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Description

[0001] The invention relates to a telescopic tube, in particular for use in a linear drive or linear motor, which
5 thus converts a rotational movement of a drive, in particular an electric motor, into a translational movement. Such linear drives are frequently used for motorized adjustment of furniture, e.g. beds, in particular hospital beds, chairs, or the like. Preferably, one linear
10 drive each is used for adjusting the lying surface of a hospital bed, namely a linear drive for adjusting a pivotably mounted head part and a further, preferably separately controlled linear drive for adjusting or pivoting a foot part of this lying surface out of the lying
15 surface upwards about a respective pivot axis.

[0002] Such a linear drive is known, for example, from the unexamined and first publication of German patent application DE 10 2011 014 567 A1. In this device, the
20 spindle mount has essentially a cylindrical base body in which a plug-in opening is formed on one end face, which is flattened on one side for a rotationally fixed connection and into which a correspondingly flattened rear gear end of a spindle is inserted in a rotationally fixed manner.
25 Around this insertion area, an insertion cylinder of reduced size compared to the outer cylindrical main body is provided on this spindle mount with an outer pinion that engages positively in a complementary mount in the worm wheel. Thus, the rotary motion of the worm wheel is
30 transmitted to the spindle holder.

[0003] Although such linear drives represent a very compact and reliable gear chain, the manufacture of these special

components is nevertheless relatively complex and in this respect costly, because the spindle with the external trapezoidal thread must be milled off from one end, flattened to produce the joining surface and then provided with journals and threads at both end faces, which involves multiple machining operations. The spindle mount with the cylindrical outer body and the mounting pinion is also made of metal and therefore has to be machined, which is also costly. At the same time, however, the compact design of such a linear transmission is desired, so that it is not possible to simply use a larger plastic housing or a larger arrangement with stronger plastic in the confined and given installation space.

[0004] Based on this prior art, a first technical problem of the invention is to at least partially avoid these disadvantages and to further develop a linear transmission of the above-mentioned kind in such a way that these disadvantages are at least partially avoided, and in particular to provide a compact, reliable linear transmission which is also significantly simpler and thus less expensive to manufacture.

[0005] A linear drive of the type mentioned above is disclosed, in which at least one notch, recess or the like is provided at the drive end of the spindle, at least the spindle holding region of the spindle holder comprises plastic, and at least one clamping pin is inserted into the at least one notch between the spindle holder and the spindle. Advantageous further developments are stated in the subclaims.

- [0006] This linear drive is particularly suitable for moving high loads of 6000 to 8000 Newtons and more, for which purpose two diametrically opposite notches extending in the longitudinal direction are preferably provided on the outer lateral surface of the spindle thread, preferably over a length of 25 to 30 mm and with a width of about 1.5 - 2 mm, so that two pins, a clamping sleeve or a hollow clamping pin with a correspondingly adapted pin diameter can then be inserted or driven into the front end of these notches between the outer lateral surface of the spindle holder, whereby the threaded portions of the internal thread located there are deformed and thus produce a fixed and captive connection between the outer spindle holder and the received spindle. According to the invention, the spindle holder thus no longer has to be manufactured as a metal part, but can now be formed as a plastic part, in particular as a injection-molded plastic part, for example comprising or completely made of polyamide or POM.
- [0007] The disclosed embodiment thus permits a particularly compact design if the spindle holder is arranged in the hollow shaft of the worm wheel or is at least partially received by the latter in the installed position.
- [0008] In the preferred embodiment, the spindle holder comprises a tubular receiving socket designed to receive the spindle and extending coaxially with the longitudinal axis of the spindle in the installed position. This receiving socket is provided with an internal thread acting complementary to the employed external thread of the spindle, i.e. preferably with an internal trapezoidal thread. Furthermore, the spindle holder comprises a connector for non-positive connection to the worm wheel,

which connector is designed in particular as a flange projecting circumferentially and radially from the outer circumferential surface of the receiving socket, particularly preferably as a connecting flange integrally formed on the receiving socket.

[0009] In a particularly stable embodiment for particularly high loads of 6000 to 8000 Newtons, the spindle holder or plastic of the spindle holder can be fiber-reinforced, in particular glass fiber-reinforced, e.g. with a proportion of 10-30% reinforcement filling.

[0010] This design is also suitable for forming a worm wheel, in particular if this worm wheel is provided with an additional connecting piece projecting laterally from the plane defined by the tooth flank and a joining surface is provided on the connector of the spindle holder or connecting flange of the spindle holder, which joining surface can be coupled to the coupling of an emergency coupling device or an emergency adjustment device arranged in a longitudinally displaceable manner on the connecting piece of the worm wheel, during engagement. A clamping element acting between the worm wheel and the coupling, preferably designed as a spring, urges the coupling into the engaged position. This coupling forms part of an emergency coupling device and enables emergency adjustment during disengagement, which may be necessary, for example, in the case of hospital beds, in order to lower the head end or foot end quickly, and without actuation of the electric motor.

[0011] Preferably, the coupling is a mechanical coupling which is unloaded in the engaged position, i.e. which

connects the worm wheel and the spindle to each other in the non-actuated state and realizes a freewheel only when the emergency coupling device or emergency adjustment device is actuated, in which case the actuated furniture component, e.g. the head end of a hospital bed, can be lowered more quickly into the horizontal position.

[0012] The emergency coupling device is preferably of positive-locking design for transmitting the higher loads, but can also be of frictional design.

[0013] The positively locking emergency coupling device comprises first teeth in indirect or direct, but rotationally fixed connection with the worm wheel. Further teeth are in indirect or direct, but rotationally fixed connection with the spindle or the spindle holder. Preferably, the teeth are designed for transmitting larger torques than splined shafts or are designed as such structures. As initially explained, these teeth are preferably formed as a one-piece molded part on the spindle holder, but may also constitute an additional component.

[0014] Furthermore, the emergency coupling device comprises a sliding element which is displaceable in the axial longitudinal direction of the spindle and which, in a preferred embodiment, is formed as an interiorly hollow sliding sleeve or as a sliding bushing. The sliding element comprises a joining structure complementary to the joining partners of the drive train, by which joining partners the joining structure connects the worm wheel and the spindle holder to one another in a rotationally fixed manner in the unloaded rest position.

[0015] The actuation of this emergency adjustment is usually carried out via a traction gear comprising emergency cables arranged laterally on the bed, which comprise, for example, a Bowden cable that transfers the coupling from the engagement position, in which it is preloaded by the spring, to the release position, thus permitting the required emergency adjustment of the spindle or of the actuated piece of furniture.

10 [0016] This embodiment without emergency coupling device comprises a worm wheel with at least one joining or wedge surface formed within the hollow shaft for non-positive and non-rotatable accommodation of the spindle holder formed complementarily for insertion into this at least one joining surface.

[0017] The variant with emergency coupling device, on the other hand, has a coupling connecting piece on the worm wheel which projects from the plane of the tooth flank and can be connected in a rotationally fixed manner to the sliding element of the coupling and, for this purpose, preferably comprises splines on the outside on which the coupling is seated in a longitudinally displaceable and rotationally connected manner. In this embodiment, the spindle sleeve of the spindle holder has a coupling flange which projects radially from the longitudinal axis and has engagement surfaces which form a rotationally fixed operative connection with the coupling in the engaged position.

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[0018] Preferably, the coupling device is designed as a claw coupling, and the joining surfaces of the coupling connecting piece and the coupling flange complementarily

formed on the spindle holder are designed as corresponding splines or spline pieces with which the coupling cooperates in a rotationally fixed manner in the various positions.

5 [0019] As a sliding element, the coupling preferably comprises a sliding sleeve, i.e. an annular body surrounding the coupling connecting piece, which annular body is displaceable between the engaged position and the disengaged position, so that the sliding sleeve transmits a
10 torque acting on the connecting piece to the coupling flange of the spindle holder in the engaged position and does not transmit this torque in the disengaged position.

[0020] The release of the coupling or the sliding sleeve is
15 effected via a pulling device forming an emergency adjustment device for actuating a spring-loaded pull rod that transfers or pulls a swingarm from a spring-preloaded engagement position against the force of a spring into the releasing emergency release position. In particular, this
20 swingarm is designed as a rocker, i.e. it pivots about a pivot axis, with the spring-biased pull rod engaging at one actuating end of the rocker and the opposite end of the rocker engaging at the coupling, preferably via a tongue-and-groove connection.

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[0021] The outside of the coupling may, for example, have a circumferential groove in which engagement pins formed on both sides of the rocker engage.

30 [0022] A separable design of the gearing elbow thus provides a modular system that can be easily redesigned by replacing the worm gear as well as the spindle holder. There are thus two embodiments, namely one without a

coupling device and one with a coupling device. The one without coupling device is about 30 to 50 mm shorter than the one without coupling because no coupling is required. Thus, the lifting tube can be retracted further into the
5 outer tube by this amount.

[0023] In one embodiment, the linear drive includes a wrap spring brake. The wrap spring brake requires a tenon or stub on which the windings of the wrap spring can be
10 mounted. For this purpose, it is advisable to design a brake stub or brake tenon directly on the worm wheel, preferably, in an embodiment including a coupling device, opposite the coupling connecting piece in a manner projecting laterally from the worm wheel. This brake stub
15 may have additional pockets or recesses for a lubricant. In the installed position, the windings of the wrap spring enclose this brake stub, the inside diameter of the windings of the wrap spring being slightly smaller than the outside diameter of the brake stub to create the required
20 braking power. Using the wrap spring brake ensures self-locking of the linear drive even when the electric motor is current-free.

[0024] An alternative brake arrangement is operatively and
25 frictionally connected to the motor shaft, the friction surfaces constantly acting on the motor shaft under a spring-elastic preload and generating a constant braking moment. The braking moment is vanishingly low compared to a braking moment generated by the wrap spring, but promotes
30 the mechanical internal friction of the drive train by the amount required for achieving self-locking. In one embodiment, the brake element, which is attached to the motor shaft, is provided with a freewheel so that it

rotates with the motor shaft in one rotating direction and is held fixed against rotation in a second rotating direction opposite the first rotating direction by said freewheel and generates a braking moment on the motor shaft.

[0025] Thus, the essential components of the linear transmission can be made of plastic, in particular as injection-molded plastic parts. It is advantageous to make the wall thicknesses of these parts as uniform as possible so that no cracks, shrinkage cavities or other distortions occur during the cooling process, i.e. no thermal distortion occurs, which is more of a problem with thick-walled workpieces. For this purpose, in the case of thicker workpieces, i.e. anything with a wall thickness of 3 mm or more, cavities, openings, expansions or the like are therefore provided in the solid material.

[0026] In addition, an emergency coupling device is disclosed, i.e. the connecting device for the pulling means for performing an emergency adjustment of the emergency release coupling device used in the linear transmission.

[0027] As previously explained, this emergency adjustment is necessary, for example, if the patient bed must be quickly moved from the position with the head and/or foot section angled to the horizontally extending rest position, e.g., in the event of an emergency.

[0028] To this end, a linear transmission known from prior art comprises an emergency coupling or emergency adjustment device with emergency handles preferably disposed on each side of the bed and with which this emergency adjustment

can be carried out in order to transfer the linear transmission from the engagement position to the freewheeling position which allows the angled bed to be quickly adjusted to the horizontal, thus without inhibition of the electric motor or the gear.

[0029] In prior art, these emergency cables further comprise Bowden cables which are passed over deflection rollers and act via a Bowden cable holder arranged substantially coaxially with the spindle and, in particular, are inserted in a form-fitting manner in corresponding receiving openings in the Bowden cable holder by means of cable thimbles, on the Bowden cable holder. The existing devices have the disadvantage that the non-actuated side slackens during the actuation and can thus frequently detach or become detached from a holder for the emergency cable. This can be disadvantageous during surgery or during rapid movements in an emergency, where this emergency cable hanging out can get caught.

[0030] In view of this prior art, the invention provides an emergency coupling device for an emergency adjustment which prevents any undesired slackening of the non-actuated emergency cable as far as possible.

[0031] In an emergency coupling device for an emergency adjustment of the type described above, this is already achieved by the fact that the Bowden cable holder is rotatably connected to a first end of a pull rod that engages an emergency coupling device with the second end. This rotatable design has particular advantages because the Bowden cable holder thus acts as an intermediate coupling which balances the emergency cable on one side of the bed

on the other, non-actuated side in such a way that this non-actuated side remains tight, i.e. slackens only very little, namely 10% at maximum, or slackens not at all. In any case does the emergency handle not detach from the holder.

[0032] Preferably, a pin is formed between the pull rod and the Bowden cable holder, which pin rotatably connects the two parts together. In particular, the pull rod has a journal which extends transversely to the pull rod longitudinal axis and to which the Bowden cable holder is rotatably attached or snapped-on.

[0033] The Bowden cable holder in the installed position thus extends transversely to the longitudinal axis of the pull rod like a T, namely preferably at the front face end thereof in the installed position, with the pivoting or rotation axis between the Bowden cable holder and the pull rod preferably engaging at the center of the Bowden cable holder so that fixing of the Bowden cables takes place laterally of this central swivel or pivot point.

[0034] The Bowden cable holder is designed in such a way that its rear side, i.e. the side facing the pull rod, bears against the bearing surfaces of the emergency coupling device in the rest position.

[0035] To achieve a harmonic, i.e. smooth movement, rolling or sliding surfaces can be formed between these bearing surfaces and the Bowden cable holder, which rolling or sliding surfaces are preferably designed as semi-circular projections.

[0036] In a preferred further development, these rear bearing surfaces of the Bowden cable holder are beveled from the center towards the back, in particular at an angle of about 45°, in order to achieve stretching of the unloaded Bowden cable on the opposite side in the manner of a rocker when the Bowden cable holder is actuated on one side, and thus to better prevent that the non-actuated Bowden cable jumps out due to slackening. Furthermore, when the Bowden cable is actuated from one side, the inclination of the rear bearing surfaces causes an additional displacement of the journal by an amount corresponding to the displacement of the Bowden cable holder 58.

[0037] The Bowden cable holder may be formed on a housing of the linear drive or may be attached to another component of the linear drive or the bed via a separate attachment device. Particularly preferably, this is provided on a clamp that is attached to the stationary outer tube of the linear drive.

[0038] The Bowden cable holder is preferably formed as a injection-molded plastic part and preferably comprises a central receptacle formed for rotatably inserting a pivot pin connected to the pull rod, as well as two insertion openings spaced laterally equidistantly from this central region for receiving the ends of the Bowden cables or the cable thimbles provided at the ends of the Bowden cable.

[0039] The invention relates to a front cover for the media-tight sealing of a telescopic tube, in particular of a linear drive according to the generic part of the independent claim.

[0040] DE 20 2004 002 245 U1 discloses a previously described linear drive with a described telescopic tube. Further prior art is known from DE 20 2006 014 117 U1, DE 10 2011 014 567 A1, DE 20 2010 012 908 U1, WO 2016/045726 A1, CN 201 008 114 Y and DE 20 2006 009 957 U1.

[0041] The telescopic tube of a linear drive comprises an outer tube, which is designed to receive a lifting tube that is longitudinally displaceable relative thereto.

10 Furthermore, this comprises a - rear - drive end through which an electromotively driven spindle extends on which a spindle nut is seated which is longitudinally displaceable by rotation of the spindle and engages the lifting tube. Finally, the telescopic tube has a front or face end from
15 which the inner tube protrudes from the outer tube. The front cover closes this front or face end to prevent media entry at least at the front end, for which purpose the front cover comprises a seal with at least one sealing lip.

20 [0042] For sealing such relatively movable parts, prior art, for example in DE 10 2008 028 335 B3, uses two end caps that can be attached to tubes seated one inside the other, with a felt ring or O-ring arranged therebetween. However, these felt rings or O-rings can only be compressed
25 to a maximum of 5 to 10 percent of their radial expansion before damage to the sealing element occurs. However, this is not always sufficient with existing manufacturing tolerances, or implies costly quality control or even rapid defects or leakage.

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[0043] Based on this prior art, it is a further object of the invention to at least partially avoid these disadvantages and to further develop a front cover of the

type mentioned at the beginning in such a way that these disadvantages are at least partially avoided, and in particular to provide a front cover which enables a reliable seal even with larger tolerances between the joining partners (outer tube, lifting tube and front cover), in particular in the case of a stationary outer tube and a lifting tube displaceably accommodated therein, in particular used in a linear drive described above.

10 [0044] According to the invention, in a front cover of the type mentioned at the beginning, this technical problem is already solved by the features of the independent claim. Advantageous further developments are stated in the subclaims relating to the front cover.

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[0045] The "spring seal" thus provided is very flexible and robust and can therefore accommodate large manufacturing tolerances by surprisingly simple means, e.g. between 0.5 to 1 mm. This solution is thus very flexible with regard to faulty installation and therefore easy to install. The spring always pulls the sealing lip optimally tight and circumferentially onto the outer lateral surface of the lifting tube. The sealing lip thus always fits tightly against the outer lateral surface of the lifting tube. In accordance with the invention, the combination of the good flexibility of the seal together with the sealing lip and the spring fitted in the area of the sealing lip results in an increased pressure force of the sealing lip on the lifting tube, while the seal itself remains resilient and flexible. Furthermore, the material of the seal can have good sliding properties with respect to the friction partner of the lifting tube.

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[0046] This spring, which may be incorporated in the sealing lip, compensates in a particularly simple manner for any tolerances that occur, in particular of the lifting tube.

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[0047] Particularly preferably, the spring of the spring seal is designed as a spiral spring which fully encloses the seal for the lifting tube and is thus also sized to fit the lifting tube. In addition to the inherent springiness of the seal, the spiral spring provides an additional circumferential spring force.

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[0048] Instead of the spiral spring, another clamping rubber can also be used as a spring.

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[0049] The proposed spring-loaded seal thus realizes the so-called "car wash suitability" according to IP67W, i.e. a seal against hard jet water, at high temperatures and with the use of chemicals.

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[0050] The spring seal is preferably adapted to the geometry of the front cover. According to the invention, this comprises a sealing plate which covers the outer tube on the front face and defines the main sealing plane, which sealing plate comprises the spring-loaded sealing lip in the center for enclosing abutment against the lifting tube, and whose outer circumferential surface comprises an outer rim for enclosing abutment against the outer tube.

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Particularly preferably, the spring-loaded sealing lip extends forwardly from the main sealing plane and the outer rim extends rearwardly from said main sealing plane.

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[0051] The front cover is configured for enclosingly receiving the spring seal in the installed position, which according to the invention is done by providing an attachment cap that can be placed on the front cover of the telescopic tube. This is achieved in that, in addition to the cover area flatly covering the face of the outer tube, this cap also has a receiving space for the spring seal. This receiving space, which projects forward from the main sealing plane of the front cover, can also form a second lifting tube guide. Particularly good guidance of the lifting tube and good compensation of tolerance differences is achieved by providing a first lifting tube guide on the inside of the outer tube, enclosed by the front cover which can be attached to the outside of the telescopic tube.

[0052] The end cover comprises an attachment cap extending in a closure plane and arranged transversely to the longitudinal axis of the telescopic tube in the installed position, an outer peripheral edge provided on the outside of this closure cap and extending transversely rearwardly from the closure plane for framing the outer tube on the outside, a receiving space for the spring seal formed forward of the closure plane, and a second lifting tube guide formed on the front edge of this receiving space.

This front cover, which is formed as an attachment cap, is preferably formed as an injection-molded plastic part.

[0053] In the following detailed description, reference is made to the accompanying drawings which form part of this description of the invention and in which specific embodiments are shown by way of illustration by which the invention may be practiced. In this regard, directional

terminology such as "top", "bottom", "front", "rear", "a front", "a rear", etc. is used with reference to the orientations of the Figure(s) described. Since components of embodiments may be positioned in a number of different orientations, the directional terminology is for
5 illustrative purposes and is not limiting in any way. It is understood that other embodiments may be used and structural or logical changes may be made without departing from the scope of protection of the present invention. The
10 following detailed description is not to be construed in a limiting sense.

[0054] In the context of this description, the terms "connected", "coupled" as well as "integrated" are used to
15 describe both a direct and an indirect connection, direct or indirect coupling as well as a direct or indirect integration. In the Figures, identical or similar elements are given identical reference signs where appropriate.

20 [0055] Reference sign lines are lines connecting the reference sign to the part in question. An arrow, on the other hand, that does not touch a part refers to an entire unit to which it is directed. Incidentally, the Figures are not necessarily drawn to scale. Certain areas may possibly
25 be shown excessively large to illustrate details. In addition, the drawings may be strikingly simplified and do not include every detail that may be present in practice. The terms "top" and "bottom" refer to the representation in the Figures. Further, for clarity, only one part at a time
30 is designated by a reference symbol when multiple corresponding parts are provided. It is shown by:

Figure 1 a perspective front view of a motor unit comprising an electric motor with a gearing elbow attached thereto and worm wheel accommodated therein according to the first embodiment without coupling device;

Figure 2 an isometric front view of the motor unit according to Figure 1;

Figure 3 an isometric view of the spindle holder according to the first embodiment without coupling device;

Figure 4 a magnified longitudinal section of the transmission-side end of the housing of the linear drive of the embodiment without coupling device;

Figure 5 an isometric view of a spindle with two diametrically opposed notches at the transmission-side end;

Figure 6 a longitudinal section of the linear drive according to the first embodiment with the lifting tube partially extended;

Figure 7 a longitudinal section of the outer tube of the telescopic tube without the lifting tube;

Figure 8 a front view of a motor unit comprising an electric motor with a gearing elbow attached thereto and a worm wheel accommodated therein according to the second embodiment with coupling device;

Figure 9 an isometric side view of the motor unit according to Figure 8;

5 Figure 10 a frontal longitudinal section through the motor unit with the coupling device in the disengaged release position (emergency position);

10 Figure 11 the view according to Figure 10 with the coupling device in the engaged position;

Figure 12 an isometric top view of the pulling means acting as an emergency adjustment device and the rocker for operating the coupling device in the engaged position;

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Figure 13 an enlarged isometric plan view of the emergency adjustment device in the disengaged release position with the pulling means pulled;

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Figure 14 an enlarged isometric longitudinal section of the spring-loaded arrangement of the pull rod in the housing;

25 Figure 15 an enlarged isometric longitudinal section of the front end of the telescopic tube with the lifting tube extended;

Figure 16 a longitudinal section of the transmission-side end of the first embodiment of the linear drive to illustrate the retraction distance of the lifting tube gained additionally gained by the omission of the coupling device;

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Figure 17 an enlarged longitudinal section of the front telescopic tube end with the front cover according to the invention;

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Figure 18 a longitudinal section of a linear drive; and

Figure 19 an enlarged top view of an alternative embodiment of the emergency adjustment device without pulling device.

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[0056] The entire linear drive according to all aspects of the invention is shown in a side view in Figure 18.

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[0057] This essentially consists of a composable housing 2 having a drive-side end which is designed in an enlarged manner for receiving an electric motor 10 having a gearing elbow 14. On the rear end of the housing 2 on the transmission side, a rear clevis 4 is located. Coaxially to this rear clevis 4 a front clevis 6 is fixed to a distally outer end of a lifting tube 8 that is slidably received in an outer tube. The lifting tube 8 can be extended from and retracted into a telescopic tube partly received in the central portion of the housing 2 in the axial longitudinal direction by means of a linear drive. The rear clevis 6 can thus be fixed in the known manner to a bed or another piece of furniture in order to achieve an adjustment, e.g. for motorized pivoting of the head or foot end of a bed. A front cover 44 seals the front side face between the outer tube 34 and the displaceably received lifting tube 8 of the telescopic tube against the ingress of pressurized water jets according to IP67W.

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[0058] Figure 1 shows a front view of a motor unit comprising an electric motor 10 installed in the transmission end of the linear transmission, with a worm shaft 12 driven by the electric motor and extending along a worm longitudinal axis protruding from the front end of the electric motor, the worm shaft 12 extending in a gearing elbow 14 fixed to the electric motor 10 and meshing there with the outer tooth flank 16.1 of a worm wheel 16 thus driving the worm wheel.

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[0059] The gearing elbow 14 is of separable design and comprises two half shells 14.1 and 14.2 which are screwed together. A first - lower - half shell 14.1 is attached to the front side of the electric motor 10 and receives the worm shaft 12 therein. This first half shell 14.1 together with the second - upper - half shell 14.2 forms a closed annular space which accommodates the respective worm wheel 16 via two bearings 18, 20 rotatably seated on bearing seats of the hollow axis 16.2.

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[0060] The worm wheel 16 has tooth flanks 16.1 on the outer lateral surface and a continuous hollow shaft 16.2 that extends in the longitudinal direction, this hollow shaft forming seat surfaces for bearings 18, 20 on both sides adjacent to the tooth flank 16.1 with which the worm wheel 16 is rotatably received in the gearing elbow 14.

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[0061] The worm wheel 16 extends towards the rear end of the linear drive and into a brake stub 16.3 that is integrally molded to the worm wheel 16 and on which the windings of a wrap spring brake 22 are wound in a manner known per se, while forming a shoulder with a reduced outer diameter. The windings 22 of the wrap spring brake have an

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inner diameter which is slightly smaller than the outer diameter of the brake stub 16.3 so that the wrap spring brake 22 tightly surrounds the brake stub 16.3 in the installed position or acts as a brake in the tensioning direction during rotation and releases the brake stub 16.3 in the opposite direction. The wrap spring brake 22 further surrounds a holding arm (not illustrated in the drawings) which protrudes from the outer lateral surface of the windings, which holding arm is inserted in an opening and fixes the wrap spring brake. The wrap spring brake 22 enables the linear drive to be designed as smooth running as possible and at the same time avoids unintentional return of the linear drive when the electric motor 10 is not under voltage.

[0062] According to Figure 2, in the first embodiment of the linear drive without coupling device shown in Figures 1 to 7, the inner lateral surface of the hollow shaft 16.2 has a total of four recesses 16.4, with two recesses each diametrically opposed to each other in pairs. In the installed position, flanks 24.1 radially projecting from a central hollow-cylindrical spindle socket 24.2 of the spindle holder 24 engage into these recesses 16.4, which flanks 24.1 are formed complementary to the recesses 16.4 of the worm wheel 16 and thus create a form-fitting and rotationally fixed connection between the worm wheel 16 and the spindle holder 24 received therein.

[0063] The spindle socket 24.2 of the spindle holder 24 accommodates a spindle 26 in the installed position, for which purpose the inner lateral surface of the spindle holder 24 has an internal thread formed complementary to this spindle 26. Preferably, the spindle 26 has a

trapezoidal thread. To the rear end of the spindle socket 24.2 a shoulder is molded that has a reduced outer cross section for forming a bearing seat 24.3. On this bearing seat 24.3 the inner race of a rear bearing 28 is seated, 5 which bearing 28 with its outer race sits in a bushing 4.1 of the rear clevis 4. The rear transmission-side end of the spindle 26 has a blind hole with an internal thread into which a clamping screw 30 is screwed and presses a pressure disc 32 with a shoulder against the inner race of the rear 10 bearing 28 and thus the rear bearing against the rear shoulder of the spindle holder 24 formed by the bearing seat 24.3.

[0064] The rotationally fixed connection between the 15 spindle holder 24 and the spindle 26 is achieved by the spindle 26 having on the transmission-side rear end diametrically opposed notches 26.1, 26.2 which extend over a length of approximately 25 mm in the longitudinal direction and into which dowel pins or clamping sleeves are 20 hammered which deform the thread turns of the internal thread of the spindle holder 24 during hammering and thus produce a rotationally fixed connection between the spindle holder 24 and the spindle 26 received therein.

25 [0065] According to Figure 6, the transmission-side rear end of the telescopic tube is enclosed in the housing 2 and is held by several retaining ribs 2.1 integrally molded to the inner side of the housing 2.

30 [0066] Within the intermediate lifting tube space 36, a longitudinally displaceable spindle nut 38 having an internal thread is provided in the outer tube 34, which internal thread meshes with the spindle 26, which is thus

converted into a translational movement by a rotation of the spindle 26 caused via the motor and the transmission unit in order to move the lifting tube 8 relative to the outer tube 34. Two limit switches 40, 42 arranged on the underside in the outer tube 34 limit in a known manner the maximum displacement of the spindle nut 38 within the outer tube 34. As soon as the spindle nut 38 with the rear enlargement touches a button of the limit switches 40, 42, the electric motor stops the movement of the lifting tube 8.

[0067] Figures 8 to 13 show the second embodiment of the linear transmission having the coupling device for carrying out the emergency adjustment. In this embodiment, the worm gear 48, which is rotatably driven in the electric motor and is again accommodated in the two half-shells 14.1, 14.2 of the gearing elbow 14, has a coupling connecting piece 48.2 that projects radially out of the plane with the tooth flanks opposite the brake stub 48.3. This coupling connecting piece 48.2 is formed on its outside with a plurality of radially outwardly projecting splines which engage with complementarily designed recesses on the inside of the sliding sleeve 50 of the coupling device which is displaceably arranged on the coupling connecting piece 48.2.

[0068] In this embodiment, the spindle holder 46 has again a centrally extending spindle socket 46.1, which is designed for receiving the spindle 26 in its interior, and further has a coupling flange 46.2, which projects radially from the outer lateral surface of the spindle socket 46.1 and which has projections for engaging into grooves formed on the inner side of the sliding sleeve 50 on its side

facing the coupling connecting piece 48.2 of the worm wheel 48.

[0069] Figure 8 shows the sliding sleeve 50 in the engaged position in which the worm wheel 48 transmits the torque to the spindle holder 46 with the spindle 26 fixed therein in the manner described above, i.e. by inserting clamping pins into the two notches 26.1, 26.2 at the transmission end of the spindle between the spindle socket 46.1 and the spindle 26.

[0070] Figure 9 shows a perspective lateral view of the electric motor 10 having the gearing elbow 14 with the worm wheel 48 inserted, wherein the coupling connecting piece 48.2 which is designed as a spline shaft can be seen particularly well.

[0071] Figure 10 shows a frontal longitudinal section through the worm wheel 48 and the spindle holder 46 with its coupling flange 46.2 in the release position, i.e. disengaged for emergency release.

[0072] Figure 11, on the other hand, shows the sliding sleeve 50 in the engaged position for transmitting torque from the worm gear 48 to the spindle holder 46.

[0073] Figure 12 shows the emergency release coupling device in the unloaded, i.e. engaged position, in which the rocker 52, which is pivotably mounted in the center on the housing, presses the axially displaceable sliding sleeve 50 onto the coupling connecting piece 46.2 of the spindle holder 46 and brings it into engagement with the splines also formed on the latter.

[0074] Figure 13 shows an enlarged isometric top view when the Bowden cable 62 is actuated as part of the emergency release. The cable thimble 61 arranged at the end of the Bowden cable 62 rotates the Bowden cable holder 58 about the central fastening pin and pulls the pull rod 54 back into the housing against the spring load of the spring 56, so that the sliding sleeve 50 is transferred from the engaged position shown in Figure 12 to the disengaged freewheeling or release position shown in Figure 13. In this position, in which the sliding sleeve 50 is thus shifted axially to the left in the Figure, a freewheel is present so that a part of the hospital bed connected to the spindle nut can lower immediately.

[0075] Figure 7 shows a cross-section of the outer tube 34 accommodated in the housing 2, which has a plurality of webs 34.1 or ribs projecting inwardly from the outer lateral surface to form a central lifting tube space 36 in which the lifting tube 8 not shown in Figure 7 is slidably guided. In addition, several screw channels 34.2 are formed on the inside of the outer tube 34, into which cap-like front covers 44 arranged at the end faces can be fastened for closing the outer tube 34 or telescopic tube.

[0076] Clearly visible in Figure 6 is the cap-like front cover 44 attached to the front end of the outer tube 34 for sealing and longitudinally displaceable mounting of the lifting tube 8 within the outer tube 34 with respect to the ingress of pressurized and splash water in accordance with IP67W.

[0077] Figure 16 shows the linear drive according to the first embodiment without coupling device to illustrate the additional possible retraction of the lifting tube 8 inwards, which is realized by omitting the coupling device, so that with the embodiment without coupling device a further retraction of the lifting tube 8 into the outer tube 34 by up to 35 mm is possible.

[0078] Figure 17 illustrates the structure of this front cover 44 according to the invention in more detail. This comprises an elastic seal 64 that defines a main sealing plane bearing against the front face of the outer tube 34 and presents, at the outer edge, a circumferential collar 64.1 which extends rearwardly and transversely to this main sealing plane and has inner and outer sealing lips, and which is fitted under pre-load against the outer side of the outer tube 34 and the inner side of a complementarily formed collar 44.2 of the front cover 44. Further, the seal 64 has a sealing stub 64.2 projecting forwardly from the main sealing plane and having an inner sealing lip which slides against the outside of the lifting tube 8 and is held under permanent preload by a circumferential annular spring 68 under spring tension. According to the invention, the front cover 44 is also designed as a lifting tube guide cap, thus providing an extended, outwardly projecting support for the lifting tube 8. The lifting tube 8 is held on the inside in the outer tube 34 at the front end by a hollow cylindrical bushing 66, which is inserted with a front stop flange into the front end between the outer tube 34 and the lifting tube and forms a first lifting tube guide. The front cover 44 also includes a - second - lifting tube guide 44.1 projecting forwardly from the primary cover surface covering the outer tube, which also

defines an annular space which receives the annular spring 68 of the spring seal. In the present case, the support length from the inner bushing 66 to the outer lifting tube guide 44.1 is thus extended from 53 to 61 mm.

5

[0079] Figure 14 shows an enlarged longitudinal section of the upper end of the linear transmission with the housing cover attached and the pull rod 54 mounted therein, which pull rod is spring-biased relative to retaining ribs 2.1

10 formed on the inside and at the rear end of which the Bowden cable holder 58 is movably mounted via the central pivot pin screwed rotatably into the end of the pull rod 54.

15 [0080] The electric motor 10 is preferably rubber-mounted to compensate for vibrations and to reduce noise, and preferably a plurality of rubber plugs 70 are placed on the electric motor 10 and bear against a respective counterpart or joining partner.

20

[0081] Figure 19 shows an enlarged top view of an alternatively configured emergency adjustment or emergency coupling device with the Bowden cable holder 58 rotatably snapped onto a pin 72 at the front end of the pull rod 54.

25 As in the first embodiment shown in Figures 12 to 14, the Bowden cable holder 58 has openings for insertion of the end-side rope thimbles 60, 61 (not shown). In contrast to the first embodiment according to Figures 12 to 14, the rear bearing surfaces arranged opposite to the pulling
30 direction are not straight, but project backwards from the central guide of the pull rod 54 at an angle of about 45°. By this embodiment, it is achieved that in case of a one-sided actuation of the Bowden cable holder 58 or its

actuation on one side, the non-actuated Bowden cable is tightened on the other side, thus preventing this non-loaded Bowden cable from jumping out.

5 [0082] In addition, in order to realize a smooth movement between the components, roundings are formed between the rear side of the Bowden cable holder 58 and the rear side bearing surface, which roundings are preferably designed as
10 cable holder.

[0083] Finally, in this embodiment, the Bowden cable holder 58 is integrated into a clamp 72 that sleeved onto the outer tube 34 of the linear actuator.

15

[0084] The subject of the present invention is apparent not only from the subject of the individual patent claims, but also from the combination of the individual patent claims among each other. All details and features disclosed in the
20 documents - including the abstract - and in particular the spatial configuration shown in the drawings, are claimed to be essential to the invention insofar as they are new compared to the prior art, individually or in combination.

25 **List of reference signs**

[0085]

2	housing
30 2.1	retaining rib
4	rear clevis
4.1	bushing
6	front clevis

	8	lifting tube
	10	electric motor
	12	worm shaft
	14	gearing elbow
5	14.1	first half shell
	14.2	second half shell
	16	worm wheel
	16.1	tooth flank
	16.2	hollow shaft
10	16.3	brake stub
	16.4	recess
	18, 20	bearing
	22	wrap spring brake
	24	spindle holder
15	24.1	flank
	24.2	spindle socket
	24.3	bearing seat
	26	spindle
	26.1, 26.2	notch
20	28	rear bearing
	30	clamping screw
	32	pressure disc
	34	outer tube
	34.1	web
25	34.2	screw channel
	36	lifting tube space
	38	spindle nut
	40, 42	limit switch
	44	front cover
30	44.1	lifting tube guide
	44.2	collar
	46	spindle holder
	46.1	spindle socket

	46.2	coupling flange
	48	worm wheel
	48.1	tooth flank
	48.2	coupling connecting piece
5	48.3	brake stub
	48.4	hollow shaft
	50	sliding sleeve
	52	rocker
	54	pull rod
10	56	pressure spring
	58	Bowden cable holder
	60, 61	cable thimble
	59, 62	Bowden cable
	64	seal
15	64.1	collar
	64.2	sealing stub
	66	bushing
	68	annular spring
	70	rubber plug
20	72	clamp

PATENTKRAV

1. Teleskopisk rør, navnlig til anvendelse i et lineardrev, hvilket teleskopiske rør omfatter et i det væsentlige stationært, ydre rør (34), der er udformet med henblik på at modtage et løfterør (8), som i længderetningen kan forskydes i forhold
5 dertil, en – bagerste – drivende, gennem hvilken der strækker sig en motordrevet spindel (26), på hvilken der sidder en spindelmøtrik (38), som i længderetningen kan forskydes ved rotation af spindlen (26), og som angriber på løfterøret (8), en forreste ende, på hvilken løfterøret (8) rager ud af det ydre rør (34),
10 hvorved den forreste ende af det teleskopiske rør kan lukkes ved hjælp af en frontafdækning (44), som omfatter en tætning (64),

der omfatter en tætningsplade, som dækker det ydre rør på dets frontende og definerer et hovedtætningsplan med henblik på at hindre medier i at indtræde, i overensstemmelse med en defineret beskyttelsestype,
15 hvorved tætningen omfatter et tætningsafsnit med en tætningslæbe, som glider på løfterøret (8) yderside og ved fjederbelastning af en periferisk, ringformet fjeder (68) holdes under permanent forspænding,
20 hvorved tætningspladen på en ydre periferiflade omfatter en ydre kant med henblik på rundgående anlæg mod det ydre rør,
hvorved frontdækslet omfatter en påsætningskappe, som strækker sig i et lukkeplan og er arrangeret på tværs af en længdeakse for det teleskopiske rør i installationspositionen,
25 og en ydre periferikant, der strækker sig udad og på tværs bagud fra lukkeplanet med henblik på at lukke det ydre rør (34) udadtil, og
et modtagerum for tætningsafsnittet og den ringformede fjeder (68) er dannet fremad og ud fra lukkeplanet, hvorved frontdækslet (44) ydermere er konfigureret til at føre løfterøret (8).

30

2. Teleskopisk rør ifølge krav 1, **kendetegnet ved, at** fjederen omfatter en spiralfjeder (68).

3. Teleskopisk rør ifølge et af de foregående krav, **kendetegnet ved, at** frontdækslet omfatter et indre føringsafsnit og et ydre føringsafsnit.

4. Teleskopisk rør ifølge krav 3, **kendetegnet ved, at** det indre føringsafsnit
5 omfatter en bøsning (66), der kan indsættes i det ydre rør, og det ydre føringsafsnit omfatter en løfterørsføring (44.1).

5. Teleskopisk rør ifølge et af kravene 1 til 4, **kendetegnet ved, at** modtagerummet danner en anden løfterørsføring.

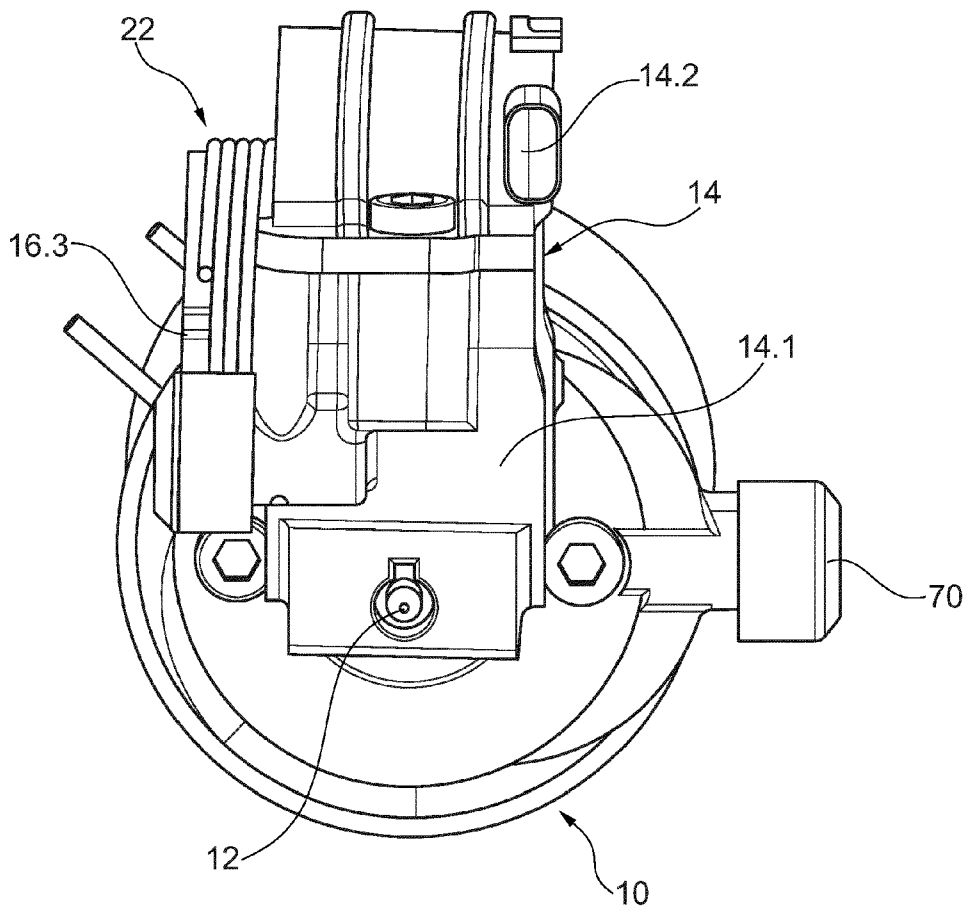


Fig. 1

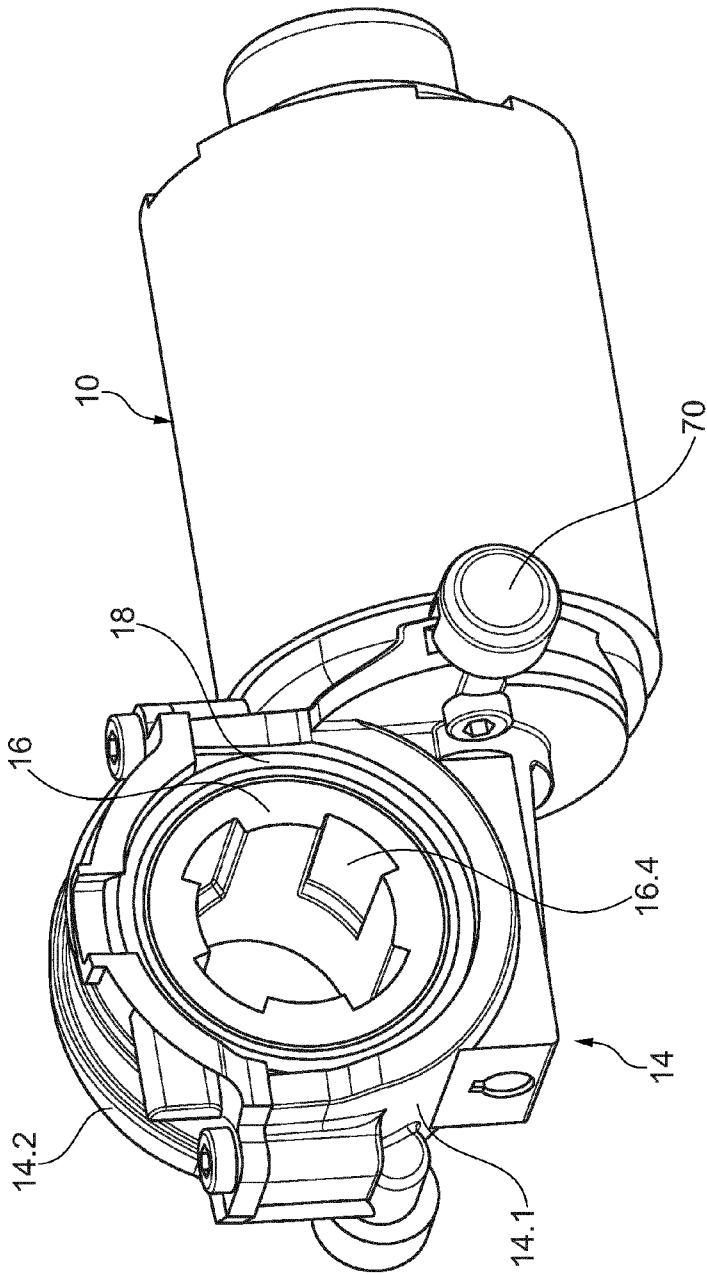


Fig. 2

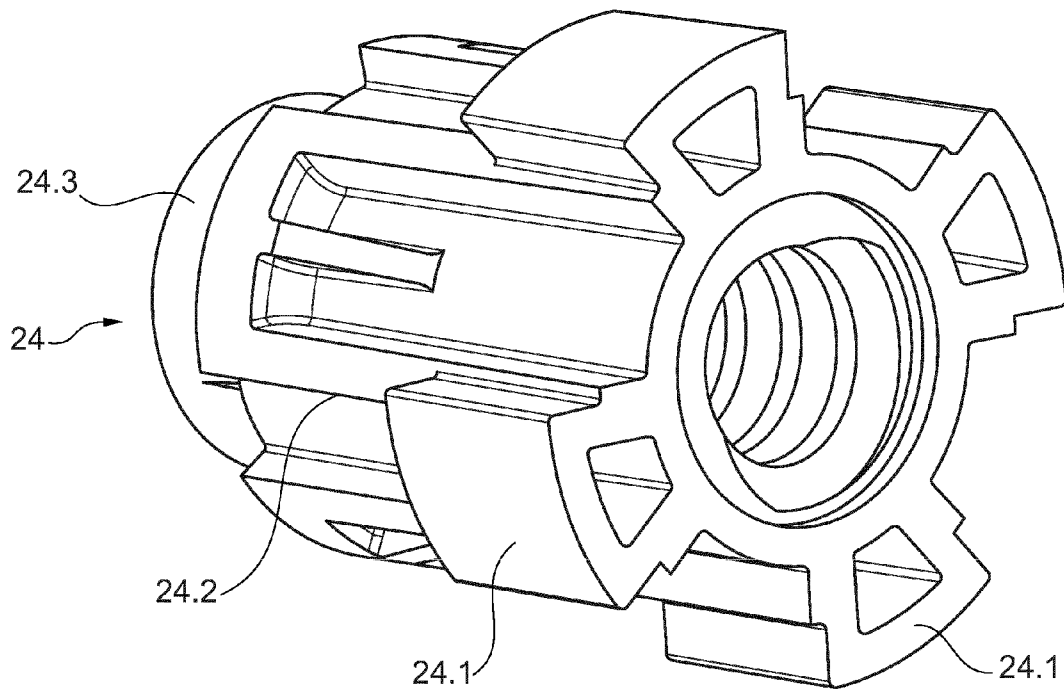


Fig. 3

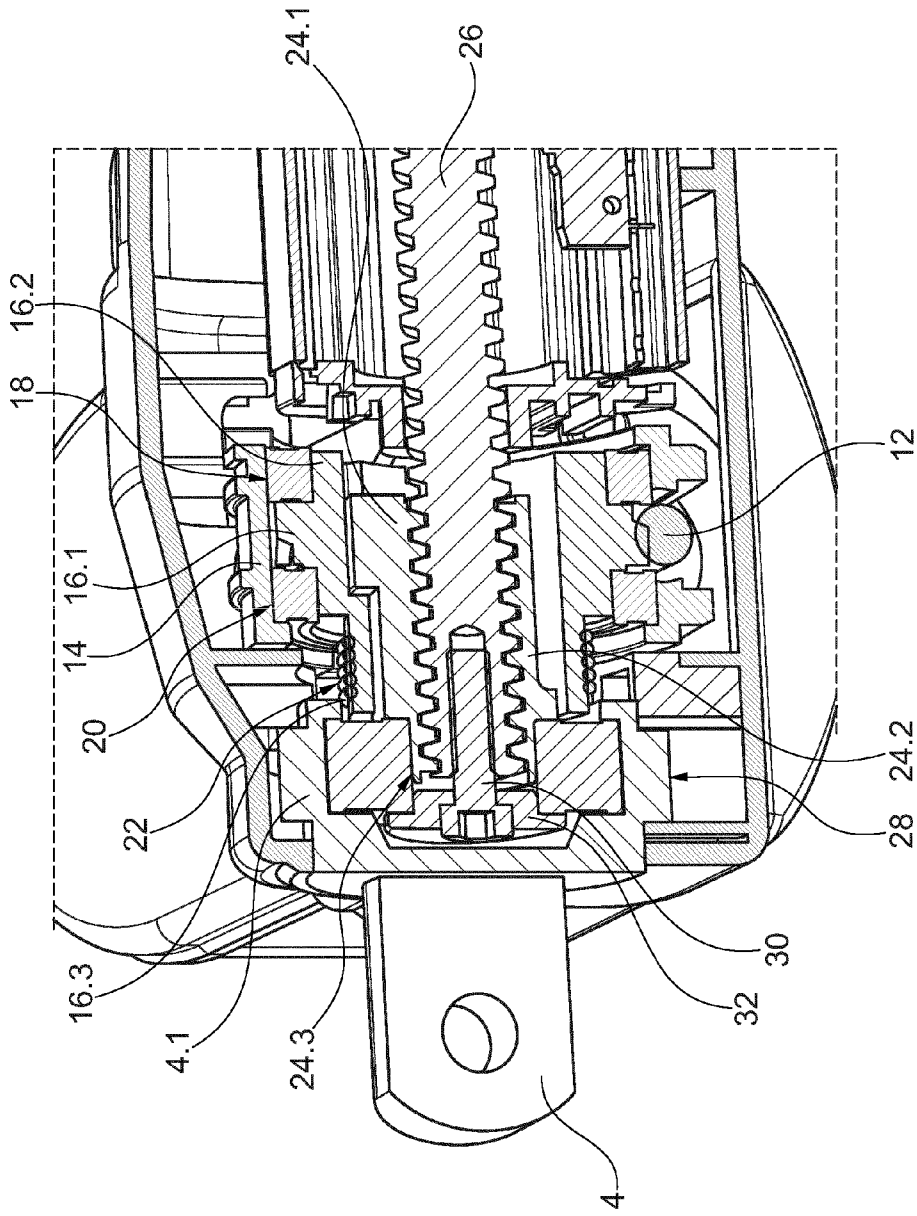
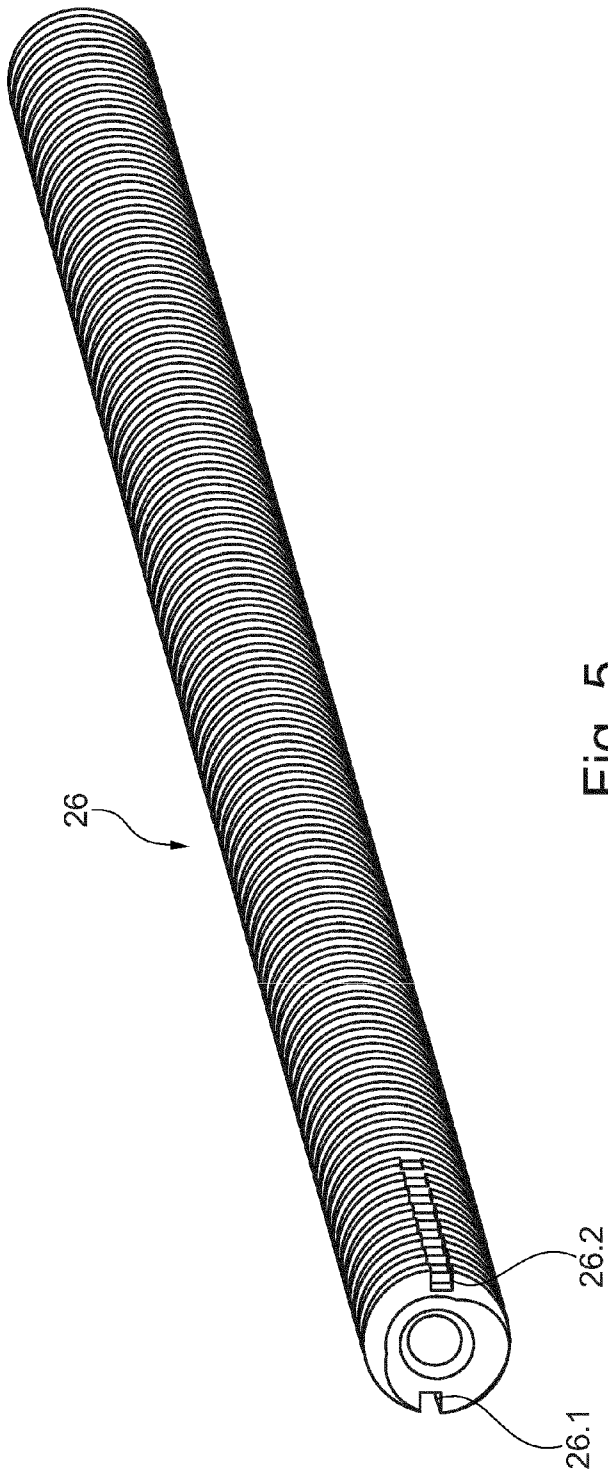


Fig. 4



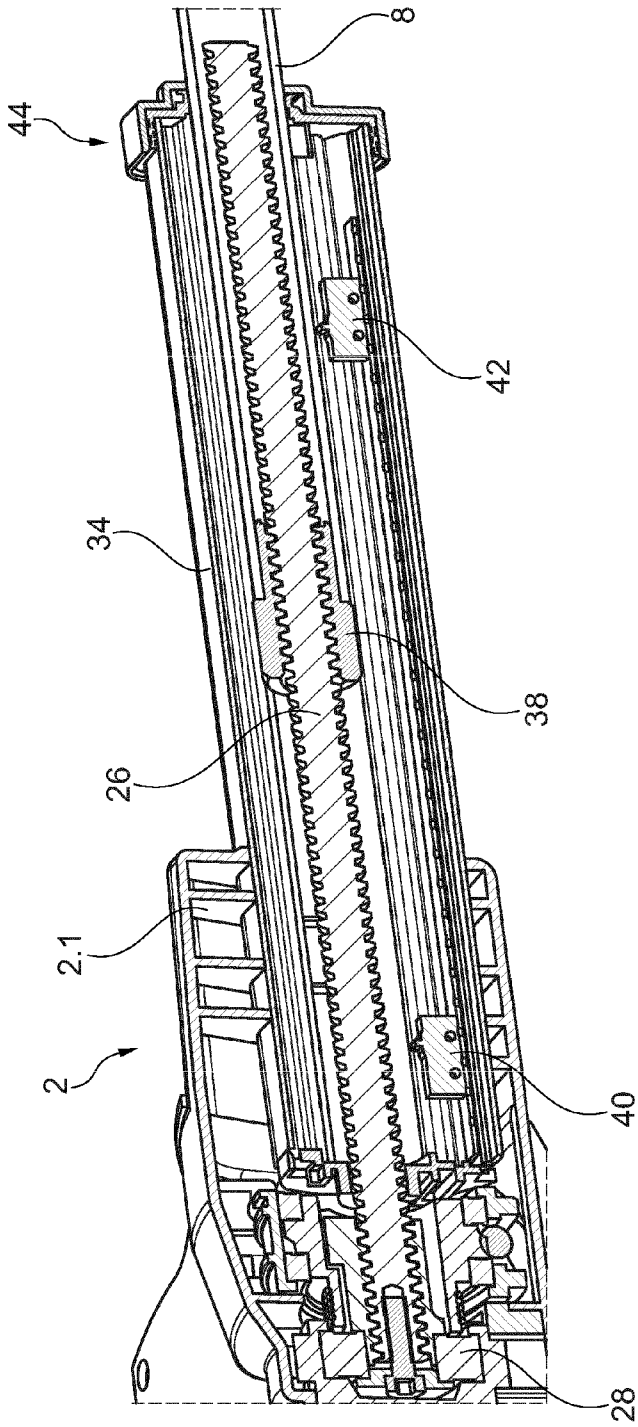


Fig. 6

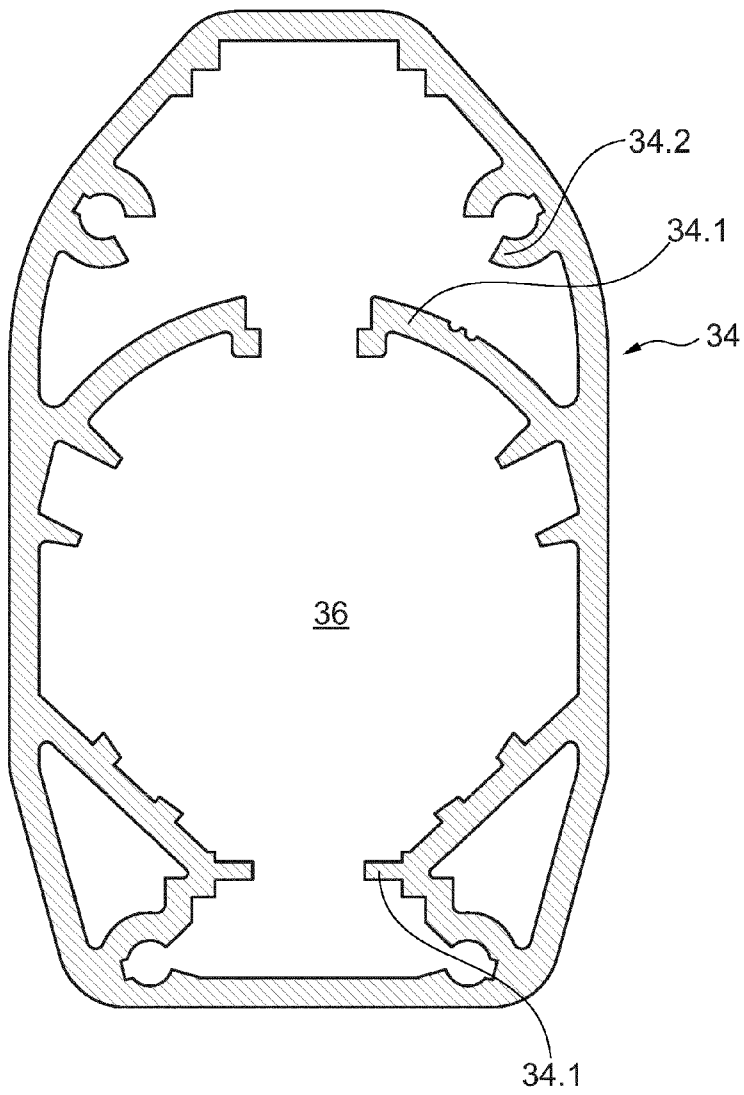


Fig. 7

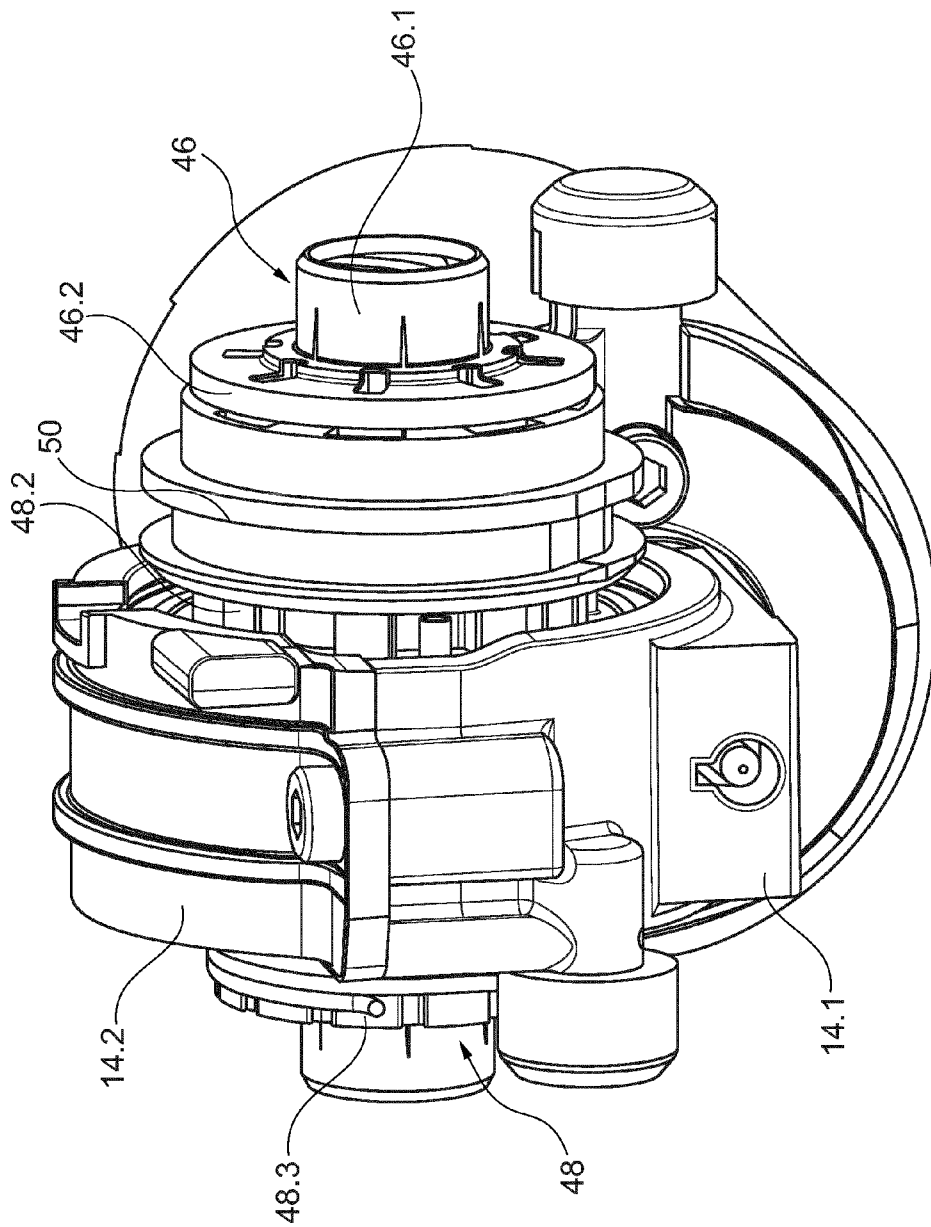


Fig. 8

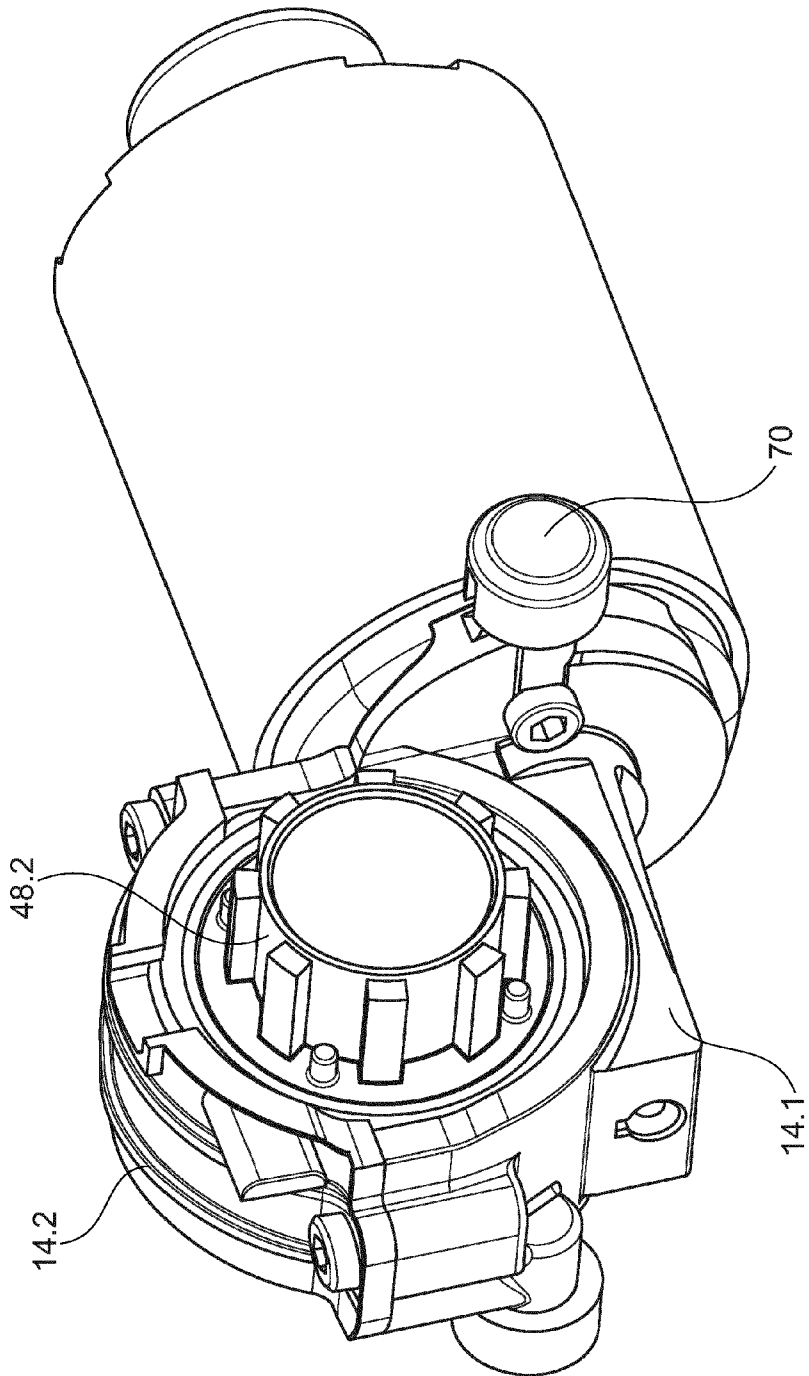


Fig. 9

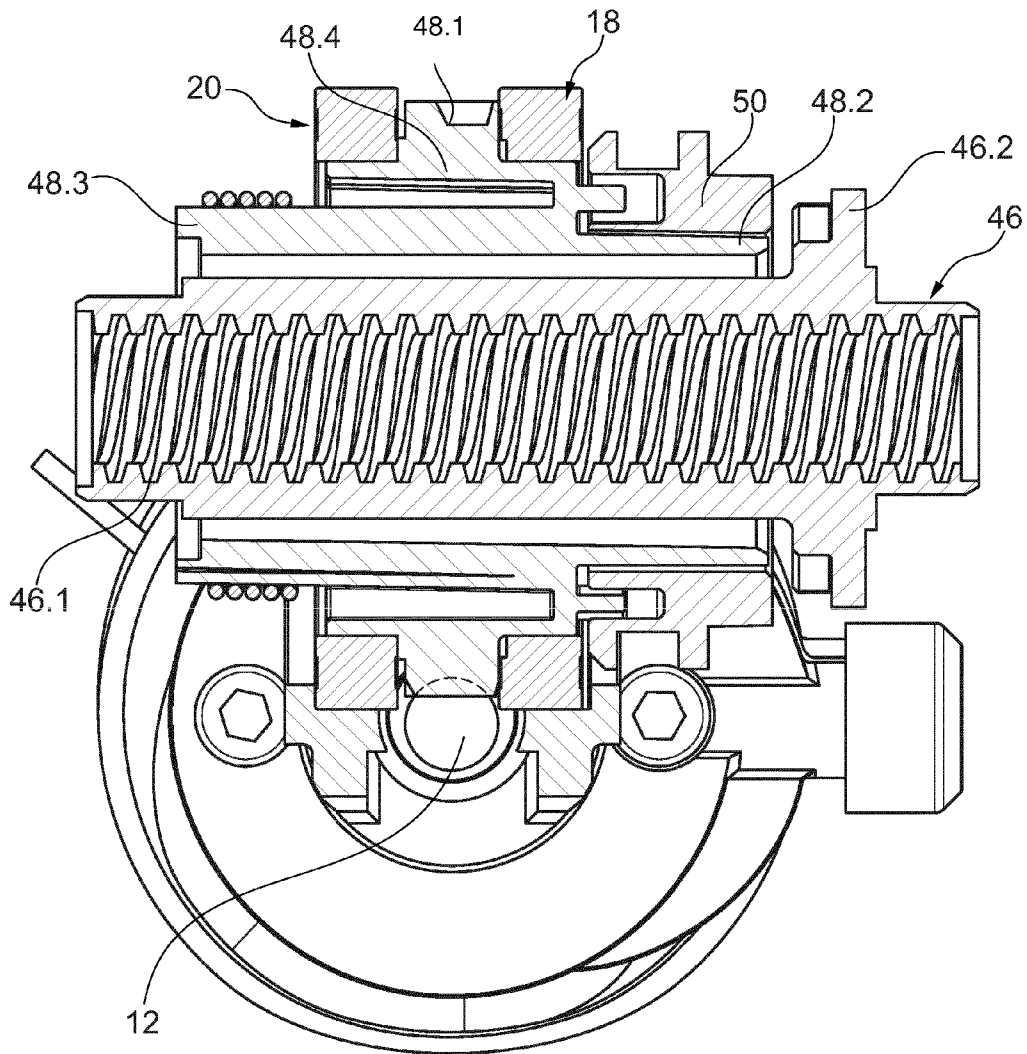


Fig. 10

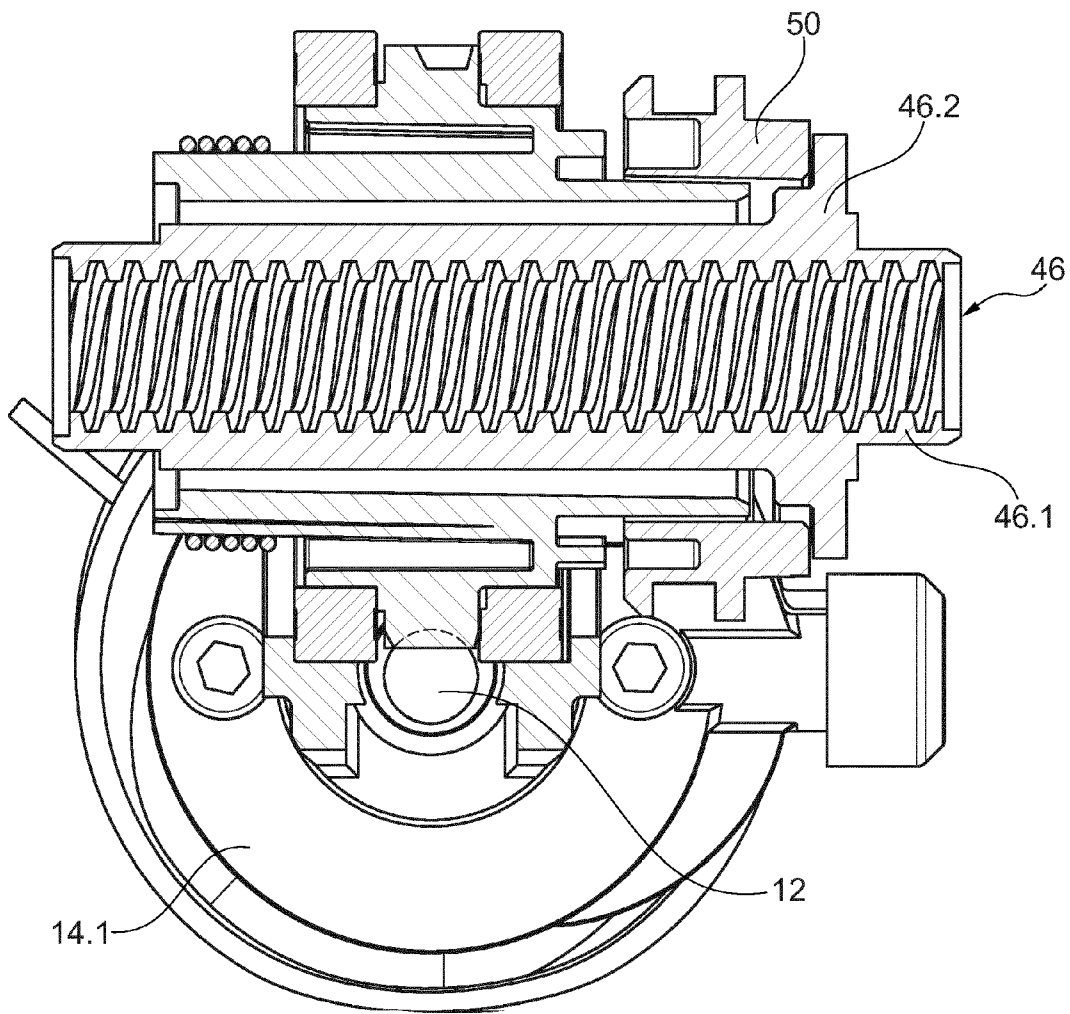


Fig. 11

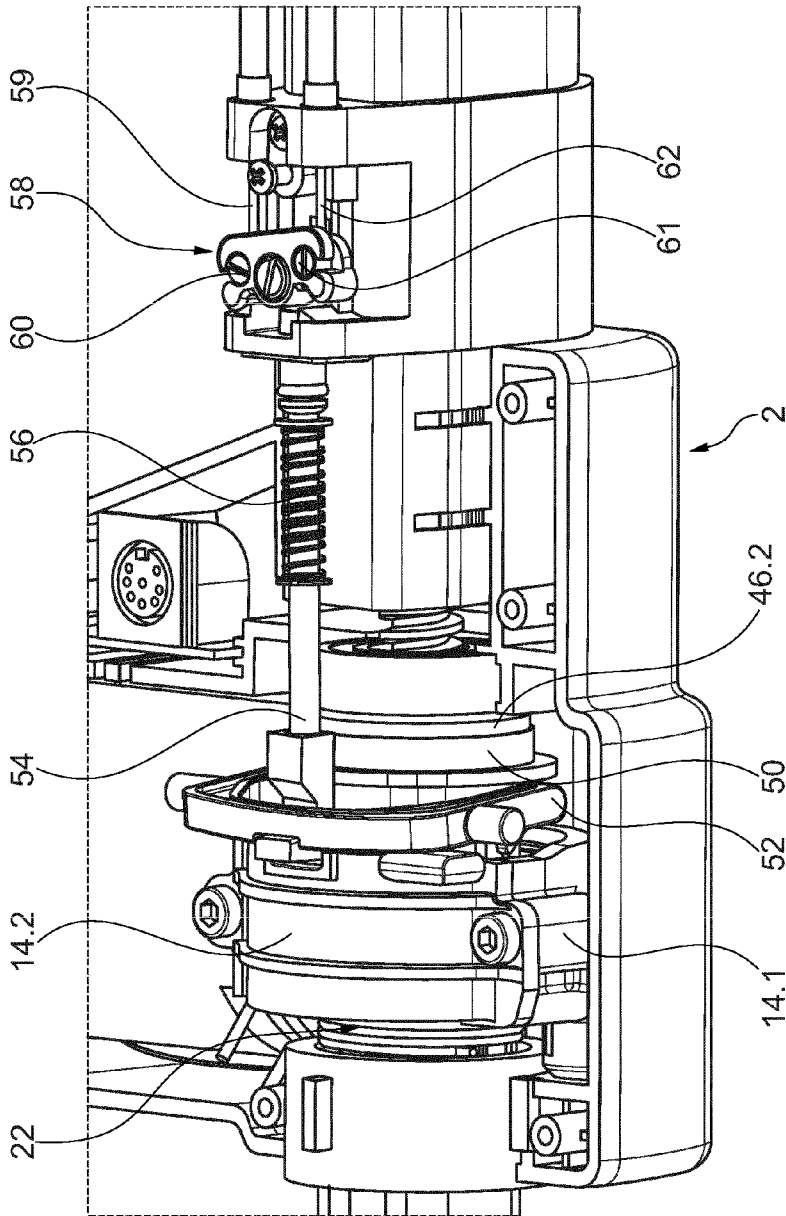


Fig. 12

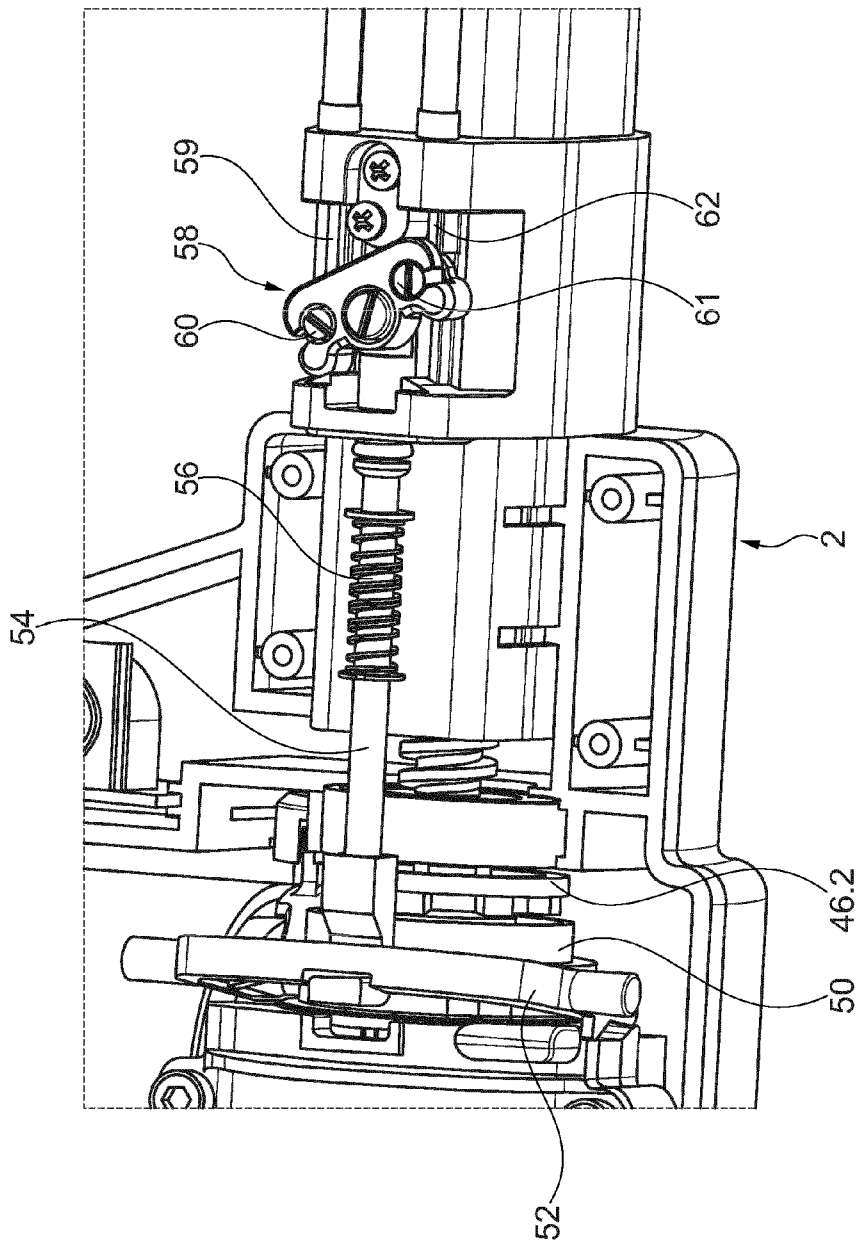


Fig. 13

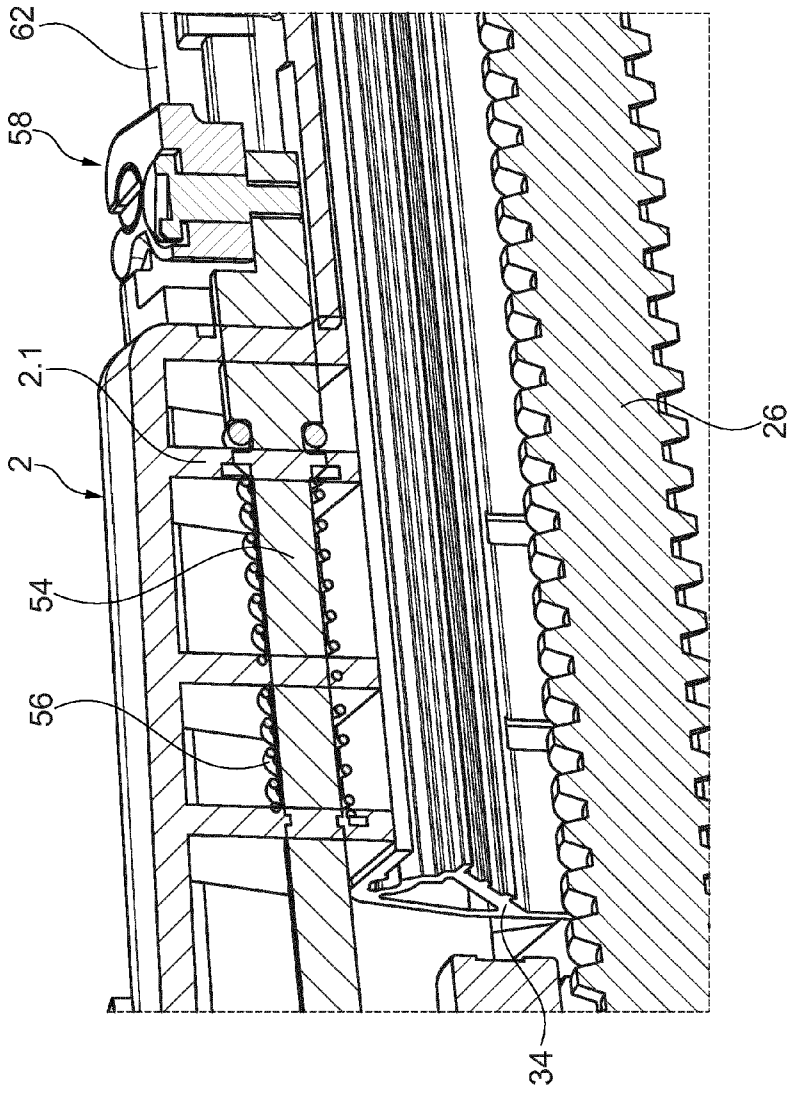


Fig. 14

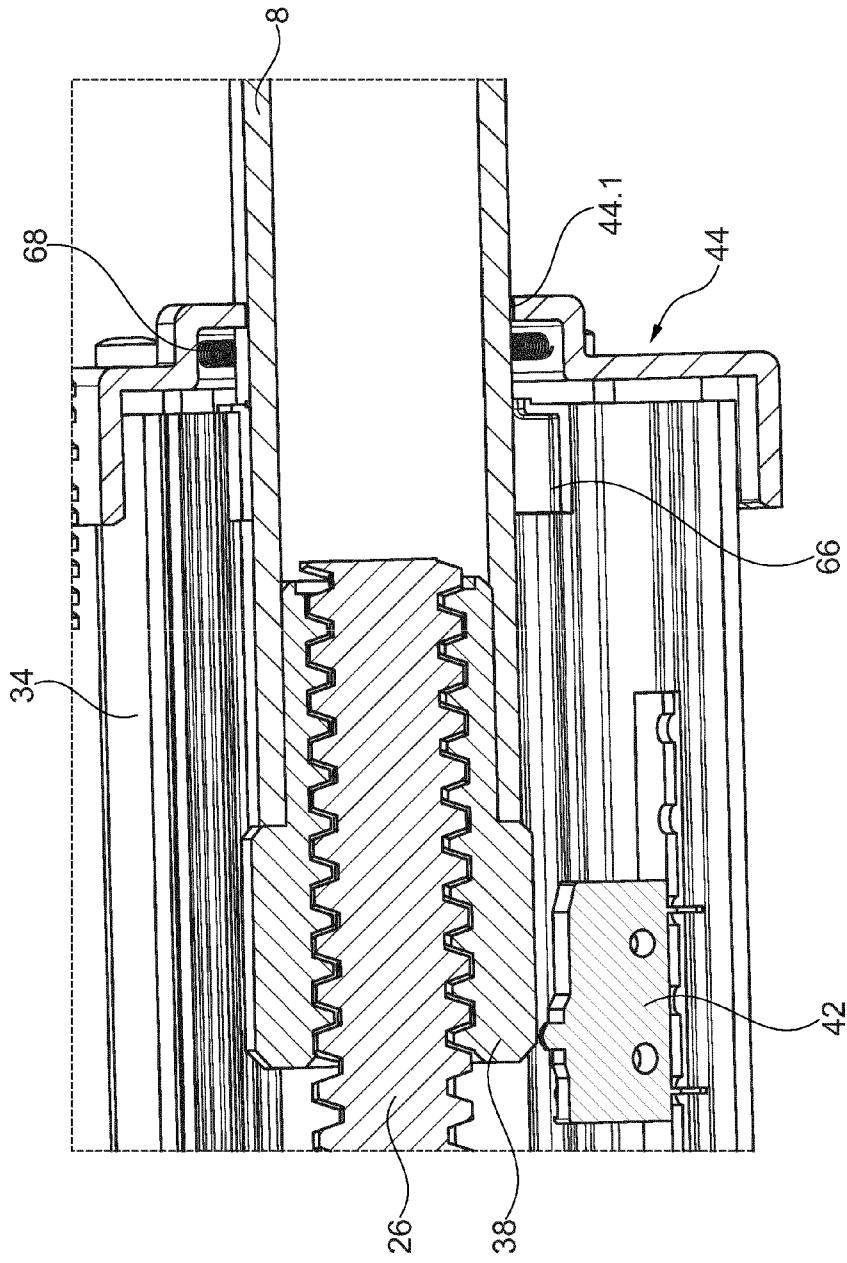


Fig. 15

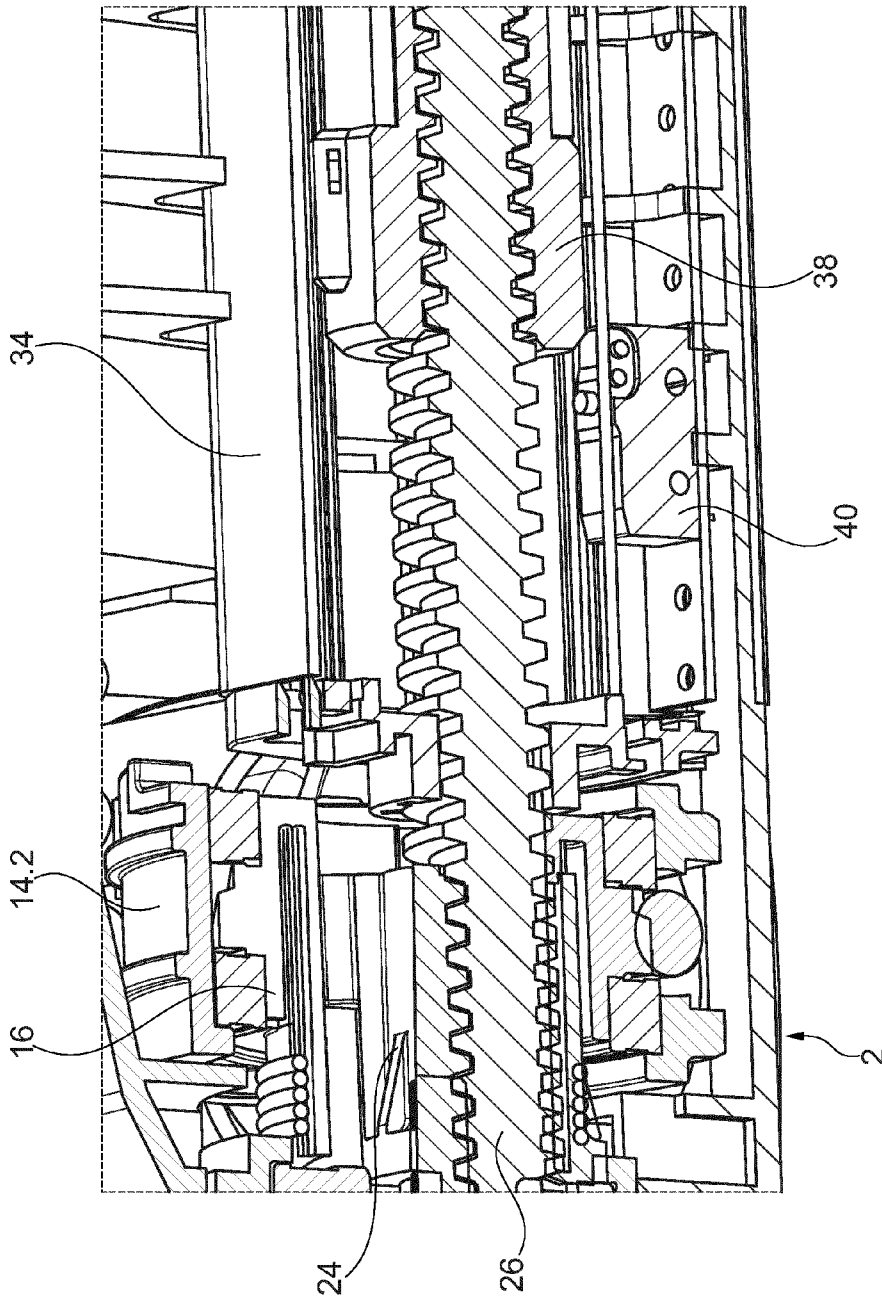


Fig. 16

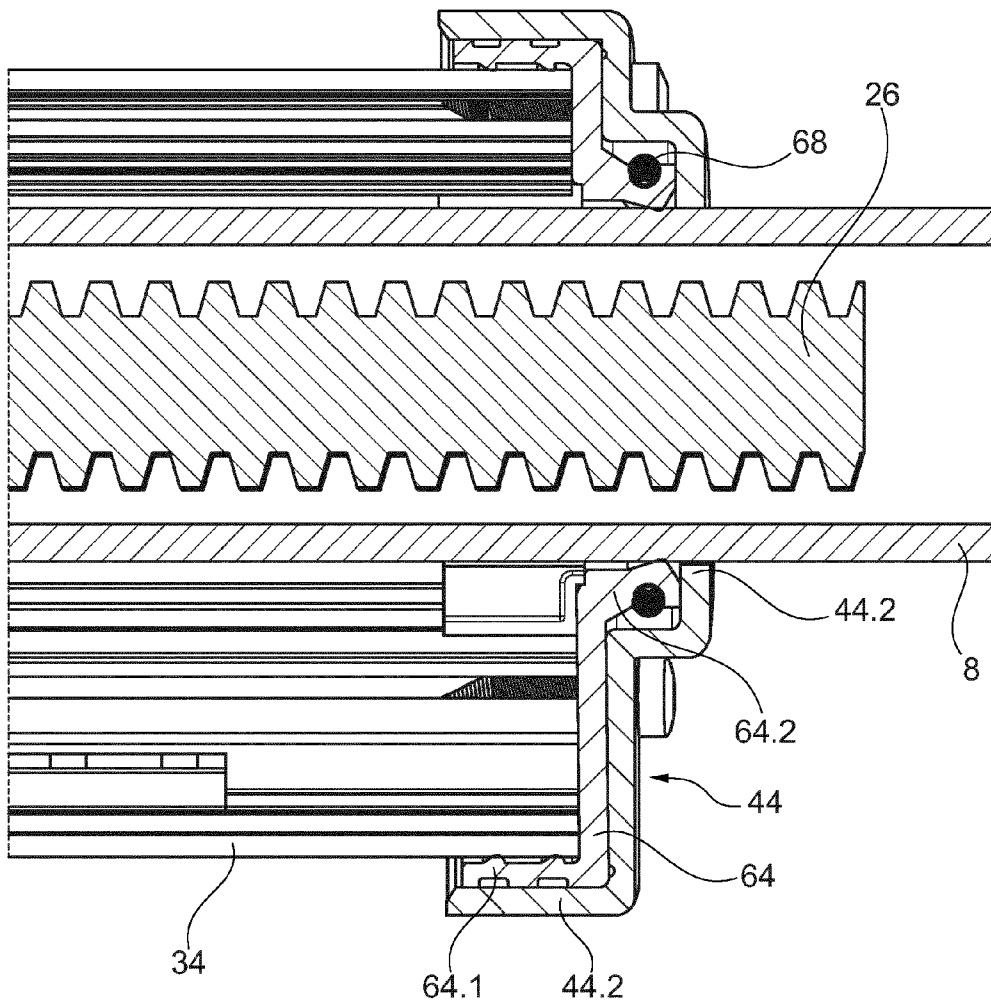


Fig. 17

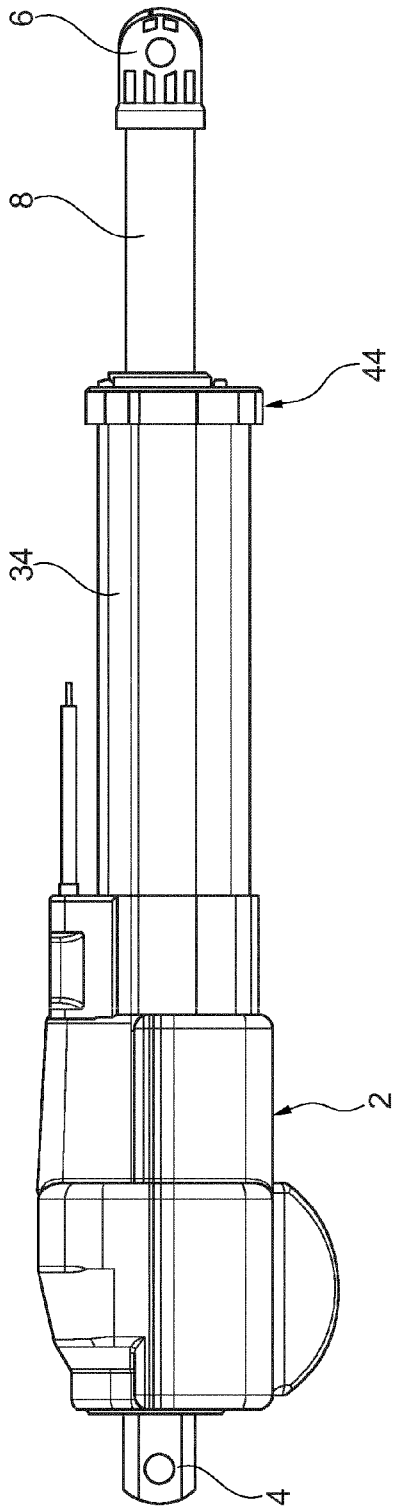


Fig. 18

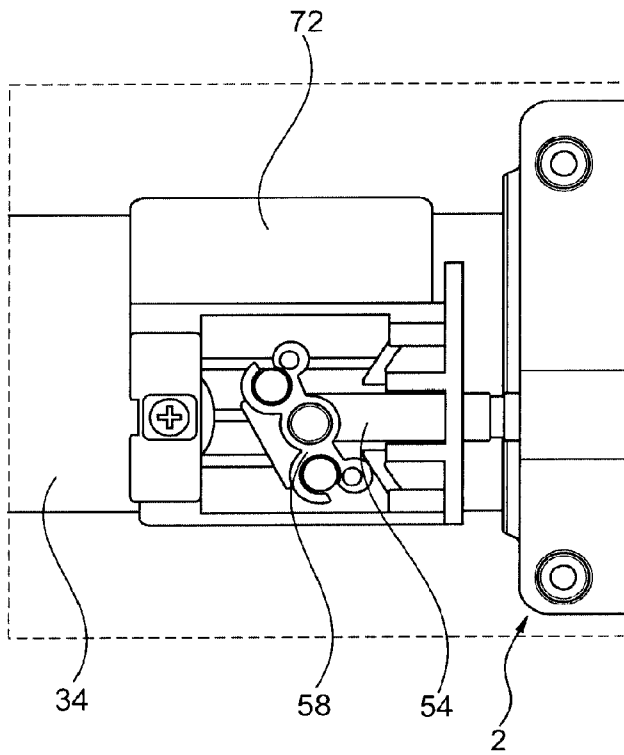


Fig. 19