



- (51) **International Patent Classification:**
H01H 1/20 (2006.01) *H01H 50/54* (2006.01)
- (21) **International Application Number:**
PCT/EP2011/072241
- (22) **International Filing Date:**
8 December 2011 (08.12.2011)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
10 2010 063 172.8
15 December 2010 (15.12.2010) DE
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(81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LI, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

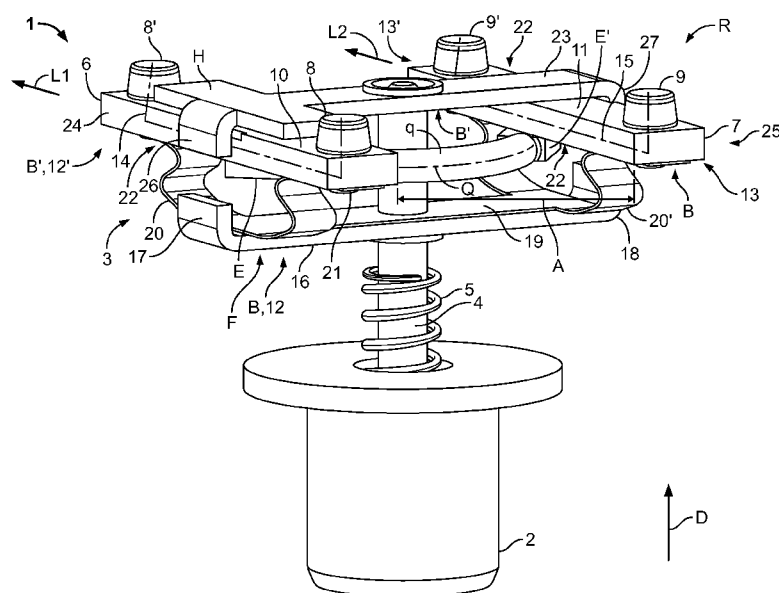
Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))

(54) **Title:** CONTACT ARRANGEMENT FOR A RELAY WITH TWO LOAD CURRENT TRACKS AND A TRANSVERSE CURRENT TRACK AND RELAY WITH CONTACT ARRANGEMENT

**Fig. 1**

(57) **Abstract:** The invention relates to a contact arrangement (1) for a relay (28) and to a relay (28) with a contact arrangement (1) for switching a high load current. In order to at least reduce overloads of components of the relay (28) not designed for this by transverse currents between the load current tracks (14, 15), it is provided according to the invention that the contact arrangement (1) has at least one transverse current track (Q), which electrically connects the load current tracks (14, 15) to one another.

5 **CONTACT ARRANGEMENT FOR A RELAY WITH TWO LOAD CURRENT**
 TRACKS AND A TRANSVERSE CURRENT TRACK AND RELAY WITH
 CONTACT ARRANGEMENT

10 The invention relates to a contact arrangement for a relay for switching a high load current, with a switching member for conducting the load current, which has at least two load current tracks physically separated from one another. Furthermore, the invention relates to a relay for switching a high load current, with an actuator for producing switching forces acting on a contact arrangement and with counter-contacts to be bridged during a switching process.

15 Contact arrangements for a relay and relays for switching a high load current are widespread. To switch the load current, counter-contacts of load current connections of the relay are bridged by the contact arrangement. These relays are used, for example, to switch drive energy of an electrically operable car.

20 Because of the current displacement at the contact point of the contact pieces (high-current density), repulsive forces act on the contact pieces. Likewise, the Lorentz force acts on the movable current-carrying parts by means of the self-field of the current supplies. All these forces are proportional to the square of the impressed current. The linear connection between the force and the square of the current is in the order of magnitude of the magnetic field
25 constant μ_0 , i.e. from a current flow of 1000 A, a separating force of several newtons acts on the contact system. Owing to the quadratic dependency of the current, in the case of large excess currents, the repulsive force can cancel the closing force provided. The contact is pressed open by the current flow. The unloading of the contact by large currents leads to a rapid increase in the contact resistance and therefore to an inadmissible increase in the power
30 conversion at the contact point. This is either the cause of an immediate welding of the switching pieces or leads to a complete destruction of the switching apparatus. At the moment of disengaging, the contact material abruptly evaporates under the action of an arc, the current flow collapses, the contacts close again and the process is repeated.

35 In order to reduce the forces caused by the high currents, contact arrangements have at least two load current tracks, over which the load current is divided during normal operation. The

5 division of the load current over a plurality of load current tracks reduces the forces produced, whereby operating disturbances are to be avoided.

However, it may occur that switching arcs occurring during the switching process ignite or burn at various times and/or these are differently formed. As a result, different electric
10 potentials can be applied to the load current tracks. These potential differences can lead to the fact that high transverse currents can flow from one of the load current tracks to another of the load current tracks. These transverse currents can also flow through components of the contact arrangement or the relay, which are not designed for this and can be damaged by the transverse currents and even destroyed. Consequently, the division of the load currents alone
15 is not sufficient to ensure the operating safety of the relay.

It is therefore the object of the present invention to provide a contact arrangement for a relay, and a relay, in which differently formed light arcs do not significantly impair the operation of the relay.

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The object is achieved according to the invention for the contact arrangement mentioned at the outset in that the switching member has at least one transverse current track running from one of the load current tracks to another of the load current tracks. The object is achieved for the relay according to the invention in that the relay is configured with a contact arrangement
25 according to the invention, the relay having one pair of counter-contacts per current track.

The current flow through individual current tracks and the counter-contacts associated with them is reduced by the use of a plurality of current tracks and the association of counter-contact pairs with a current track. If, for example, two load current tracks are used, half of
30 the load current can in each case flow through one of the load current tracks. With the same high load current to be carried, the necessary force to keep the switching connection to a contact arrangement according to the invention and a relay according to the invention closed is halved. The current tracks may be arranged in a parallel connection when the relay is in a closed switching state. It is thus ensured that only one part of the high load current in each
35 case flows through one of the load current tracks.

5 The possibly occurring transverse currents are conducted along the transverse current track and past parts of the contact arrangement or the relay not designed for these transverse currents. These parts of the contact arrangement or the relay are thus not impaired with regard to their function by the transverse currents.

10 The solution according to the invention can be further improved by various configurations, which can be combined with one another as desired and are advantageous per se. These embodiments and the advantages connected with them will be dealt with below.

15 In a first advantageous configuration, the transverse current track can run through a transverse current conductor, which electrically conductively connects the two load current tracks to one another. The transverse current conductor can be adapted to the expected transverse currents, so it can reliably conduct these transverse currents during the service life of the relay or the contact arrangement.

20 In order to be able to bridge counter-contacts of the relay arranged spaced apart from one another with the switching member, each of the load current tracks can have a contact body of the switching member. The contact body may bridge the counter-contacts when the relay is in a closed switching state and, for example, be cylindrical and, in particular, beam-like. Switching contacts may be arranged on one side of the contact body, which can also be called
25 a contact bridge. The switching contacts may, for example, be arranged spaced as far apart from one another as possible on the contact body and pointing away from the armature and consist of a material which withstands the switching sparks or switching arcs well. Consequently, the switching contacts wear less as a result of many switching processes than, for example, switching contacts made of copper.

30 In order to prevent the switching process, in particular a process for closing the relay, from being impaired by so-called bouncing of the switching contacts of the switching member and the counter-contacts of the relay, the contact bodies may be resiliently mounted. In particular, the contact bodies can be elastically deflectable from their rest position relative to
35 an armature connected to the switching member in a movement-transmitting manner.

5 The switching member may be formed with a bearing element, which is rigidly connected to the armature with respect to movement and on which the contact bodies are resiliently mounted. For example, the bearing element may be elongate and the contact bodies may be connected by at least one spring element to ends of the bearing element. The spring element, in this case, at at least two bearing portions that are spaced apart from one another of one of
10 the respective contact bodies, connect the latter in a resilient manner to the bearing element. The spring element can be fastened both to one of the contact bodies and to the bearing element.

So that transverse currents do not flow through the spring element connecting the load current
15 tracks to one another and may possibly damage it, the spring element itself may be manufactured from an electrically non-conductive material and/or be coated therewith. Furthermore, the connection of the spring element to at least one of the contact bodies may be such that the transverse currents cannot flow from the contact body into the spring element. Spring elements that are easy and economical to produce and are to be connected to the
20 contact bodies are, however, often manufactured from electrically conductive materials such as metal and, for example, welded to the contact bodies. Spring elements of this type, which generally function well over the long term, conduct the transverse currents, however, often not resisting them and at least being damaged by the transverse currents.

25 In order to prevent significant parts of the transverse currents flowing through the spring element, the electric resistance of one of the load current tracks to the other load current track via the spring element may be higher than via the transverse current track.

In particular, the transverse current conductor may be a transverse current-proof short-circuit
30 conductor. A short-circuit conductor has a very small resistance, so transverse currents can flow substantially completely via a transverse conductor configured in this manner.

Furthermore, the transverse current conductor may be configured as a load current-proof conductor if the complete load current is to flow from one of the load current tracks via the
35 transverse current conductor to the other of the load current tracks.

5 Owing to this arrangement of the spring element, the switching contacts of each contact body can be elastically deflected substantially independently of one another. If the geometry of one of the switching contacts should have changed more owing to wear, for example owing to burn-off, than the geometry of the other switching contact of the contact bodies, the switching contacts of the contact bodies can nevertheless be brought into electrical contact
10 with the counter-contacts.

So that the compensation effect of the spring element is not impaired, the transverse current conductor can be configured in such a way that it only insignificantly impairs relative movements of the load current tracks with respect to one another. In particular, the
15 transverse current conductor may have a flexible litz wire conductor. The transverse current conductor may substantially consist of the flexible litz wire conductor, ends of the transverse current conductor being able to be less flexible for connection to the load current tracks than portions of the transverse current conductor arranged between the ends.

20 In order to minimise the mechanical loading of the load current tracks or the contact bodies and the spring element by the transverse current conductor, the latter may be arranged in an arcuate manner between the two load current tracks. Deflections of the load current tracks relative to one another only lead to a deformation of the flexible transverse current conductor owing to the arcuate arrangement of the transverse current conductor but not to significant
25 pulling or pushing forces. Furthermore, the curved form of the transverse current conductor may lead to the transverse current conductor being held by bending forces in a plane in which the bend runs. A further fixing of the transverse current may be superfluous as a result.

For example, the contact arrangement may have an actuating element, which is rigidly
30 connected to the armature and around which the transverse current track is guided in an arcuate manner from one load current track to the other load current track.

One end of the transverse current track may be electrically conductively connected in each case to one of the contact bodies. This avoids projecting portions of the transverse current
35 track or the transverse current conductor leading to undesired electrical contacts.

- 5 The ends of the transverse current conductor may rest on sides of the contact bodies, which are configured without switching contacts. This ensures that the transverse current conductor is not brought into electrical contact with counter-contacts of the relay during the switching process, which can lead to a malfunction of the relay.
- 10 The transverse current conductor, between the bearing portions that are spaced from one another and, for example, in a central region of the contact bodies, can be non-detachably connected to the latter. Because of the central attachment of the transverse current conductor to the contact bodies, these are not loaded in a one-sided manner and asymmetric deflections of the contact bodies are avoided.
- 15 In order to not conduct the required separating force to open the switching connection via the spring element, the switching member may have a driver rigidly connected to the armature with respect to movement to open the closed switching connection. On opening the relay, the driver can forcibly remove the contact bodies from the counter-contacts without the required
- 20 switching forces being applied by the spring element and the latter possibly becoming overloaded. The overloading of the spring elements can be prevented as even large separating forces are absorbed by the driver. These large separating forces can occur, for example, when the switching contacts are welded to the counter-contacts as a result of a switching process. A substantially uniform opening of the relay is thereby also ensured, even
- 25 if different forces are necessary to separate individual switching contacts from the respective counter-contacts.
- The contact arrangement is therefore optimally adapted both to the closing process and also to the process for separating the switching connection owing to the combination of the
- 30 spring-elastic mounting of the contact bodies when closing the relay and the forced movement of the contact bodies produced by the driver when opening the switching connection, transverse currents occurring in particular during the closing but also during the opening of the switching connection being reliably guided along the transverse current track.
- 35 In their rest position, the contact bodies can rest with their side remote from the armature on the driver and be resiliently pressed against the driver. Despite the movable mounting of the

5 contact bodies by means of the spring elements, their position relative to the counter-contacts is well defined. Furthermore, the driver can have guide portions, by means of which a tilting of the contact bodies can be prevented. The guide portions may, for example, be configured by bent-over ends of the driver.

10 So that the contact bodies cannot tilt in a rocker-like manner, in particular when opening the switching connection, the driver may have a stabilising element, which may extend along the contact bodies and rest flat on the side provided with the switching contacts.

The contact bodies may be pressed against the driver in such a way that the spring elements
15 are prestressed. With a large prestressing, the change of the contact force, with which the switching contacts are pressed against the counter-contacts, is even relatively small when the switching contacts or the counter-switching contacts are worn to different extents by burn-off. In order to be able to arrange the switching contacts and the counter-contacts in the relay
in such a way that the spacing of the respective contacts from one another is sufficient for air
20 insulation, the contact bodies may be elongate and arranged spaced apart from one another transverse to their longitudinal axes.

To transfer the switching member into a rest switching position, the contact arrangement may
be configured with an armature spring which presses the armature into the rest switching
25 position when the contact arrangement is assembled in the relay. For example, the rest switching position may be the opened switching position of the relay. A relay of this type is also called a closer relay as the actuator has to produce forces to close the relay in this case.

In order to be able to check whether the contact arrangement reaches its rest position when
30 the actuator is inactive, the contact arrangement may comprise a locator. The locator can be immovably formed relative to the driver and, for example, be fastened to the armature. If the locator reaches the rest switching position, it can interact with a detector arranged in the relay. The detector can emit a signal during operation when the armature has reached its rest switching position or is arranged therein.

- 5 Alternatively, the locator may be part of the armature and, in particular, an end portion of the armature pointing away from the switching member. In the rest position or in the rest switching position, the locator may project from the control chamber or from the holding bracket or terminate flush with one of these parts.
- 10 In this position, the locator, in other words, for example, the armature or its end portion, may close a gap of a measuring circuit, which may lead to a change in a magnetic flux through the measuring circuit. The measuring circuit may, in this case, be arranged outside the control chamber or the holding bracket. The measuring circuit may have a magnet, for example a permanent magnet, and a magnetic conductor, for example in the form of an iron yoke. The
- 15 magnetic conductor may interact with the field of the magnet and conduct this, for example, and have the gap of the measuring circuit. In particular, the magnetic conductor can be interrupted by the gap.

If the armature and, in particular, its end portion is arranged at least in portions in the gap, the

20 magnetic flux through the measuring circuit changes, which can be detected by a detector, for example a Hall sensor. If the switching member is moved from the rest switching position in the closing direction, the locator, in other words, for example, the armature or its end portion, can be moved out of the gap. As a result, the magnetic flux through the measuring circuit in turn changes. This change can also be recognised by the detector and converted into a

25 measuring signal.

Owing to the arrangement of the measuring circuit provided substantially outside the control chamber or the holding bracket, the measuring circuit and, in particular, the detector, are protected from environmental conditions within the relay. In particular, pressures of up to 60

30 bar possibly prevailing within the relay during the switching process can namely influence the determination of the switching state and, in particular, the detector. Pressures of this type can develop if voltages of up to 800 V and currents of up to 6 kA are switched by the relay.

It can thus be checked whether the armature spring has really transferred the switching

35 member into the rest switching position or whether, for example, switching contacts and counter-contacts welded to one another are preventing an opening of the switching

5 connection and consequently a return of the switching member into the rest switching position.

For example, the detector may be configured as a Hall sensor and the locator as a magnet interacting with the Hall sensor during operation. Alternatively, optical, capacitive or
10 resistive locators and detectors can also be used.

In order to minimise wear of the switching contacts and the counter-contacts during switching processes, wear caused by burn-off is to be avoided as far as possible, in particular. When switching high load currents and, in particular when separating the closed switching
15 connection, switching arcs may occur, in which temperatures of several thousand kelvin can prevail. In particular, owing to the thermal energy produced in the arcs, the switching contacts and counter-switching contacts can melt and even evaporate. The material removal can lead to a deformation of the contacts and a failure of the relay. Consequently, it is desirable to keep the introduction of thermal energy into the contacts as small as possible. A
20 shortening of the burning period of the arcs, which can be influenced by magnetic fields, can contribute to this, in particular. To produce the magnetic fields, the contacts, in each case, can be adjacent to at least one magnet and, in particular, flanked by two magnets. A pair of magnets may, for example, flank a switching pair composed of a switching contact and a counter-contact. The magnets may, for example, be configured as permanent magnets in the
25 form of neodymium magnets.

As the high load current to be switched only flows proportionately through the respective contact bodies, these can be formed with a reduced cross-section in comparison to a contact body, which has to conduct the entire high load current. Owing to the smaller cross-section
30 of the contact bodies, the magnets can therefore be arranged closer to the contacts, so the magnetic field is stronger in the region of the contacts and the possibly occurring arcs. The burning duration of the arcs can be reduced by this to 0.1 second or less.

The invention will be described by way of example below with the aid of embodiments with
35 reference to the drawings. The different features of the embodiments may be combined here

5 independently of one another, as has already been shown in the individual advantageous configurations.

In the drawings:

10 Fig. 1 shows a schematic view of a first embodiment of the contact arrangement according to the invention in a perspective view;

Fig. 2 shows a schematic sectional view of a first embodiment of the relay according to the invention;

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Fig. 3 shows a schematic exploded view of a part of the relay according to the invention of Fig. 2;

20 Fig. 4 shows a schematic perspective view of counter-contacts of the relay of the embodiment of Fig. 2;

Fig. 5 shows a schematic perspective view of further components of the relay with the contact arrangement according to the invention.

25 The structure and function of a contact arrangement 1 according to the invention are firstly described with reference to the embodiment of Fig. 1. The contact arrangement 1 for a relay for switching a high load current is schematically shown here with an armature 2 and a switching member 3, the armature 2 and the switching member 3 being able to be rigidly connected to one another by means of an actuating element 4 in the form of an actuating rod.

30 Furthermore, the contact arrangement 1 can also comprise an armature spring 5, which is configured as a helical spring in the embodiment shown. The actuating rod 4 can be guided by the helical armature spring 5 and can project together with the armature spring 5 from the armature 2 in the direction of the switching member 3.

35 The switching member 3 is shown by way of example with two contact bodies 6, 7, which can bridge counter-contacts of the relay and therefore can also be called contact bridges. The

5 contact bodies 6, 7 can, in each case, have two switching contacts 8, 8', 9, 9' and be arranged electrically insulated from one another in the switching member 3. The contact bodies 6, 7 are formed, by way of example, to be elongate and, for example, beam-like in the embodiment shown, the switching contacts 8, 8', 9, 9' being able to be arranged on sides 10, 11 pointing away from the armature 2 in the region of ends 12, 12', 13, 13' located in the longitudinal direction L1, L2. It is possible for there to be arranged between the switching contacts 8, 8' and 9, 9' of each of the contact bodies 6, 7, a load current track 14, 15, in each case, the course of which through the contact bodies 6, 7 is shown schematically in Fig. 1 by a dash-dot line.

15 The contact bodies 6, 7 can be arranged parallel to one another and held transversely to their longitudinal directions L1, L2 spaced apart from one another in the switching member 3. To at least minimise a so-called bouncing during closing of the relay, the contact bodies 6, 7 can be resiliently mounted in the switching member 3. Owing to the resilient mounting of the contact bodies 6, 7, these can be elastically deflectable relative to the armature 2 parallel to a closing direction D, in particular toward the latter or away from it. The closing direction D points here from the armature 2 to the switching member 3.

To position the contact bodies 6, 7 at a spacing A transverse to the longitudinal directions L1, L2 thereof with respect to one another, the switching member 3 can have a bearing element 16, on which the contact bodies 6, 7 are resiliently mounted. The bearing element 16 can be rigidly connected to the armature 2 here with respect to movement and, for example, be fixed to the actuating rod 4 extending in the closing direction D. The bearing element 16 may be plate-like and extend substantially perpendicular to the actuating rod 4, the actuating rod 4 being able to project through a central region of the bearing element 16. Ends 17, 18 of the bearing element 16 pointing away from the actuating rod 4 can be oriented parallel to the actuating rod 4 and pointing away from the armature 2. The ends 17, 18 can be formed as guide portions here and prevent a displacement of the contact bodies 6, 7 away from one another, at least when the contact bodies 6, 7 are elastically deflected from their rest position R shown in Fig. 1 in the direction of the bearing element 16.

- 5 The contact bodies 6, 7 can be mounted by means of at least one spring element F on the bearing element 16. For example, the spring element F may be configured with leaf spring elements 20, the ends of which are substantially configured in an S-shape, which are arranged substantially mirror-symmetrically with respect to one another and the bends of which pointing to one another can be connected to one another in one piece. The leaf spring
10 elements 20 can be separate or connected to one another by means of a spring bridge 19. The free bends pointing away from one another may be fastened to one of the contact bodies 6, 7. Centre portions of the leaf spring elements 20 adjoining the spring bridge 19 may, like the spring bridge 19, be fastened to the bearing element 16.
- 15 The spring element F may comprise one or more springs, which, for example, can be configured as leaf spring elements 20. A central region of a leaf spring element 20 of this type can be fixed to the bearing element 16, the ends of which arch away from the bearing element 16 and from the armature 2 and can be fixed to one of the contact bodies 6, 7. In particular, free ends 21 of the leaf spring element 20 can be fixed to bearing portions B, B',
20 arranged spaced apart from one another, of each contact body 6, 7. The bearing portions B, B' can be configured on sides 22 of the contact bodies 6, 7 pointing away from the switching contacts 8, 8', 9, 9' and be configured for non-detachable connection to the spring element F. The ends 12, 12', 13, 13' can be resiliently mounted substantially independently of one another by means of an arrangement of this type of the spring element F.
- 25 The switching member 3 can be configured with a driver 23, by means of which the contact bodies 6, 7 can be moved away from counter-contact elements. The driver 23 can be configured similarly to the bearing element 16 and be arranged mirror-symmetrically with respect thereto, the contact bodies 6, 7 being able to be arranged between the driver 23 and
30 the bearing element 16. In their rest position R, the contact bodies 6, 7 can rest with their sides 10, 11 pointing away from the armature 2 on the driver 23 and be pressed if possible by the prestressed spring element F against the driver 23. Owing to the prestressing of the spring element F, it can be ensured that the switching contacts 8, 8', 9, 9', when the relay is in the closed switching state, always rest with a substantially identical force on counter-contacts,
35 even if the shape of the switching contacts 8, 8', 9, 9' should have changed, for example, by burn-off.

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The spring element F may be manufactured from an electrically non-conductive material, coated with a material of this type or insulated in another manner from the load current tracks 14, 15 or from the contact bodies 6, 7. This avoids transverse currents being conducted via the spring element F, by means of which the spring element F can be damaged or destroyed.

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Spring elements F made of metal have higher stability, however, and are more economical to produce and to fasten to the contact bodies 6, 7 without an electrically insulating coating than with a coating of this type.

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In order to avoid transverse currents being conducted via the spring element F between the load current tracks 14, 15, the contact arrangement 1 can be configured with a transverse current track Q, which can conduct electric voltages being built up under some circumstances between the load current tracks 14, 15, in the form of transverse currents, at least partially, between the load current tracks 14, 15 and past the spring element F, in particular, but also past the driver 23.

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Sides 24, 25 of the contact bodies 6, 7 pointing away from the respective other contact body 6, 7 can rest on ends 26, 27 of the driver 23. The ends 26, 27 can be configured as guide portions for the contact bodies 6, 7 and be arranged running parallel to the actuating rod 4 and guide the contact bodies 6, 7 in an elastic deflection process in such a way that they cannot be tilted away from one another.

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In the rest position R shown, at least one of the contact bodies 6, 7 can rest on the driver 23 in such a way that it is secured against rocking or tilting transverse to the longitudinal direction L1, 2 thereof. For this purpose, the driver 23 may have at least one stabilising element H, which can adjoin the ends 26, 27. The stabilising element H can project over the ends 26, 27 in the longitudinal direction L1, 2. In this case, the stabilising element H may be substantially beam-like and extend between the switching contacts 8, 8' or 9, 9', without touching them. In the closing direction D, the stabilising element H can be less high, at least in the region of the switching contacts 8, 8', 9, 9' so that the switching contacts 8, 8', 9, 9' project over it in the closing direction D. The bearing element 16 and the driver 23 may be fixed at a constant spacing with respect to one another on the actuating rod 4.

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The transverse current track Q can run along a transverse current conductor q. The transverse current conductor q can electrically connect the contact bodies 6, 7 to one another and, for example, rest thereon or be non-detachably connected thereto. The transverse current conductor q may have a smaller electrical resistance than other components connecting the contact bodies 6, 7 to one another. In particular, the transverse current conductor q can be a short-circuit conductor, which is transverse current-proof or load current-proof. Owing to the high electrical conductivity of the transverse current conductor q configured as a short-circuit conductor, transverse currents can be guided substantially completely via the transverse current conductor q along the transverse current track Q. Significant transverse currents via other components are thus avoided.

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In order to not impair the spring-elastic mobility of the contact bodies 6, 7, the transverse current conductor q may be flexible and, for example, configured with a litz wire conductor. In order to also minimise force transmissions via the transverse current conductor q during relative movements of the contact bodies 6, 7 with respect to one another, the transverse current conductor q may be guided in an arcuate manner from the contact body 6 to the contact body 7. Different movements of the contact bodies 6, 7 then result in a shape change of the flexible transverse current conductor q. The arcuate arrangement of the transverse current conductor q furthermore has the advantage that a flexible transverse current conductor q is also automatically held owing to its curved shape substantially in a plane running through the bend. A further securing of the transverse current conductor q can be avoided by this.

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Ends E, E' of the transverse current conductor q can be configured such that they can be fastened well to the contact bodies 6, 7 and, for example, on their sides 22 pointing away from the switching contacts 8, 8', 9, 9'. An arrangement of this type of the ends E, E' disturbs neither the contact of the driver 23 with the contact bodies 6, 7 nor switching processes. For example, the litz wire may be mechanically and/or thermally sealed in the region of the transverse current conductor q, so that the ends E, E' have a higher rigidity in comparison to the remaining transverse current conductor q. Alternatively, the ends E, E' of the transverse current conductor may be arranged in sleeves and, for example, soldered, welded or crimped to these sleeves. The fastening of the ends E, E' of the transverse current

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5 conductor q to the contact bodies 6, 7 may be configured in diverse ways. Care should be taken that the connection of the transverse current conductor q to the contact bodies 6, 7 has a high electrical conductivity, without switching processes being hindered by the transverse current conductor q. Welding, soldering, screwing or other positive, material-uniting or non-positive connections are permanent rigid connection possibilities that are easy to realise.

10 Fig. 2 shows a first embodiment of a relay 28 according to the invention with the contact arrangement 1 of the embodiment of Fig. 1. For elements which correspond to the elements of the embodiment of Fig. 1 with respect to function and/or structure, the same reference numerals are used. For the sake of brevity, only the differences from the embodiment of Fig.
15 1 will be dealt with.

Fig. 2 shows the relay 28 in a sectional view, the sectional plane running through the actuating element 4 and along the driver 23 and intersecting the contact bodies 6, 7 transverse to their longitudinal directions L1, L2 substantially centrally.

20 The relay 28 is shown in an open switching position, which corresponds to a rest switching position S of the contact arrangement 1 in the relay 28. In the rest switching position S, the armature 2 is pressed away from counter-switching contacts of the relay 28 by the armature spring 5. The relay 28 is thus formed as a closer, which does not conduct the load current in
25 the unswitched state. Obviously, the relay 28 can also be configured as an opener or with a changeover contact.

The substantially cylindrical and, for example, circular-cylindrical armature 2 has, at its end pointing to the switching member 3, a collar 30 projecting away from a central opening 29.

30 A cylindrical portion 31 extending from the collar and pointing away from the switching member 3 is configured with a smaller diameter than the collar 30 and arranged in a guide sleeve 32 of the relay 28. The armature spring 5 presses the armature 2 of this relay 28 configured as an opener away from the counter-contacts of the relay 28, only two counter-contacts 33, 34 being shown here. However, the relay can have one counter-contact 33, 34
35 for each switching contact 8, 8', 9, 9'. The counter-contacts 33, 34 may be electrically conductively connected to one another and to a load current connection 35 of the relay 28.

5 The load current can be supplied to the relay 28 or removed therefrom via the load current connection 35, when the contact arrangement 1 is arranged offset in the closing direction D from the rest switching position S shown. For example, a control signal can be supplied to the relay 28 via a control connection 36. With the aid of the control signal, the actuator 37 arranged in the relay 28 and configured, for example, as a coil, can produce a magnetic field
10 exerting a force on the armature 2, said magnetic field displacing the armature 2 and therefore also the switching member 3 in the closing direction D toward the counter-contacts 33, 34.

The central opening 29 of the armature 2 may be cup-like, in particular, so that at least the armature spring 5 or else the actuating rod 4 can be arranged, at least in portions, in the
15 opening 29. Both the actuating rod 4 and the armature spring 5 may be fixed on the base of the opening 29 on the armature 2. In the embodiment shown, the base of the opening 19 is open and, for example, configured as a hole, to which the actuating rod 4 can be screwed or otherwise rigidly connected.

20 A locator 38, which interacts with a detector 39 in the rest switching position S, can be arranged on an end of the armature 2 pointing away from the switching member 3. For example, the locator 38 and the detector 39 can be arranged closer together in the rest switching position S than in other switching positions. In particular, the locator 38 can be formed as a permanent magnet and the detector 39 as a Hall sensor. The locator 38 can be
25 fastened by a fastening element 40 to the armature 2 or, for example, to the actuating rod 4. By means of this fastening, the locator 38 can be rigidly provided with respect to movement, in particular with respect to the driver 23 in the relay 28. As the driver 23 forcibly guides the contact bodies 6, 7 during the change of a closed switching state into the open switching or rest state S shown, it is ensured that the switching position of the relay is always open when
30 the locator 38 is arranged close to the detector 39.

Alternatively, the locator 38 may be part of the armature 2 and, in particular, an end portion M of the armature 2 pointing away from the switching member 3. In the rest position R or in the rest switching position S, the locator 38 can project out of the control chamber 44 or out
35 of the holding bracket 48 or terminate flush with one of these parts.

5 In this position, the locator 38, in other words, for example, the armature 2 or the end portion M thereof, can close a gap of a measuring circuit, which can lead to a change in the magnetic flux through the measuring circuit. The measuring circuit can, in this case, be arranged outside the control chamber 44 or the holding bracket 48. The measuring circuit may have a magnet, for example a permanent magnet, and a magnetic conductor, for example in the form
10 of an iron yoke. The magnetic conductor can interact with the field of the magnet and, for example, conduct it and have the gap of the measuring circuit. In particular, the magnetic conductor can be interrupted by the gap.

If the armature 2 and, in particular, its end portion M is arranged, at least in portions in the
15 gap, the magnetic flux through the measuring circuit changes, which can be detected by a detector 39, for example a Hall sensor. If the switching member is moved out of the rest switching position S in the closing direction D, the locator 38, in other words, for example, the armature 2 or its end portion M, can be moved out of the gap. As a result, the magnetic flux through the measuring circuit in turn changes. This change can also be recognised by
20 the detector 39 and converted into a measuring signal.

Owing to the arrangement of the measuring circuit substantially provided outside the control chamber 44 or the holding bracket 48, the measuring circuit and, in particular, the detector 39, are protected from environmental conditions within the relay 28. In particular, pressures
25 possibly prevailing within the relay during the switching process of up to 60 bar can namely influence the determination of the switching state and, in particular, the detector 39. Pressures of this type can be produced when voltages of up to 800 V and currents of up to 6 kA are switched by the relay.

30 The contacts 8' and 33 and 9' and 34 oppose one another pair-wise. Both the contact pair 8', 33 and the pair 9', 34 are arranged between two permanent magnets 42. The magnetic field of the permanent magnets 42 disturbs the formation and/or maintenance of switching arcs, which can occur when the closed connection of the switching contact 8', 9' and counter-contact 33, 34 is opened. As a result, switching arcs burn more briefly than without
35 permanent magnets 41, so less thermal energy is introduced into the contacts 8', 9', 33, 34 involved and these wear less as a result of burn-off.

5

Both the load current connection 35 and the permanent magnets 41 are shown floating freely within a switching chamber 42 of the relay 28 in Fig. 2. To fix at least the load current connection 35 and the permanent magnets 41, the relay can at least have one fixing member, which is shown in the following figures.

10

The switching chamber 42 can be separated by an assembly plate 43 from a control chamber 44, in which the actuator 37 and the armature 2 are arranged. The actuating rod 4 can project from the control chamber 44 into the switching chamber 42 through the assembly plate 43.

15

The relay 28 can be configured with a housing 45, which encloses the switching chamber 42 and the control chamber 44 and can form a continuous receiving volume for the remaining components of the relay 28 without the assembly plate 43. At least the switching chamber 42 can be accessible from the outside through an assembly opening 46 provided in the housing 45. In the embodiment shown, the assembly opening 46 is closed by a lid 47. The housing 45 itself and components of the relay 28 arranged in the housing 45 can be connected to one another in such a way that moisture cannot penetrate into the housing 45 or from a part region of the housing 45 into another part region. Thus, the use of the relay 28 can be ensured even in moist environments, for example in the engine compartment of a car.

20

25

The ends E, E' of the transverse current conductor q rest on the sides 22 pointing away from the switching contacts 8, 8', 9, 9' in a central portion of the contact bodies 6, 7 located in the sectional plane.

30

Fig. 3 shows parts of the relay 28 of the embodiment of Fig. 2 without the housing 45 in an exploded view.

35

In Fig. 3, the actuator 37 is shown assembled in a holding bracket 48, the holding bracket 48 being open toward the assembly plate 43 and being fastened by this open end to the assembly plate 43. The assembly plate 43 closes the open end 48 of the holding bracket.

5 The switching member 3 is arranged on the side of the assembly plate 43 remote from the actuator 37. Each of the switching contacts 8, 8', 9, 9' is flanked, transverse to the closing direction D, by two permanent magnets 41, which extend substantially in the closing direction D and along contact bodies 6, 7. Two magnets 41 are shown arranged on the inside
10 clamp 49 may, for example, be formed from a magnetically conductive material.

In addition to the load current connection 35, a second load current connection 50 is shown here, which can be configured similarly to the load current connection 35. The load connections 35, 50 are arranged behind the switching member 3 in the closing direction D.
15 When the relay 28 is assembled, the counter-contacts 33, 34 of the load current connection 35 and the counter-contacts of the load current connection 50 project into the intermediate spaces of two magnets 41, which are fixed on a holding clamp 49. The contacts of the pairs of switching contacts 8, 8', 9, 9' and counter-contacts 33, 34 can be arranged opposing one another in the closing direction D.

20

To fix the magnets 41 and the load current connections 35, 50, the relay 28 can have a fixing member 51, with which the magnets 41 and the load current connections 35, 50 can, for example, be positively connected to one another. The fixing member 51 can be secured by a holding connector 52 in the relay 28 against slipping, at least transverse to the closing
25 direction D, the holding connector 52 being able to be fixed in a peripheral groove of the assembly plate 43.

Fig. 4 shows the fixing member 51 with magnets 41 and load current connections 35, 50.

30 Connecting regions 53, 54 of the load current connections 35, 50 project from the fixing member 51. The fixing member 51 is shown in the closing direction D, so the counter-contacts 33, 34 of the load current connection 35 and the counter-contacts 33', 34' of the load current connection 50 project out of the plane of the drawing.

35 When the relay 28 is in the electrically conductive state, the counter-contacts 33, 33' are electrically bridged by the contact body 6 and the counter-contacts 34, 34' by means of the

5 contact body 7. The contact bodies 6, 7 are indicated here by dashed lines. The current track 55 resulting for the load current is inter alia composed of the load current tracks 14, 15 shown by dash-dot lines and arranged in a parallel connection P here. Half the load current flowing via the load current connections 35, 50 in the embodiment shown in each case, flows through one of the load current tracks 14, 15.

10 The fixing member 52 can be configured, at least in portions, complementary to the contact bodies 6, 7 and the driver 23. In particular, the fixing member 52 can have a substantially H-shaped receiving region 56, in which the contact bodies 6, 7 and the driver 23 can be at least partially arranged, when the relay 28 is closed. In this case, a transverse connection of the H-shaped receiving region 56 can be configured as a receiving trough 57 for the driver 23. The receiving trough 57 can be configured so deep in the closing direction D that the contact bodies 6, 7 no longer rest on the driver 23 when the relay 28 is closed, but are arranged elastically deflected and spaced apart from the driver 23. This may even be the case if at least one of the switching contacts 8, 8', 9, 9' or the counter-contacts 33, 33', 34, 34' is worn by burn-off.

15 Fig. 5 shows a further embodiment of components of the relay 28 according to the invention, the same reference numerals being used for elements which correspond to the elements of the previous embodiments with regard to function and/or structure. For the sake of brevity, only the differences from the previous embodiments are dealt with.

20 The assembly plate 43 is substantially rectangular here and formed with recesses 58 for fastening elements 59 of the holding bracket 48. The recesses 58 may be symmetrically arranged and provided on opposing sides of the rectangular assembly plate 43, the recesses 58 being able to run completely through the assembly plate 43 in the closing direction D.

25 The fastening elements 59 can fasten the holding bracket 48 and the assembly plate 43 to one another. Alternatively or additionally, the fastening elements 59 can project over the assembly plate 43 in the closing direction D and be used to fasten further components of the relay 28. The fastening elements 59 may, for example, be configured as latching elements and latch with counter-latching structures of the further components of the relay 28.

- 5 Alternatively, the fastening elements 59 can be formed differently and, for example, as receivers for screws.

The present invention furthermore relates to:

- 10 A contact arrangement for a relay for switching a high load current, with an armature and a switching member, which is connected in a movement transmitting manner to the armature to conduct the load current, characterised in that the switching member has at least two load current tracks electrically separated from one another for the load current.
- 15 A contact arrangement, characterised in that each of the load current tracks has a contact body of the switching member.

A contact arrangement characterised in that the contact bodies are resiliently mounted.

- 20 A contact arrangement, characterised in that the contact bodies can be elastically deflected relative to the armature from their rest position.

- A contact arrangement, characterised in that the switching member has a driver which is rigidly connected to the armature, with respect to movement, to open a closed switching
25 connection of the contact bodies to counter-contacts of the relay.

- A contact arrangement, characterised in that in the rest position the contact bodies rest with their side remote from the armature on the driver and are resiliently pressed against the
30 driver.

- 30 A contact arrangement, characterised in that the contact bodies are elongate and are arranged spaced apart from one another transverse to their longitudinal axes.

- A contact arrangement, characterised in that each of the contact bodies has at least two
35 bearing portions, by means of which the contact body is resiliently mounted.

- 5 A contact arrangement, characterised by a locator immovably formed relative to the driver.

A relay for switching a high load current, with an actuator for producing switching forces acting on an armature and with counter-contacts to be bridged during a switching process, characterised by a contact arrangement according to any one of claims 1 to 8, the relay
10 having one pair of counter-contacts per load current track.

A relay, characterised in that when the relay is in a closed switching state, the load current tracks are arranged in a parallel connection.

- 15 A relay characterised in that the contact bodies, upon a movement of the driver in an opening direction pointing counter to the closing direction and away from the counter-contacts, are forcibly moved by the driver.

A relay characterised in that the relay is provided with a detector, which emits a signal during
20 operation when the armature is arranged in its rest switching position.

5 CLAIMS

1. Contact arrangement (1) for a relay (28) for switching a high load current, with a switching member (3) for conducting the load current, which has at least two load current tracks (14, 15) physically separated from one another, characterised in that the switching
10 member (3) has at least one transverse current track (Q) extending from one of the load current tracks (14, 15) to another of the load current tracks (14, 15).
2. Contact arrangement (1) according to claim 1, characterised in that the transverse current track (Q) runs through a transverse current conductor (q), which electrically
15 conductively connects the two load current tracks (14, 15) to one another.
3. Contact arrangement (1) according to claim 1 or 2, characterised in that the contact arrangement has at least one spring element (F), on which the at least two load current tracks (14, 15) are resiliently mounted, the electric resistance from one of the load current tracks
20 (14, 15) to the respective other load current track (14, 15) via the spring element (F) being higher than via the transverse current track (Q).
4. Contact arrangement (1) according to claim 2 or 3, characterised in that the transverse current conductor (q) is a transverse current-resistant short circuit conductor.
25
5. Contact arrangement (1) according to any one of claims 2 to 4, characterised in that the transverse current conductor (q) is configured in such a way that it only insignificantly impairs relative movements of the load current tracks (14, 15) with respect to one another.
- 30 6. Contact arrangement (1) according to any one of claims 2 to 5, characterised in that the transverse current conductor (q) has a flexible litz wire conductor.
7. Contact arrangement (1) according to any one of claims 1 to 6, characterised in that the load current tracks (14, 15) in each case run through a contact body (6, 7) of the switching
35 member and one end of the transverse current track (Q) is in each case electrically conductively connected to one of the contact bodies (6, 7).

5

8. Contact arrangement (1) according to claim 7, characterised in that at least one side (10, 11) of at least some of the contact bodies (6, 7) is provided with at least two switching contacts (8, 8', 9, 9') and ends (E, E') of the transverse current conductor (q) rest on sides (22) of the contact bodies (6, 7), which are configured without switching contacts (8, 8', 9, 9').

10

15

9. Contact arrangement (1) according to claim 7 or 8, characterised in that the transverse current conductor (q) is non-detachably connected to a central region of the contact bodies (6, 7).

10. Contact arrangement (1) according to any one of claims 1 to 9, characterised in that the contact arrangement (1) has an actuating element (4), which connects the load current tracks (14, 15) in a movement-transmitting manner to an armature (2) of the contact arrangement (1) and in that the transverse current track (Q) is guided in an arcuate manner from one load current track (14, 15) to the other load current track (14, 15) around the actuating element (4).

20

11. Relay (28) for switching a high load current, with an actuator (37) for producing switching forces acting on a contact arrangement (1) and with counter-contacts (33, 33', 34, 34') to be bridged during a switching process, characterised by a contact arrangement (1) according to any one of claims 1 to 10, the relay (28) having a pair of counter-contacts (33, 33', 34, 34') per load current track (13, 14).

25

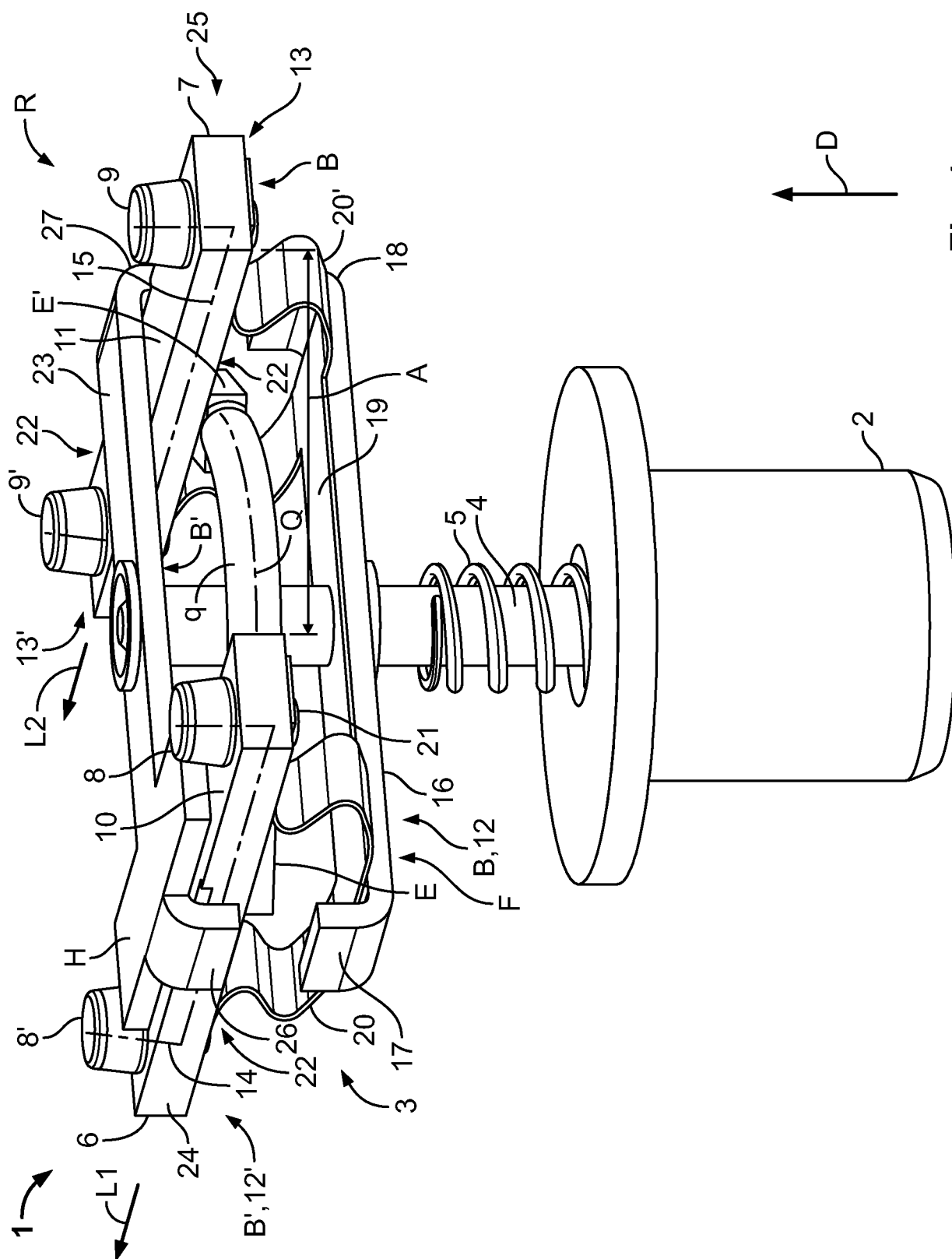


Fig. 1

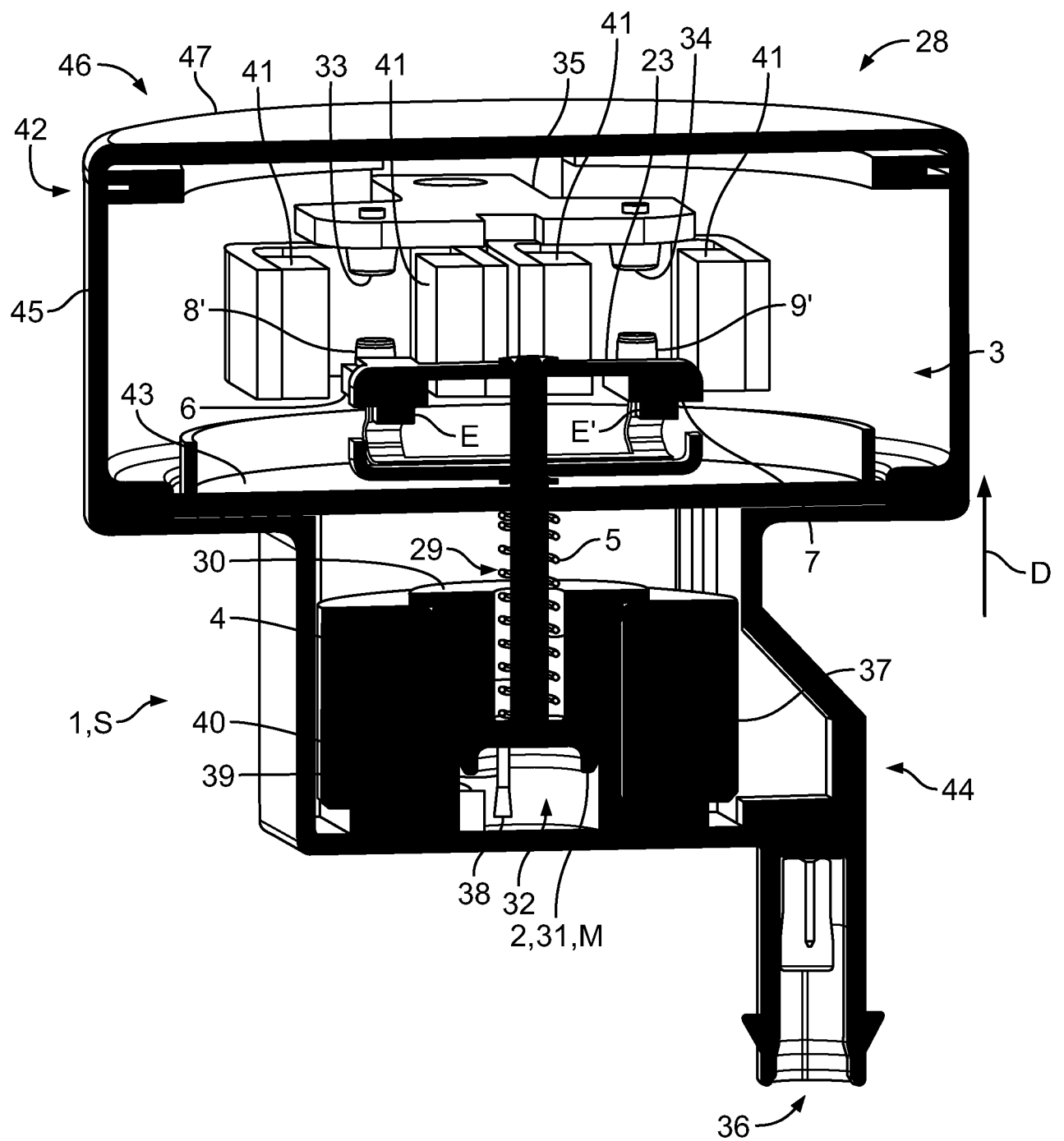


Fig. 2

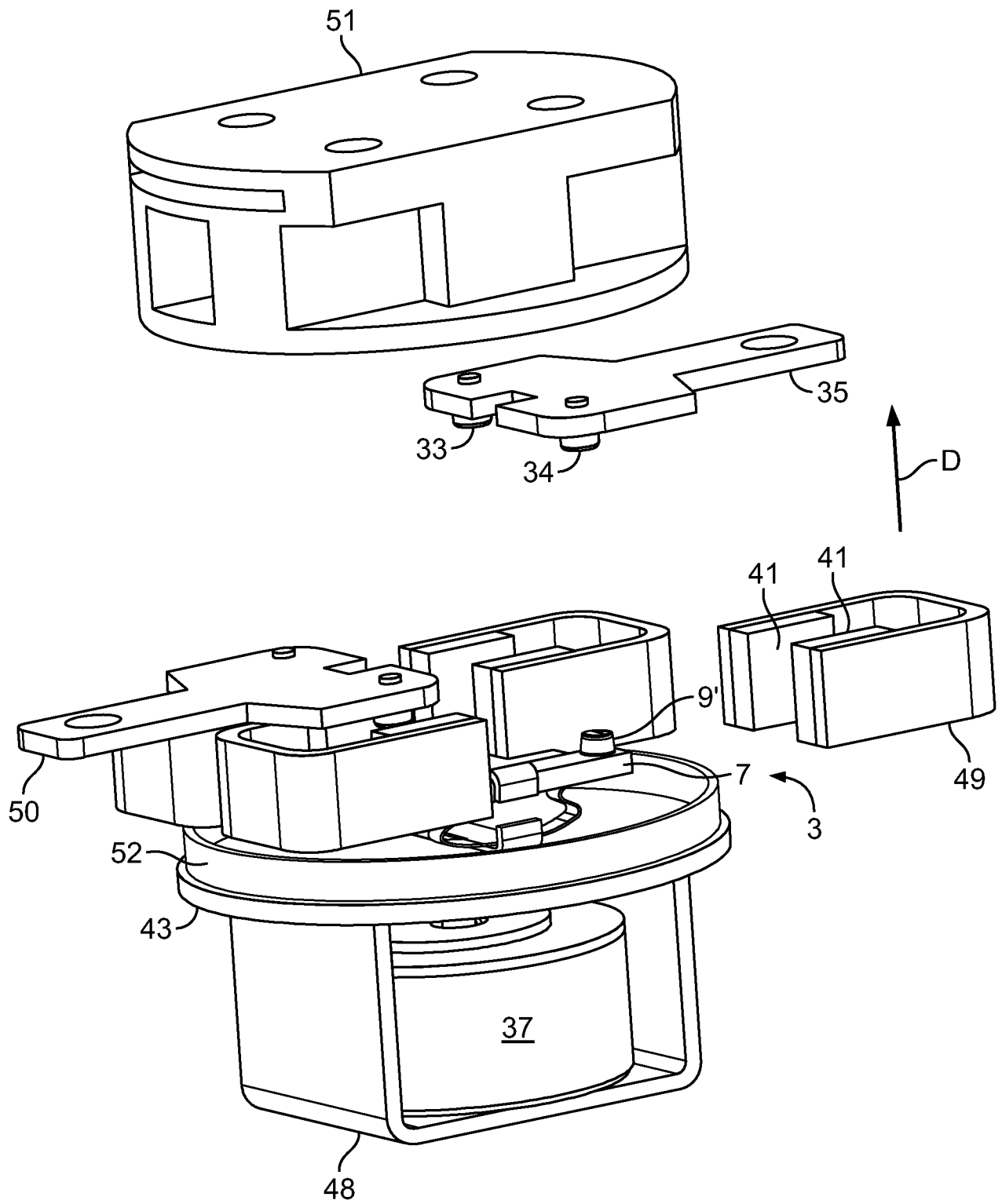


Fig. 3

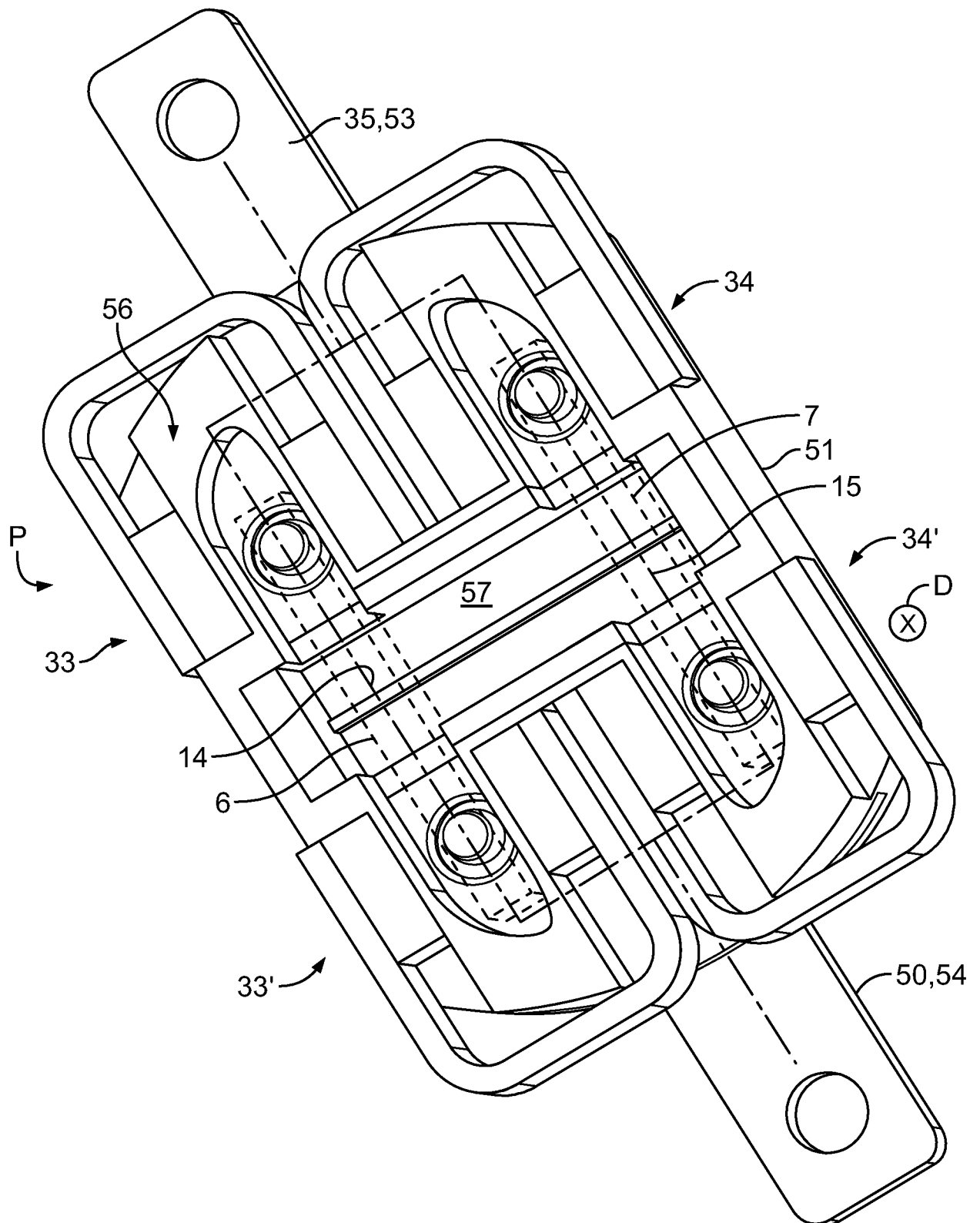
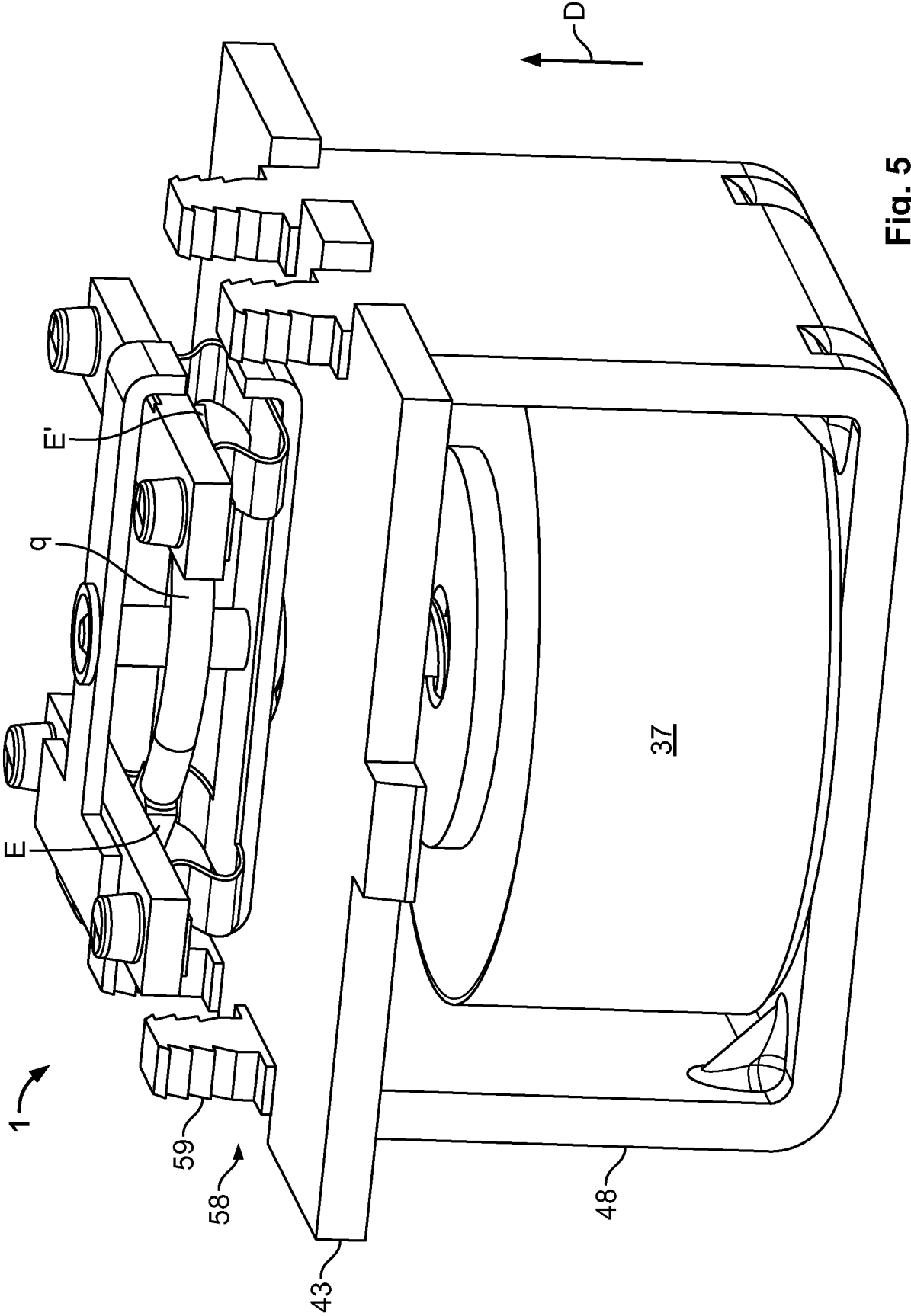


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2011/072241

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01H1/20 H01H50/54
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	column 5, line 74 - column 6, line 52; figures 11-13	6
X	EP 1 367 617 A1 (BITRON SPA [IT]) 3 December 2003 (2003-12-03)	1-5,7-11
A	paragraph [0010] - paragraph [0013]; figures 4-6	6
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A	figures 1-4	6
Y	DE 10 2008 039704 A1 (TYCO ELECTRONICS AMP GMBH [DE]) 4 March 2010 (2010-03-04)	6
A	paragraph [0003] - paragraph [0004]; figures 1,3 paragraph [0015] - paragraph [0023]	1-5,7-11



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

7 February 2012

Date of mailing of the international search report

13/02/2012

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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