(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 397 647 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.12.2011 Bulletin 2011/51

(51) Int Cl.:
E06B 9/72 *(2006.01)*

(21) Application number: **10166550.3**

(22) Date of filing: **18.06.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
BA ME RS

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(54) **Tubular gearmotor for actuating roller blinds**

(57) In order to decrease the noise and the vibrations generated by a gear motor (NC) for rolling shutters comprising a tubular casing (10) having a longitudinal axis (X), motor means contained in the casing, an output shaft (30), able to rotate around a rotation axis (Y), which comes out from the tubular casing and suitable for moving a rolling shutter, and an epicyclic reduction gear (R) to reduce the revs generated by the motor means and transfer them to the output shaft, the invention foresees spherical shape coupling means (32, 80 34, 54, 36, 58) to connect the output shaft and the reduction gear, so that the axis of said shaft can tilt with respect to the longitudinal axis of the casing.

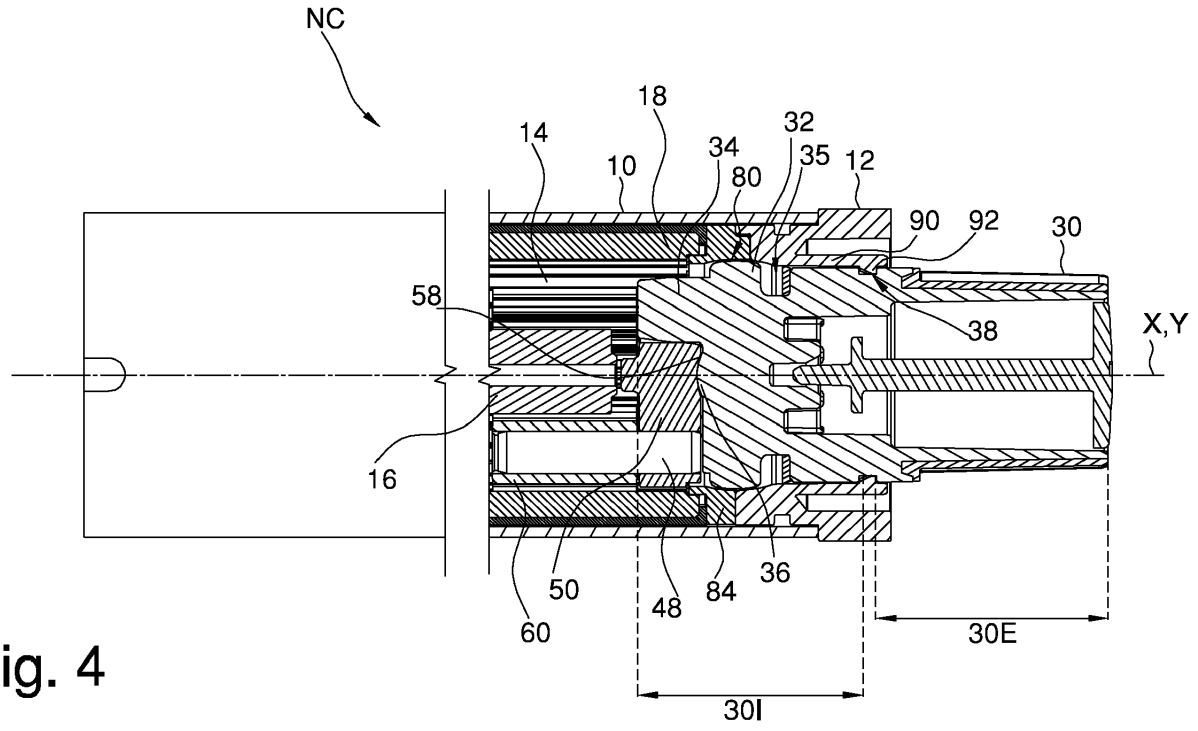

Fig. 4

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention refers to a tubular gear motor used to actuate and automate movable barriers or closing systems in general such as gates, doors, garage doors or for moving rolling shutters in general such as curtains, rolling gates, blinds or similar elements.

[0002] The described solution refers in particular to a gear motor of the type used in moving rolling shutters in general, but the same concepts can be used in any other mechanical reduction gear.

STATE OF THE ART

[0003] A gear motor AZ of this type (see fig. 1a) in general is made up of a tube T that contains: an electric motor M, a mechanical reduction gear R contained in a casing or crown C, and part of a head H in which control circuits, as well as mechanical and/or electronic end stop devices are housed. The head H can be partially slotted inside the end of the tube T and with it fixed to a wall or box W, with or without the help of the relative support. Projecting at the other end of the tube T there is an output shaft or pinion P directly connected inside the reduction gear R, to move a rolling shutter.

[0004] The reduction gear R is designed to make large reduction ratios. Given the small size of the tube T, the reduction gear R is selected to be of the epicyclic type and made up of many stages (generally 3) in cascade. At the output shaft P a pulley K is fitted to transmit rotary motion to a winding tube V on which the rolling shutter is wound. Roughly at the head H there is an adaptation pulley G that receives rotary motion from the winding tube V and transmits it to the electronic or mechanical device for measuring the end stops. Generically, the gear motor AZ is almost totally slotted/inserted inside the winding tube V; only part of the head H remains outside to be fixed to the wall or box W. The winding tube V and the gear motor AZ are both fixed and mounted canti-levered to the wall or box W at one of its ends. At the other end they interact and support one another, see pulley G and K.

[0005] Particularly considering the field of application, i.e. building industry, it can be understood that the installations can have rough tolerances. Possible clearances between the mechanical members and/or assembly errors mean significant alignment errors between the rotation axis of the winding tube V and that of the pulley K, which in turn misaligns the output shaft P and thus the mechanical members of the reduction gear R. In fig. 1b for example it is possible to appreciate another cause of misalignment - the weight of the rolling shutter, indicated with the arrow MC. Since the gears are designed to work coaxially, any misaligned position produces high levels of noise and can lead to early breaking or wear.

[0006] US 6 979 962 describes a tubular motor for a window-covering panel that adopts multiple elastic insulation joints to avoid transmitting vibrations to the outside. The electric motor and the mechanical reduction gear are not in direct contact with the containment tube but are insulated, and the transmission of motion takes place through an elastic joint. Substantially, it is taught to insert a gear motor inside an outer tube but the construction is very complex and particularly expensive. And there is the problem that the use of one or more elastic joints in applications that are often exposed to the sun and to high temperatures can be problematic.

[0007] EP 0 783 155 describes a motor for a panel. Like in the previous case, elastic couplings are also used here to damp or cancel out vibrations and noise, made through connecting elastic discs between rotating parts. The elastic discs allow a bending around and along the rotation axis but they are torsionally rigid.

[0008] WO03/008818 describes a particular elastic element for transmitting rotary motion in these applications. The elastic element is flexible with respect to a longitudinal axis and extendible along it, but torsionally rigid.

[0009] A11 of these solutions have their drawbacks.

[0010] Those presented in US 6 979 962 and EP 0 783 155 are without doubt very complex, and therefore expensive. In particular, the elastic element in EP 0 783 155 is very bulky, and difficult to use in modem actuation systems that increasingly tend to reduce their size so as to take up less space. The elastic element in US 6 979 962, on the other hand, is difficult to assemble, requires many discs to be really effective and is very bulky.

[0011] The elastic element of WO03/008818 has above all problems of durability, because a small crack in the structure can lead to it breaking apart.

[0012] In summary, the prior art currently only indicates solutions unable to be taken up by the market because the relative production costs are excessive and cannot be justified.

PURPOSES OF THE INVENTION

[0013] The main object of the invention is to improve the state of the art, with a low-noise gear motor.

[0014] Other objects of the invention are to make a gear motor of the aforementioned type that

- transmits less vibrations to the application to which it is installed, and/or
- has an output shaft that also tolerates assembly misalignments; and/or
- can be produced at reasonable cost.

[0015] Such objects are obtained by a gear motor of the aforementioned type comprising

- a tubular casing having a longitudinal axis,

- motor means contained in the casing,

- an output shaft, able to rotate around a rotation axis, which comes out from the tubular casing and adapted for moving a rolling shutter,

- an epicyclic reduction gear to reduce the revs generated by the motor means and transfer them to the output shaft,

characterised by comprising spherical shapecoupling means to connect the output shaft and the reduction gear, so that the axis of said shaft can tilt with respect to the longitudinal axis of the casing.

[0016] The spherical shape-coupling that is exploited to connect the output shaft and the reduction gear allows the axis of the shaft to oscillate if necessary around the reference axis of the gear motor and of the inner rotating members. In this way the shaft decouples sufficiently, whilst still receiving driving torque, so as not to transfer vibrations to such rotating members, or cause misalignment or an anomalous operation condition thereof. As a result of this there is always optimal operation that is not sensitive to the stresses on the shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Further characteristics and advantages of the invention will become clearer from the example description of a gear motor, together with the attached drawing, in which:

figures 1a, 1b show a schematic side view of a known actuation system;

figure 2 shows an exploded view of part of a stage according to the invention;

figure 3 shows an exploded view of the stage of fig. 2 from another angle;

figure 4 shows a vertical section view of a reduction gear stage;

figures 5 and 6 show an enlarged view of the section of fig. 2 in two different operative positions.

EMBODIMENTS OF THE INVENTION

[0018] Figure 4 shows a tubular motor or gear motor NC formed by a containment tube or tubular casing 10, with longitudinal axis X. An end of the tube 10 is closed by a cover or cap 12 from which a rigid output shaft 30 comes out, having rotation axis Y, intended to set the winding tube of the rolling shutter in motion thanks to the interposition of an adapter pulley (not shown).

[0019] Through a planet gear carrier disc 50 the output shaft 30 is connected to the last stage of a mechanical reduction gear (of the known type), which is connected to the previous stage by means of the relative output pinion 16.

[0020] The pinion 16 receives the motion from the previous stage or from the electric motor, and engages on three planetary gear wheels 60 mounted so as to be able to rotate, through pins 48, on the planet gear carrier disc 50 and each arranged at 120° (like the vertices of an equilateral triangle). The planet gears 60 at the centre engage and interact with the pinion 16, whereas peripherally they engage with the toothing 14 of a fixed sleeve 18 arranged in the tube 10. The planet gear carrier disc 50 is shaped like a disc having three inlets 54 in the perimeter, which extend from the outer edge inwards, arranged symmetrically at 120°. Visually, the planet gear carrier disc 50 could be described as a flower with three symmetrical petals or an element with a trefoil plan.

[0021] Three sectors or petals 52 arranged at 120° and symmetrically with respect to the centre remain defined by the inlets 54. Each sector or branch 52 is provided with holes 56 (only some are indicated). At the centre of the planet gear carrier disc 50, on a face, there is a semispherical or lenticular recess or concavity 58.

[0022] The output shaft 30 at the end that projects from the cap 12 has a known configuration, i.e. a grooved profile to couple with the pulley that moves the rolling shutter. Roughly in the middle area it is furrowed by a circumferential groove 38, used to block the shaft 30, which defines a part 30E arranged outside and a part 301 arranged inside the tube 10. The part 301 hidden inside the tube 10 interacts with the mechanical reduction gear and at its end has a ring 32 in relief, perimetrically separated from the central area by a throat 35, from which three teeth 34 extend parallel to the axis Y, arranged at 120° around the axis Y. At the centre of the ring 32, between the teeth 34 and at the axis Y, there is a small semispherical ridge or stud 36, complementary to the concavity 58.

[0023] The cap 12, on the inside, has a plurality of cantilevered flexible tabs 90, in direct contact with the output shaft 30, which are oriented parallel to the axis X and have a stop tooth 92 at the outer end on the side facing towards the axis X. The tooth 92 has dimensions complementary to the groove 38.

[0024] During assembly, the output shaft 30 is inserted into the tube 10 and is in turn closed by the cover 12, so that the teeth 92 snap into the groove 38. It is thus ensured that there is free rotation of the output shaft 30 around its axis Y but at the same time it is retained, constrained by the teeth 92, so that it does not move along the axis X.

[0025] The outer surface of the ring 32 rests and slides on an (optional) complementary concave seat 80 present on the inner surface of the end of the cap 12 and of a locating ring 84, whereas the teeth 34 are slotted into the seats 54 of the planet gear carrier disc 50. The mutual dimensions are such that the stud 36 inserts into the concavity 58 (see also fig. 5 and 6).

[0026] All of the contact surfaces, like that of the ring 32, of the seat 80, the side surfaces of the teeth 34 are advantageously semi-spherical to facilitate and favour the conical movement of the output shaft 30.

[0027] In operation, the pinion 16 is set in rotation by the electric motor or by the previous stage of the reduction gear, and makes the planets 60 rotate. Through the pins 48 the torque is imparted to the planet gear carrier disc 50, and from here, through the teeth 34, to the shaft 30. Along the axis X the output shaft 30 is blocked. On one side it is held by the teeth 92 and on the other side by the opposition of (and the contact with) the planet gear carrier disc 50, whereas it is allowed to make possible precession motion around the axis X. The sliding of the ring 32 in the concave seat 80, of the stud 36 in the concavity 58, of the teeth 34 in the respective seats 54 and the flexing of the tabs 90, allows the output shaft 30 to tilt its axis Y with respect to the axis X.

[0028] This allows a rotation movement in which the trajectory of the axis Y can describe a cone the vertex of which is roughly positioned at the contact surfaces of the stud 36 and concavity 58. In the example shown the sliding surfaces and the relative curvatures are sized to allow an oscillation of about $\pm 2°$ of the axis Y with respect to the axis X. The angle between the axes has its vertex roughly on the bottom of the concavity 58, see also angle H in fig. 5 and 6, where the neighbourhood of the stud 36 and of the concavity 58 is illustrated in an enlargement to highlight the two opposite positions of the shaft 30 for a maximum oscillation. As can be seen, the shaft 30 can "rock/oscillate" on the planet gear carrier disc 50, thanks to the rolling of the stud 36 in the concavity 58, to the clearance between a tooth 34 and its seat 54, to the curved contact surfaces of the tooth 34 and its seat 54 and to the shaping of the surfaces 80 and 32.

[0029] Basically, the configuration of the shaft 30, of the cap 12 and of the planet gear carrier disc 50 form a spherical joint with a small stroke. It should be observed that a solution that makes the shaft 30 oscillate through for example pure mechanical clearances creates many problems. The output shaft 30 not aligned with the axis X would transmit stresses to the gears of the reduction gear, and it would create unforeseen friction and wearing of the contact surfaces as well as increasing the amount of noise produced (see fig. 1b).

[0030] On the other hand, the invention envisages to configure all the parts involved like a spherical joint (for example by curving some surfaces of the output shaft 30 and of the components to which it is constrained).

[0031] Experimentally it has been found that if the shaft 30 can tilt by an angle H equal to about 4-5° with respect to the axis X, the noise and the vibrations are greatly reduced without at all compromising the structural strength of the actuation system.

[0032] The position of the teeth 34 and of the seats 54 can also be inverted.

Claims

1. Gear motor (AZ) for rolling shutters comprising

- a tubular casing (10) having a longitudinal axis (X),
- motor means contained in the casing,
- an output shaft (30), rotatable around a rotation axis (Y), which comes out from the tubular casing and is adapted for moving a rolling shutter,
- an epicyclic reduction gear (R) to reduce the revolutions generated by the motor means and transfer them to the output shaft,

characterised by comprising spherical shape-coupling means (32, 80 34, 54, 36, 58) to connect the output shaft and the reduction gear, so that the axis of said shaft can tilt with respect to the longitudinal axis of the casing.

2. Gear motor according to claim 1, wherein said means comprise a convex or concave surface (32) of the output shaft in contact with a complementary convex or concave surface (80) of an element (12, 84) inside the casing, so that said two surfaces can slide or roll on one another.

3. Gear motor according to claim 1 or 2, comprising a planet gear carrier disc (50), equipped with planetary gear wheels (60) constituting a stage of the reduction gear, adapted for transferring rotary motion to the output shaft through mutually jointed parts (34, 54), said parts having shaped and/or conjugated curves to allow the output shaft to rotate on the planet gear carrier disc and tilt with respect to the longitudinal axis of the casing.

4. Gear motor according to claim 3, wherein the output shaft has a plurality of axial pins (34) and the planet gear carrier disc has a plurality of seats (54) corresponding to the pins, or vice-versa, so as to receive them therein, in order to transfer rotary motion to the output shaft through the deriving joint.

5. Gear motor according to claim 4, wherein said seats and/or said pins have mutual contact arched surfaces to promote a relative rolling motion when the output shaft tilts with respect to the longitudinal axis of the casing.

6. Gear motor according to claim 4 or 5, wherein the plurality of seats in the planet gear carrier disc are configured as introflexions (54) of its perimeter.

7. Gear motor according to claim 6, wherein the introflexions define, in the planet gear carrier disc, a plurality of sectors (52) provided with holes (56) in which pins (48) can be inserted that are adapted for

rotatably supporting the planetary gear wheels.

8. Gear motor according to one of claims 3 to 7, wherein the planet gear carrier disc has a support surface (58) for the output shaft at the rotation axis, said support surface comprising a convexity or concavity that is complementary to a concavity or convexity (38) of the output shaft, the latter being able to slide or roll on the corresponding one of the planet gear carrier disc to promote the tilting of the output shaft with respect to the longitudinal axis of the casing.

9. Gear motor according to any one of the previous claims, comprising elastic means (90) to elastically keep the rotation axis of the output shaft coinciding with the longitudinal axis of the casing.

10. Gear motor according to claim 9, wherein the elastic means comprise flexible tabs (90) integral with and fixed inside the casing configured to push the rotation axis of the output shaft towards the longitudinal axis of the casing.

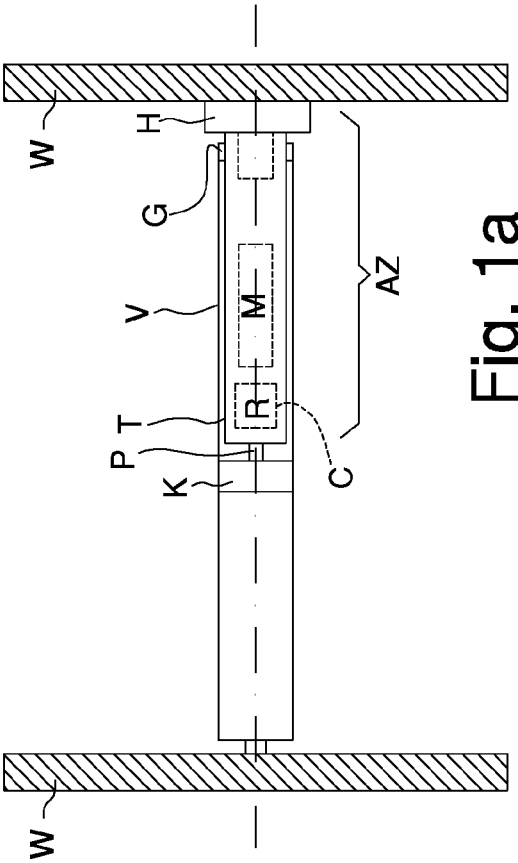

Fig. 1a

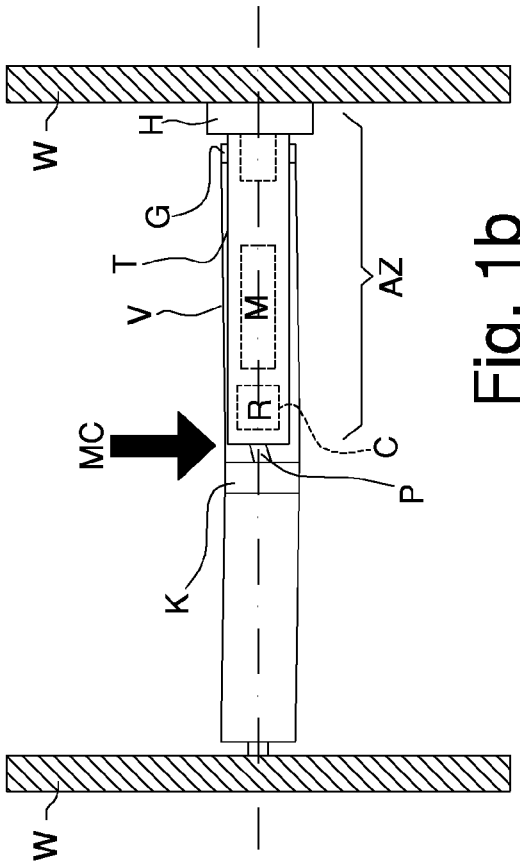

Fig. 1b

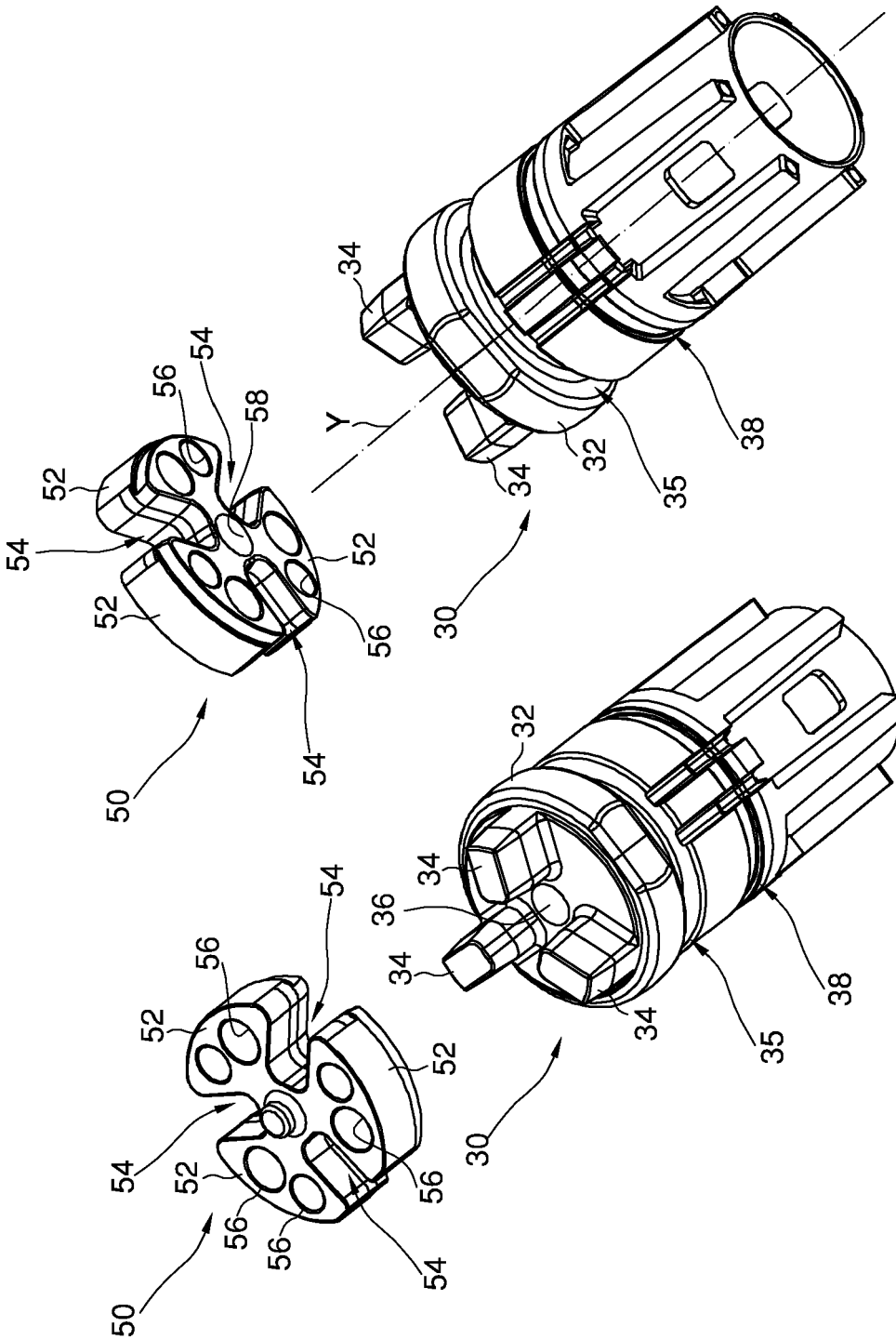
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Fig. 3

Fig. 2

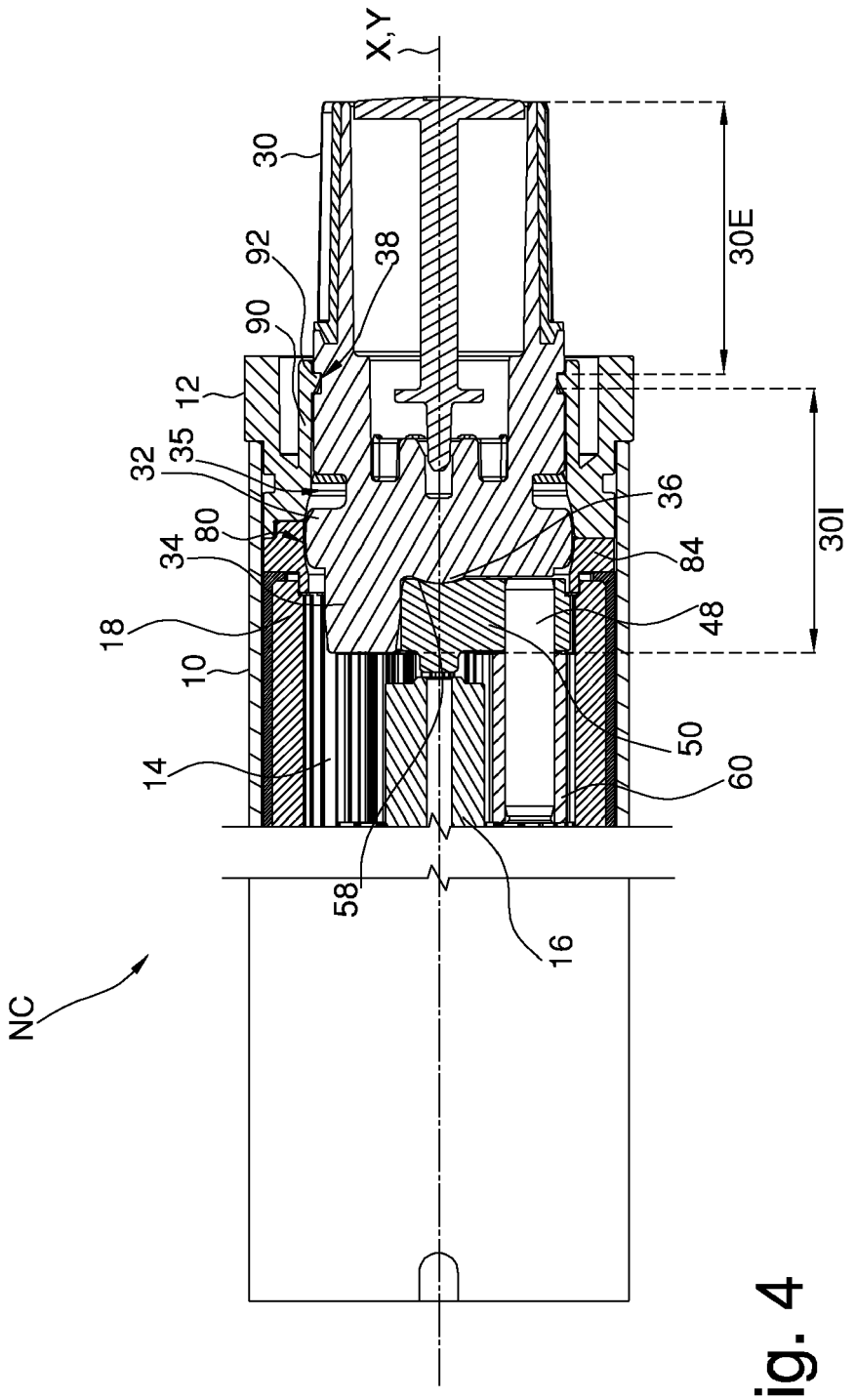

Fig. 4

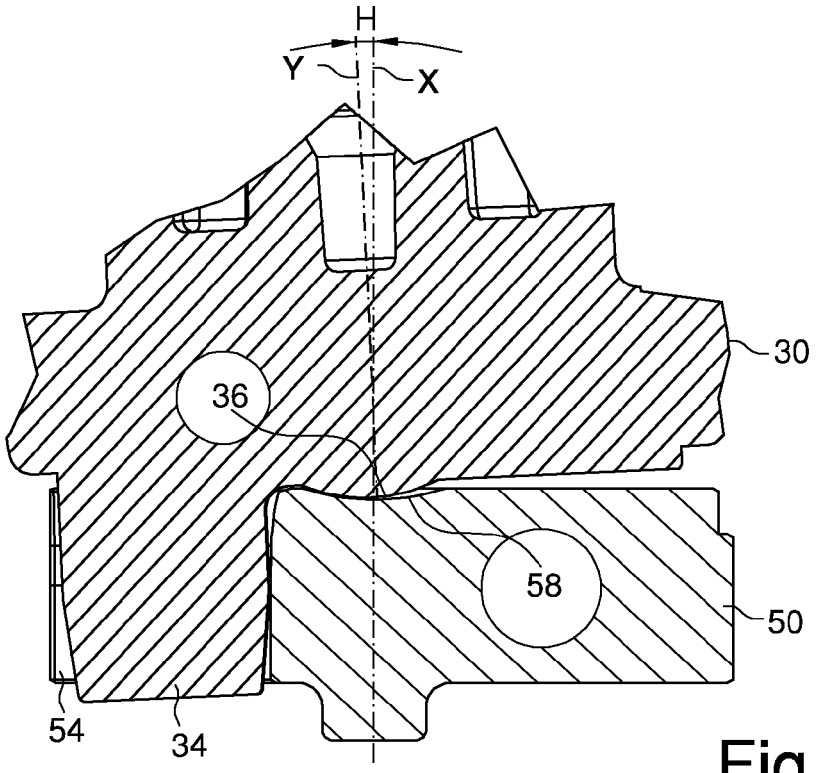

Fig. 5

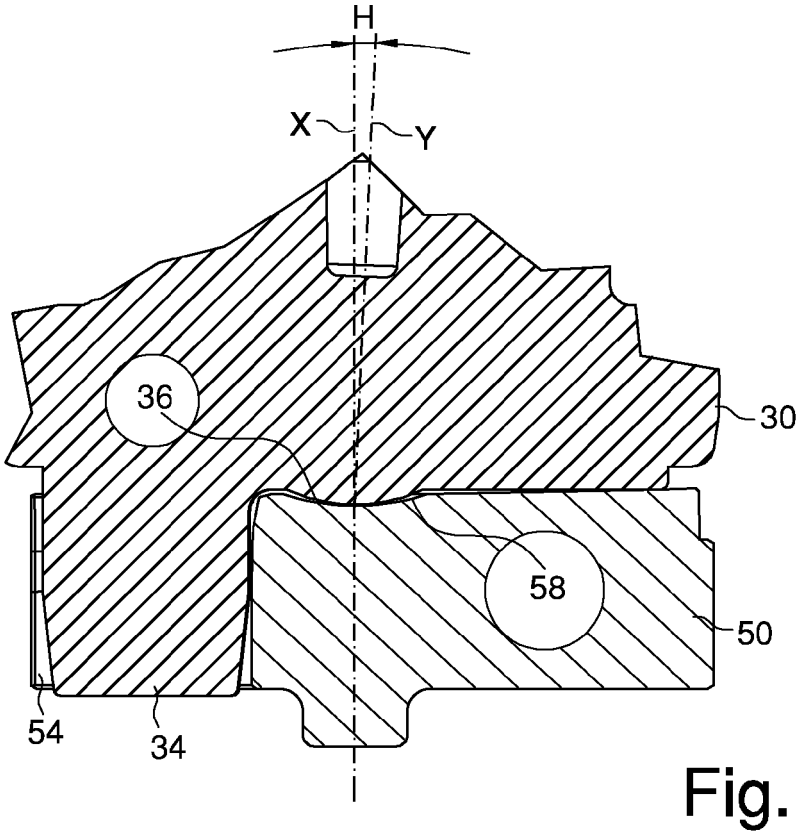

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 10 16 6550

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	FR 2 934 006 A1 (ZURFLUH FELLER [FR]) 22 January 2010 (2010-01-22) * page 4, line 15 - line 19; figure 2 * -----	1	INV. E06B9/72
			TECHNICAL FIELDS SEARCHED (IPC) E06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 December 2010	Peschel, Gerhard

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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03-12-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2934006 A1	22-01-2010	NONE	

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

REFERENCES CITED IN THE DESCRIPTION

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- US 6979962 B **[0006] [0010]**
- EP 0783155 A **[0007] [0010]**
- WO 03008818 A **[0008] [0011]**