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(12) (19) (CA) **Brevet-Patent**

(11) (21) (C) **2,167,889**
(22) 1996/01/23
(43) 1996/10/01
(45) 2000/02/22

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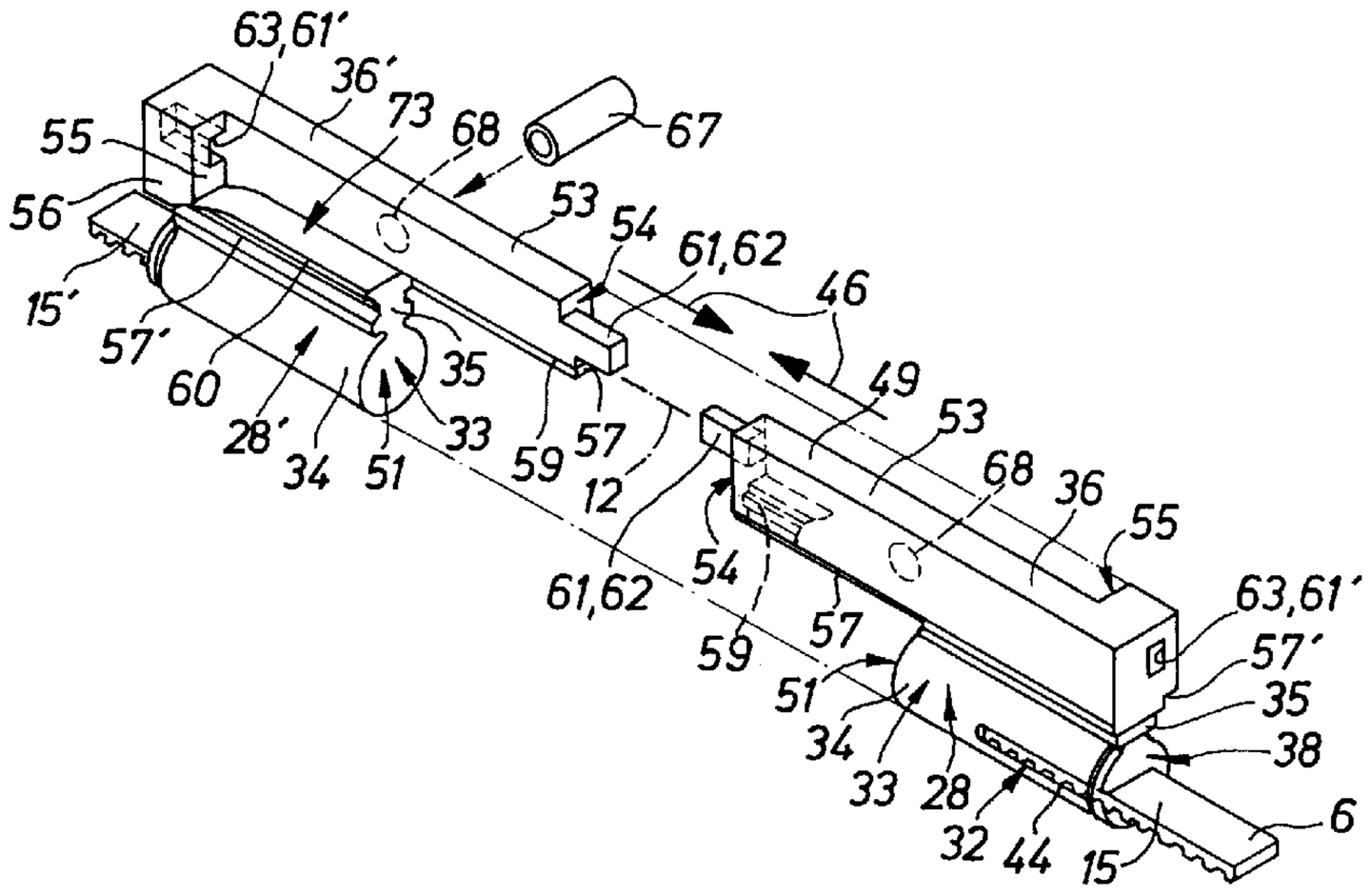
(51) Int.Cl.[6] F16H 19/06
(30) 1995/03/31 (295 05 345.3) DE

(54) **ELEMENT MENANT D'UN ENTRAINEMENT LINEAIRE**
(54) **OUTPUT MEMBER OF A LINEAR DRIVE**



(57) An output drive member of a linear drive arranged between the two ends of a traction means trained around bend elements. The output drive member is designed in the form of a connecting and tensioning link for the traction means and for this purpose is divided into two link elements each respectively associated with one of the ends of the traction means. These link elements possess closure sections, which overlap one another laterally in the longitudinal direction and are furthermore coupled, in a longitudinally sliding manner, with each other for stepless adjustment of the tension of the traction means. In order to fix the parts in the closed setting the link elements are able to be set in relation to each other at the overlapping parts of the closure sections.

Abstract of the Disclosure

An output drive member of a linear drive arranged between the two ends of a traction means trained around bend elements. The output drive member is designed in the form of a connecting and tensioning link for the traction means and for this purpose is divided into two link elements each respectively associated with one of the ends of the traction means. These link elements possess closure sections, which overlap one another laterally in the longitudinal direction and are furthermore coupled, in a longitudinally sliding manner, with each other for stepless adjustment of the tension of the traction means. In order to fix the parts in the closed setting the link elements are able to be set in relation to each other at the overlapping parts of the closure sections.

Figure 5.

--AN OUTPUT MEMBER OF A LINEAR DRIVE--

The invention relates to an output member of a linear drive arranged between the two ends of a traction means, as for example a toothed belt, trained around reversing elements and adapted in operation to perform a linear movement caused by the driven traction means in the longitudinal direction of the housing of the linear drive, ends of the two traction means ends being respectively attached to the output member by means of a connecting device.

The German patent publication 4,016,867 A1 discloses a linear drive, which comprises a toothed belt running around bend elements in the form of gear wheels and having ends secured by means of connecting device in the form of screw fastening means to a drive output member, which can be coupled with a load to be moved. The necessary preliminary tension of the toothed belt functioning as the traction means is set by the connecting devices, which possess chocks engaged with the toothed belt and able to be set with the aid of screws in relation to the output member.

The adjustment of the tension of the traction means is a comparatively elaborate operation in the known linear drive. For this purpose a screwdriver must be used between the runs of the toothed belt. Furthermore the known design of an output drive member is hardly able to be designed as a component employed in very small linear drives, since the limits of miniaturization are rapidly reached.

Accordingly it is one object of the present invention to provide an output drive member of the type initially mentioned, which also renders possible a presetting of the desired tension

of the traction means even in the case of small sizes of equipment.

According to the present invention there is provided an output member of a linear drive arranged between the two ends of a traction means trained around reversing elements and adapted in operation to perform a linear movement caused by the traction means in the longitudinal direction of a housing of the linear drive, two ends of the traction means ends being respectively attached to the output member by means of a connecting device, wherein said output member is designed in the form of a tensioning and connecting link for the traction means and for this purpose is divided into two link elements respectively associated with one of the ends of traction means and able to be locked in a closed setting against one another corresponding to a desired degree of tension of the traction means, the link elements respectively possess a guide section extending within a longitudinal recess, open on the longitudinal side, in the housing and connected by means of one of the connecting devices with one of the ends of the traction means and also possess a closure section arranged clear of the longitudinal recess, the link elements overlapping at least at their closure sections laterally in the longitudinal direction, for steplessly adjusting the tension of the traction means, the link elements are coupled together in a longitudinally sliding fashion using longitudinal guides, and the link elements are able to be fixed together, in order to set them in the closed setting, at the overlapping parts of the closure sections.

It is in this manner that the invention provides an output member which prior to assembly is in two parts, each of such parts termed link elements being able to be fixed to one end of the respective traction means. It is then only necessary to place the traction means, fitted with the link element in this manner, in the linear drive and to unite the tensioning and connecting link by attachment together of the link elements. In this respect the variable closed setting of the link is an advantage because it renders possible the

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preset of the different degrees of tension in the traction means or can be employed to allow for inaccuracies in manufacture. The link elements mating with each other by means of the longitudinal guides, may be slid together until the desired value of a preset tension is reached in order to then lock the closed setting, arrived in this manner, using suitable fastening means acting between overlapping portions of the closure sections. Since the zone of locking may be placed clear of the longitudinal recess, it

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is conveniently accessible so that the tensioning and connecting link is simple to manipulate. The design in accordance with the invention of the output drive member renders possible the production of links with a small overall size, this being something facilitating miniaturization.

Further advantageous developments of the invention are defined in the claims.

It is preferred for the longitudinal guides to be groove and tenon arrangements which are simple to manufacture.

The operation of closing the novel connecting and tensioning link is simplified if at least during the terminal part of the sliding movement the link elements bear against one another in all transverse directions. In this case it is sufficient to subject the link elements to a suitable compression force, there being no necessity for lateral support owing to the integrated transverse supporting effect.

For the mutual fastening together of the link elements a screw or pin connection system may for example be provided, which comprises at least one bolt-like transverse member, which simultaneously fits in the two overlapping parts of the closing sections, more particularly by extending through same. The recesses serving to accommodate the transverse member are preferably arranged in the closing sections, when the desired closed setting has been reached.

Advantageous further possibilities for fixing the two link elements in place reside in the production of adhesive and/or welded joints.

The guide section, cooperating in use with the housing of the linear drive, of the output drive member is preferably constituted by guide pistons provided on the two link elements, such pistons being connected with the closure sections by means of narrow guide ribs.

It is preferred for the two link elements to be identical in configuration, same expediently being single-piece components consisting of plastic.

In what follows the invention will be described with reference to the accompanying drawings in more detail.

Figure 1 shows a partly broken away view of a first design of the output drive member in accor-

dance with the invention together with a linear drive equipped with it.

Figure 2 is a longitudinal section taken through the arrangement illustrated in figure 1 looking in the direction of the arrow II in figure 1.

Figure 3 is a separate lateral elevation of the drive output member in accordance with figures 1 and 2, the closure section of the right element being shown broken away so that the reader is free to partly see the overlapping portion of the left link element.

Figure 4 is a cross section taken through the output drive member of figure 3 taken on the section line IV - IV.

Figure 4 shows a cross section taken through the output drive member of figure 3 on the section IV - IV.

Figure 5 shows the output drive member in a separate view in which the link elements are still separate in the disconnected state prior to fastening the output drive member functioning as a connecting and tensioning link.

In figures 1 and 2 the reader will perceive an electric motor driven linear drive 1. It possesses an elongated housing 2 with a suitably designed cross section, which at the ends is provided with a respective cover 3 and 3'. In each cover there is a reversing or bend element 4 and 4', here in the form of a rotatably mounted gear wheel. The one bend element 4 is mounted for free rotation. The other bend element 4' is drivingly connected with an electric motor 5, which is more particularly flange mounted on the side of and on the associated cover 3.

A filamentary traction means 6 is trained around the bend elements 4 and 4'. It is able to yield in the transverse

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direction and in the present case is in the form of a toothed belt, which meshes with the two bend elements 4 and 4'. Instead of such traction element it would be possible to utilize a means in the form of links, as for instance a chain, or some other

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element in the form of a band or tape.

The traction means 6 possesses two runs 7 and 8, which extend parallel to one another and are both aligned in the longitudinal direction of the housing 2. The one run 7, which is lower down in terms of figure 2, is continuous and extends in a groove-like recess 13, running in the longitudinal direction 12, in the housing 2. It is accordingly sunken in the housing 2. The longitudinally extending mouth of the recess 13 can be covered by a rail-like cover 14. The entry of the first run 7 in the two covers 3 and 3´ to reach the two bend elements 4 and 4´ is through suitable openings in the covers 3 and 3´.

The second run 8 of the traction means 6 is interrupted. The two ends 15 and 15´, produced by having such interruption, of the traction means are secured to an intermediately placed output drive member 16 so that in all there is a loop-like or continuous arrangement around the bend elements 4 and 4´.

The output drive member 16 possesses a coupling section 17 to the side of and outside the housing 2 and which is adapted for coupling with a load to be moved. This load, which is not shown in detail, may be secured to the coupling section 17 directly or with suitable intermediate connecting elements. For instance it is possible for the load to be moved to be attached to a guide carriage, not illustrated, which is connected with the coupling section 17 and bears against an external longitudinal guide.

During operation of the linear drive 1 the traction means 6 is driven with the aid of the electric motor 5 to perform a circulating movement, which results in a linear movement of the output drive member 16 in either of two possible directions of motion along the longitudinal axis 12. The load coupled with the output drive member 16 will move accordingly.

In the case of a further possible embodiment, not illustrated here, the drive force is supplied by the action of a fluid on a piston driven to perform a movement, such piston being arranged intermediately in the first run 7.

In order to ensure a certain amount of lateral guiding action for the output drive member 16 the same has a guide part 18 thereof running in a longitudinal recess 23, open on the longitudinal side toward the external surface 22 of the hous-

ing, in the housing 2. The second run 8 of the traction means 6 extends in the interior of this longitudinal recess 23 in parallelism to same. The ends 15 of the traction means are attached to the guide part 18.

The longitudinal recess 23 in the present instance possesses a transversely widened section 24, which is placed at a lower level than the external surface 22 of the housing, such section 24 preferably having a circular cross section. It is for example cylindrical in form. The connection with the external surface 22 of the housing is also in the form of a slot-like, narrow section 25 extending also in the longitudinal direction 12. This section 25 is covered over from the outside by a cover tape 26, which prevents ingress of dirt and at the end is secured to the two covers 3 and 3´. The output drive member 16 comprises an axially continuous opening 27, which has the cover tape 26 extending through it and possesses the curved form as shown in figure 3, which means that during longitudinal motion of the output drive element 16 the cover tape 26 is locally lifted clear of the slot-like section 25 adjacent to the output drive member.

The output drive member 16 serves not only to transmit force to the outside, but also constitutes a connecting and tensioning link for the traction means 6. The output drive member 16 is employed during assembly of the traction means 6 in order to connect together the two ends 15 and 15´ of the traction means 6 to form a closed loop thereof.

As is more particularly indicated in figure 5, the output drive member or connecting and tensioning link 16 is composed of two link elements 28 and 28´, in the case of which it is a question of separate components in the undone or open position illustrated here. The two link elements 28 and 28´ are, in accordance with an advantageous design, made integral, and are more particularly in the form of injection molded synthetic resin parts. Both the link elements 28 and 28´ are furthermore made identical, something which reduces costs.

The two ends 15 and 15´ of the traction means are respectively secured to the respective ends of the link elements 28 and 28´, more particularly in a detachable manner. In the case of the connecting means 32 employed in the present case it is

preferred not to employ screw connecting means as they would hinder miniaturization.

Each link element 28 and 28´ possesses a guide section 33, which is received within the longitudinal recess 23 allowing longitudinal movement. The same comprises in the present embodiment a guide piston 34 running in the widened section 24 and a narrower guide rib 35 adjoining same radially outward. The guide rib 35 extends through the slot-like section 25. It is adjoined by a closure section 36 and 36´ placed outside the longitudinal recess 23.

The ends 15 and 15´ of the traction means are respectively connected by a connecting means 32 with the one guide piston 34 permanently. The connecting means 32 in the present embodiment possesses a slot-like recess 37, running in the plane of the traction means 6, which is open on one longitudinal side (at 44) and toward the rear end surface 38 of the guide piston 34. For the example the lower internal surface, which faces the closure section 36 and 36´, bears a linear toothed structure 43, which is complementary to the toothed structure of the traction means 6. The height of the recess 37 is generally equal to the thickness of the traction means 6, which by way of the longitudinal side opening 44 (arranged on the cylindrical surface of the guide piston 34) is thrust sideways into the recess 37. The traction means 6 has its full width within the guide piston 34, while at the rear end surface 38 its section leading to the first run 7 it projects outward. It is in this manner that the respective end 15 and 15´ of the traction means is positively and grippingly held on the respective link element 28 and 28´. In order to lock the connection it is possible as well to provide a securing or locking ring 45 on a terminal collar on the guide piston 34, which holds together the piston sections divided by the recess 37 and furthermore surrounds the traction means 6. There is accordingly a very simple connecting means 32, not requiring the use of screws, which may also be employed on output drive members 16 of small overall size.

In order to apply the tension to the traction means 6, slung around the bend elements 4 and 4´ as is necessary for operation, it is unnecessary, and indeed impossible, to perform

any adjustment to the connecting means 32. The desired tension of the traction means is set by a greater or lesser axial movement together of the two link elements 28 and 28´, into which the output drive member 16 is subdivided. During assembly of the traction means 6 on the linear drive 1 the link elements 28 and 28´ attached to the ends 15 and 15´ of the traction means are shifted from the initial open position into a closed position as indicated in figures 1 through 4, in which same are fixedly joined together. In this state they complement each other to form the output drive member 16.

On closing the connecting and tensioning link 16 the link elements 28 and 28´ are slid together linearly as indicated by the arrows 46 with their front sides leading. The farther the link elements 28 and 28´ are thrust together, the greater the tension in the connected traction means 6. It is convenient if the link elements 28 and 28´ are thrust together using a suitable measuring device until the desired tension has been reached. In this position of sliding, referred to as the closed position, larger or smaller axial intermediate spaces 47 may be present between the axially facing surfaces of the link element 28 and 28´.

The arrangement illustrated by way of example is so designed that the guide sections 33 do not overlap in the closed position. The two guide pistons 34 and the two guide ribs 35 adjoin each other in an aligned fashion, forming the above mentioned guide part 18, which is only divided axially at an interruption 48, such interruption possibly comprising an intermediate space 47.

The closure sections 36 and 36´ are so designed that in the closed position they overlap each other laterally in the longitudinal direction 12 which coincides with the direction 46 of sliding. The closure sections 36 and 36´ are generally elongated in form, same extending from the rear side of a respective link element 28 and 28´, i. e. from the vicinity of the rear end surface 28 linearly forward, a front part 49 thereof extending axially past the front side of the associated guide piston 34. For instance each respective closure section 36 and 36´ is approximately twice as long as a respective guide section 33.

The two closure sections 36 and 36´ complement one another in the closed position to give the coupling section 17. In this respect the overlapping parts 53, which are in the form of rails, overlap, same resting laterally against each parting plane 52 extending in the longitudinal direction 12 between the overlapping parts 53 which extend in parallelism to the plane of circulation of the traction means 6 and preferably centrally as well. The front end surface 54 of a respective overlapping part 52 will then be opposite to a limiting surface 55, which is provided on a part 56, preferably acting as an abutment portion, formed by a rear end region of the respectively other closure section 36 and 36´. Between the surfaces 54 and 55 extending athwart the longitudinal direction 12 the said intermediate spaces 47 may be located, although it is to be noted that the two link elements 28 and 28´ may also be in direct contact with one another given a suitable closed position adjacent to the intermediate spaces 47.

In plan view and looking from an external point toward the output drive member 16, each closure section 36 and 36´ as shown in the present embodiment, will be seen to possess an L-like configuration, the longer L limb forming the overlapping part 53, which is aligned in the longitudinal direction 12 and the shorter L limb forming the abutment part 56 extending in the transverse direction.

In order to ensure that the adjustment of the tension in the traction means may be performed simply, the link elements 28 and 28´ are connected together by means of cooperating longitudinal guides 57 and 57´ while allowing longitudinal sliding motion. The present embodiment possesses two pairs of positively cooperating longitudinal guides 57 and 57´, which are preferably in the form of interlocking groove and tenon arrangements 58. On the lower edge of the front part 49 each overlapping part 53 possesses an inwardly open guide groove 59 into which there fits a guide rib 60 arranged on the other link element in the transition part between the guide section 33 and the closure section 36 and 36´

During the first part of the displacement of the guide contact the link elements 28 and 28´ can be lifted clear of each other without any difficulty. As soon as however they are

drawn together a certain extent, further cooperating longitudinal guides 61 and 61´ become effective, which are responsible for a transverse supporting action right the way round so that there is now only one degree of freedom, i. e. freedom of axial shift.

In the illustrated working embodiment of the invention the longitudinal guides 61 and 61´ serving for transverse support comprise bolt-like spurs 62 and recesses 63 cooperating together in pairs. On the front end 54 of a respective overlapping part of a respective overlapping part 53 a lug 62, which may also be termed a spur, is arranged which projects axially, it being opposite to a recess 63 provided on the part 56 of the respectively other link elements 28 and 28´. On sliding the link elements 28 and 28´ together during the last part of movement one respective lug 62 of the one link element 28 and 28´ will fit axially into a complementary recess 63 in the other link element 28´ and 28. With the exception of the axial direction the link elements are accordingly locked and unmovable.

The abutment part 56 present in the path of displacement of a respective overlapping part 53 may also contribute to preventing excessive stretch during the tensioning operation. This protective function may however also be assumed by the facing front end surfaces 54 of the guide sections 33, in which case the abutment part 56 may simply have the purpose of making available a locking recess 63 for the lugs 62 and the transverse locking, caused thereby, of the two link elements 28 and 28´

It would be feasible to provide longitudinal guides simultaneously performing a transverse supporting action. Thus the link elements 28 and 28´ could for example be coupled together by means of longitudinally extending dovetail guides. In the illustrated working embodiment it would be feasible furthermore to dispense with the groove and tenon arrangements 58 and only to provide the further longitudinal guides 61 and 61´ to have a sliding guiding action for the link elements 28 and 28´.

In order to arrest the link elements 28 and 28´ in the set, closed position, certain attachment means are provided between the overlapping parts 53. In the embodiment of the invention the attachment means involves the production of a pin

connection 66, in which at least one pin transverse member 67 simultaneously interlockingly fits into both overlapping parts 53. This provision is preferably made by holding the two overlapping part 53 after reaching the closed setting and jointly drilling through the same so that two aligned openings 68, indicated in broken lines in figure 5, are obtained, into which the transverse member 67 may then be inserted or pressed.

Instead of having a pin connection 66 it would also be feasible to have a screw or rivet joint, a releasable joint offering the advantage of it being possible to readily replace the traction means 6 after failure thereof.

In the case of a further embodiment, not illustrated, the attachment means between the two link elements 28 and 28´ could be a bond or a welded joint, preferably an ultrasonic weld. The bonded or welded surfaces would then conveniently be the lateral surfaces, facing one another in the parting plane 52 , of the overlapping parts 53.

Preferably the positions of separation of the two link elements 28 and 28´ are so placed that for the entire length thereof there is a longitudinal division of the opening 27, through which the covering tape 26 extends, such that the opening 27 is longitudinally open in the open position of the connecting and tensioning link. Both link elements 28 and 28´ possess limiting surfaces 69 and 69´, which in the fitted together state of the link elements 28 and 28´ cooperate together to form the inner surface of the opening 27. In the illustrated working embodiment the opening 27 extends adjacent to the two closure sections 36 and 36´, whose overlapping parts 53 constitute the lateral surfaces of the opening 27. The base surface 73 of the opening is preferably predetermined on the guide section 33.

In the illustrated working embodiment the coupling section 17 possesses a plurality of transverse holes 70, which render possible the attachment of a load to be moved. For the same reason the pin-like transverse member 67 is designed in the form of a sleeve.

At least one of the guide pistons 34 may possess a recess 71, in which a magnet part 72 is rotatably mounted belonging to a position detecting device of the linear drive 1.

Since the two closure sections 36 and 36´ assume positions outside the longitudinal recess it is readily possible to take hold of them, clamp them and attach them to one another. Accordingly it is unnecessary for the user to place his hand in the close vicinity of the traction means.

CLAIMS:

1. An output member of a linear drive arranged between the two ends of a traction means trained around reversing elements and adapted in operation to perform a linear movement caused by the traction means in the longitudinal direction of a housing of the linear drive, two ends of the traction means ends being respectively attached to the output member by means of a connecting device, wherein said output member is designed in the form of a tensioning and connecting link for the traction means and for this purpose is divided into two link elements respectively associated with one of the ends of traction means and able to be locked in a closed setting against one another corresponding to a desired degree of tension of the traction means, the link elements respectively possess a guide section extending within a longitudinal recess, open on the longitudinal side, in the housing and connected by means of one of the connecting devices with one of the ends of the traction means and also possess a closure section arranged clear of the longitudinal recess, the link elements overlapping at least at their closure sections laterally in the longitudinal direction, for steplessly adjusting the tension of the traction means, the link elements are coupled together in a longitudinally sliding fashion using longitudinal guides, and the link elements are able to be fixed together, in order to set them in the locked setting, at the overlapping parts of the closure sections.

2. The drive output member as set forth in claim 1, wherein the longitudinal guides are constituted at least partly by interlocking groove and tenon devices.

3. The drive output member as set forth in claim 1, wherein the link elements bear against each other more particularly by way of the mutually cooperating longitudinal guides, at least during the end part of the displacement path in all transverse directions.

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4. The drive output member as set forth in claim 3, wherein for transverse support a lug is provided on at least link element, said lug being able to fit into a recess arranged in the other link element in the path of displacement of the lug.

5. The drive output member as forth in claim 4, wherein both link elements are provided with a lug and with a recess axially spaced therefrom, such lugs and recesses partly fitting into each other in pairs during sliding the link elements for tautening the traction means.

6. The drive output member as set forth in claim 5, wherein the lug is arranged at the front end side of a respective closure section and the associated recess is arranged on a part, opposite to this end side in the direction of sliding, of the other closure section.

7. The drive output member as set forth in claim 1, wherein said closure sections possess rail-like overlapping parts.

8. The drive output member as set forth in claim 1, comprising, for mutually locking the link elements in the closed setting, a screw or pin connection, effective between the closure sections, with at least one transverse member fitting into both overlapping parts.

9. The drive output member as set forth in claim 1, comprising a bonded or welded joint between the closure sections for the purpose of fixing the link elements in the closed setting thereof.

10. The drive output member as set forth in claim 1, wherein the two closure sections, which are fitted together, constitute a coupling section, which is able to be coupled jointly with the load to be moved, of the output drive member.

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11. The drive output member as set forth in claim 1, wherein each guide section possesses a guide piston running in a widened complementary section of the longitudinal recess, on which piston the associated traction means end is fixed by way of the connecting device.

12. The drive output member as set forth in claim 11, wherein each guide section possesses a guide rib, which extends through a slot-like narrow section of the longitudinal recess radially adjoining the widened section of the longitudinal recess and connects the guide piston with the associated closure section.

13. The drive output member as set forth in claim 11, wherein the guide pistons of the two link elements are arranged axially aligned in sequence without mutual overlap.

14. The drive output member as set forth in claim 11, wherein the closure section of each respective link element extends past the front side of the associated guide piston.

15. The drive output member as set forth in claim 1, wherein said output member has an opening extending axially through it, which for its part is adapted to have a cover tape extending through it covering the longitudinal recess, and is furthermore longitudinally divided by the separating region of the two link elements along the entire length thereof so that the opening is accessible from the longitudinal side in the separated state of the link elements.

16. The drive output member as set forth in claim 1, wherein the connecting devices are formed by internally toothed recesses accommodating ends of the traction means.

17. The drive output member as set forth in claim 1, wherein the two link elements are identical to one another in design.

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18. The drive output member as set forth in claim 1, wherein the linear drive is an electric motor driven linear drive, in the case of which at least one of the bend elements is in the form of a mechanically driven wheel.

19. The drive output member as set forth in claim 1, wherein the two link elements are respectively designed in the form of integral components, which are more particularly manufactured of plastic.

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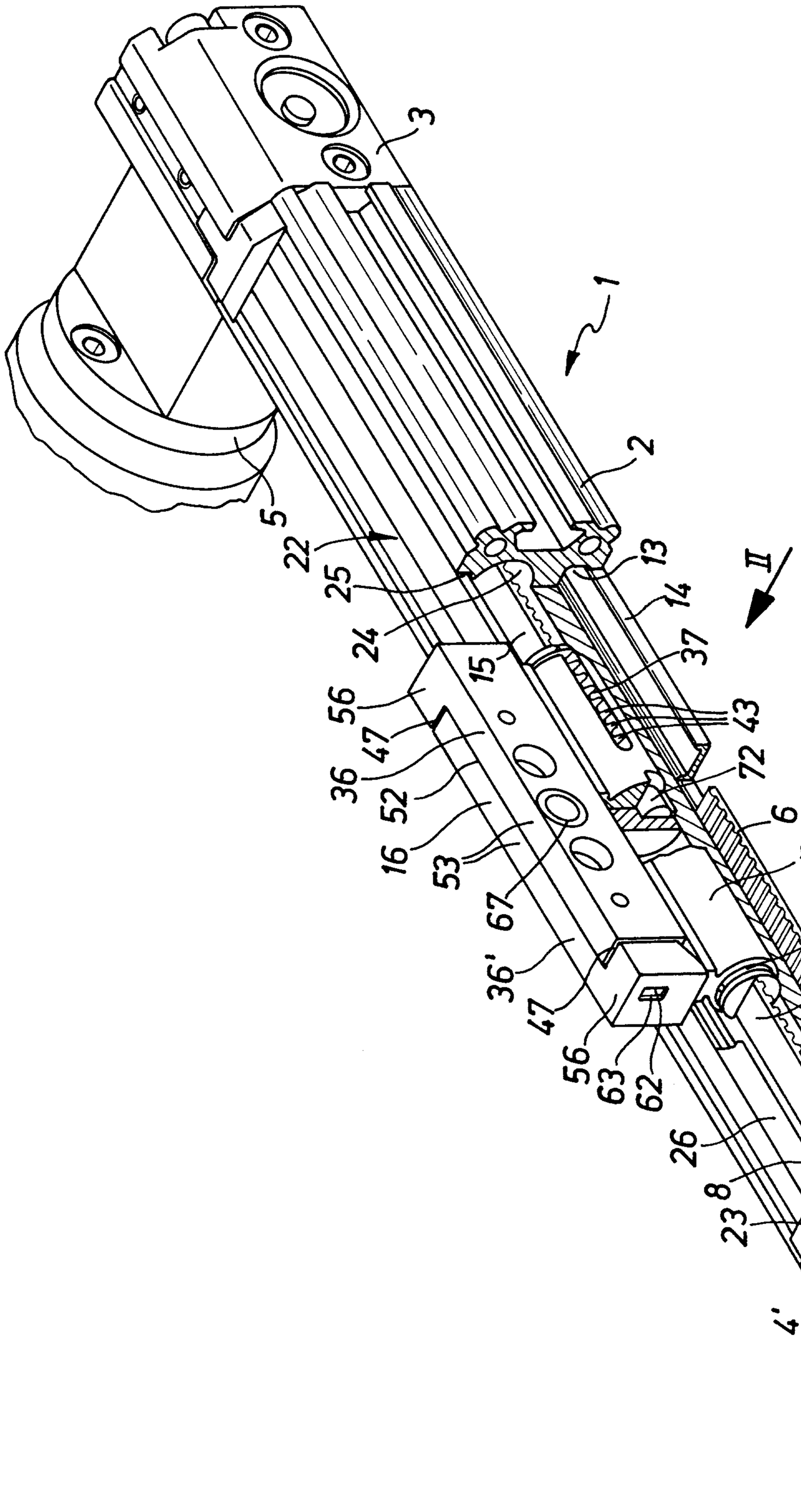

Fig.1

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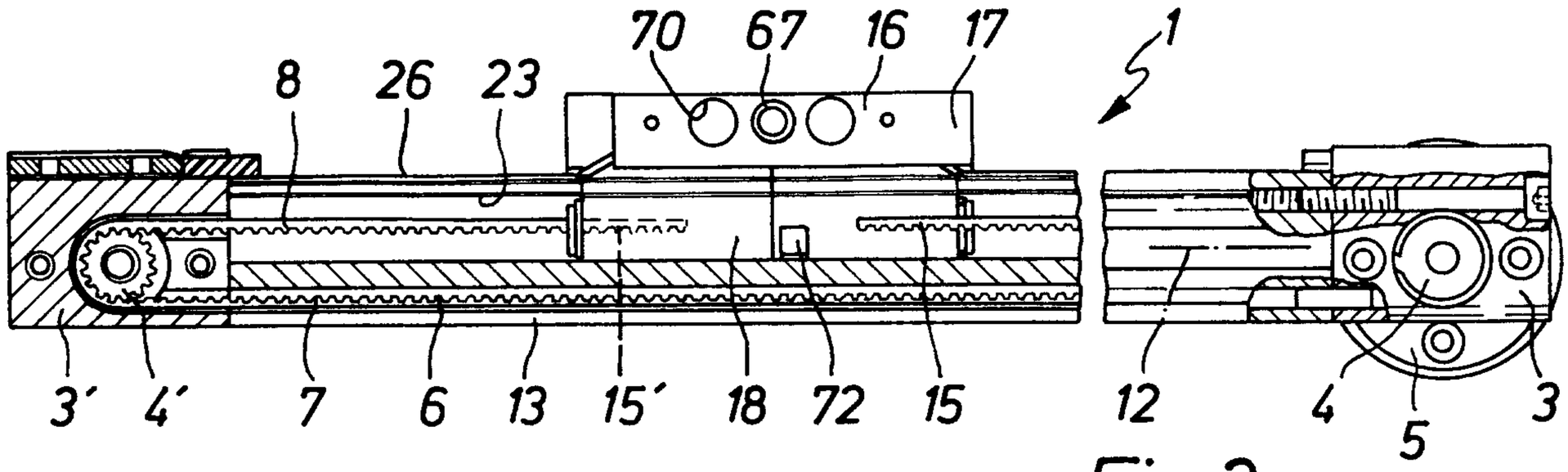

Fig. 2

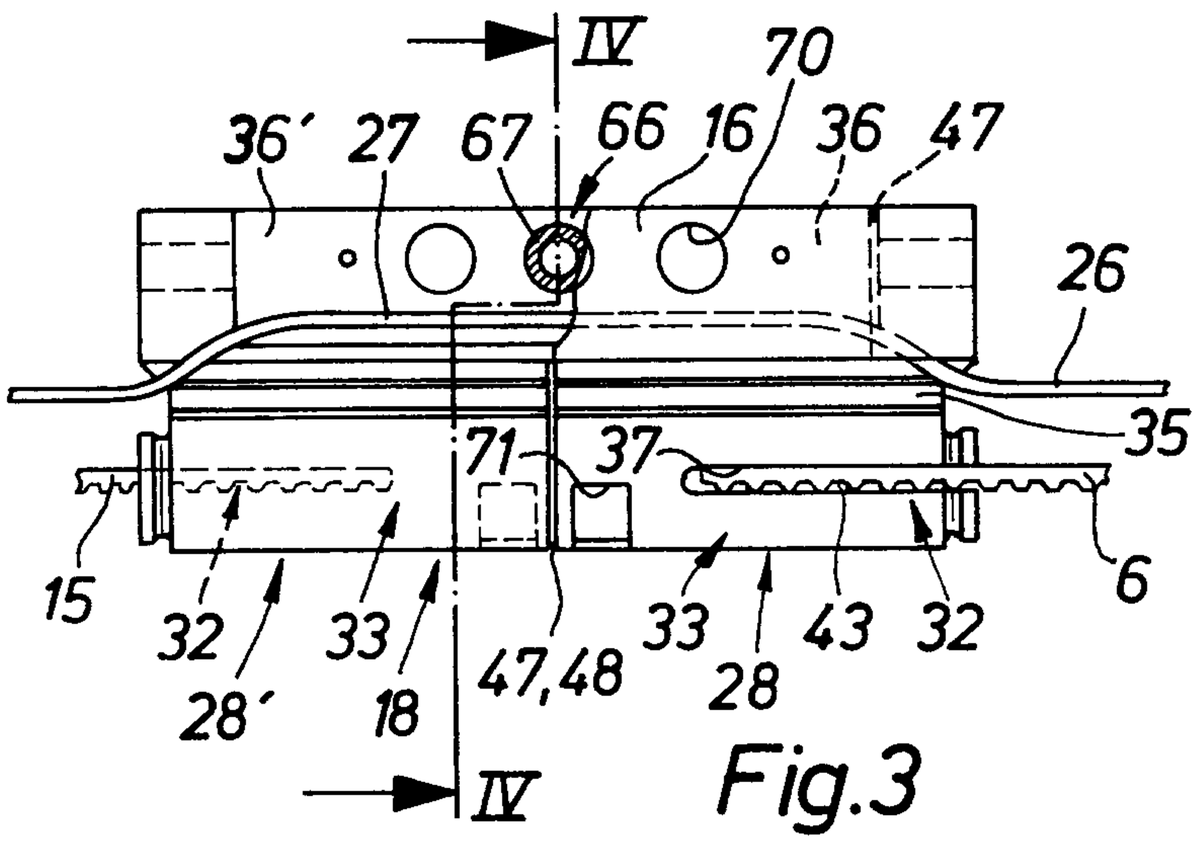

Fig. 3

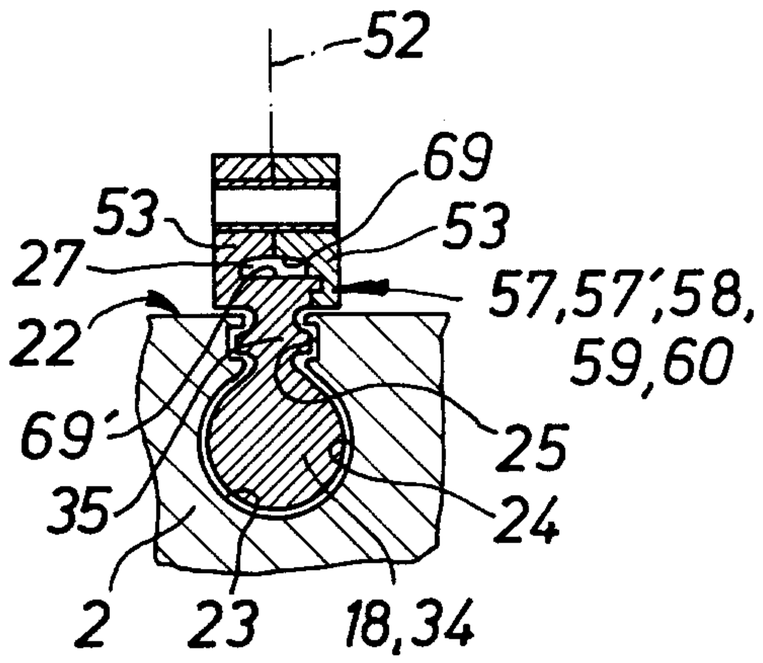

Fig. 4

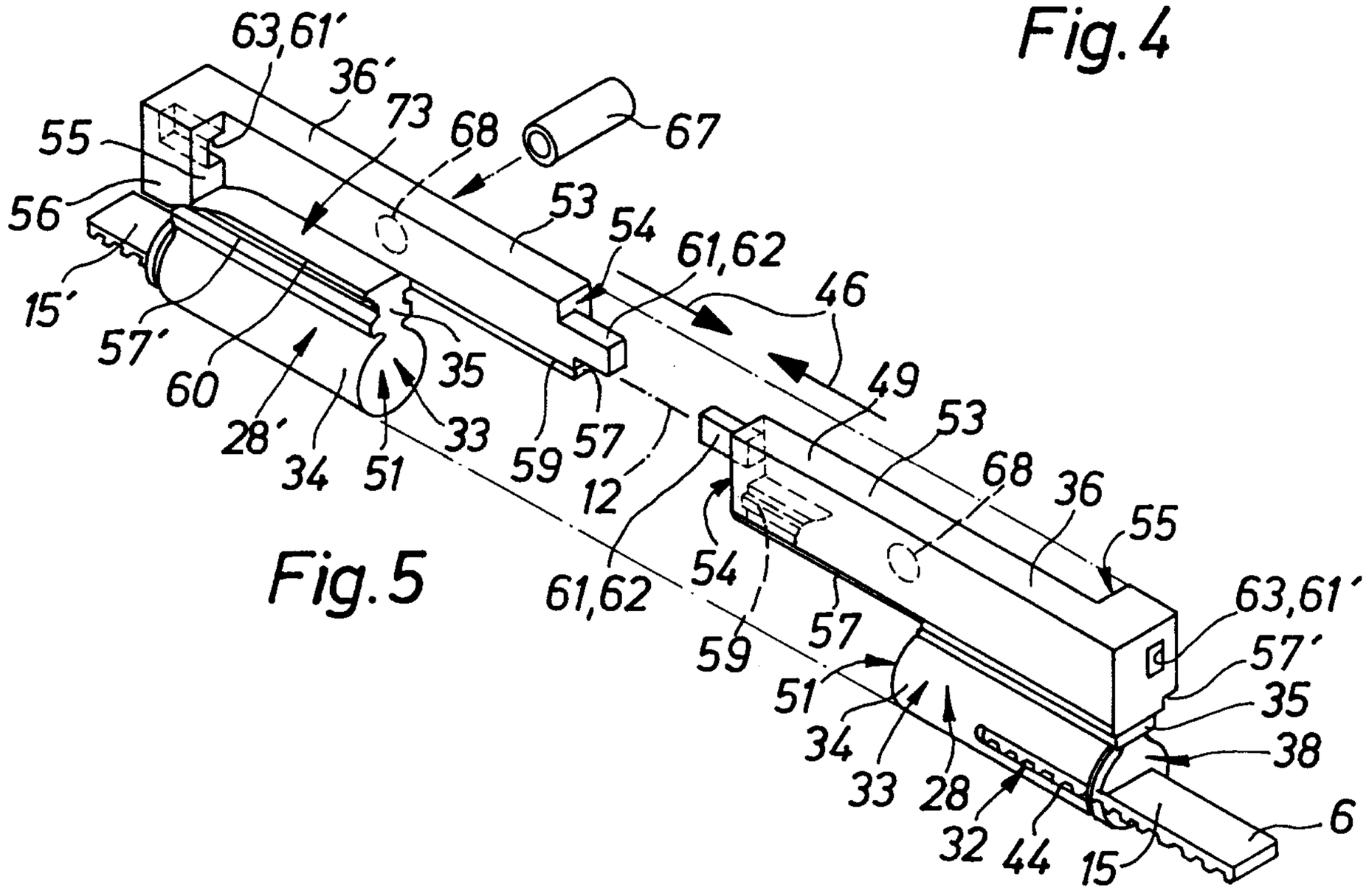

Fig. 5

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