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(54) CHAIN ACTUATOR DRIVE WITH BRACKET SUPPORTING WORM DRIVE AND BEARING

(57) A building chain actuator drive arrangement (1) comprising a worm screw (2) having a center axis (C) and a worm wheel (3) configured to engage the worm screw (2). The worm wheel (3) is operatively connected to a chain actuator (4). A motor (5) is operatively connected to the worm screw (2) and configured to rotate the worm screw (2) around the center axis (C). At least one bearing (6) has a center axis coaxial with the center

axis (C) of the worm screw (2). A bracket element (7) is fixed to a center shaft (3a) of the worm wheel (3) by means of an opening in the bracket element (7) configured to accommodate the center shaft (3a). The bracket element (7) comprises at least one axially extending recess (8) configured to accommodate the at least one bearing (6), the bearing (6) being configured to support the worm screw (2).

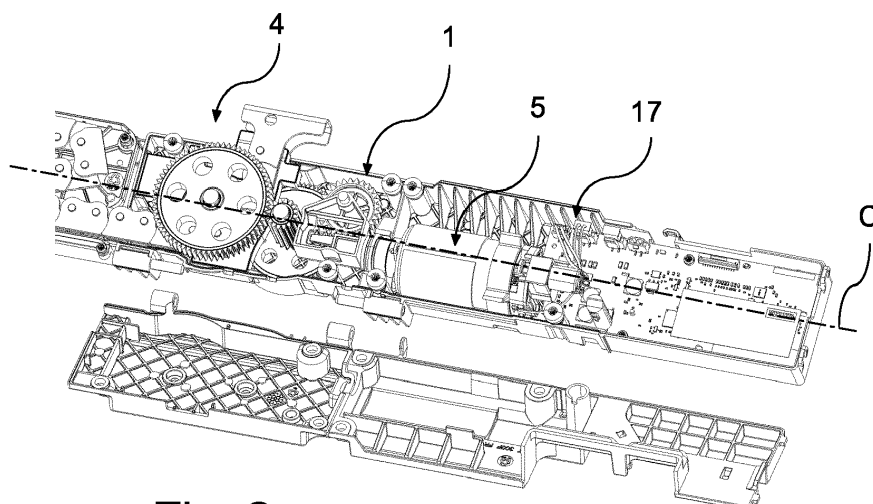


Fig. 2

EP 4 080 005 A1

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Description

TECHNICAL FIELD

[0001] The disclosure relates to a building chain actuator drive arrangement comprising a worm drive operatively connected to a chain actuator, a motor operatively connected to the worm screw, and at least one bearing.

BACKGROUND

[0002] Windows and doors installed in a building, for example in an inclined roof surface, usually comprise a frame that is fixed to the building structure and a sash or door which is hingedly connected to the frame, such that the sash or door can be pivoted about the hinge relative to the frame. Such a building element can be either operated manually by a user or be operated by a controllable drive arrangement comprising an electrical motor.

[0003] In particular, roof windows are preferably provided with an electrically operated drive arrangement, since that allows one or several hard-to-reach roof windows to be moved between open and closed positions by means of remote control, see e.g. WO 02/31304 A1. The use of such electrically operated drive arrangement furthermore allows automatic operation for indoor temperature regulation or automatic closing of an open window due to changing weather conditions.

[0004] One typical drive and actuator combination comprises a push-pull chain which can be collapsed and wound together, when the building element is in a closed position, and have a straight or slightly arched configuration when used to push the building element to, or maintain the building element in, an open position. Transmission elements such as a worm drive and a gear reduction are oftentimes used to interconnect the electric motor and the push-pull chain.

[0005] Vibrations caused by the electric motor can affect the drive arrangement negatively and reduce the service life of the drive arrangement. Furthermore, the worm screw transmits longitudinal and perpendicular reaction forces. Drive and actuator components may deform, detach, or generate noise due to such forces and vibrations.

[0006] The components of a drive arrangement are usually assembled with a tight fit and/or by being fixedly attached to each other, in order to achieve a sufficiently stiff and well-centered drive arrangement and to prevent that the components of the drive arrangement become displaced as the worm screw forces and vibrations caused by the motor propagate through the drive arrangement. This leads to high demands on the manufacturing and assembly processes in terms of tolerances, alignment etc.

[0007] Furthermore, this requires most, if not all, vibration and worm screw force absorption and possibly static load from the open window to be done by the motor's internal bearings, effectively reducing the service life of

at least the motor.

[0008] The vibrations wear the components of the drive assembly down, leading to gaps and/or increased gaps between components. Such gaps between components lead to drive assembly power loss, reducing the maximum effective load which can be maneuvered by the drive arrangement.

[0009] Consequently, it would be advantageous to provide a drive arrangement that has a longer service life and which simplifies manufacture and assembly while also reducing the risk of human error during assembly.

SUMMARY

[0010] It is an object to provide an improved drive arrangement for a building chain actuator. The foregoing and other objects are achieved by the features of the independent claims. Further implementation forms are apparent from the dependent claims, the description, and the figures.

[0011] According to a first aspect, there is provided a building chain actuator drive arrangement comprising a worm drive comprising a worm screw having a center axis and a worm wheel configured to engage the worm screw, the worm wheel being operatively connected to a chain actuator, a motor operatively connected to a proximal end of the worm screw and configured to rotate the worm screw around the center axis, at least one bearing having a center axis coaxial with the center axis (of the worm screw, and a bracket element fixed to a center shaft of the worm wheel by means of an opening in the bracket element configured to accommodate the center shaft. The bracket element comprises at least one axially extending recess configured to accommodate the at least one bearing, the bearing being configured to support a distal end of the worm screw when located in the recess.

[0012] Such a solution not only facilitates simple yet reliable assembly, but also allows for a drive arrangement wherein the components are firmly interconnected without any tension being incurred by the interconnections themselves. By fixing the position of the motor relative the center shaft by means of the bracket, alignment between motor and worm drive is ensured without inducing tension. Furthermore, the components are interconnected such that the vibrations generated by the motor are distributed and dampened by means of several components and not only the motor bearings, reducing the wear on the motor and, subsequently, providing a drive arrangement with increased service life.

[0013] In a possible implementation form of the first aspect, the center shaft of the worm wheel is a fixed shaft having a center axis extending perpendicular to the center axis of the worm screw.

[0014] In a further possible implementation form of the first aspect, the bearing is press-fit onto the distal end of the worm screw, facilitating simple assembly yet sufficiently fixed interconnection.

[0015] In a further possible implementation form of the

first aspect, the bracket element comprises a tubular section extending along the center axis and partially enclosing the worm screw, allowing a drive assembly having an as small volume as possible.

[0016] In a further possible implementation form of the first aspect, the tubular section being has a partially open wall, the worm screw engaging the worm wheel via the open wall, providing a drive arrangement having an as small volume as possible.

[0017] In a further possible implementation form of the first aspect, the bracket element is configured to support an axial face of the worm wheel by means of a support surface preferably having an area equal to, or smaller than, a diameter of the center shaft of the worm wheel. This allows for a drive assembly that has a small volume yet still provides sufficient support for its different components.

[0018] In a further possible implementation form of the first aspect, the bracket element is detachably connected to the motor by means of axially extending tongues, the tongues extending parallel with the center axis from a proximal end of the bracket element, the distal end of the motor comprising corresponding axially extending grooves, facilitating simple yet reliable assembly as well as a tension-free interconnection.

[0019] In a further possible implementation form of the first aspect, movement of the bearing in the first direction out of the recess is prevented by a bottom of the recess, easily securing the bearing in one direction.

[0020] In a further possible implementation form of the first aspect, the recess comprises a sidewall, extending from the bottom in a direction towards the motor and being configured to enclose the bearing, the sidewall comprising a plurality of radially extending flexible elements, the flexible elements being configured to center and fixate the bearing within the recess.

[0021] In a further possible implementation form of the first aspect, the flexible elements are arranged equidistantly along the sidewall, ensuring the bearing is centered within the recess.

[0022] In a further possible implementation form of the first aspect, the flexible element comprises a bendable sheet material, optionally being an integral part of the bracket element facilitating assembly and allowing the flexible elements to be molded in one piece with the bracket.

[0023] In a further possible implementation form of the first aspect, the building chain actuator drive arrangement comprises a bearing configured to support the proximal end of the worm screw and/or a bearing configured to support the proximal end of the motor. This provides maximum flexibility and allows the drive arrangement to be adapted to different external loads and different motor characteristics.

[0024] In a further possible implementation form of the first aspect, the building chain actuator drive arrangement further comprises at least one radial damping element configured to reduce transmission of vibrations

from the motor to the remainder of the building chain actuator drive arrangement, the radial damping element(s) having center axes coaxial with the center axis of the worm screw, and the radial damping element(s) being arranged concentric with at least one of the bracket element and the motor. The radial damping elements facilitates assembly as well as allows tension free interconnection with surrounding surfaces such as the insides of the housing element.

[0025] In a further possible implementation form of the first aspect, the building chain actuator drive arrangement further comprises at least one of a first radial damping element arranged concentric with the motor and configured to extend between an outer surface of the motor and an adjacent, stationary surface, a second radial damping element arranged concentric with the distal end of the motor and the tubular bracket element at an interface between the motor and the bracket element, and a third radial damping element arranged concentric with the tubular bracket element and configured to extend between an outer surface of the tubular bracket element and an adjacent, stationary surface. This allows the components of the drive arrangement to be interconnected, and to engage adjacent surfaces in a way such that the vibrations generated by the motor are distributed and dampened by means of several components and not only the motor bearings, reducing the wear on the motor and, subsequently, providing a drive arrangement with increased service life.

[0026] In a further possible implementation form of the first aspect, there is no axially or radially fixed connection between the bracket element and the motor, or between an adjacent, stationary surface and the motor, preventing any added tension from arising due to interconnections.

[0027] In a further possible implementation form of the first aspect, the bracket element comprises at least one resilient assembly, arranged adjacent the at least one recess and configured to allow the bearing to be inserted into the recess by moving the bearing in a first direction along the center axis, the resilient assembly being configured to prevent the bearing from moving in a second, opposite direction along the center axis after the bearing has been fully inserted into the recess, facilitating assembly while still ensuring the assembled components remain fixed in position and do not move.

[0028] In a possible implementation form of the first aspect, the bearing is retained within the recess such that the bearing is stationary in the first direction and in the second direction along the center axis, providing a fixed longitudinal position without using separately assembled and/or rigid fastening elements.

[0029] In a further possible implementation form of the first aspect, the resilient assembly comprises a plurality of radially resilient elements at least partially extending towards the center axis and partially overlapping an opening of the recess, the resilient elements being configured to deflect away from the center axis in response to the bearing being moved in the first direction along the

center axis, into the recess, and the resilient elements being configured to reflect back towards the center axis when the bearing has been fully inserted into the recess, facilitating assembly while still ensuring the assembled components remain fixed in position and do not move.

[0030] In a further possible implementation form of the first aspect, the resilient elements extend radially inwards, toward the center axis, and deflect radially outwards, away from the center axis, allowing the bearing to be inserted into the recess as well as maintained in the recess after insertion.

[0031] In a further possible implementation form of the first aspect, the resilient assembly is a snap-fit assembly, each resilient element optionally being a cantilever snap element, simplifying assembly as well as providing an indication that assembly has been made correctly in that the snap action generates tactile and/or auditory feedback.

[0032] In a further possible implementation form of the first aspect, the resilient element comprises a longitudinally extending arm, the arm at least partially extending at an acute angle to the center axis, a distal end of the arm being arranged adjacent the recess and overlapping the opening of the recess, facilitating a resilient element that does not obstruct the movement of other components such as the worm screw.

[0033] In a further possible implementation form of the first aspect, the resilient element comprises a radially extending protrusion extending towards the center axis and partially overlapping the opening of the recess, providing an end stop having a relatively large contact surface preventing movement of the bearing after assembly.

[0034] In a further possible implementation form of the first aspect, the radially extending protrusion is wedge-shaped, the largest radial dimension of the wedge being at a distal end of the resilient element, providing a relatively large contact surface with the bearing while taking up as little volume as possible.

[0035] In a further possible implementation form of the first aspect, the resilient element is unstressed when in a first, non-deflected position, and subject to stress when deflected away from the center axis to a second, deflected position, allowing the resilient element to remain in the non-deflected position, preventing movement of the bearing, without requiring additional elements or application of force.

[0036] In a further possible implementation form of the first aspect, the resilient elements are part of the tubular section and arranged equidistantly around the tubular section, allowing the resilient elements to be manufactured in one piece with the bracket.

[0037] In a further possible implementation form of the first aspect, the building chain actuator drive arrangement is configured to move a building element arranged in an opening in a building between an open position and a closed position by means of the chain actuator, facilitating an at least partially automated way of reliably operating the opening and closing of a building element.

[0038] According to a second aspect, there is provided a roof window comprising a window frame, a pivotable window sash, a chain actuator, and a building chain actuator drive arrangement according to the above, wherein the building chain actuator drive arrangement is configured to be attached to, or arranged within, a member of the window frame or a member of the window sash, the actuator comprises a push-pull-chain and a pinion assembly, the pinion assembly being configured to interconnect the worm wheel of the building chain actuator drive arrangement and the push-pull-chain, optionally with a gear ratio $> 50:1$.

[0039] This allows for a roof window with a drive arrangement having increased service life, significantly reducing the maintenance requirements for the roof window as well as the operational reliability of the window. Furthermore, the solution facilitates a reliable interconnection which has a small volume and can easily be adapted to specific configurations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] In the following detailed portion of the present disclosure, the aspects, embodiments, and implementations will be explained in more detail with reference to the example embodiments shown in the drawings, in which:

Fig. 1 shows a perspective view of a roof window comprising a chain actuator and a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 2 shows a perspective view of a chain actuator and a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure, wherein the housing of the arrangement is opened;

Fig. 3 shows a partial perspective view of a chain actuator and a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 4 shows a partially exploded view of a chain actuator and a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure, wherein the pinion assembly of the chain actuator is shown separately;

Fig. 5 shows a cross-sectional perspective view of a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 6 shows a cross-sectional top view of a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 7 shows a perspective view of a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 8 shows an exploded view of the example of Fig. 7;

Fig. 9 shows a partially cross-sectional top view of the example of Figs. 7 and 8;

Fig. 10 shows a cross-sectional side view of a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 11 shows a partial cross-sectional side view of a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 12 shows a perspective view of a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 13 shows perspective views of a bracket, a bearing, and a worm screw of a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 14 shows a perspective view of a bracket of a building chain actuator drive arrangement in accordance with an example of the embodiments of the disclosure;

Fig. 15 shows a side view of the example of Fig. 14.

DETAILED DESCRIPTION

[0041] Fig. 1 illustrates a roof window 14 comprising a window frame 15, a pivotable window sash 16, a chain actuator 4, and a building chain actuator drive arrangement 1 which is described in more detail below. The building chain actuator drive arrangement 1 is configured to be attached to, or arranged within, a member of the window frame 15 or a member of the window sash 16. The building chain actuator drive arrangement 1 may be configured to move any suitable building element 14, such as a door or a window sash, which is arranged in an opening in a building between an open position, such as the position shown in Fig. 1, and a closed position (not shown), by means of the chain actuator 4.

[0042] The chain actuator 4 may comprise a push-pull-chain 4a and a pinion assembly 4b, as shown in Figs. 2 to 4. The pinion assembly 4b is configured to interconnect the worm wheel 3 of the building chain actuator drive arrangement 1 and the push-pull-chain 4a, optionally with a gear ratio > 50:1.

[0043] As shown in varying detail in Figs. 5 to 13, the

building chain actuator drive arrangement 1 comprises a worm drive comprising a worm screw 2 having a center axis C and a worm wheel 3 configured to engage the worm screw 2. Such worm screw drives have self locking properties which may be an advantage for maintaining doors or windows in the open position or in the closed position.

[0044] The worm wheel 3 is operatively connected to the chain actuator 4, preferably to the above-mentioned pinion assembly 4b.

[0045] A motor 5 is operatively connected to a proximal end of the worm screw 2 and is configured to rotate the worm screw 2 around the center axis C.

[0046] In embodiments of this invention the motor 5 shaft is directly connected to the worm screw 2. In other words the worm screw 2 is arranged on the motor 5 output shaft.

[0047] A bracket element 7 is fixed to the center shaft 3a of the worm wheel 3, as shown in Figs 5 to 10 and 12, the bracket fixing the position of the motor relative to the center shaft 3a. The bracket element 7 is fixed to the center shaft 3a by means of an opening 7a in the bracket element 7 configured to accommodate the center shaft 3a. The center shaft 3a may be a fixed shaft having a center axis C2 extending perpendicular to the center axis C of the worm screw 2, and the opening 7a may extend in a plane perpendicular to the center axis C2.

[0048] The bracket element 7 may also be configured to support an axial face 3b of the worm wheel 3 by means of a support surface 3c, shown in Figs. 8 and 14. The support surface 3c preferably has a surface area equal to, or smaller than, the diameter of the center shaft 3a of the worm wheel 3. The smaller the surface area, the lower the friction forces affecting the rotation of the worm wheel 3 around the center shaft 3a.

[0049] The bracket element 7 comprises at least one axially extending recess 8 configured to accommodate at least one bearing 6, the bearing 6 having a center axis coaxial with the center axis C of the worm screw 2. The bearing 6 is configured to support a distal end of the worm screw 2 when located in the recess 8, as shown in Figs. 5 to 13. The bearing 6 may be an axial bearing and optionally a radial bearing such as a ball bearing or a roller bearing.

[0050] The building chain actuator drive arrangement 1 may comprise one or several of bearings 6, such as a bearing 6 configured to support the distal end of the worm screw 2, a bearing 6 configured to support the proximal end of the worm screw 2 (not shown), and a bearing 6 configured to support the proximal end of the motor 5 (not shown). The bearing 6 may be press-fit onto the worm screw 2, optionally the distal end of the worm screw 2.

[0051] The bracket element 7 may be configured to accommodate at least the distal end of the worm screw 2, optionally by means of a tubular section extending along the center axis C and partially enclosing the worm screw 2. The tubular section may have a partially open wall, such that the worm screw 2 engages the worm

wheel 3 via the open wall.

[0052] The bracket element 7 encloses at least the main part of the building chain actuator drive arrangement 1 and the actuator 4, shown in Figs. 2, 5, and 6, is connected to the motor 5.

[0053] As shown in Figs. 5, 6, and 9, the bracket element 7 may be detachably connected to the motor 5 by means of axially extending tongues 9, or pins, the tongues 9 extending parallel with the center axis C from a proximal end of the bracket element 7, the distal end of the motor 5 comprising corresponding axially extending grooves 10. There may be at least three tongues 9, arranged non-equidistantly, such that erroneous assembly is avoided.

[0054] The tongues 9 are inserted into the grooves 10, in the axial direction, without any fixation occurring. The tongues 9 and the grooves 10 may be configured to allow microdisplacement along the center axis C of the motor 5 relative to the bracket element 5. The movement of the bracket element 7 relative to the motor 5 may be limited by the bottom of the grooves 10 in one axial direction. The movement of the bracket element 7 relative to the motor 5, in the opposite axial direction, may be limited by the interconnection between worm wheel center shaft 3a, bracket 7, and bearing 6 which is described in more detail below.

[0055] The recess 8 comprises a bottom and a sidewall extending from the bottom towards the main opening 8a of the recess 8, i.e., the opening 8a through which the bearing 6 is inserted into the recess 8. The bottom may comprise a throughgoing opening at least partially having a circumference that is smaller than the circumference of the bearing 6. Movement of the bearing 6 in the first direction D1, i.e., in a direction out of the recess 8, is prevented by the bottom of the recess 8.

[0056] The sidewall, which extends from the bottom in a direction towards the motor 5, i.e., in the second direction D2, is configured to enclose the bearing 6. The sidewall may comprise a plurality of radially extending flexible elements 11, such as lips, as shown in Figs. 12 to 15. The flexible elements 11 are configured to center the bearing 6 within the recess 8. Preferably, the flexible elements 11 are arranged equidistantly along the sidewall. The flexible element 11 may comprise a bendable sheet material, preferably a relatively thin material. Furthermore, the flexible element 11 may be an integral part of the bracket element 7, e.g. be molded as one unit together with the bracket element 7.

[0057] The bracket element 7 and/or the housing element 17 furthermore comprises at least one resilient assembly 12, arranged adjacent the at least one recess 8. The resilient assembly 12 is configured to allow the bearing 6 to be inserted into the recess 8 by moving the bearing 6 in a first direction D1 along the center axis C. Furthermore, the resilient assembly 12 is configured to prevent the bearing 6 from moving in a second, opposite direction D2 along the center axis C, the second direction D2 being opposite to the first direction, after the bearing

6 has been fully inserted into the recess 8. Figs. 7 and 9 to 11 show the bearing 6 fully inserted into the recess 8. The bearing 6 is, in other words, retained within the recess 8 such that the bearing 6 is stationary in the first direction D1 as well as in the second direction D2 along the center axis C.

[0058] The resilient assembly 12 may comprise a plurality of radially resilient elements 13 at least partially extending towards the center axis C and partially overlapping the opening 8a of the recess 8, i.e., the resilient elements 13 may extend radially inwards towards the center axis C when not affected by any external force.

[0059] The resilient elements 13 are configured to deflect away from the center axis C, i.e. radially outwards, in response to the bearing 6 being moved in the first direction D1 along the center axis C, into the recess 8, i.e. when force is applied onto the resilient elements 13 by the outer surface of the bearing 6. The resilient elements 13 may deflect by bending at a free end while remaining stationary at a fixed end.

[0060] The resilient elements 13 are furthermore configured to reflect back towards the center axis C, preferably to their original position, when the bearing 6 has been fully inserted into the recess 8 and there no longer is a force applied onto the resilient elements 13 by the outer surface of the bearing 6.

[0061] The resilient assembly 12 may be a snap-fit assembly, each resilient element 13 optionally being a cantilever snap element. The resilient elements 13 may, in other words, be unstressed when in a first, non-deflected position, and subject to stress when deflected away from the center axis C to a second, deflected position.

[0062] Each resilient element 13 may comprise a longitudinally extending arm 13a, the arm 13a at least partially extending at an acute angle to the center axis C. A distal end of the arm 13a may be arranged adjacent the recess 8 and overlap the opening 8a of the recess 8 when not affected by any external force. Each resilient element 13 may also comprise a radially extending protrusion 13b extending towards the center axis C and partially overlapping the opening 8a of the recess 8 when not affected by any external force.

[0063] Preferably, the radially extending protrusion 13b extends from the distal end of the arm 13a, at an angle to the arm 13a, preferably 90°. The radially extending protrusion 13b may be wedge-shaped, the largest radial dimension of the wedge being at the most distal end of the resilient element 13. When the bearing 6 is fully inserted in the recess 8, movement of the bearing 6 in the second direction D2 is stopped as the bearing 6 engages the distal end surface of the wedge, preferably a straight surface with maximum wedge height, the height being the dimension measured radially from the center axis C.

[0064] The resilient elements 13 may be part of the tubular section of the bracket element 7, e.g. created by means of slits extending longitudinally from a distal end of the tubular section towards its proximal end. The re-

silient elements 13, preferably two, optionally three, may be arranged equidistantly around the tubular section.

[0065] The building chain actuator drive arrangement 1 may further comprise at least one radial damping element 18, as shown in Figs. 6 to 13. The radial damping elements 18 are configured to reduce transmission of vibrations from the motor 5 to the remainder of the building chain actuator drive arrangement 1.

[0066] The radial damping elements 18 have center axes coaxial with the center axis C of the worm screw 2, are arranged concentrically with at least one, preferably both, of the bracket element 7 and the motor 5.

[0067] The building chain actuator drive arrangement 1 may comprise at least one of a first radial damping element 18, a second radial damping element 18, and a third radial damping element 18. The Figs. show embodiments comprising all three of these radial damping elements 18.

[0068] The first radial damping element 18 is arranged concentric with the motor 5 and configured to extend between an outer surface of the motor 5 and an adjacent, stationary surface. The second radial damping element 18 is arranged concentrically with the distal end of the motor 5 and the tubular bracket element 7 at an interface between the motor 5 and the bracket element 7. The third radial damping element 18 is arranged concentric with the tubular bracket element 7 and configured to extend between an outer surface of the tubular bracket element 7 and an adjacent, stationary surface. The adjacent, stationary surface may be a surface of an additional component or an inner surface of a housing element 17 enclosing the building chain actuator drive arrangement 1. The motor 5 may be separated from, and suspended with regards to, the housing element 17 by means of the radial damping elements 18 only. In other words, the radial damping elements 18 allows there to be no axially or radially fixed connection between the bracket element 7 and the motor 5, or between the housing element 17 and the motor 5.

[0069] The radial damping elements 18 may comprise of a flexible material, preferably a rubber material or a silicone material, or any deformable element configured to expand in one direction when pressure is applied onto the element in a further direction. Preferably, the radial damping elements 18 expand radially when pressure is applied in directions along the center axis C, and, oppositely, expand in directions along the center axis C when pressure is applied radially. The flexible material preferably has a Shore A hardness in the range of 20-80.

[0070] The various aspects and implementations have been described in conjunction with various embodiments herein. However, other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed subject-matter, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere

fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage.

[0071] The reference signs used in the claims shall not be construed as limiting the scope. Unless otherwise indicated, the drawings are intended to be read (e.g., cross-hatching, arrangement of parts, proportion, degree, etc.) together with the specification, and are to be considered a portion of the entire written description of this disclosure. As used in the description, the terms "horizontal", "vertical", "left", "right", "up" and "down", as well as adjectival and adverbial derivatives thereof (e.g., "horizontally", "rightwardly", "upwardly", etc.), simply refer to the orientation of the illustrated structure as the particular drawing figure faces the reader. Similarly, the terms "inwardly" and "outwardly" generally refer to the orientation of a surface relative to its axis of elongation, or axis of rotation, as appropriate.

Claims

1. A building chain actuator drive arrangement (1) comprising:
 - a worm drive comprising a worm screw (2) having a center axis (C) and a worm wheel (3) configured to engage said worm screw (2), said worm wheel (3) being operatively connected to a chain actuator (4);
 - a motor (5) operatively connected to a proximal end of said worm screw (2) and configured to rotate said worm screw (2) around said center axis (C);
 - at least one bearing (6) having a center axis coaxial with said center axis (C) of said worm screw (2); and
 - a bracket element (7) fixed to a center shaft (3a) of said worm wheel (3) by means of an opening in said bracket element (7) configured to accommodate said center shaft (3a), said bracket element (7) comprising at least one axially extending recess (8) configured to accommodate said at least one bearing (6), said bearing (6) being configured to support a distal end of said worm screw (2) when located in said recess (8).
2. The building chain actuator drive arrangement (1) according to claim 1, wherein said bracket element (7) comprises a tubular section extending along said center axis (C) of said worm screw (2) and partially enclosing at least said distal end of said worm screw (2).
3. The building chain actuator drive arrangement (1) according to claim 1 or 2, wherein said bracket element (7) is configured to support an axial face (3b)

of said worm wheel (3) by means of a support surface (3c) preferably having an area equal to, or smaller than, a diameter of said center shaft (3a) of said worm wheel (3).

4. The building chain actuator drive arrangement (1) according to any one of the previous claims, wherein said bracket element (7) is detachably connected to said motor (5) by means of axially extending tongues (9), said tongues (9) extending parallel with said center axis (C) from a proximal end of said bracket element (7), said distal end of said motor (5) comprising corresponding axially extending grooves (10).
5. The building chain actuator drive arrangement (1) according to any one of the previous claims, comprising a bearing (6) configured to support said proximal end of said worm screw (2) and/or a bearing (6) configured to support said proximal end of said motor (5).
6. The building chain actuator drive arrangement (1) according to any one of the previous claims, further comprising at least one radial damping element (18) configured to reduce transmission of vibrations from said motor (5) to the remainder of said building chain actuator drive arrangement (1), said radial damping element(s) (18) having center axes coaxial with said center axis (C) of said worm screw (2), and said radial damping element(s) (18) being arranged concentric with at least one of said bracket element (7) and said motor (5).
7. The building chain actuator drive arrangement (1) according to any one of the previous claims, wherein said bracket element (1) further comprises at least one resilient assembly (12), arranged adjacent said at least one recess (8) and configured to allow said bearing (6) to be inserted into said recess (8) by moving said bearing (6) in a first direction (D1) along said center axis (C), said resilient assembly (12) being configured to prevent said bearing (6) from moving in a second, opposite direction (D2) along said center axis (C) after said bearing (6) has been fully inserted into said recess (8).
8. The building chain actuator drive arrangement (1) according to any one of the previous claims, wherein said resilient assembly (12) comprises a plurality of radially resilient elements (13) at least partially extending towards said center axis (C) and partially overlapping an opening of said recess (8), said resilient elements (13) being configured to deflect away from said center axis (C) in response to said bearing (6) being moved in said first direction (D1) along said center axis (C), into said recess (8), and said resilient elements (13) being configured to re-

flect back towards said center axis (C) when said bearing (6) has been fully inserted into said recess (8).

9. The building chain actuator drive arrangement (1) according to claim 8, wherein said resilient element (13) comprises a longitudinally extending arm (13a), said arm (13a) at least partially extending at an acute angle to said center axis (C), a distal end of said arm (13a) being arranged adjacent said recess (8) and overlapping said opening of said recess (8).
10. The building chain actuator drive arrangement (1) according to claim 8 or 9, wherein said resilient element (13) comprises a radially extending protrusion (13b) extending towards said center axis (C) and partially overlapping said opening of said recess (8).
11. The building chain actuator drive arrangement (1) according to any one of claims 8 to 10, wherein said resilient elements (13) are part of said tubular section and arranged equidistantly around said tubular section.
12. The building chain actuator drive arrangement (1) according to any one of the previous claims, wherein said building chain actuator drive arrangement (1) is configured to move a building element (14) arranged in an opening in a building between an open position and a closed position by means of said chain actuator (4).
13. A roof window (14) comprising a window frame (15), a pivotable window sash (16), a chain actuator (4), and a building chain actuator drive arrangement (1) according to any one of claims 1 to 12, wherein said building chain actuator drive arrangement (1) is configured to be attached to, or arranged within, a member of said window frame (15) or a member of said window sash (16), said chain actuator (4) comprising a push-pull-chain (4a) and a pinion assembly (4b), said pinion assembly (4b) being configured to interconnect the worm wheel (3) of said building chain actuator drive arrangement (1) and said push-pull-chain (4a), optionally with a gear ratio > 50:1.

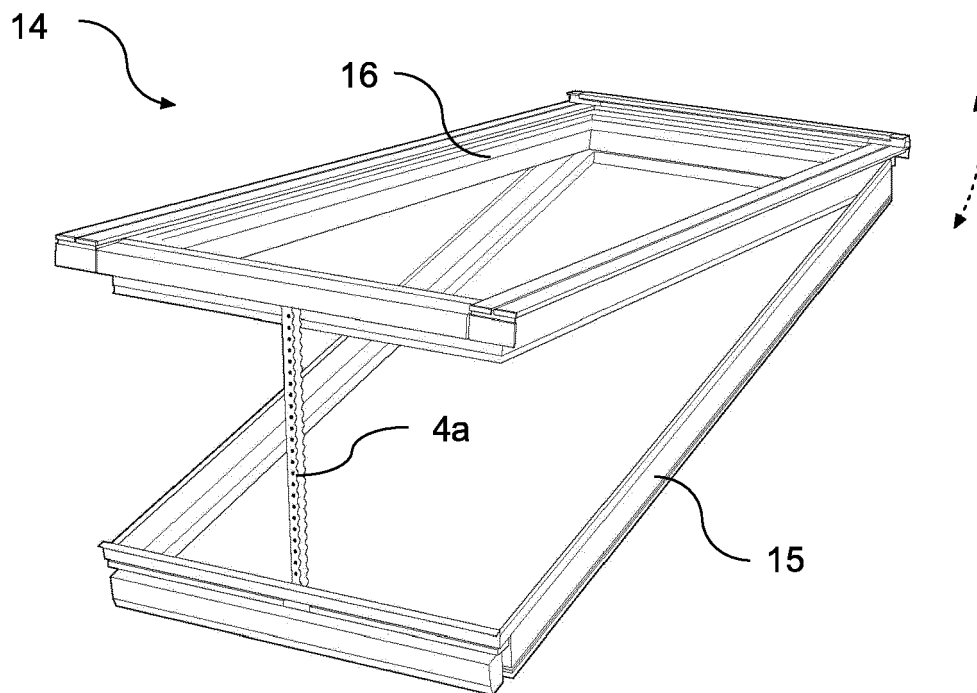


Fig. 1

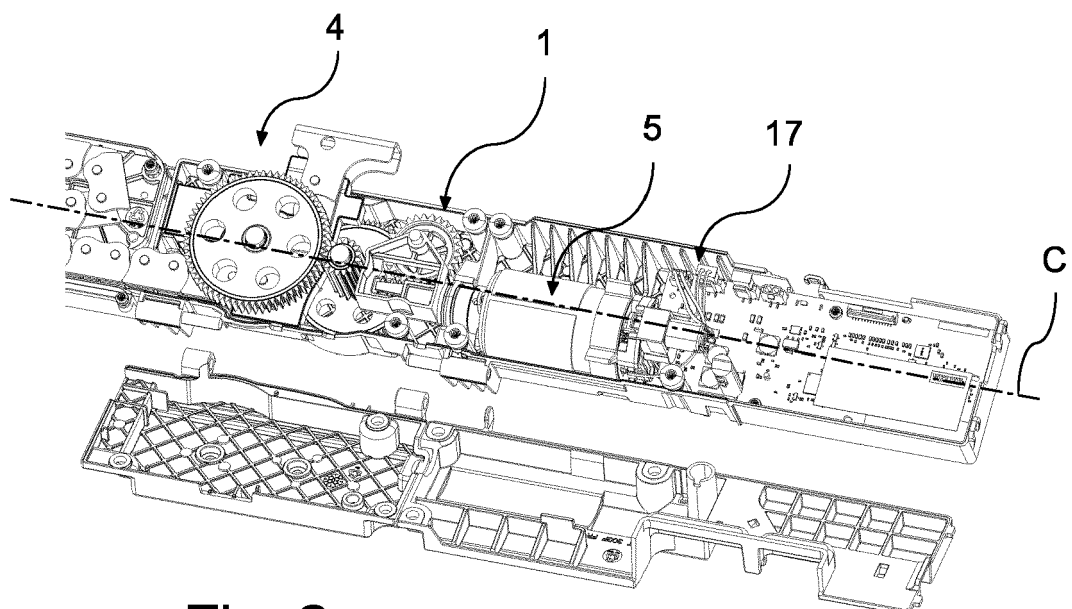
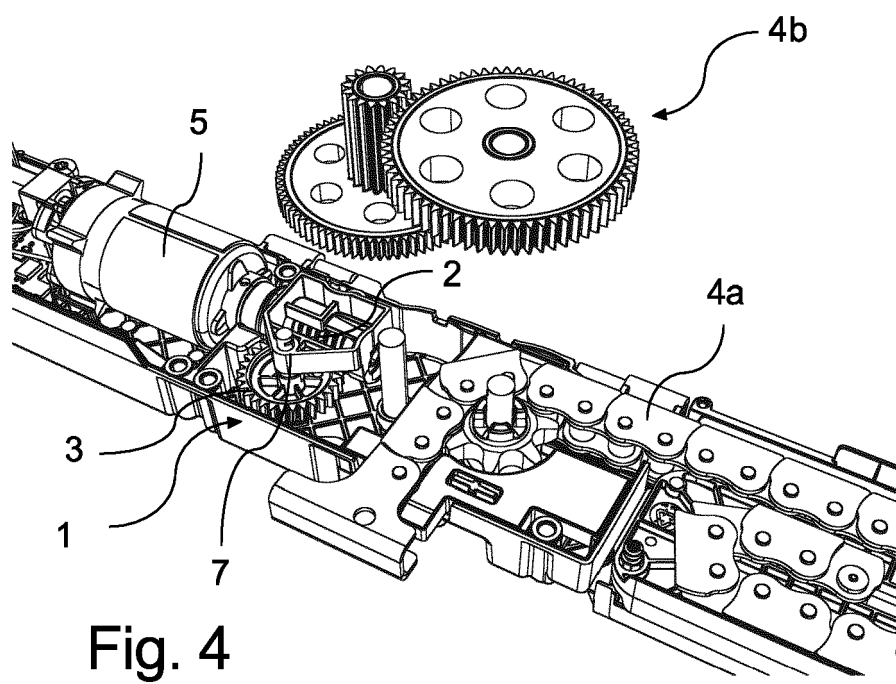
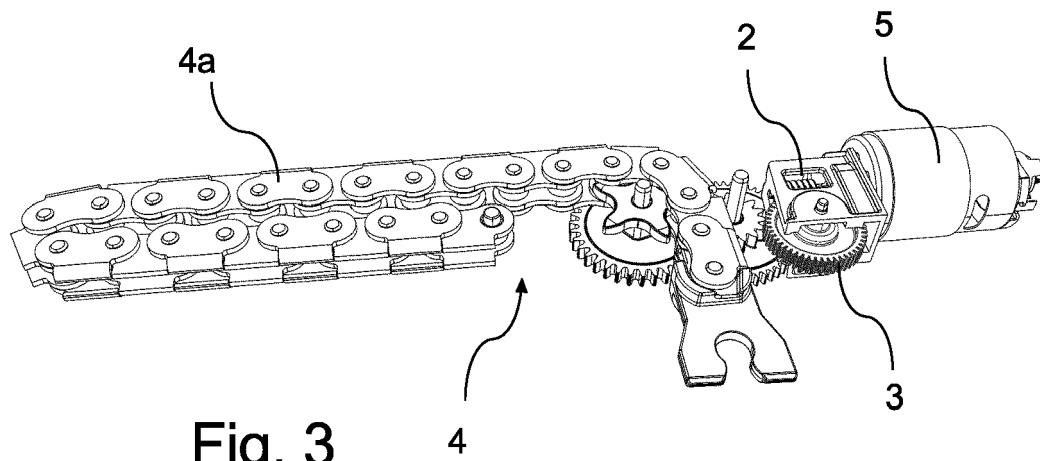
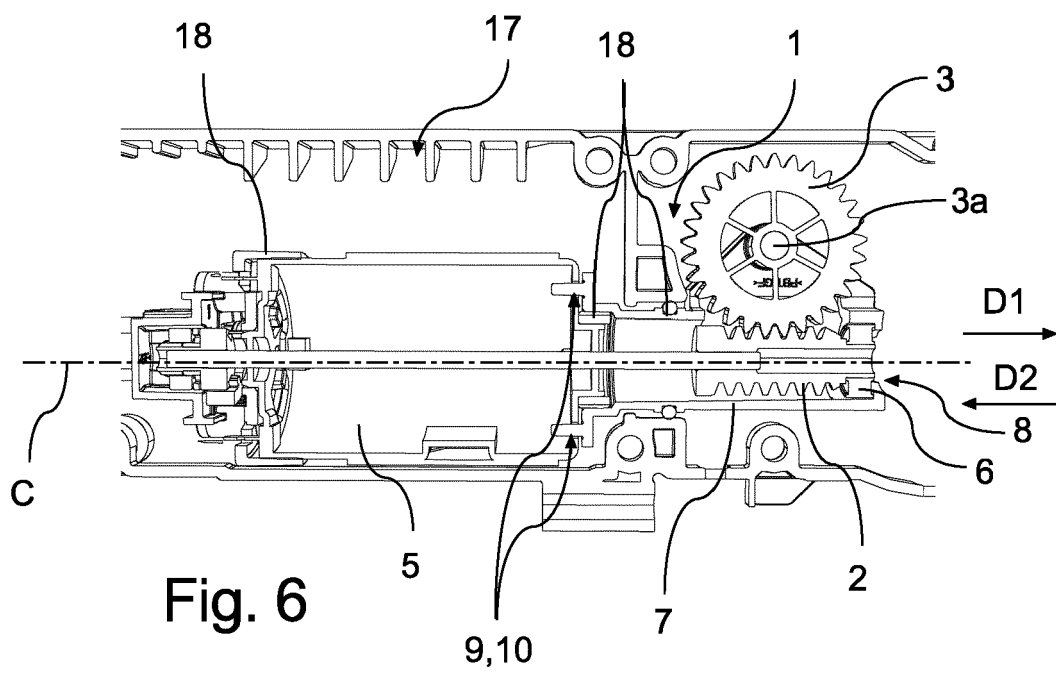
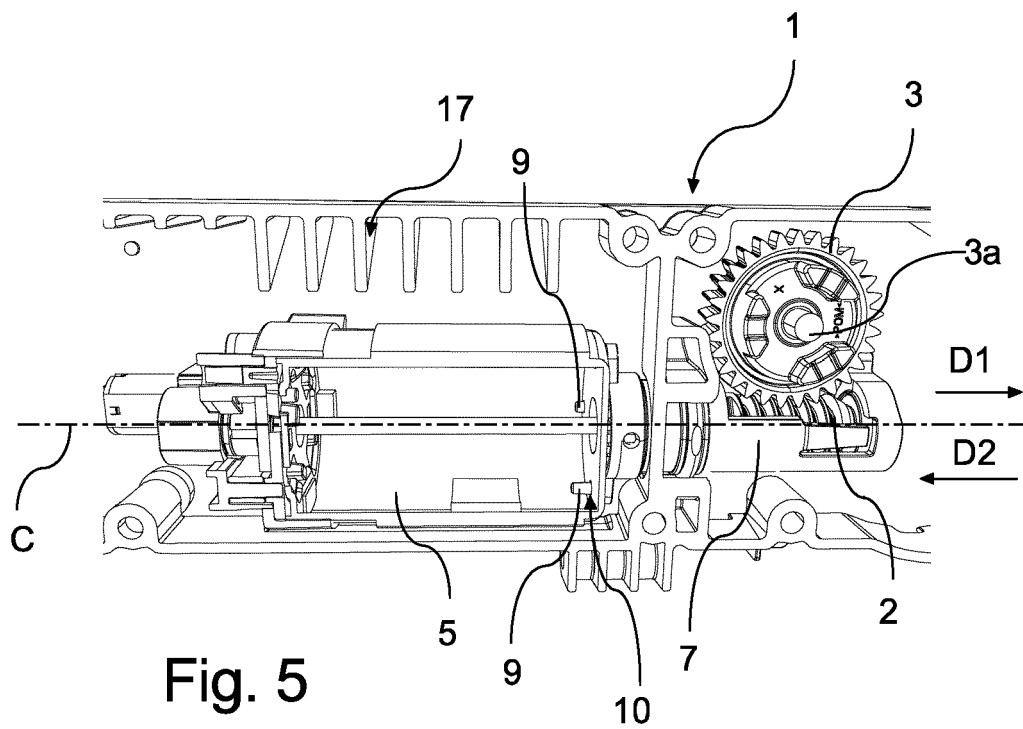


Fig. 2





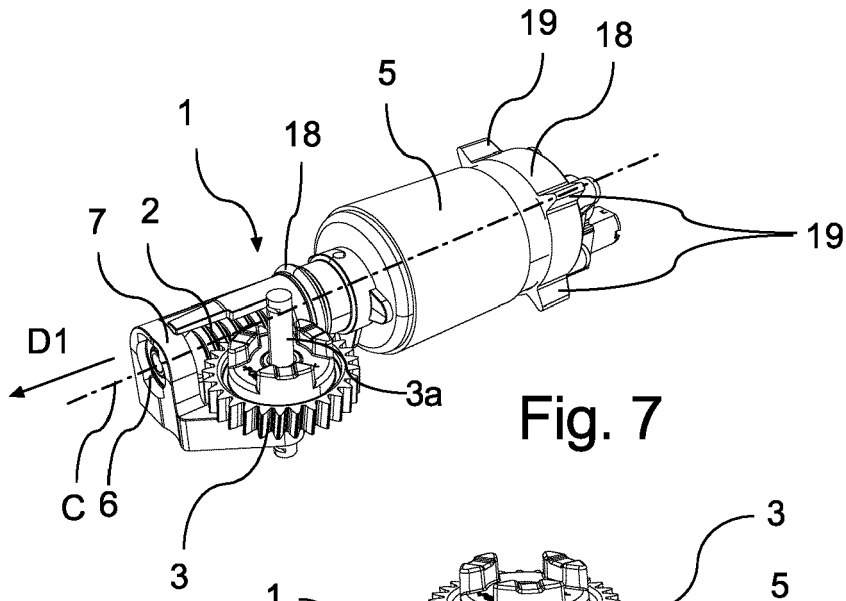


Fig. 7

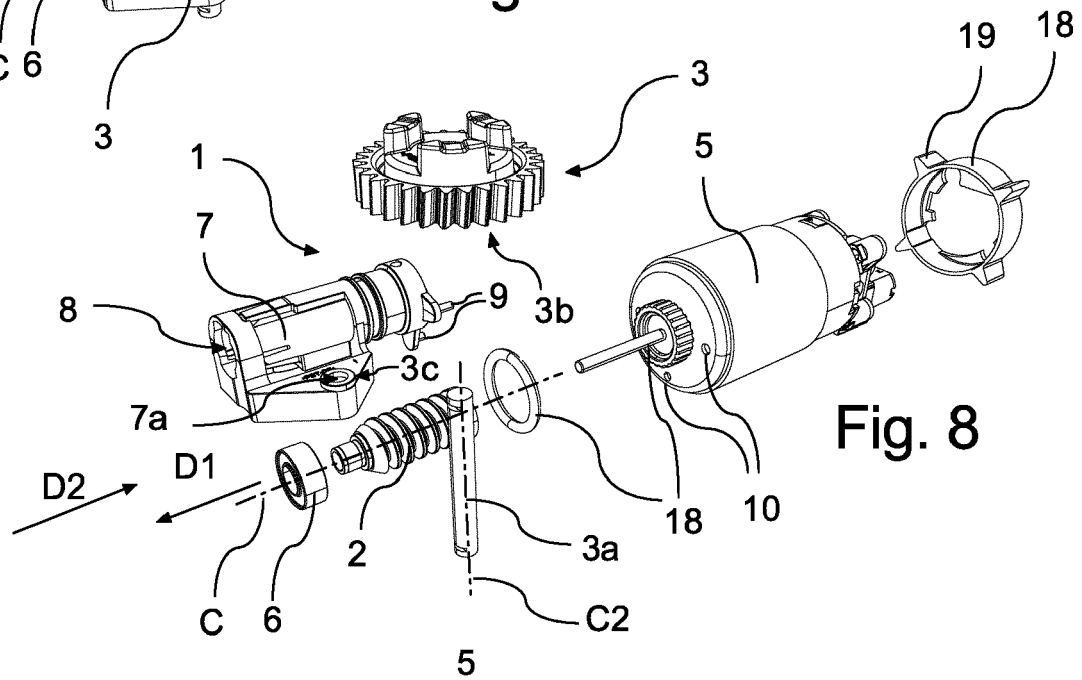


Fig. 8

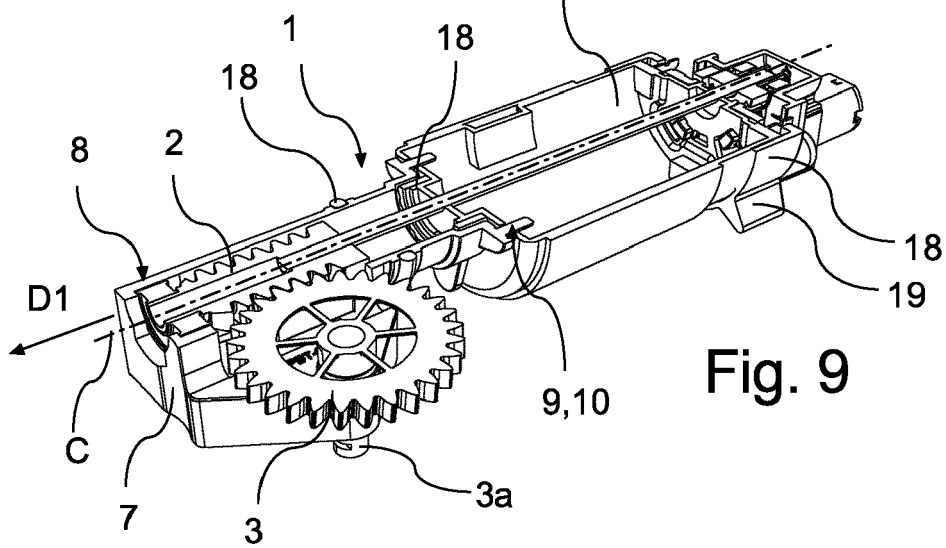


Fig. 9

Fig. 10

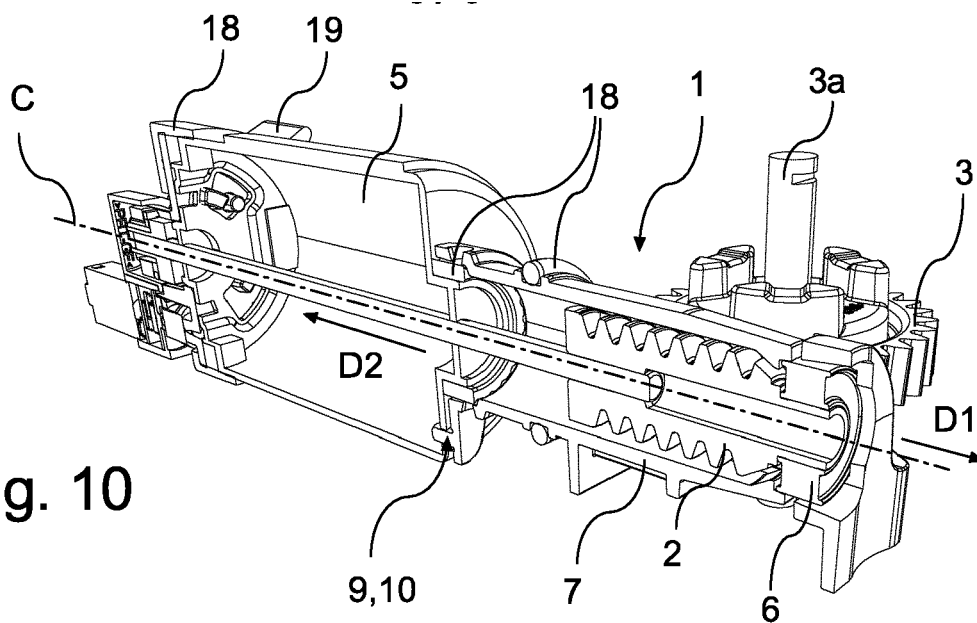


Fig. 11

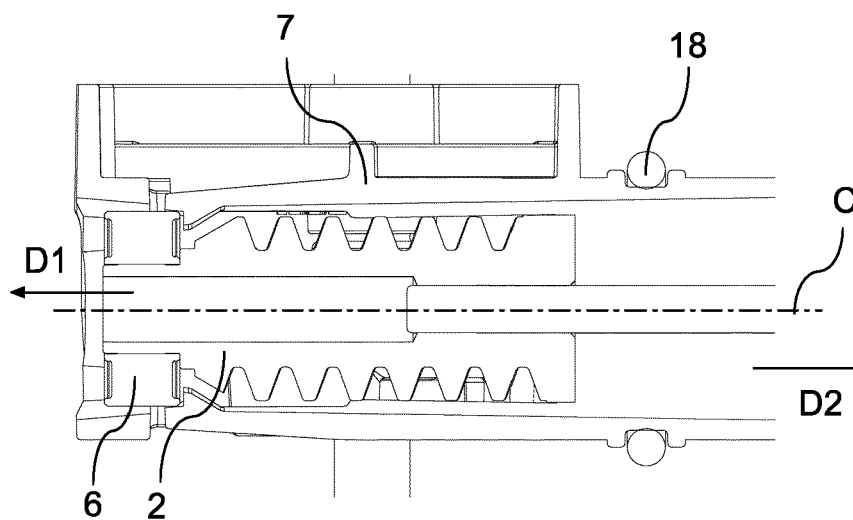
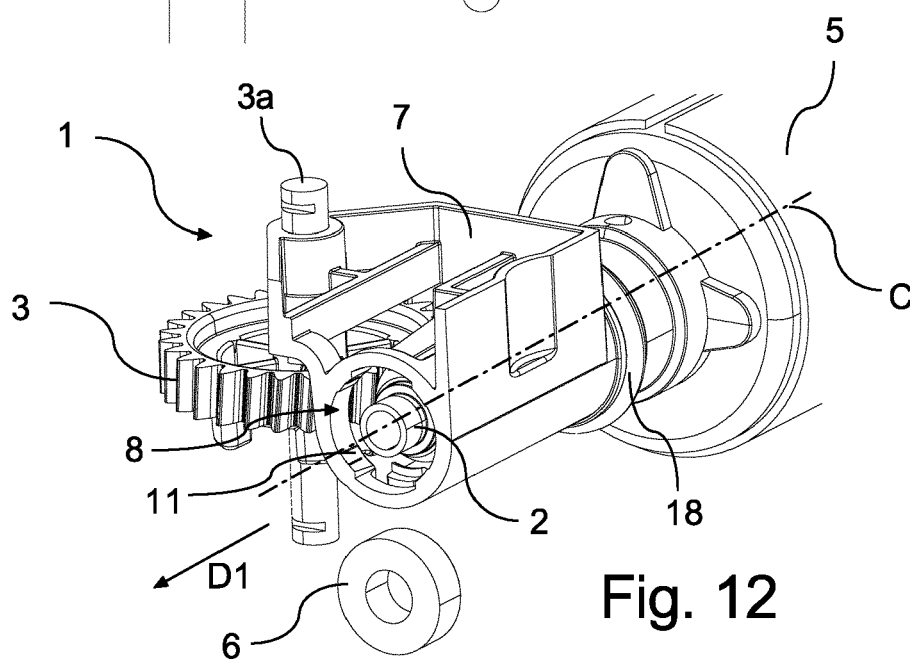
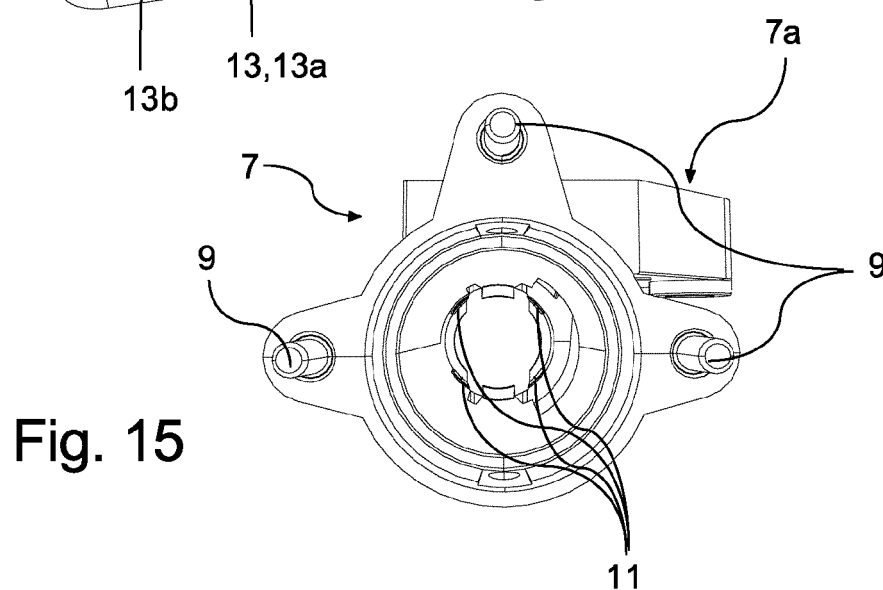
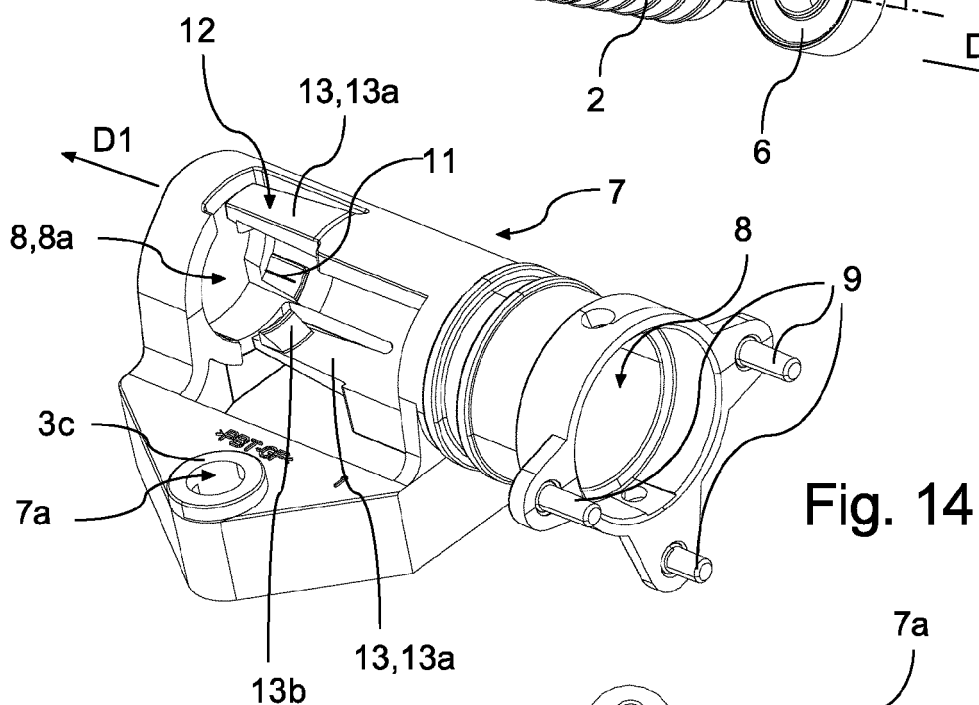
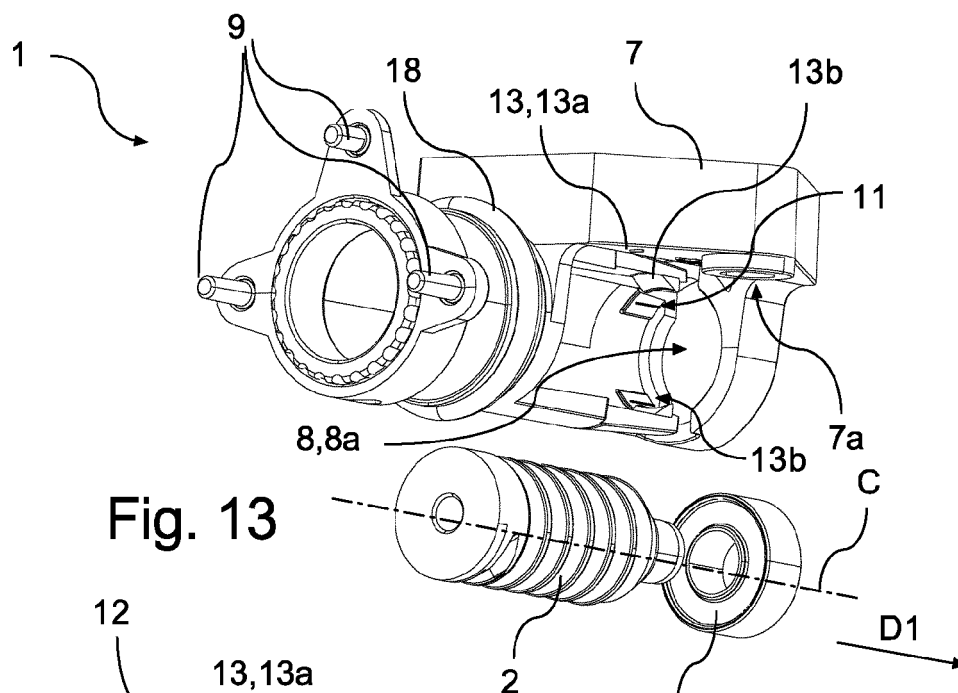


Fig. 12







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A	* paragraphs [0025] - [0032], [0042] - [0044]; figures 1-6, 12-16 *	11	
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A	* paragraphs [0031] - [0033], [0038], [0044], [0067] - [0071]; figures 2, 3, 6 *	7-10	
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	* paragraphs [0043], [0064]; figures 1-12 *		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			E05F
Place of search		Date of completion of the search	Examiner
The Hague		5 October 2021	Rémondot, Xavier
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