(19) DANMARK

(10) **DK/EP 2575153 T3**

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: ***H 01 H 33/666 (2006.01)*** ***H 01 H 3/42 (2006.01)*** *H 01 H 3/48 (2006.01)*

(45) Oversættelsen bekendtgjort den: **2017-10-30**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2017-07-19**

(86) Europæisk ansøgning nr.: **12184683.6**

(86) Europæisk indleveringsdag: **2012-09-17**

(87) Den europæiske ansøgnings publiceringsdag: **2013-04-03**

(30) Prioritet: **2011-09-30 DE 202011106188 U**

(84) Designerede stater: **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 RS SE SI SK SM TR**

(73) Patenthaver: **Fritz Driescher KG Spezialfabrik für Elektrizitätswerksbedarf GmbH & Co. KG, Industriestrasse 2, 41837 Wegberg, Tyskland**

(72) Opfinder: **Bünger, Stefan, Rheinweg 191 c, 41812 Erkelenz, Tyskland**

(74) Fuldmægtig i Danmark: **Awapatent A/S, Strandgade 56, 1401 København K, Danmark**

(54) Benævnelse: **Afbryderpolenhed**

(56) Fremdragne publikationer:
CN-Y- 2 590 157
DD-A1- 240 801
DE-A1- 2 934 776
DE-A1- 2 949 753
DE-A1- 19 906 156
JP-A- S55 131 919
US-A- 3 784 774
DATABASE WPI Week 200972 Thomson Scientific, London, GB; AN 2009-Q32776 XP002734615, -& CN 201 327 799 Y (ZHENJIANG DAQUAN YINDUN ELECTRIC APPLIAN) 14. Oktober 2009 (2009-10-14)
DATABASE WPI Week 201022 Thomson Scientific, London, GB; AN 2010-C69075 XP002734616, -& CN 201 417 684 Y (TU D) 3. März 2010 (2010-03-03)

Pole-type switch gear

The invention relates to a pole-type switch gear, in particular for a vacuum circuit breaker, having a vacuum-tight housing (2.1) with at least one stationary contact and at least one movable contact (2.2), in particular a bolt, which may be moved into a closed position by driving means.

Vacuum circuit breakers are electrical switches which are designed for high currents and isolate an electrical connection in the vacuum-tight housings provided for this. A conventional vacuum-tight housing has a vacuum casing in which two contacts are arranged. One of the contacts is designed as a stationary contact and the other as a movable contact, usually in the form of a conductor bolt. In the closed switch state, the two contacts make contact and therefore establish an electrical connection. In this state they are subjected to a continuous contact pressure which presses the two contacts against each other with a defined force. To isolate the electrical connection, the movable contact is moved away from the stationary contact at a high speed and produces an isolating distance between the two contacts. Since the voltage range in which circuit breakers of this kind are to be be used is always increasing, the demands on the circuit breaker in terms of construction increase, because the higher the voltage that is to be switched is, the higher the isolating distance, closing and opening speeds and the level of the contact pressure demanded are.

DE 299 06 480 U 1 describes a typical construction of a pole-type switch gear of the type mentioned in the introduction. The vacuum-tight housing is arranged in a pole tube. To close the circuit, a driving force is transmitted via a joint bolt and a rotatably mounted switching transformer to a contact that is to be linearly moved. As a result, an opening spring is automatically pre-stressed in addition to an electrical connection being established between the contacts in the vacuum-tight housing. The situation can occur with vacuum circuit breakers of this kind that the poles do not sit cleanly on each other in the closed state and wear prematurely as a result.

A further typical pole-type switch gear is known from DE 40 06 452 A1. The driving forces are transmitted here from a switch rod to a control disc. The control disc is rotatably mounted and has an arcuately curved slot recess. The movable contact has a plunger which engages in the slot recess and is positively guided hereby. By rotating the control disc, the movable contact, which can be linearly moved in the vacuum circuit breaker in the pole-type switch gear casing, is moved into a “closed” position and an opening spring pre-stressed. With this construction the friction losses are comparatively high, and this leads to high wear of the mechanical components and to slow switching times. Furthermore, with the positive guidance provided by the arcuately curved slot recess, a comparatively large angle of rotation of the control disc is necessary for the linear movement of the movable contact required for switching, and this similarly leads to increased switching times.

A pole-type switch gear of the type mentioned in the introduction is also known from US 3 784 774 A for a vacuum circuit breaker, in which the moveable contact, together with a pressure spring arrangement, is guided by two bearings, of which one is located inside the casing of the vacuum circuit breaker and the other is located outside of the casing.

The present invention is therefore based on the object of creating a pole-type switch gear whose construction fulfils the requirements of high voltage ranges and is simple at the same time.

According to the invention this object is achieved by the features of Claim 1. Preferred embodiments of the invention result from the subclaims.

A linear guide is here taken to mean a machine element from linear technology which enables optimally friction-free translation of the movable contact, or a driving element connected therewith and linearly moved in the same direction, and at the same time guarantees compliance with the direction of movement – a linear path.

Use of a linear guide that is arranged at a spacing from the vacuum-tight housing produces two results with respect to the known pole-type switch gear described in the introduction. Firstly, the movable contact, or a driving element connected therewith and linearly moved in the same direction, is positively guided, so driving forces, which are not transmitted exactly axially, do not lead to transverse deflection of the movable contact or the driving element connected therewith. This ensures plan parallel application of the contacts in the vacuum chamber in the closed state, something which is not ensured with, in particular, a pole-type switch gear according to DE 299 06 480 U1 since there the movable contact does not have a linear course of movement and instead the axis of the movable contact tilts slightly owing to the rotational movement of the switching transformer in its closing movement. Secondly, owing to the linear guide it is possible to use a large number of different gears to drive the movable contact, so, in particular, the laborious force transmission of the pole-type switch gear known from DE 40 06 452 A1 can be avoided and be replaced by a simpler, smoother-running driving means construction.

The linear guide is designed as a recirculating ball bearing guide. A recirculating ball bearing guide is distinguished by low static and dynamic rolling friction, low wear and good guide accuracy throughout its life. Furthermore, the guide can absorb forces in two directions, and this makes it a suitable linear guide for the specific application. The high guide accuracy achieved and the low coefficients of friction, mean that high speeds and a reduction in the mechanical load on the means, which provide for the movement of the contact, are achieved. Of course a linear guide with slide contact bearings can also be used, however.

In a preferred embodiment the pole-type switch gear according to the invention has an opening spring, which directly acts on the movable contact or a counter bearing being rigidly connected to said movable contact. The movable contact is therefore directly connected to the opening spring, and this leads to fast accelerations and opening times.

A further preferred embodiment is characterised by a contact pressure device acting on the movable contact, in particular if it is arranged axially aligned with the moveable contact and acts on the movable contact in the axial direction.

Use of a linear guide enables use of a crankshaft driving means having a connecting rod with which a torque transmitted by the driving means is transformed to a force axially acting on the movable contact without the movement of the connecting rod transverse to the longitudinal axis of the movable contact resulting in imprecise contacting of the contacts in the vacuum-tight housing. At the same time, this kind of transfer of driving forces is very simple in terms of construction and low in friction losses.

The pivot of the connecting rod should advantageously be located on the longitudinal axis of the movable contact below the contact pressure device. In the closed state of the switch, the location of the connecting rod should have an optimally low angle of inclination relative to the movable contact in order to obtain a good power ratio against the high contact pressure forces that occur at the end of the switching process.

The connection between the connecting rod and an element on the side of the movable contact is preferably configured with a slide contact bearing or a rolling contact bearing or ball-bearing that is even lower in friction in order to minimise friction losses further.

Driving means for pole-type switch gears according to the invention, as are also described in DE 299 06 480 U 1, are constructed in such a way that the driving force ceases after closing. The closed state is then conventionally maintained by a catch mechanism in the driving means outside of the pole-type switch gear since the opening spring, which is automatically also pre-stressed during closing, wants to restore the mechanical systems to the initial state. During opening, all driving means, which are located from the connecting rod of the pole-type switch gear through to the catch mechanism, consequently also have to be moved.

By contrast, a further advantageous embodiment of the invention consists in integrating the catch mechanism in the pole-type switch gear by constructing it, in particular, such that it can act on a crank, connecting the connecting rod to the crankshaft, or a crank web. The number of parts to be moved during opening, and therewith the inertia that is to be overcome, as well as friction losses,

can be significantly reduced hereby. As a result, the opening spring force necessary for opening, in addition to the opening time, can be reduced, whereby it is possible for the opening spring to have smaller dimensions.

The construction according to the invention satisfies the requirements of high voltage ranges when using the standard driving means. Consequently, a considerable change or reconstruction of the driving means can be omitted, resulting in a considerable cost advantage.

Using the described measures according to the invention, pole-type switch gears can be constructed which are suitable for voltages of up to 40.5 kV or even above this.

The invention will be described in more detail below with reference to figures which show preferred embodiments of a pole-type switch gear according to the invention, in which:

Fig. 1 shows a view of a pole-type switch gear according to the invention in the open state;

Fig. 2 shows a view of the pole-type switch gear shown in Fig. 1 in the closed state; and

Fig. 3 shows a view of a pole-type switch gear according to the invention with integrated catch mechanism in the closed state.

The pole-type switch gear shown in figures 1 and 2 has a vacuum-tight housing 2.1 which is arranged in a casing 3. A movable contact 2.2 designed as a bolt projects from the bottom of the vacuum-tight housing 2.1 and at its lower end is provided with a threaded section. A first nut 4 sits on the threaded section and forms a lower contact surface for an opening spring 5. The casing 3 forms the upper contact surface for the opening spring 5, so the movable contact 2.2 and the opening spring 5 are in direct operative connection with each other. A flexible copper strip 6 is connected to the movable contact 2.2 below the nut 4 and is held on the movable contact 2.2 by a lower counter nut 7 that cooperates with the nut 4. The copper strip 6 and the movable contact 2.2 are therefore electrically connected together and form the lower connecting point of the pole-type switch gear 1. The upper connecting point of the pole-type switch gear connected to the stationary contact in the vacuum-tight housing is not shown for reasons of simplification.

Below the lower connecting point is a contact pressure device. The contact pressure device has a threaded adapter 8 which is permanently connected to the movable contact 2.2. The thread adapter 8 is provided with an upper contact surface for a contact pressure spring 9 which is likewise a component of the contact pressure device and is supported at its lower side on a piston-like driving element 10. At the lower side of the threaded adapter 8 it has a guide pin 11 whose longitudinal axis aligns with that of the movable contact 2.2 The guide pin 11 is axially guided in a bushing 12

provided in the piston-like driving element 10 and can move freely in the axial direction. Since the driving element forms the lower bearing for the contact pressure spring 9, it is likewise regarded as a component of the contact pressure device. The piston-like driving element 10 is guided by a linear guide 12 in the axial direction of the movable contact. The linear guide is constructed as a recirculating ball bearing guide.

The piston-like driving element is connected by a connecting rod 13 to the crank web 14 of a crankshaft 15. The connecting rod is connected to the piston-like driving element 10 and the crank web 14 by slide contact bearing or rolling bearings. By adjusting the crank web to the crankshaft cross-section or by choosing a crank web suitable for a particular shaft cross-section, the pole-type switch gear can be used with a large number of shaft driving means.

The crankshaft 15 is made from a non-conductive material.

To close the switch, the shaft in the diagram is rotated anti-clockwise, so the piston-like driving element 10 is raised. As a result, the contact pressure spring 9 as well as the opening spring 5 are pre-stressed, wherein the contact pressure spring 9 presses the movable contact 2.2 upwards in the axial direction.

Fig. 2 shows the pole-type switch gear 1 in the closed state. In this state, a crank pin 16 connecting the connecting rod to the piston web 14 has almost reached its highest point, so a torque from the opening spring 5 still acts on the crankshaft 16, but the torque is as low as possible. In this position the driving means should be latched by a suitable mechanical system. The circuit is opened by releasing this catch mechanism (or a maintained driving torque), so the entire unit is transferred into the initial state again, which is shown in Fig. 1, due to the pre-stressed opening spring 5.

Fig. 3 shows a further possible embodiment in which inertia and friction points are reduced further. Compared to the embodiment described in relation to figures 1 and 2, the catch mechanism 20, which is conventionally located in the driving means outside of the pole-type switch gear, is integrated directly in the pole-type switch gear 1. The catch mechanism 20 is implemented by a half-shaft mounted in the casing 3. After reaching the closed position, the crank web 21 locates itself with a cam-like part 22 behind the half-shaft, which faces the crank web, and the closed state is therefore maintained. Rotating the half-shaft releases the catch mechanism 20 and the mechanical system is transferred into the initial state again due to the force of the opening spring.

The driving means is designed in such a way that the crankshaft 23 takes along the connecting rod 13 only as far as behind the catch mechanism 20 and from this position on automatically returns to the starting point again. For this function the crankshaft 23 is rotatably mounted in the crank web

21, wherein an exposed area 24 is provided on the inner bearing surface of the crank web 21, in which area a journal 25 provided on the crankshaft 23 engages, so the free path for rotation of the crankshaft 23 relative to the crank web 21 is limited.

P A T E N T K R A V

1. Afbryderpolenhed, navnlig til en vakuumeffektafbryder, med et vakuumafbryderkammer (2.1) med mindst én fast kontakt og mindst én bevægelig kontakt (2.2), navnlig en bolt, som ved hjælp af et drev kan bringes til en indkoblingsposition, k e n d e t e g n e t ved en i afstand fra vakuumafbryderkammeret (2.1) anbragt kugleomløbsføring til lineær føring af den bevægelige kontakt (2.2) eller et dermed forbundet, i samme retning lineært bevægeligt drivelement (10).

2. Afbryderpolenhed ifølge krav 1, k e n d e t e g n e t ved en udkoblingsfjeder (5), som virker umiddelbart på den bevægelige kontakt (2.2) eller et derpå stift anbragt modleje.

3. Afbryderpolenhed ifølge krav 1 eller 2, k e n d e t e g n e t ved en på den bevægelige kontakt (2.2) virkende kontakttrykindretning (8).

4. Afbryderpolenhed ifølge ét af kravene 1 til 3, k e n d e t e g n e t ved, at drevet omfatter en krumtapaksel (15, 23) og en plejlstang (13), med hvilke et fra drevet overført drejningsmoment omsættes til en kraft, der virker aksialt på den bevægelige kontakt (2.2).

5. Afbryderpolenhed ifølge krav 4 når afhængigt af krav 3, k e n d e t e g n e t ved, at drejepunktet af plejlstangen (13) er anbragt nedenfor kontakttrykindretningen (8) på den langsgående akse af den bevægelige kontakt (2.2).

6. Afbryderpolenhed ifølge krav 4 eller 5, k e n d e t e g n e t ved, at plejlstangen (13) over et glideleje er forbundet med et element på kontaktsiden.

7. Afbryderpolenhed ifølge krav 4 eller 5, k e n d e t e g n e t ved, at plejlstangen (13) over et kugleleje er forbundet med et element på kontaktsiden.

8. Afbryderpolenhed ifølge kravene 2 og 4, eller ét af kravene 5 til 7 når afhængigt af kravene 2 og 4, k e n d e t e g n e t ved en udkoblingsindgrebsmekanisme (20), som kan virke på en krumtap eller en krumtaparm (21), som forbinder plejlstangen (13) med krumtapakslen (23), for i indkoblingstilstanden at forhindre en direkte genudkobling på grund af den forspændte udkoblingsfjeder (5).

9. Afbryderpolenhed ifølge krav 8, k e n d e t e g n e t ved, at krumtapakslen (23) er lejret drejeligt i krumtaparmen (21), at der i en indre lejeflade af krumtaparmen (21) er tilvejebragt en frigørelse (24), og at krumtapakslen (23) omfatter en akseltap (25), som griber ind i frigørelsen (24), og som begrænser den frie vej til drejning af krumtapakslen (23) i forhold til krumtaparmen (21).

Fig. 1

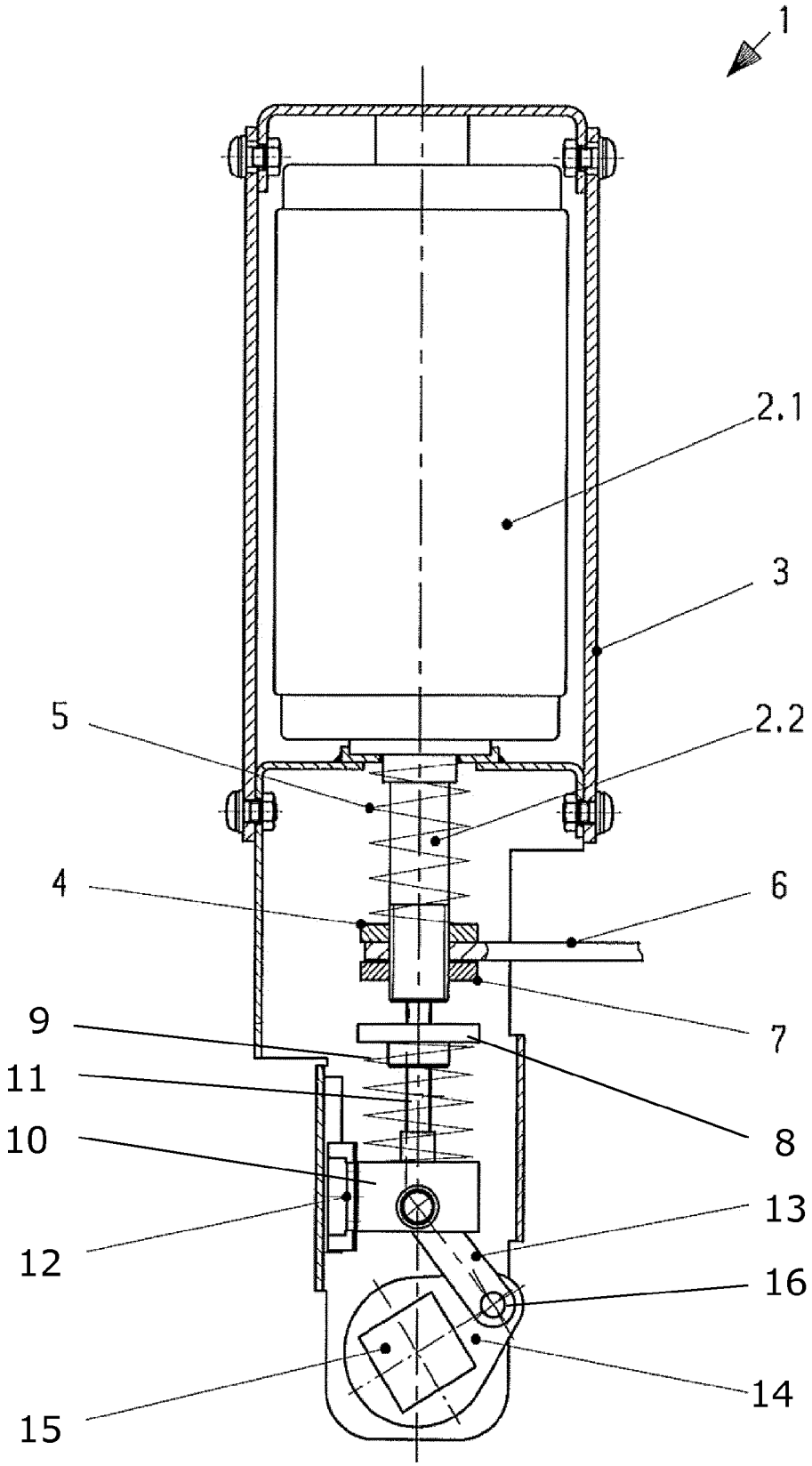

Fig. 2

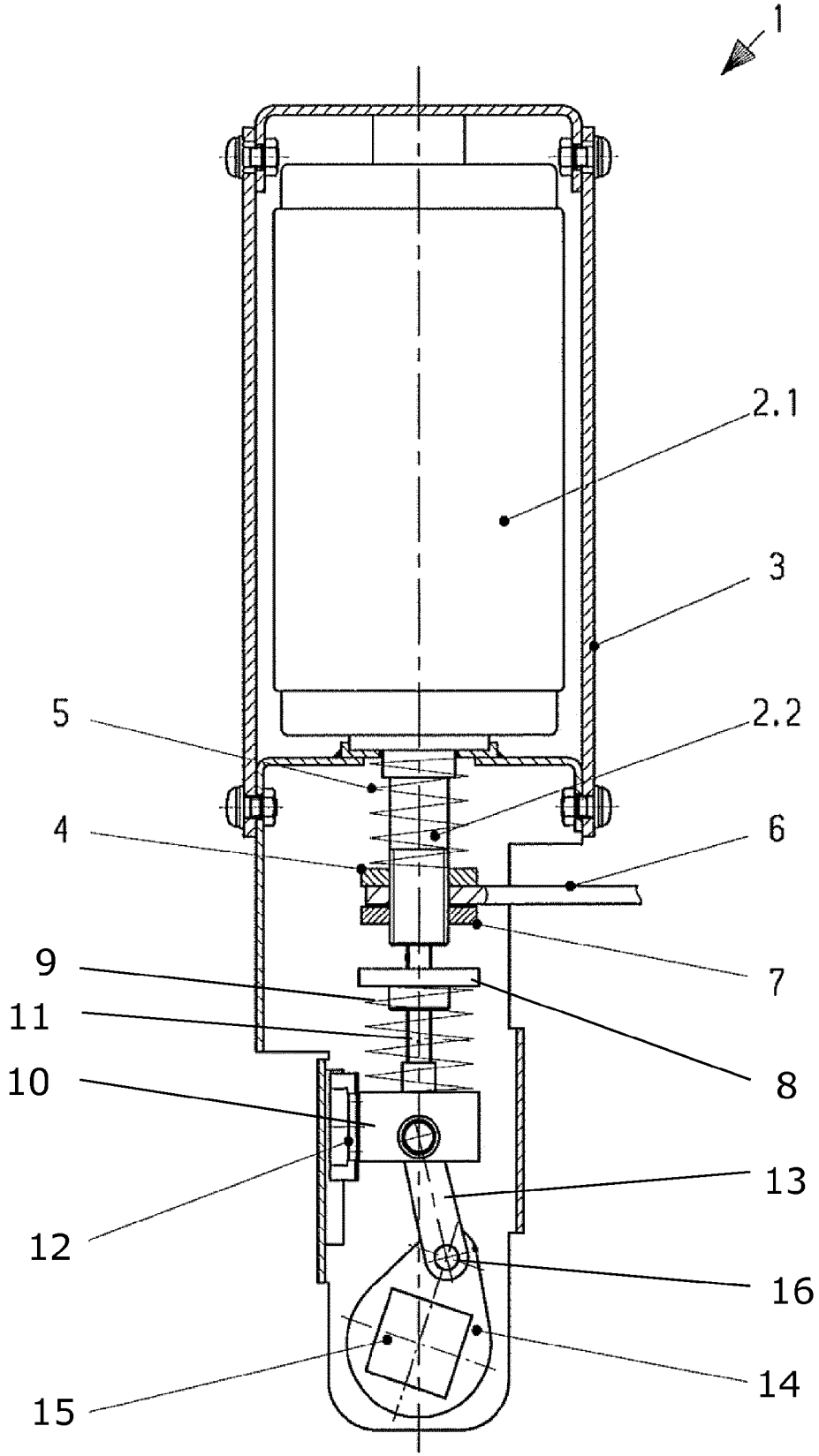

Fig. 3