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(54) **LOW VOLTAGE CIRCUIT BREAKER**
NIEDERSpanungSSCHUTZSCHALTER
DISJONCTEUR BASSE TENSION

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Description

[0001] The present invention relates to a circuit breaker, in particular a low voltage circuit breaker, for example for domestic environments.

[0002] A low voltage circuit breaker is known, in particular for domestic environments,. This device is positionable between a closed position, in which it creates an electrical and mechanical contact between movable contact elements and fixed contact elements, and an open position, such that electrical and mechanical contact is inhibited.

[0003] Known examples of circuit breakers are described in patent documents DE2138381A1 and DE1840006U, each disclosing the preamble of claim 1. A circuit breaker of this kind comprises a positioning mechanism which is settable from the open position to the closed position through input means, such as a button, lever or tab, and settable from the closed position to the open position through one of the following means:

- input means, such as those mentioned above; or
- safety means, capable of snap actuating said mechanism.

[0004] These safety means normally comprise both fault detection means and actuation means: The fault detection means comprise, for example, phase to neutral short-circuit detectors or the like, and are capable of detecting fault situations; the actuation means are instead capable, following recognition of the fault situation, of forcing said positioning mechanism to switch to the open position, regardless of the state of the input means.

[0005] Normally, the positioning mechanism can be snap actuated, for example by means of spring mechanisms, through the actuation means, which usually comprise electromagnetic actuators, for example piston-coil means comprising a coil capable of inducing, in short circuit conditions, a magnetic field in an actuator with movable piston so as to actuate said spring mechanism.

[0006] Faults in, for example, domestic electrical systems, have potentially catastrophic consequences both on the appliances connected to the system, and on the circuit breaker itself following the formation of an electric arc during the opening movement in short circuit conditions. Therefore, it is necessary to speed up the positioning mechanism as much as possible, so as to allow the open position to be set in the shortest time possible and thus prevent the fault condition from being prolonged.

[0007] Although this kind of circuit breaker is advantageous from many viewpoints, it would be preferably to speed up the positioning mechanism even further.

[0008] In fact, the aim of the present invention is to speed up the positioning mechanism.

[0009] In accordance with the invention, this problem is solved by a low voltage circuit breaker as defined by claim 1. Preferably, the electromagnetic actuator means comprise piston-coil means.

[0010] The piston-coil means are composed, for example, of a relay device, in which a current capable of moving the piston, which is preferable inserted in the area of the magnetic axis of the coil, passes through the coil in short circuit conditions; the magnetic field generated by the coil is also capable of intercepting the ferromagnetic component so as to express a force of attraction between the relay and said ferromagnetic component.

[0011] Preferably, the ferromagnetic component is facing the electromagnetic actuator means, for example piston-coil means, and the movable device can travel between a distal position, corresponding to the closed position, and a proximal position, corresponding to the open position. Preferably the ferromagnetic component is positioned asymmetrically in a peripheral zone of the moving device and in particular of the axis of rotation of this movable device. In this manner, the force of attraction, due to the magnetic field of the electromagnetic actuator means and acting on the ferromagnetic component is taken to a torque which facilitates rotation of the movable contact device.

[0012] Preferably, passage from the closed position to the open position is assisted by a magnetic force for alignment of the ferromagnetic component with the magnetic axis of said electromagnetic actuator means, so as to facilitate rotation of the movable contact device.

[0013] Preferably, the ferromagnetic component comprises a ferromagnetic plate interlocked with the movable device, in turn integral with the first movable contact element. In this manner, ferromagnetic plate, movable device and first movable contact element are part of the same integral structure, without interposition of mechanisms: the invention therefore has particular reactivity to movement, without impairing the reliability of the limiting circuit breaker.

[0014] Preferably, the aforesaid ferromagnetic plate is structured with an edge interposed between a first surface, preferably flat, and a second surface, preferably convex and curved, so that, in closed position, the edge is facing the electromagnetic actuator means and, in open position, the second surface is facing the electromagnetic actuator means. The convex curve of the ferromagnetic plate means that there are no edges and consequently allows improved positioning of the plate under the electromagnetic actuator means.

[0015] Further characteristics and advantages of the present invention will be more apparent from the description of preferred, but not exclusive, embodiments of the present invention shown by way of example in the accompanying drawings, wherein:

- Figure 1 shows a perspective interior view of a low voltage circuit breaker according to the present invention in a first operating position thereof;
- Figure 2 shows a view analogous to that of Figure 1 in a second operating position thereof;
- Figure 3 shows a component of the device of Figure 1;

- Figure 4 shows a component of the device of Figure 1.

With reference to the accompanying figures, the numeral 1 indicates a low voltage circuit breaker according to the present invention, in particular for a low voltage domestic system.

[0016] This low voltage circuit breaker 1 is used for reciprocal contact between at least a first movable contact element 2, connected to a distribution network, and a second fixed contact element, not shown in the figures, connected to a load network (in another embodiment, the movable contact element could be connected to the network downstream). In the embodiment illustrated, the first movable contact element 2 is essentially formed by a pair of contacts 2a made of a conductive metal material, each of which is suitable to contact a respective fixed contact of a corresponding pair of fixed contacts.

[0017] The contact elements are reciprocally positioned between one of the following two positions:

- a closed position, wherein said first 2 and second electric contact elements are in reciprocal contact; in this position, the circuit breaker 1 is closed and electric current is allowed to pass through the electric contacts 2a to feed the load network;
- an open position, in which the first 2 and second electric contact element are reciprocally separated, so as to prevent the passage of current, disconnect the loads and prevent any fault from being prolonged in time.

[0018] The first movable contact element 2 is supported by a movable device, which in the present example is composed of a contact shaft 6, made of plastic material, which is part of a kinematic chain 4 of known type, and settable so as to force the aforesaid positionings of the electric contacts. In particular, the contact shaft 6 is rotatable, so that the movable contacts 2a also rotate.

[0019] The kinematic chain 4 can be snap actuated through electromagnetic actuator means, for example of the piston-coil type, which in the present case are composed of a relay 5, of known type, with a coil housed in a coil casing 5a made of plastic material and a piston inserted inside said coil, in axial position, said piston having a fixed part 5b and a movable part 5c capable of moving through said magnetic field and of snap actuating the kinematic chain 4 of the circuit breaker. In fact, in short circuit conditions, a current passes through the coil of the relay 5 such as to generate a magnetic field capable of forcing the piston 5c to snap actuate the kinematic chain 4 of the circuit breaker, and consequently separate the first movable contact element 2 from the respective fixed contact element.

[0020] According to the invention, the contact shaft 6 comprises a ferromagnetic component, which in the example shown is composed of a ferromagnetic plate 7 interlocked with the contact shaft 4 through shape mat-

ing. This ferromagnetic plate 7 is preferably located in an asymmetrical and peripheral position with regard to the axis of rotation of the contact shaft 6.

[0021] In the embodiment shown, the ferromagnetic plate 7 is structured so as to present an edge 10 interposed between a first flat surface 9 and a second convex and curved surface 8.

[0022] The ferromagnetic plate 7 is facing the relay 5. In particular, with regard to the relay 5, the ferromagnetic plate 7 is located in one of the following positions:

- a distal position, represented in Figure 1, which is obtained when the first movable contact element 2 is in closed position;
- a proximal position, represented in Figure 2, which is obtained when the first movable contact element 2 is in open position.

[0023] In practice, starting from the position depicted in Figure 1, in short circuit conditions a current passes through the coil of the relay 5 such as to generate a magnetic field suitable to move the piston 5c, the end of which interacts with the release mechanism 4a of the kinematic chain 4 determining, according to known mechanisms, release thereof and rotation of the contact shaft 6 to the position of Figure 2.

[0024] The travel between the distal position and the proximal position is thus caused, in the first place, by the known effects of the kinematic chain 4 of the circuit breaker. Moreover, according to the invention, added to the effects of the kinematic chain 4 is the force of attraction between the magnetic field generated by the relay 5 and the ferromagnetic plate 7, so as to impart an increased thrust to make the contact shaft 6 rotate at a greater speed. This results in an increased separation speed between the first movable contact element and the second fixed contact element, and therefore in increased opening speed of the circuit in a short circuit fault situation.

[0025] Advantageously, in distal position, the edge 10 of the ferromagnetic plate 7 is positioned closer to the relay 5, while the movement towards the proximal position is further facilitated by the convex and curved structure of said second surface 9, which tends to face the bottom of the relay 5.

[0026] The ferromagnetic plate 7 therefore tends to align itself with the magnetic axis of the piston-coil means.

[0027] The greatest advantage of the present invention is that of utilizing the magnetic field of the electromagnetic actuator means not only for actuation of the kinematic chain 4, but also to attract the ferromagnetic component 7. Therefore, the presence of a magnetic field, usually an undesirable condition, in this case becomes an advantageous condition.

[0028] As shown in Figure 3, if the circuit breaker is a two-pole circuit breaker with both poles provided with electromagnetic actuator means, for example relays 5 of the aforesaid type, the contact shaft 6 comprises a ferromagnetic component 7 for each pole. In practice, ac-

cording to this embodiment and as can be seen in the example illustrated, the contact shaft advantageously comprises two ferromagnetic plates 7 interlocked with the contact shaft 4 through shape mating and facing two corresponding relays 5 (not shown).

[0029] The low voltage circuit breaker according to the present invention also provides for the use of input means normally provided for manual positioning between the closed position and the open position and vice versa, so as to allow manual opening and closing of the circuit.

[0030] On the basis of the description provided, other characteristics, modifications or improvements are possible and evident to a person skilled in the art. These characteristics, modifications and improvements should therefore be considered a part of the present model, as defined by the scope of the appended claims. In practice, the materials used and the contingent dimensions and forms can be any, according to requirements and to the state of the art.

Claims

1. Low voltage circuit breaker (1) comprising a first (2) and a second electric contact element reciprocally positionable between a closed position such that said first (2) and second electric contact elements are in reciprocal contact, and an open position such that said first (2) and second electric contact elements are reciprocally separated, said low voltage circuit breaker (1) comprising a kinematic chain (4) for actuating positioning between said closed position and said open position, wherein said kinematic chain (4) can be snap actuated through electromagnetic actuator means (5), **characterized in that** said kinematic chain (4) comprises a contact shaft (6) rotatable about an axis of rotation and capable of moving said first electric contact element between said open and closed position and comprising a ferromagnetic component (7) sensitive to the magnetic field due to said electromagnetic actuator means (5) and suitable to impart a thrust to said contact shaft (6) in the rotation about said axis of rotation.
2. Low voltage circuit breaker as claimed in claim 1, **characterized in that** said contact shaft (6) is integral with said first contact element (2).
3. Low voltage circuit breaker as claimed in one of the preceding claims, **characterized in that** said electromagnetic actuator means (5) comprise piston-coil means.
4. Low voltage circuit breaker as claimed in claim 3, **characterized in that** piston-coil means (5) provide for the passage of electric current through said coil so as to generate a magnetic field capable of intercepting said ferromagnetic component (7) so as to

express a force of attraction between said ferromagnetic component (7) and said piston-coil means (5).

5. Low voltage circuit breaker as claimed in one of the preceding claims, **characterized in that** said contact shaft (6) is such that said ferromagnetic component (7) is facing said electromagnetic actuator means (5), and **in that** said ferromagnetic component (7) travels between a distal position, corresponding to said closed position, and a proximal position, corresponding to said open position.
6. Low voltage circuit breaker as claimed in one of the preceding claims, **characterized in that** said ferromagnetic component (7) is located in an asymmetrical and peripheral position in relation to the axis of rotation of said contact shaft (6).
7. Low voltage circuit breaker as claimed in one of the preceding claims, **characterized in that** said ferromagnetic component (7) comprises a ferromagnetic plate interlocked with said contact shaft (6).
8. Low voltage circuit breaker as claimed in claim 7, **characterized in that**, in the position protending towards said electromagnetic actuator means (5), said ferromagnetic plate (7) has an edge (10) interposed between a first flat surface (9), and a second convex and curved surface (8), such that, in closed position, said edge (10) is facing said electromagnetic actuator means (5) and, in open position, said second surface (8) is facing said electromagnetic actuator means (5).

Patentansprüche

1. Niederspannungsstromkreisunterbrecher (1), der ein erstes (2) und ein zweites elektrisches Kontaktelement umfasst, die wechselseitig zwischen einer geschlossenen Position, in der das erste (2) und das zweite elektrische Kontaktelement in wechselseitigem Kontakt sind, und einer offenen Position, in der das erste (2) und das zweite elektrische Kontaktelement wechselseitig getrennt sind, positionierbar sind, wobei der Niederspannungsstromkreisunterbrecher (1) eine kinematische Kette (4) zum Betätigen der Positionierung zwischen der geschlossenen Position und der offenen Position umfasst, wobei die kinematische Kette (4) durch elektromagnetische Aktuarmittel (5) schnappend betätigt werden kann, **dadurch gekennzeichnet, dass** die kinematische Kette (4) eine Kontaktwelle (6) aufweist, die um eine Drehachse drehbar ist und fähig ist, das erste elektrische Kontaktelement zwischen der offenen und der geschlossenen Position zu bewegen, und eine ferromagnetische Komponente (7) aufweist, die gegenüber dem Magnetfeld aufgrund der elektromag-

netischen Aktuatorenmittel (5) empfindlich ist und geeignet ist, der Kontaktwelle (6) einen Schub in der Drehung um die Drehachse zu verleihen.

2. Niederspannungsstromkreisunterbrecher nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kontaktwelle (6) einstückig mit dem ersten Kontaktelement (2) ausgebildet ist. 5
3. Niederspannungsstromkreisunterbrecher nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die elektromagnetischen Aktuatorenmittel (5) Kolben-Spulenmittel umfassen. 10
4. Niederspannungsstromkreisunterbrecher nach Anspruch 3, **dadurch gekennzeichnet, dass** die Kolben-Spulenmittel (5) für den Durchgang von elektrischem Strom durch die Spule sorgen, um so ein Magnetfeld zu erzeugen, das fähig ist, die ferromagnetische Komponente (7) zu erfassen, um so eine Anziehungskraft zwischen der ferromagnetischen Komponente (7) und den Kolben-Spulenmitteln (5) zu bewirken. 15 20
5. Niederspannungsstromkreisunterbrecher nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Kontaktwelle (6) derart ist, dass die ferromagnetische Komponente (7) dem elektromagnetischen Aktuatorenmittel (5) zugewandt ist und dass sich die ferromagnetische Komponente (7) zwischen einer distalen Position, die der geschlossenen Position entspricht, und einer proximalen Position, die der offenen Position entspricht, bewegt. 25 30
6. Niederspannungsstromkreisunterbrecher nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die ferromagnetische Komponente (7) in einer asymmetrischen und peripheren Position in Bezug auf die Drehachse der Kontaktwelle (6) angeordnet ist. 35 40
7. Niederspannungsstromkreisunterbrecher nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die ferromagnetische Komponente (7) eine ferromagnetische Platte aufweist, die mit der Kontaktwelle (6) verriegelt ist. 45
8. Niederspannungsstromkreisunterbrecher nach Anspruch 7, **dadurch gekennzeichnet, dass** die ferromagnetische Platte (7) in der Position, die sich zu dem elektromagnetischen Aktuatorenmittel (5) erstreckt, eine Kante (10) aufweist, die zwischen einer ersten flachen Fläche (9) und einer zweiten konvexen und gekrümmten Fläche (8) liegt, sodass die Kante (10) in geschlossener Stellung dem elektromagnetischen Aktuatorenmittel (5) zugewandt ist, und in offener Stellung die zweite Fläche (8) dem elek-

tromagnetischen Aktuatorenmittel (5) zugewandt ist.

Revendications

1. Disjoncteur basse tension (1) comprenant un premier (2) et un second élément de contact électrique pouvant être positionnés l'un par rapport à l'autre entre une position fermée dans laquelle lesdits premier (2) et second éléments de contact électriques sont en contact l'un avec l'autre, et une position ouverte dans laquelle lesdits premier (2) et second éléments de contact électrique sont séparés l'un de l'autre, ledit disjoncteur basse tension (1) comprenant une chaîne cinématique (4) pour actionner le positionnement entre ladite position fermée et ladite position ouverte, dans lequel ladite chaîne cinématique (4) peut être actionnée rapidement par des moyens actionneurs électromagnétiques (5), **caractérisé en ce que** ladite chaîne cinématique (4) comprend un arbre de contact (6) pouvant tourner autour d'un axe de rotation et qui est capable de déplacer ledit premier élément de contact électrique entre ladite position ouverte et fermée et comprenant un composant ferromagnétique (7) sensible au champ magnétique dû auxdits moyens actionneurs électromagnétiques (5) et apte à transmettre une poussée audit arbre de contact (6) dans la rotation autour dudit axe de rotation.
2. Disjoncteur basse tension selon la revendication 1, **caractérisé en ce que** ledit arbre de contact (6) fait partie intégrante dudit premier élément de contact (2).
3. Disjoncteur basse tension selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lesdits moyens actionneurs électromagnétiques (5) comprennent des moyens à piston-bobine.
4. Disjoncteur basse tension selon la revendication 3, **caractérisé en ce que** les moyens à piston-bobine (5) assurent le passage de courant électrique à travers ladite bobine de manière à produire un champ magnétique capable d'intercepter ledit composant ferromagnétique (7) de manière à montrer une force d'attraction entre ledit composant ferromagnétique (7) et lesdits moyens à piston-bobine (5).
5. Disjoncteur basse tension selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit arbre de contact (6) est tel que ledit composant ferromagnétique (7) fait face auxdits moyens actionneurs électromagnétiques (5), et **en ce que** ledit composant ferromagnétique (7) se déplace entre une position distale, correspondant à ladite position fermée, et une position proximale, correspondant à ladite position ouverte.

6. Disjoncteur basse tension selon l'une des revendications précédentes, **caractérisé en ce que** ledit composant ferromagnétique (7) est situé dans une position asymétrique et périphérique par rapport à l'axe de rotation dudit arbre de contact (6). 5
7. Disjoncteur basse tension selon l'une des revendications précédentes, **caractérisé en ce que** ledit composant ferromagnétique (7) comprend une plaque ferromagnétique interverrouillée avec ledit arbre de contact (6). 10
8. Disjoncteur basse tension selon la revendication 7, **caractérisé en ce que**, dans la position s'étendant vers lesdits moyens actionneurs électromagnétiques (5), ladite plaque ferromagnétique (7) comporte une arrête (10) interposée entre une première surface plane (9), et une seconde surface convexe et incurvée (8), de sorte que, en position fermée, ladite arrête (10) fait face auxdits moyens actionneurs électromagnétiques (5) et, en position ouverte, ladite seconde surface (8) fait face auxdits moyens actionneurs électromagnétiques (5). 15 20

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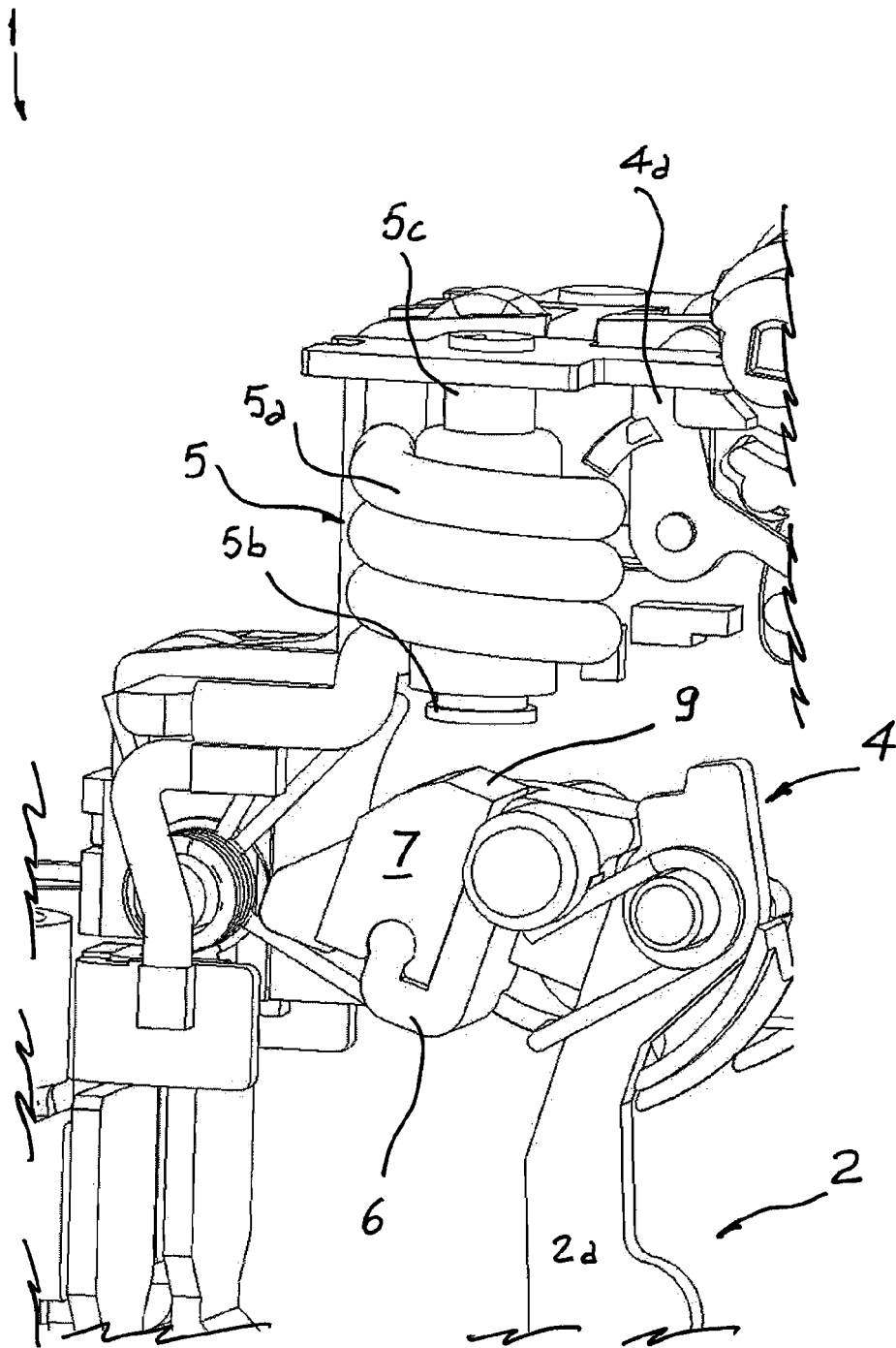
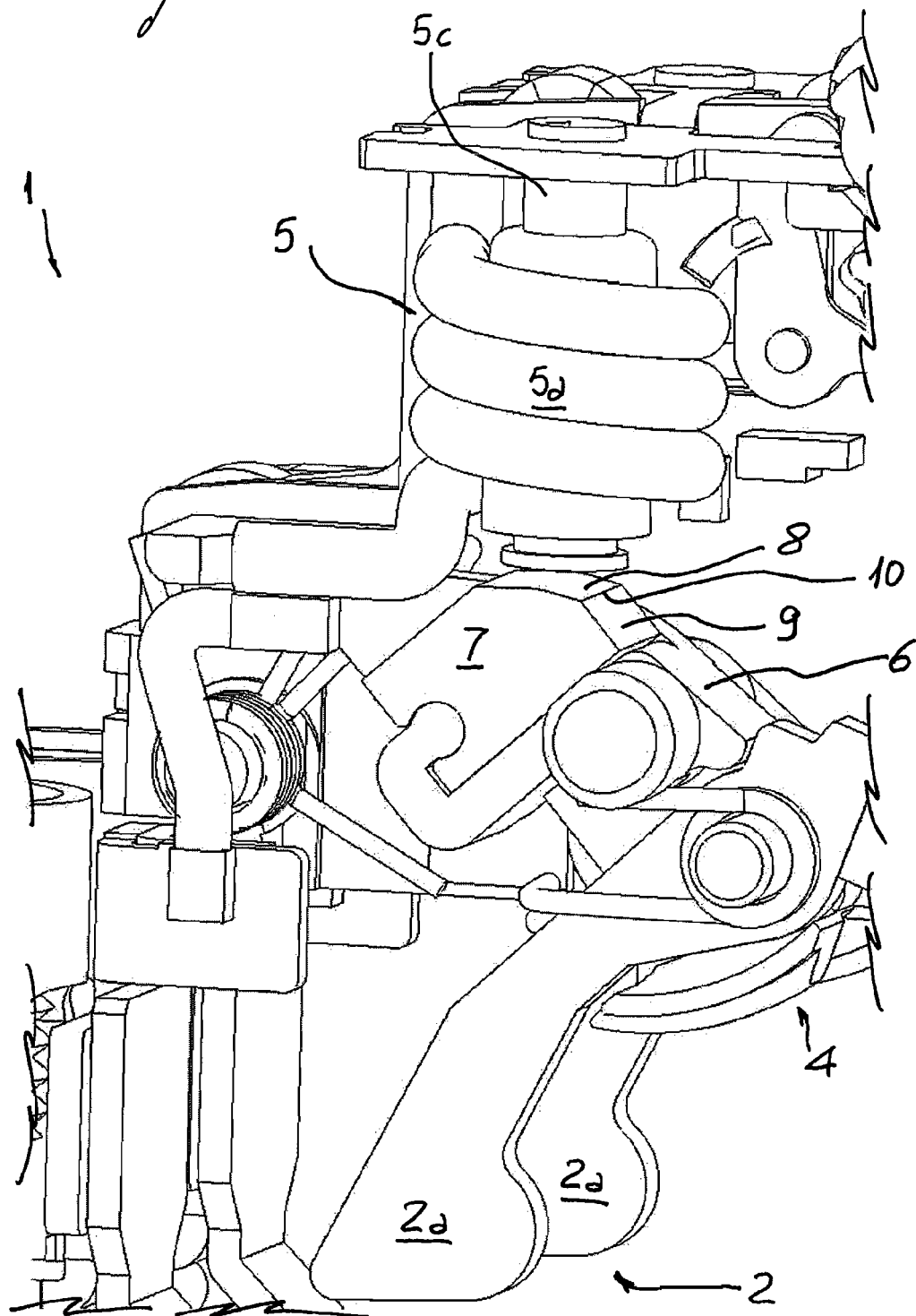


Fig. 1

Fig. 2



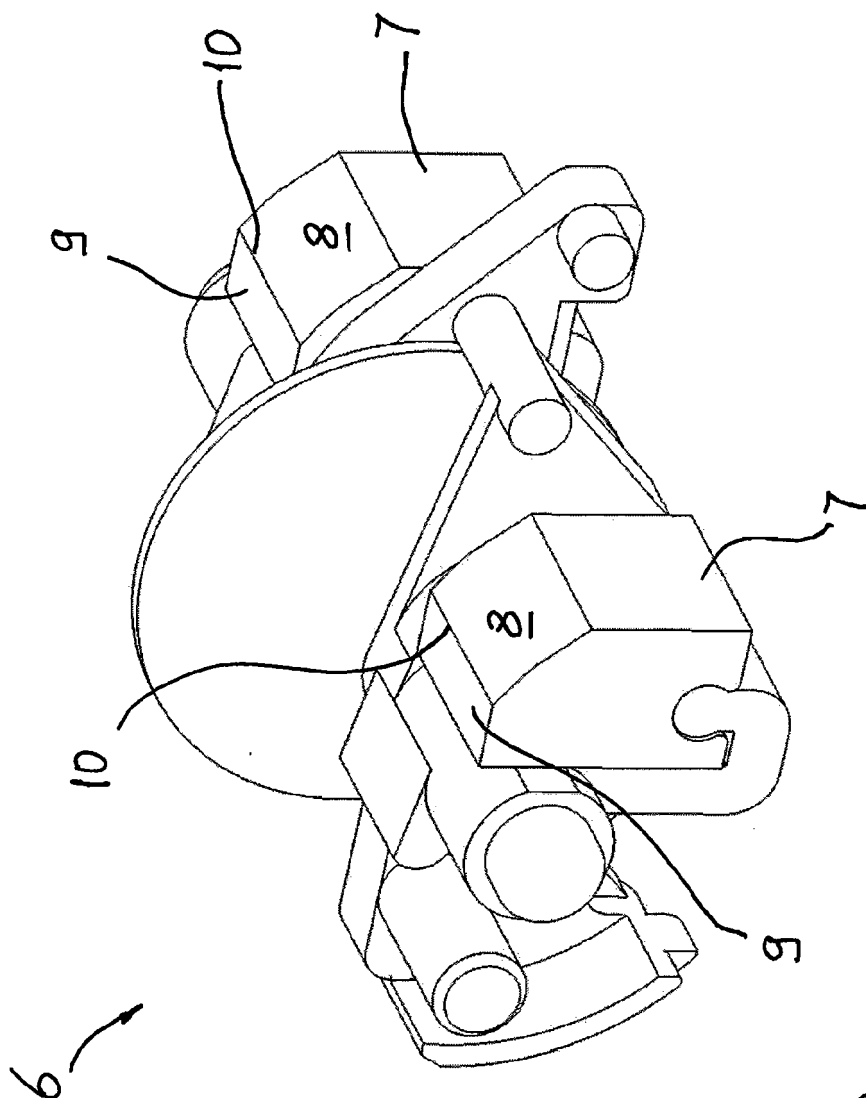


Fig. 3

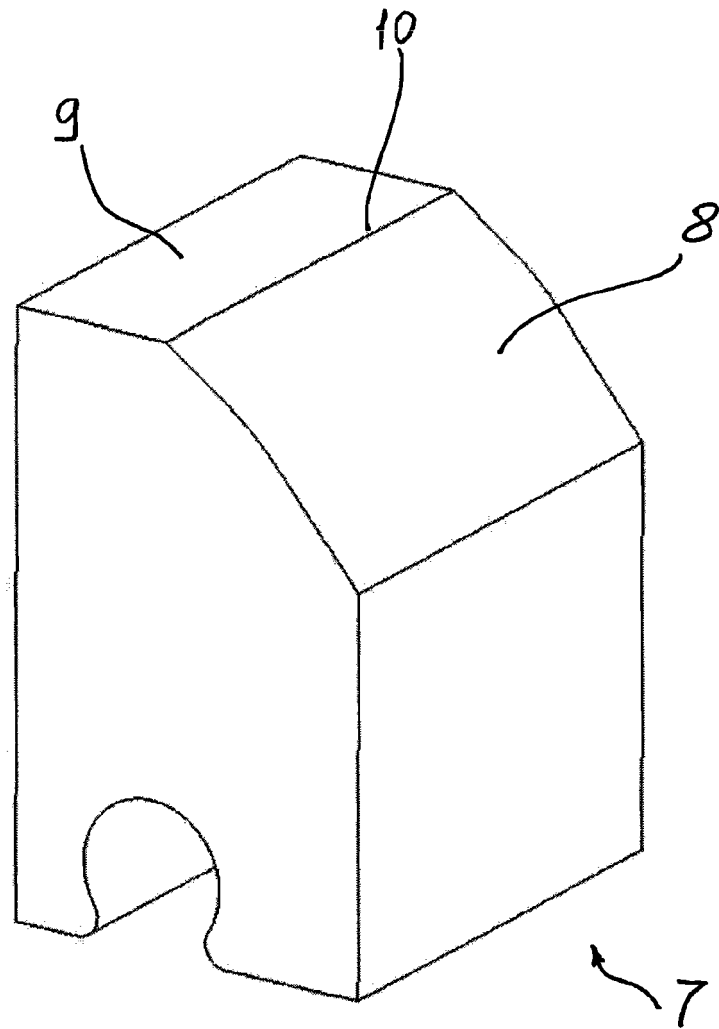


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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