is adjustable continuously or discretely.

6. Chain actuator (1) according to the preceding claim, wherein each one of said head segment (42) and said coupling element (34) comprises a respective first interference surface (421, 341);

and wherein said coupling element (34) comprises a second interference surface (342) and said head segment (42) comprises a coupling seat and said actuator (1) comprises an adjustment element (43) at least partially housed in said coupling seat and configured to be moved between at least one extracted position in which it protrudes relative to said coupling seat and a retracted position,
and wherein said angular jamming position is determined, alternatively, by the interference between:

- said first interference surface (421) of said head segment (42) against said first interference surface (341) of said coupling element (34); or
- said adjustment element (43), in an extracted position, against said second interference surface (342) of said coupling element (34).

7. Chain actuator (1) according to any one of the preceding claims in combination with claim 2, wherein

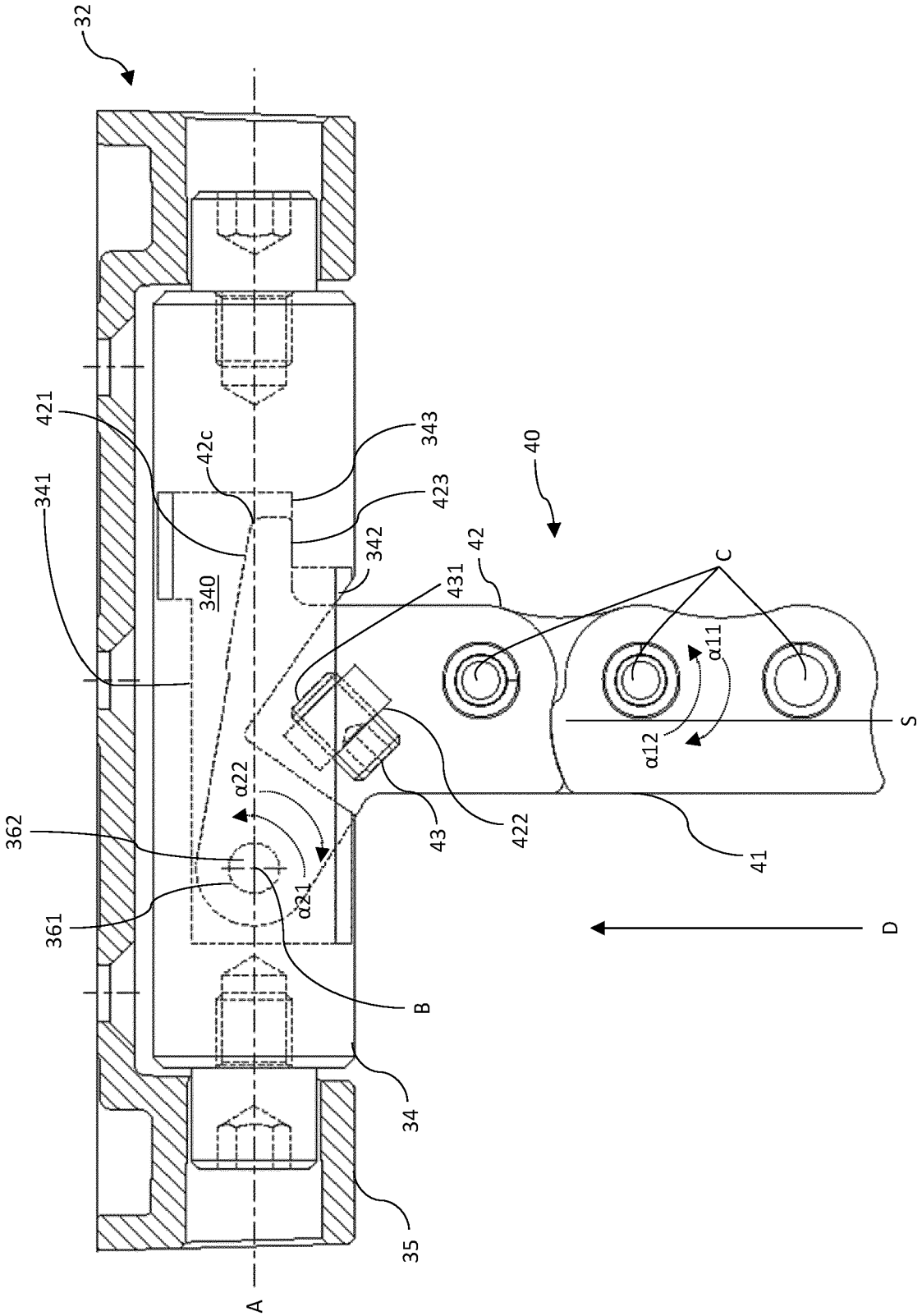
each one of said head segment (42) and said coupling element (34) comprises an abutment surface (423, 343), wherein in said angular winding position said abutment surface (423) of said head segment (42) abuts against the abutment surface (343) of said coupling element (34).

8. Chain actuator (1) according to any one of claims 4 or 6, wherein said head segment (42) comprises a tooth (42a) and wherein said first interference surface (421) of said head segment (42) and said abutment surface (423) of said head segment (42) are two opposite surfaces of said tooth (42c).

9. Chain actuator (1) according to any one of the preceding claims, wherein said coupling element (34) comprises a housing seat (340) and wherein said head segment (42) is at least partially housed within said housing seat (340).

10. Chain actuator (1) according to any one of the preceding claims, wherein said head segment (42) comprises a plate-like element (42a) and said first interference surface (421) is defined along said plate-like element (42a).

11. Chain actuator (1) according to any preceding claim, wherein said plate-like element (42a) is a first plate-like element and said head segment (42) comprises a second plate-like element (42b) and wherein said first interference surface (421) is defined along said first and second plate-like elements (42a, 42b).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42
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α21
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D
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Fig. 1

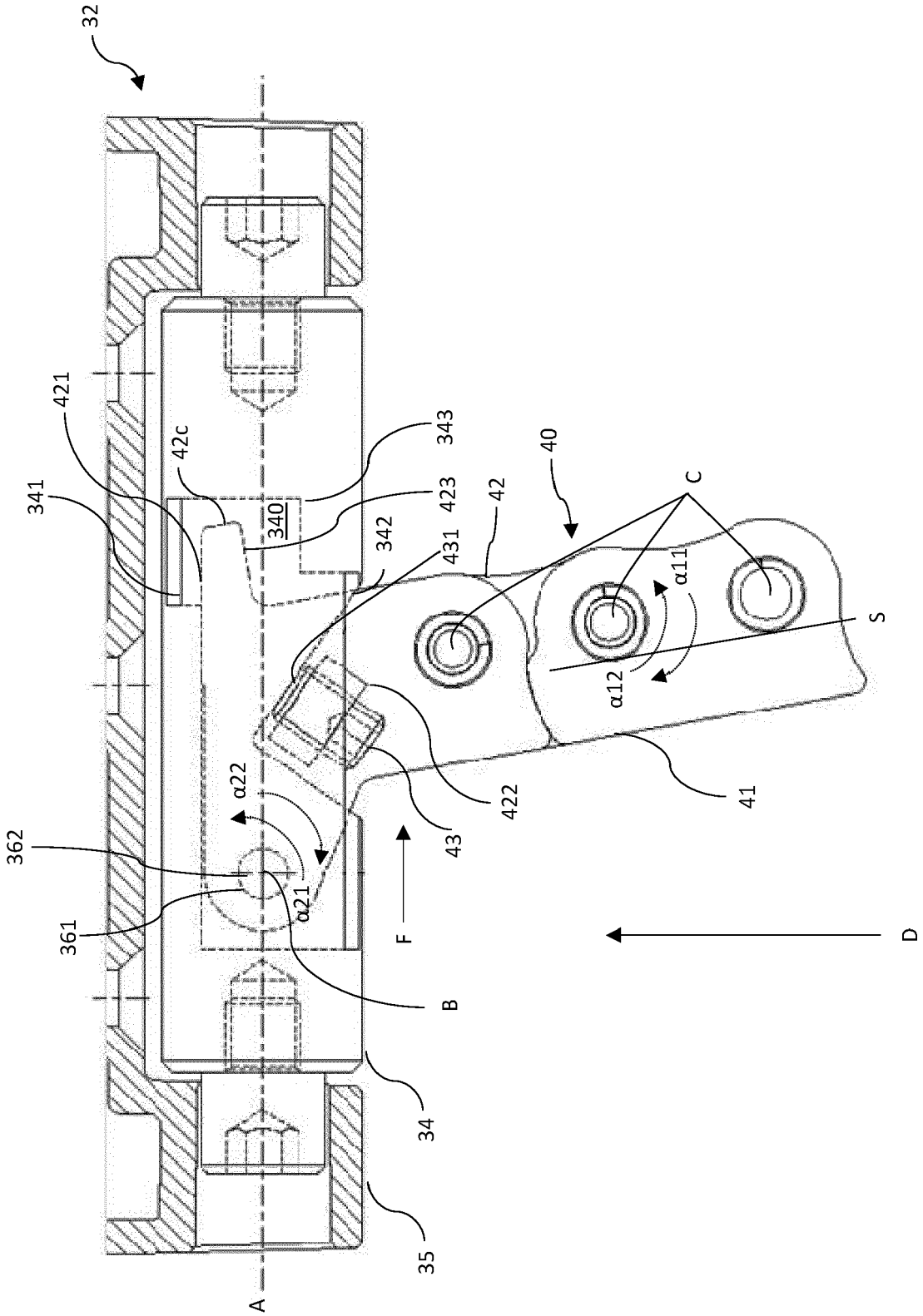
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Fig. 2

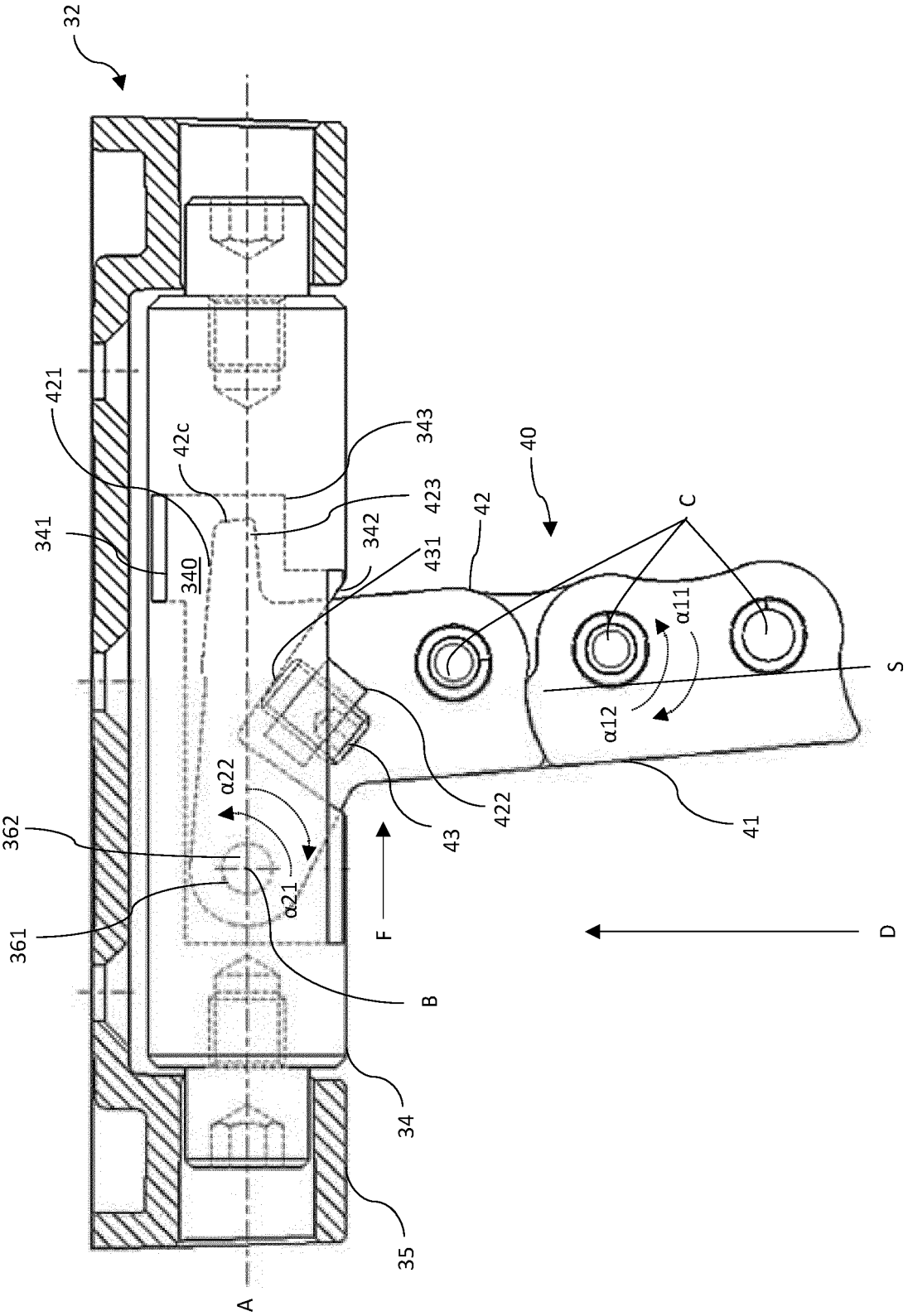
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Fig. 3

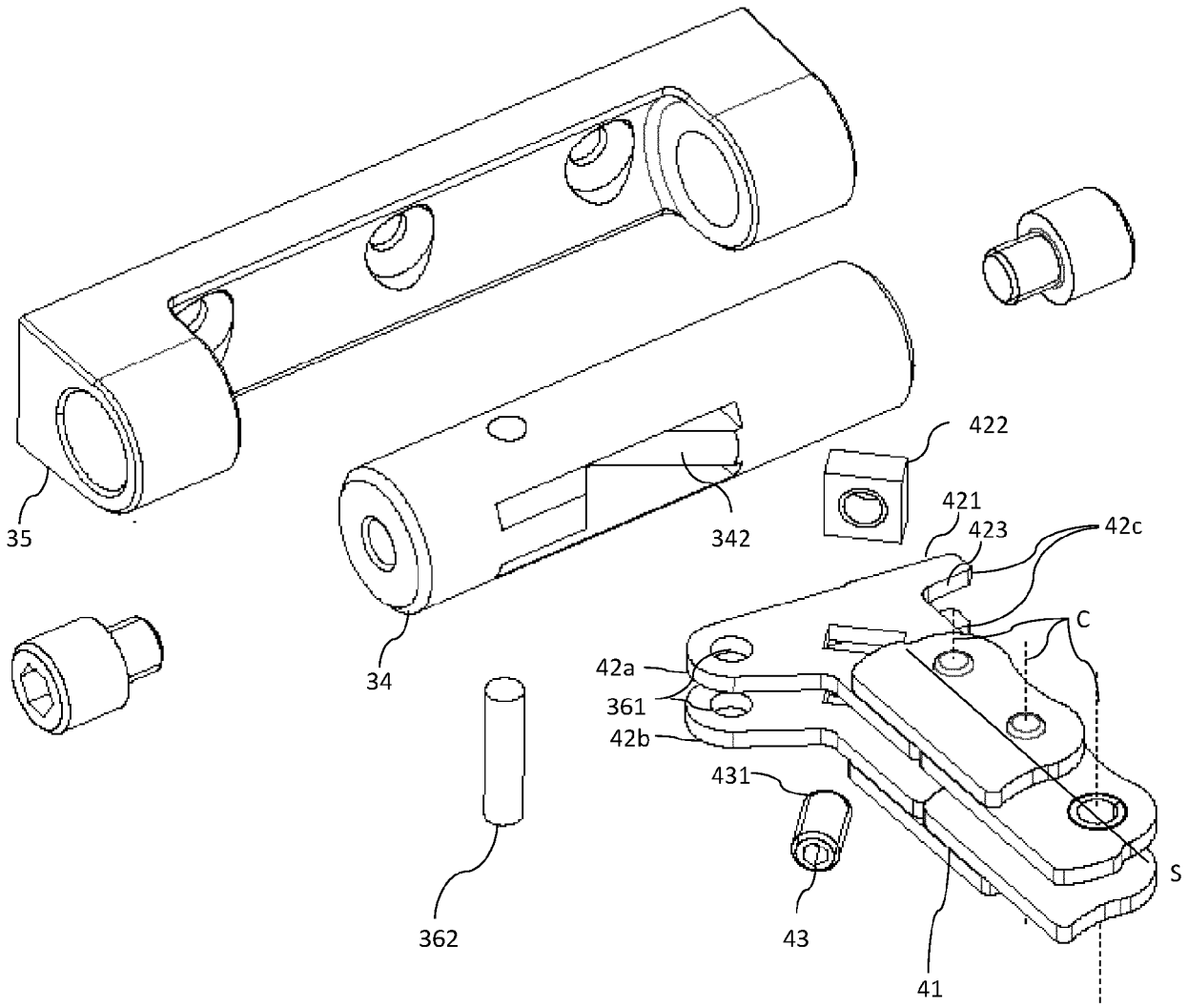

Fig. 4

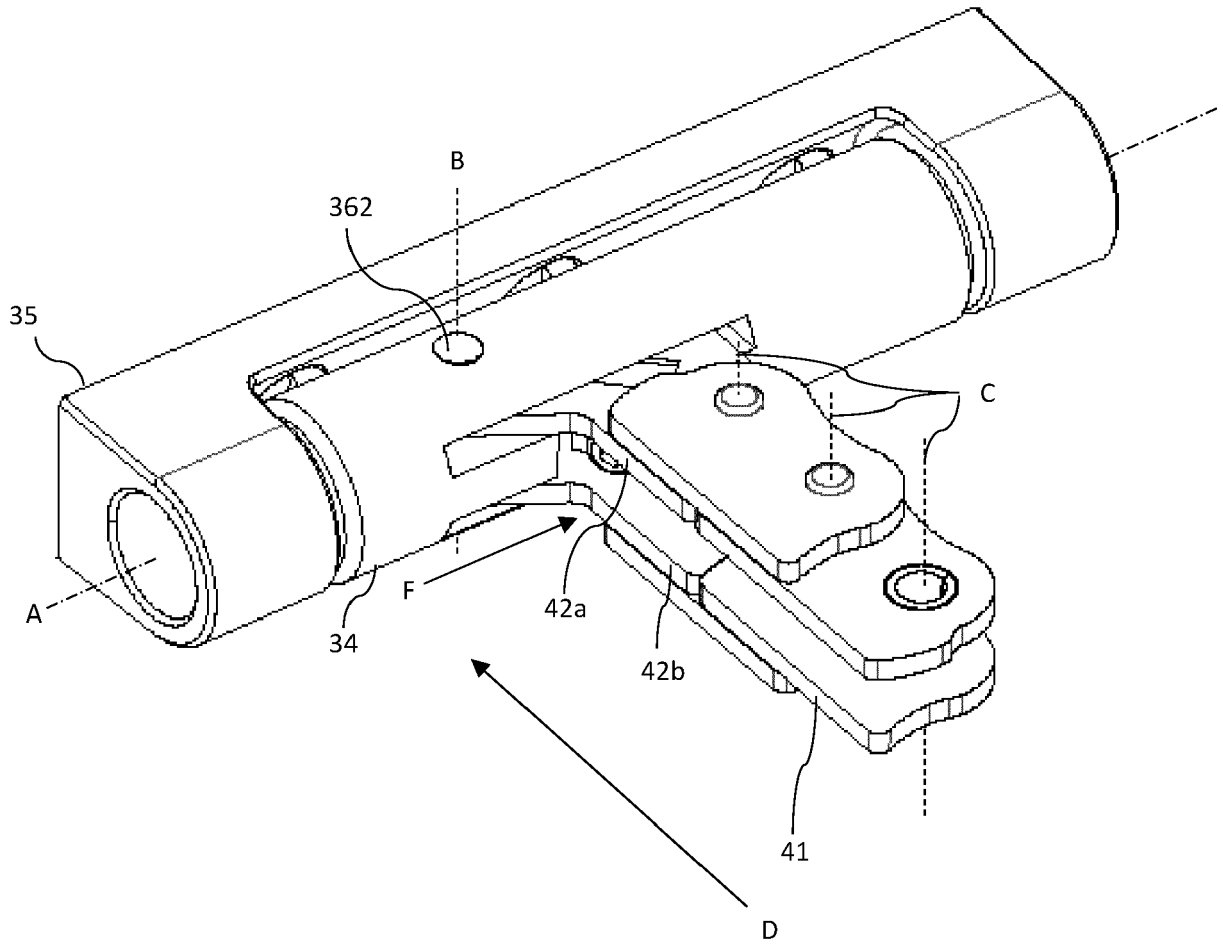

Fig. 5

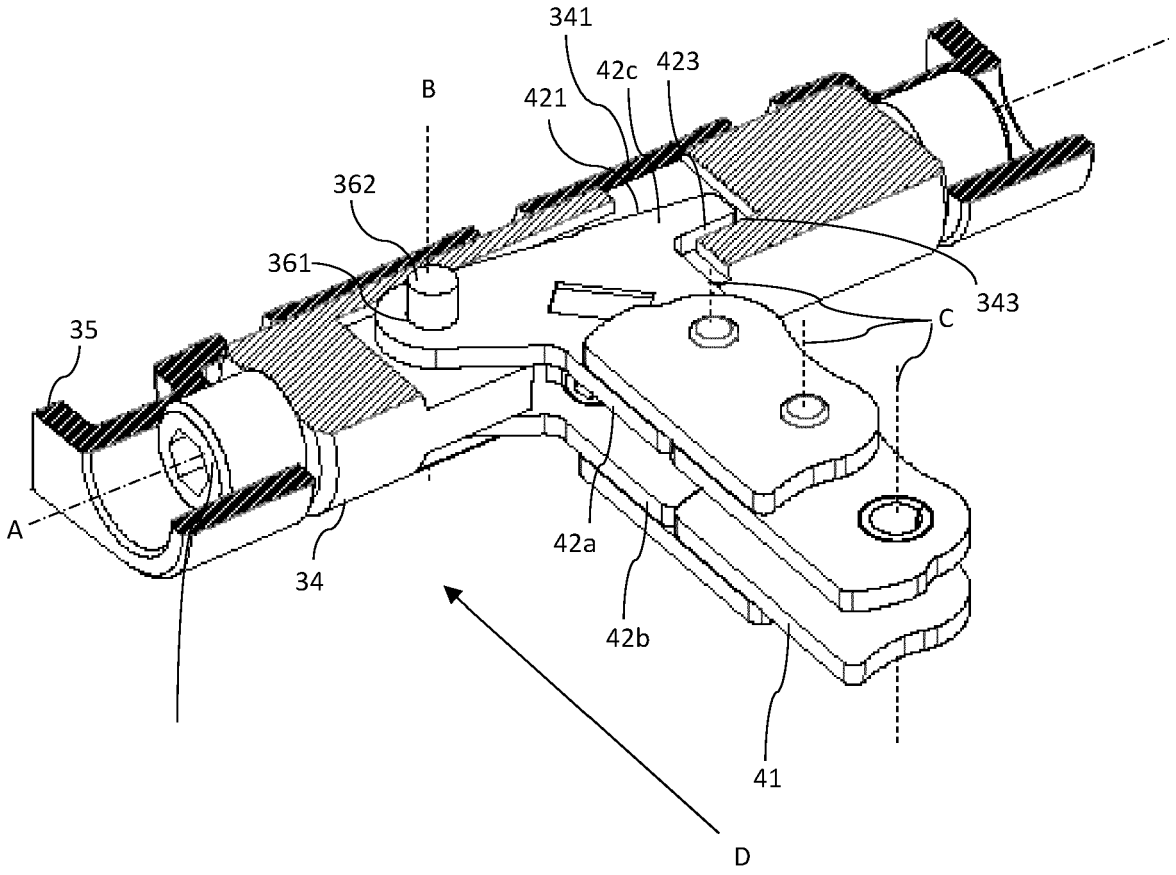

Fig. 6

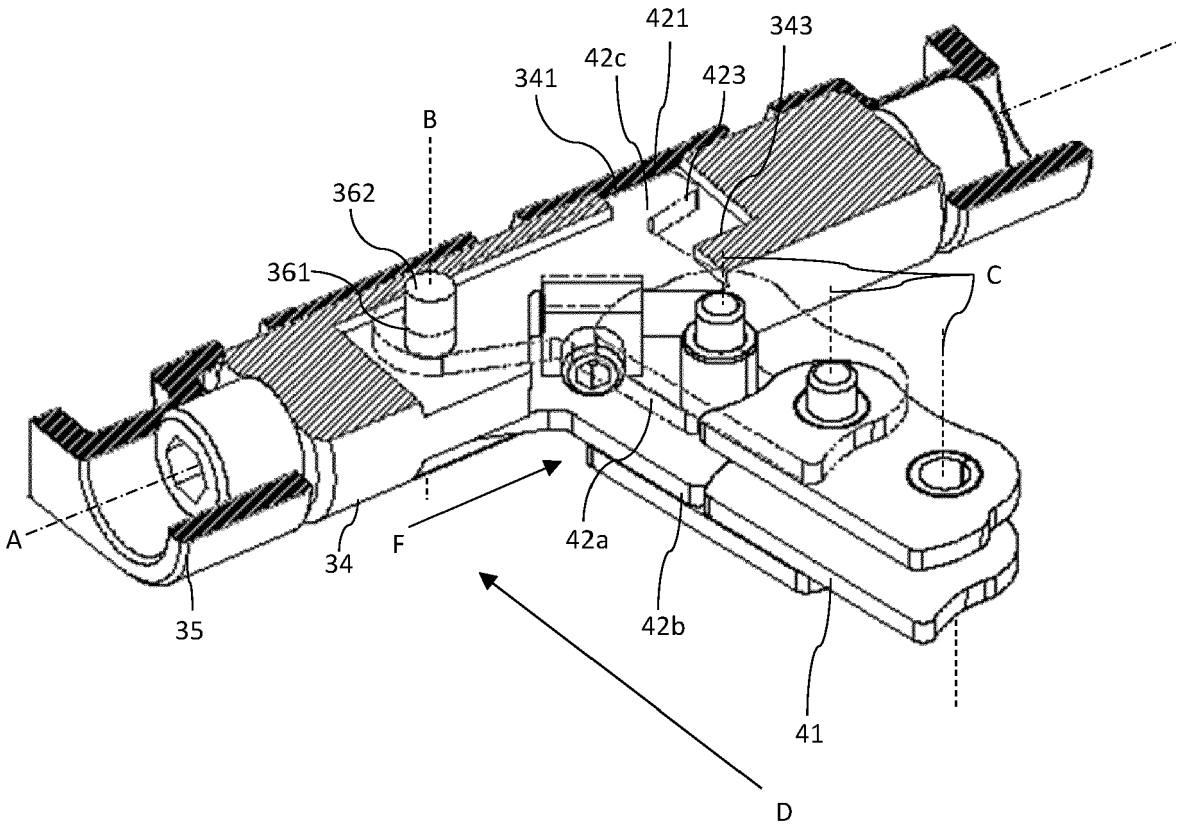

Fig. 7

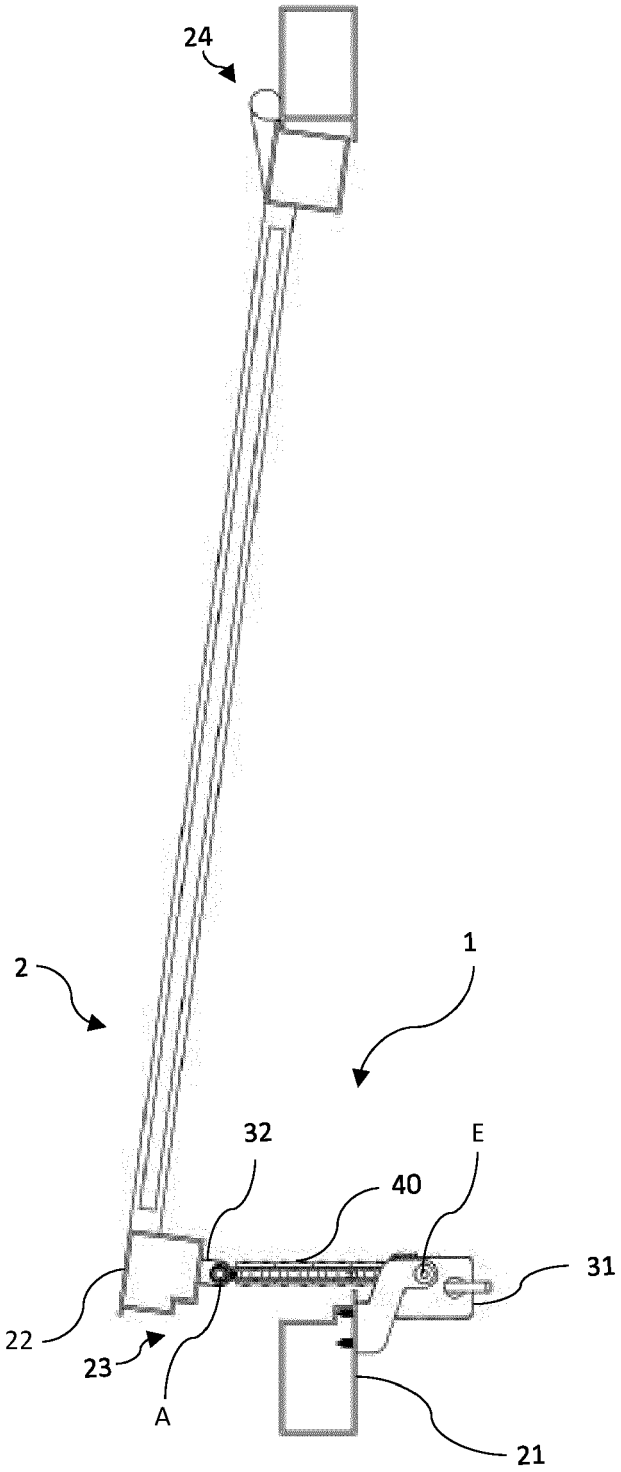

Fig. 8

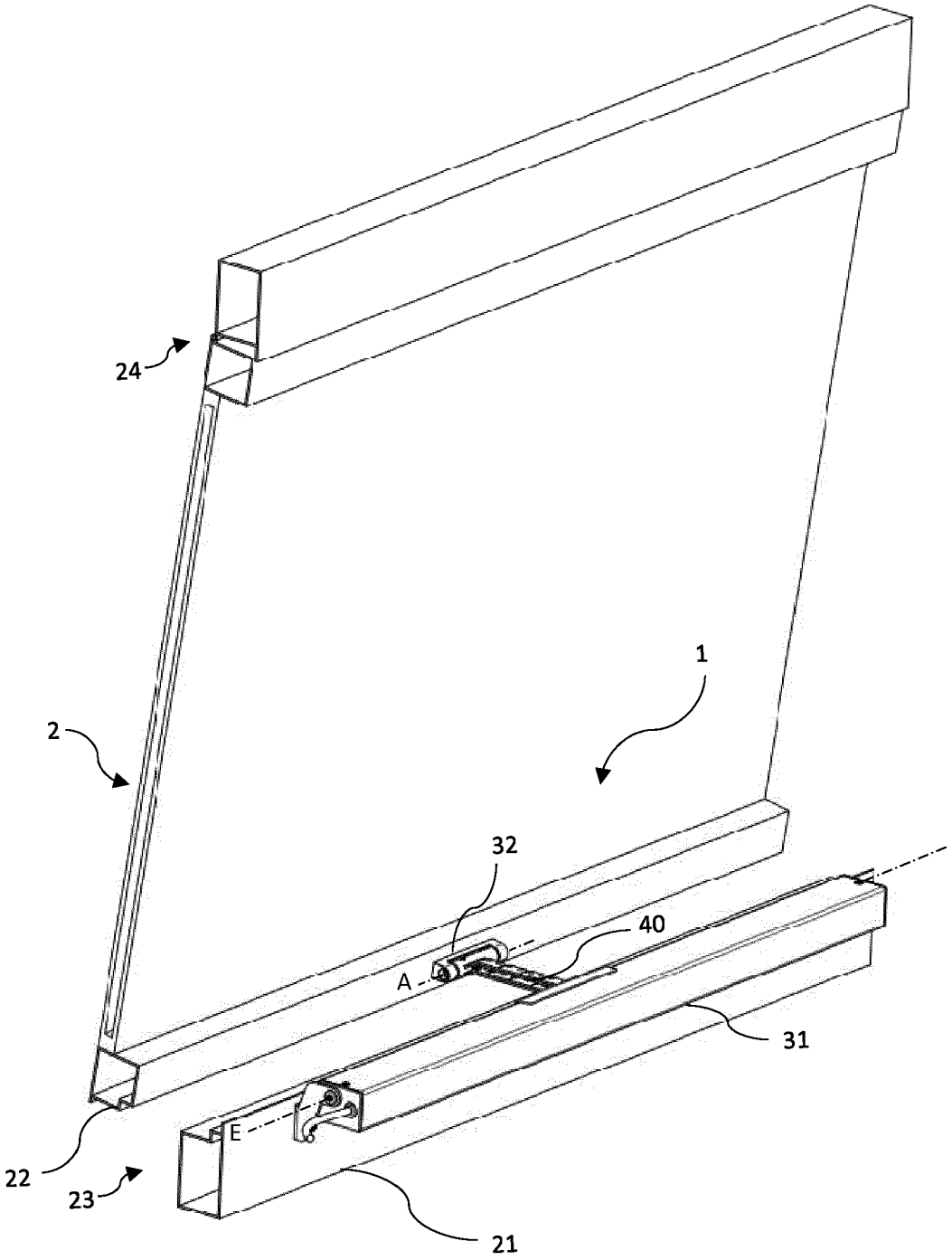

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 24 16 1810

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* paragraphs [0029] - [0035] * * paragraph [0056] * * paragraphs [0061], [0062] * * figures *	5,6	E05F15/619
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A	* page 4, line 25 - page 5, line 14 * * page 6, line 24 - page 7, line 6 * * figures *	5,6	
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E05F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 July 2024	Mund, André

CATEGORY OF CITED DOCUMENTS

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15-07-2024

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