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(71) Applicant: **ABB Schweiz AG**
**5400 Baden (CH)**

(72) Inventors:
- **Cortinovis, Gianluca**
  **I-24021 Albino (BG) (IT)**
- **Bruni, Jacopo**
  **I-26900 Lodi (IT)**
- **Piazza, Roberto**
  **I-26845 Codogno (LO) (IT)**
- **Pesenti, Luca**
  **I-24044 Dalmine (BG) (IT)**

(74) Representative: **De Bortoli, Eros et al**
**Zanoli & Giavarini S.p.A.**
**Via Melchiorre Gioia, 64**
**20125 Milano (IT)**

# (54) MEDIUM VOLAGE SWITCH MOVABLE CONTACT ASSEMBLY

(57) A Medium Voltage switch movable contact assembly (1, 10, 50) comprising a first (61) and a second (62) contact blades facing each other at a distance, said first (61) and second (62) contact blades being provided with a corresponding first (71) and second (72) contact element positioned facing each other at a first end (610, 620) of the corresponding blade (61, 62). The first (71) and second (72) contact element are adapted to be coupled with a corresponding first fixed contact (110) of a Medium Voltage switch. The movable contact assembly (1, 10, 50) is characterized in that said movable contact assembly (1, 10, 50) comprises at least a spacer (20, 200) interposed between said first (61) and second (62) contact blades, wherein said spacer (20, 200) comprises a hollow body (21, 210) housing an elastic element (30, 300) which has a first operative end (31, 310) operatively connected to one of said first (61) and second (62) contact blades and a second operative end (32, 320) operatively connected to the other of said first (61) and second (62) contact blades, said elastic element (30, 300) exerting an attractive force between said first (61) and second (62) contact blades.

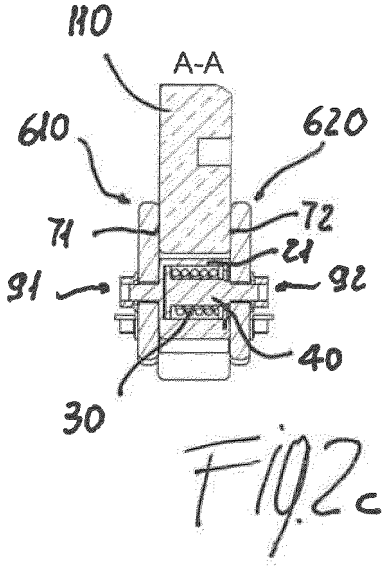


Fig.2c

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## Description

**[0001]** The present invention relates to a movable contact assembly for a Medium Voltage switch and to a Medium Voltage switching unit comprising such movable contact assembly. More in particular, the present invention relates to a movable contact assembly provided with an improved contact blades system and to a Medium Voltage switch, in particular a disconnector or earthing switch equipped with such improved contact blades system.

**[0002]** For the purposes of the present invention, the term Medium Voltage is intended to designate electrical systems operating at voltage levels higher than 1 kV AC and 1.5 kV DC up to some tens of kV, e.g., up to 72 kV AC and 100 kV DC.

**[0003]** Medium Voltage switches, in particular disconnector and earthing switches, equipped with a movable contact assembly comprising movable contact blades are well known in the art and are normally used, e.g., to electrically connect a supply terminal with a load terminal, or a load terminal to earth. The movable contact is normally designed to move, linearly or rotationally, between an open position in which it is separated from the corresponding fixed contact and a closed position in which it electrically coupled with the fixed contact.

**[0004]** When the switch is in the closed position, the connection between the movable contact and the corresponding fixed contact shall withstand the electrodynamic forces generated both under rated current and fault current conditions. To this purpose, a system of springs is generally provided in order to guarantee the required contact force between the movable contact and the corresponding fixed contact.

**[0005]** An example of a Medium Voltage disconnector of known type is represented in the attached Figure 1a and Figure 1b.

**[0006]** The Medium Voltage disconnector shown in such figures, is provided with a movable contact assembly 100 which comprises a pair of contact blades 101 and 102 positioned facing each other at a distance. A first end of the contact blades 101 and 102 is provided with contact elements for electrical coupling with a fixed contact 110.

**[0007]** In the example shown in Figures 1a and 1b, a terminal portion 103 of the contact blades 101 and 102 is rotationally mounted on a fixed support so as to allow rotation of the contact blades 101 and 102 between the closed position shown in the Figures and an open position, and vice-versa.

**[0008]** Movement of the movable contact blades 101 and 102 between the different operating position is imparted by a kinematic system 150 which connects, through a mechanical transmission system comprising levers and an operating shaft (partially shown), the movable contact blades 101 and 102 to an actuating drive (not shown).

**[0009]** In the disconnector shown in Figures 1a and 1b, the contact force between the movable contact blades 101 and 102 and the corresponding fixed contact 110 is provided by two compression springs 106 and 107 which are mounted on a pin 105 transversally connecting the movable contact blades 101 and 102 with each other. In this way, thanks to the pressure exerted by the compression springs 106 and 107 on the external surfaces of the movable contact blades 101 and 102, the required contact force between movable and fixed contacts when they are in the closed position can be guaranteed.

**[0010]** The traditional Medium Voltage disconnectors switches are normally positioned inside a pressurized tank filled with a sulphur hexafluoride ($SF_6$) atmosphere, as this insulation gas ensures excellent performances in terms of dielectric insulation and arc-quenching capabilities when currents are interrupted. As is known, however, $SF_6$ is a very potent greenhouse gas, and its use is subject to severe restrictions for environmental preservation purposes. For this reason, over the years, there has been made a considerable effort to design Medium Voltage switches not employing $SF_6$ as an insulation gas.

**[0011]** In the most recent Medium Voltage switches, $SF_6$ has been substituted by other gases, e.g., pressurized dry air, which however have lower insulating properties with respect to $SF_6$. The design of a Medium Voltage switch should therefore take into account, in addition to the other operative requirements, the need to keep under control the electric field and avoid the risk of electrical discharges.

**[0012]** The main aim of the present invention is to provide a Medium Voltage switch, in particular a disconnector or earthing switch, which allows overcoming or mitigating the drawbacks of the known art.

**[0013]** Within this aim, a purpose of the present invention is to provide a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, which allows overcoming the problems deriving from the use of insulating gases with lower insulating properties with respect to $SF_6$.

**[0014]** A further purpose of the present invention is to provide a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, in which the problems of electrical discharges due to inhomogeneous electrical fields are minimized.

**[0015]** A further purpose of the present invention is to provide a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, in which the required contact force in the closed position between movable contact(s) and fixed contact(s) is guaranteed.

**[0016]** A further purpose of the present invention is to provide a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, which is less prone to damages with respect to the conventional systems.

**[0017]** A further purpose of the present invention is to provide a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, in which the various components of the switch

can be pre-assembled and pre-tested, as self-standing kits, before final assembling.

**[0018]** A further purpose of the present invention is to provide a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, which has a simple and compact structure with a relatively low number of components.

**[0019]** A further purpose of the present invention is to provide a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, which is relatively simple and cheap to be manufactured at industrial levels.

**[0020]** The above aim and purposes, as well as other purposes that will emerge clearly from the following description and attached drawings, are provided, according to the invention, by a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the following claim 1 and the related dependent claims.

**[0021]** In a further aspect, the present invention also relates to a Medium Voltage switch, in particular a disconnector or earthing switch, which comprises a movable contact assembly as described herein.

**[0022]** In a general definition, the movable contact assembly for a Medium Voltage switch of the present invention comprises a first and a second contact blades which are positioned parallel and facing each other at a distance. The first and second blades are provided with a corresponding first and second contact element positioned facing each other at a first end of the corresponding blade and the first and second contact elements are adapted to be coupled with a corresponding first fixed contact of a Medium Voltage switch.

**[0023]** The movable contact assembly for a Medium Voltage switch of the present invention is characterized in that it comprises at least a spacer which is interposed between said first and second contact blades. Said spacer comprises a hollow body which houses an elastic element which has a first operative end operatively connected to one of said first and second contact blades and a second operative end operatively connected to the other of said first and second contact blades, said elastic element exerting an attractive force between said first and second contact blades.

**[0024]** For the purposes of the present invention, the terms "first operative end" and "second operative end" are not meant to designate the physical limits of the elastic element but the operational points of the elastic element in which the designated functions are carried out.

**[0025]** In practice, and as better explained hereinafter, in the movable contact assembly for a Medium Voltage switch of the invention, the design and positioning of the elastic elements provides an efficient system for providing the required contact force between movable contact(s) and fixed contact(s) in the closed position without having the troubles deriving from an inhomogeneous electric field.

**[0026]** Indeed, in the conventional systems like the one represented in Figure 1a and Figure 1b, the protrusion created on the external surfaces of the movable contact blades 101 and 102 by the transversal pin 105 and by the springs 106 and 107 mounted on said pin 105 can create a high electric field with consequent possible electrical discharges.

**[0027]** Conversely, in the presently claimed movable contact assembly, the elastic element - e.g., a spring - and the corresponding housing provided in the hollow body of the spacer are located in a confined space between the contact blades and there are no significant protrusions on the external surfaces of the contact blades that can create an inhomogeneous electric field with the related problems of electrical discharges.

**[0028]** Moreover, if the area of the contact blades is involved in arc phenomena during normal switching operation or in case of fault currents, possible risks of damaging the elastic element are avoided since it is protected inside the hollow body of the spacer.

**[0029]** It has also to be noted that the sub-assembly comprising the spacer with the hollow body and the elastic element can be made as a self-standing kit which is preassembled and adjusted in order to provide the required force value. The production process of the whole movable contact assembly is therefore more effective and simplified.

**[0030]** According to some embodiments of the movable contact assembly of the invention, the spacer is preferably positioned proximate to said first and second contact element. In this way, the force generated by the elastic element on the contact system in the closed position can be maximized.

**[0031]** Preferably, the elastic element is positioned substantially perpendicular to said first and second contact blades. In practice, in this embodiment, the movable contact blades are substantially parallel to each other and positioned at a distance while the elastic element in transversally positioned between the blades and substantially perpendicular to said blades.

**[0032]** In a general embodiment of the invention, the operative connection of the elastic element with the contact blades can be direct, i.e., the first and second operative ends of the elastic element can be directly connected to the contact blades. However, as better explained in the following detailed description, such operative connection between the elastic element and the blades may involve intermediate elements.

**[0033]** In a largely preferred embodiment of the movable contact assembly, according to the invention, the spacer conveniently comprises a coupling element which is slidingly inserted into said hollow body. A first end of the coupling element is rigidly coupled with one of said first or second contact blades, while said hollow body is rigidly coupled with the other of said first or second contact blades. For the purposes of the present invention, the term "first end of the coupling element" is not meant to designate a physical limit of the coupling element but its

operational points where the designated function is carried out.

**[0034]** In practice, according to this embodiment, the spacer subassembly comprises two elements, i.e., the hollow body and the coupling element, each of which is rigidly connected to a different contact blade with respect to the other.

**[0035]** Then, according to a preferred mode of carrying out this embodiment, the first operative end of the elastic element may be operatively connected to one between said coupling element or hollow body and the second operative end of the elastic element may operatively connected to the other between said coupling element or hollow body.

**[0036]** In this way, as better explained hereinafter, the elastic element is operatively connected to the first and second movable contact blades through the hollow body of the spacer and through the coupling element.

**[0037]** In a possible practical embodiment of the movable contact assembly, according to the invention, the coupling element may conveniently comprise a pin having a first end which is rigidly coupled with one of said first or second contact blades and a second end which is operatively connected to said elastic element.

**[0038]** For the purposes of the present invention, the term "pin" is meant to designate in general a shaped body which at one end is rigidly coupled to one of the contact blades and at the other end is operatively connected to the elastic element. Also, the terms "first end" and "second end" of the pin are not meant to designate the physical limits of the pin but the operational points of the pin in which the designated functions are carried out.

**[0039]** In particular, in a possible embodiment of the invention, the second end of the pin may comprise a first protruding surface which is positioned internally to said hollow body.

**[0040]** Then, according to a preferred mode of carrying out this embodiment, the first protruding surface on the second end of the pin may be operatively connected to one of said first or second operative end of the elastic element.

**[0041]** In such an arrangement, according to some embodiments of the invention better described in details hereinafter, the hollow body of the spacer may comprise a second protruding surface which is operatively connected to the other of said first or second operative end of said elastic element.

**[0042]** As better explained in the following detailed description of the invention, the first and second protruding surfaces may be integrally made on the body of the corresponding pin and hollow body, or may be made by elements which are fixed on the body of the corresponding pin and hollow body.

**[0043]** In practice, according to this embodiment, the elastic element is operatively connected to one of the contact blades through an operative connection with the coupling element and to the other contact blade through an operative connection with the hollow body of the spacer.

**[0044]** According to some embodiments of the invention, the elastic element may be a compression spring which is interposed between the first protruding surface on the second end of the pin and the second protruding surface on the hollow body of the spacer. In particular, the compression spring may have a first operative end resting on said first protruding surface and a second operative end resting on said second protruding surface, thereby pushing said first and second protruding surfaces, and consequently the corresponding pin and hollow body, in opposite diverging directions. In other words, in this embodiment, the pin and the hollow body of the spacer are subject to a force that tends to push away them from each other.

**[0045]** According to some alternative embodiments of the invention, the elastic element may be a traction spring which is interposed between the first protruding surface on the second end of the pin and the second protruding surface on the hollow body of the spacer. In particular, the traction spring may have a first operative end engaged with said first protruding surface and a second operative end engaged with said second protruding surface, thereby pulling said first and second protruding surfaces, and consequently the corresponding pin and hollow body, in opposite converging directions. In practice, in this embodiment, the pin and the hollow body of the spacer are subject to a force that tends to pull them closer to each other.

**[0046]** According to some embodiments of the movable contact assembly of the invention, the movable contact assembly may conveniently comprise regulating means for adjusting the preload of said elastic element, e.g., washers, shims or screw means for regulating the preload of the elastic element.

**[0047]** In some embodiments of the movable contact assembly of the invention, and depending on the intended application, the first and second blades may be provided with a corresponding third and fourth contact element which are adapted to be coupled with a corresponding second fixed contact of a Medium Voltage switch and which are positioned facing each other at a second end of the corresponding blade. Advantageously, in these embodiments, the movable contact assembly may further comprise a first and a second of said spacer as described hereinabove, which are respectively positioned proximate to said first and second contact element and to said third and fourth contact element. In other words, when a double contacts system is involved, a double system of spacers and corresponding elastic elements may be provided. The spacers are then conveniently positioned proximate to the contact points, so that the force generated by the elastic elements on the contact systems in the closed position can be maximized.

**[0048]** A Medium Voltage switching unit comprising a movable contact assembly as described herein is also part of the present invention.

**[0049]** In particular, the Medium Voltage switch of the

present invention can be a disconnector or an earthing switch or a combined disconnector and earthing switch.

**[0050]** In the Medium Voltage switching unit of the invention, the arrangement and the type of movement of the movable contact assembly, e.g., linear or rotational, can be any according to the needs and according to solutions well known in the art. Also, the Medium Voltage switching unit is normally provided with kinematic chains and transmission links between the movable contact assembly and an actuator that can be of any type, according to the needs and according to solutions well known in the art.

**[0051]** Further features 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 examples in the accompanying drawings, wherein:

- Figure 1a is a first view of an embodiment of a contact assembly of a Medium Voltage disconnector of the prior art;
- Figure 1b is a second view of an embodiment of a contact assembly of a Medium Voltage disconnector of the prior art;
- Figure 2a is first view of a first embodiment of a contact assembly comprising a movable contact assembly for a Medium Voltage switch according to the present invention;
- Figure 2b is second view of a first embodiment of a contact assembly comprising a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 2c is section view of a detail of a first embodiment of a contact assembly comprising a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 3a is side view of a component of a first embodiment of a contact assembly comprising a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 3b is a first section view of a component of a first embodiment of a contact assembly comprising a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 3c is a second section view of a component of a first embodiment of a contact assembly comprising a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 4a is first view of a second embodiment of a contact assembly comprising a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 4b is second view of a second embodiment of a contact assembly comprising a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 5a is side view of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, used in the embodiment of Figures 4a-4b;
- Figure 5b is a first section view of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, used in the embodiment of Figures 4a-4b;
- Figure 5c is a second section view of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, used in the embodiment of Figures 4a-4b;
- Figure 6a is side view of a third embodiment of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 6b is first section view of a third embodiment of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 6c is second section view of a third embodiment of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 7a is a first section view of a component of a third embodiment of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 7b is a second section view of a component of a third embodiment of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 8a is a first section view of a component of a first embodiment of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention;
- Figure 8b is a second section view of a component of a first embodiment of a movable contact assembly for a Medium Voltage switch, in particular a disconnector or earthing switch, according to the present invention.

**[0052]** With reference to the attached figures, the present invention in its more general definition, relates to a movable contact assembly for a Medium Voltage switch, which in the embodiments of the attached figures is a disconnector, while the movable contact assembly is of the rotational type. As previously said, the arrangement and the type of movement of the movable contact assembly, e.g., linear or rotational, can be any according to

the needs and according to solutions well known in the art. Also, the Medium Voltage switching unit is normally provided with kinematic chains and transmission links between the movable contact assembly as well as with an actuator that can be of any type - according to the needs and according to solutions well known in the art - that will not be described in further details.

**[0053]** The movable contact assembly of the invention - designated with the reference numeral 1, 10, 50 in the various embodiments - generally comprises a first contact blade 61 and a second contact blade 62 which are positioned parallel and facing each other at a distance.

**[0054]** With reference to Figures 2a and 2b, the first 61 and second 62 contact blades are respectively provided with a corresponding first 71 and second 72 contact element which are positioned facing each other at a first end 610, 620 of the internal surfaces of the corresponding blade 61, 62.

**[0055]** For the purposes of the present invention, the term "internal" referred to the contact blades is meant to designate the surfaces of the blades facing each other in the assembly, while the term "external" referred to the contact blades is meant to designate the surfaces of the blades directed outwardly in the assembly.

**[0056]** In the embodiment shown in Figures 2a and 2b, a terminal portion 103 of the contact blades 61 and 62 is rotationally mounted on a fixed support so as to allow rotation of the contact blades 61 and 62 between the closed position shown in the Figures - in which the first 71 and second 72 contact element are electrically coupled with a first fixed contact 110 of the Medium Voltage switch - and an open position, and vice-versa.

**[0057]** Movement of the movable contact blades 61 and 62 between the different operating position is imparted by a kinematic system 150 which connects, through a mechanical transmission system comprising levers and an operating shaft (partially shown), the movable contact blades 61 and 62 to an actuating drive (not shown).

**[0058]** In the various embodiments shown in the attached figures, the movable contact assembly 1, 10, 50 of the present invention comprises at least a spacer 20, 200 which is interposed between the internal surfaces of the first 61 contact blade and the second contact blade 62 contact blades. In general, the spacer 20, 200 comprises a hollow body 21, 210 which houses an elastic element 30, 300 which has a first operative end 31, 310 operatively connected to one of said first 61 and second 62 contact blades and a second operative end 32, 320 operatively connected to the other of said first 61 and second 62 contact blades.

**[0059]** For instance, the hollow body 21, 210 can have a cylindrical shape with one base of the cylinder closed and resting on one of the contact blades 61 or 62, and the other base of the cylinder open and directed toward the other contact blade 62 or 61.

**[0060]** The positioning and the features of the elastic element 30, 300 are such that it exerts an attractive force between said first 61 and second 62 contact blades, thereby providing the required contact force between the fixed 110 and movable 71, 72 contact elements when they are in the closed position.

**[0061]** In a general embodiment of the invention, the operative connection of the elastic element 30, 300 with the contact blades 61, 62 can be direct, i.e., the first 31, 310 and second 32, 320 operative ends of the elastic element 30, 300 can be directly connected to the contact blades 61, 62. However, the operative connection between the elastic element 30, 300 and the blades 61, 62 conveniently involves intermediate elements, as better explained in the following description of the embodiments illustrated in the Figures.

**[0062]** In the embodiments of the movable contact assembly 1, 10, 50 shown in the attached figures, the spacer 20, 200 and the elastic element 30, 300 are conveniently positioned proximate to the first 71 and second 72 contact elements, so as to maximize the force generated by the elastic element 30, 300 on the contact system in the closed position.

**[0063]** Also, the spacer 20, 200 and the elastic element 30, 300 are conveniently positioned so that the force exerted by the elastic element 30, 300 on the contact blades 61, 62 is substantially perpendicular to the internal surfaces of the first 61 and second 62 contact blades.

**[0064]** As shown in the attached Figures, and in particular in Figures 3a-3c, 7a-7b and 8a-8b, the spacer 20, 200 comprises a coupling element 40, 400 which is slidingly inserted into the hollow body 21, 210 of the spacer 20, 200.

**[0065]** The coupling element 40, 400 has a first end 41, 410 which is rigidly coupled with one of said first 61 or second 62 contact blades (e.g., the contact blade 62 in the attached Figures). The rigid coupling can be obtained, e.g., with screw means 92 which are fixed on a threaded portion of the first end 41, 410 of the coupling element 40, 400. Other fixing means, e.g., snap-fit means, direct screwing on the contact blade, fastening means and similar means, can however be used.

**[0066]** In turn, the hollow body 21, 210 is rigidly coupled with the other of said first 61 or second 62 contact blades (e.g., the contact blade 61 in the attached Figures).

**[0067]** For instance, in the embodiment shown in the attached Figures, the hollow body 21, 210 has a cylindrical shape with one base of the cylinder closed and resting on the internal surface of the contact blade 61. A fixing pin 28, 280 protrudes from such base and is inserted in a seat on the contact blade 61. The rigid coupling between the hollow body 21, 210 and the contact blade 61 can be obtained, e.g., with screw means 91 which are fixed on a threaded portion of the fixing pin 28, 280 protruding from the base of hollow body 21, 210. Other fixing means, e.g., snap-fit means, direct screwing on the corresponding contact blade, fastening means and similar means, can however be used.

**[0068]** With particular reference to Figures 3a-3c, 7a-7b and 8a-8b which show the detailed design of

possible embodiments of the spacer 20, 200, the first operative end 31, 310 of the elastic element 30, 300 is operatively connected to one between said coupling element 40, 400 or hollow body 21, 210 and the second operative end 32, 320 of said elastic element 30, 300 is operatively connected to the other between said coupling element 40, 400 or hollow body 21, 210.

**[0069]** In the embodiment shown in the Figures referred to above, the first operative end 31, 310 of the elastic element 30, 300 is operatively connected to the coupling element 40, 400 while the second operative end 32, 320 of the elastic element 30, 300 is operatively connected to the hollow body 21,210.

**[0070]** In the embodiment of the attached Figures, the coupling element 40, 400 comprises a pin 45, 450 having a first end 41, 410 which is rigidly coupled with one of said first 61 or second 62 contact blades and a second end 42, 420 which is operatively connected to said elastic element 30, 300. In the embodiment shown in the Figures referred to above, the first end 41, 410 of the pin 45, 450 is rigidly coupled with the second 62 contact blade and the second end 42, 420 of the pin 45, 450 is operatively connected to said elastic element 30, 300.

**[0071]** Shape and dimensions of the pin 45, 450 can be different depending on the design and functioning features of the spacer assembly 20, 200, as illustrated by some examples reported below.

**[0072]** For instance, the second end 42, 420 of the pin 45, 450 may comprise a first protruding surface 46, 460 which is positioned internally to the hollow body 21, 210. Also in this case, shape and dimensions of the first protruding surface 46, 460 can be different depending on the design and functioning features of the spacer assembly 20, 200. For instance, the first protruding surface 46, 460 may be integrally made on the body of the corresponding pin 45, 450, or may be made by elements which are fixed on the body of said pin 45, 450.

**[0073]** In general, the first protruding surface 46, 460 on the second end 42, 420 of the pin 45, 450 is operatively connected to one of said first 31, 310 or second 32, 320 operative end of said elastic element 30, 300. With particular reference to Figures 3a-3c, 7a-7b and 8a-8b, the first protruding surface 46, 460 on the second end 42, 420 of the pin 45, 450 is operatively connected to the first 31, 310 operative end of the elastic element 30, 300.

**[0074]** In turn, the hollow body 21, 210 may comprise a second protruding surface 26, 260 which is operatively connected to the other of said first 31, 310 or second 32, 320 operative end of said elastic element 30, 300. With particular reference to Figures 3a-3c, 7a-7b and 8a-8b, the second protruding surface 26, 260 of the hollow body 21, 210 is operatively connected to the second 32, 320 operative end of said elastic element 30, 300.

**[0075]** Shape and dimensions of the second protruding surface 26, 260 can be different depending on the design and functioning features of the spacer assembly 20, 200. For instance, the second protruding surface 26, 260 may be integrally made on the body of the corresponding hollow body 21, 210, or may be made by elements which are fixed on said hollow body 21,210.

**[0076]** For instance, with reference to Figures 2a-2c, 3a-3c, 4a-4b, 5a-5c, 8a-8b, the hollow body 21 has a cylindrical shape with one base of the cylinder closed and resting on the internal surface of the contact blade 61. A fixing pin 28 protrudes from such base and is inserted in a seat on the contact blade 61. The rigid coupling between the hollow body 21 and the contact blade 61 is obtained with screw means 91 which are fixed on a threaded portion of the fixing pin 28 protruding from the base of hollow body 21.

**[0077]** On the opposite side of the hollow body 21 with respect to the fixing pin 28, the hollow body 21 is provided with a second protruding surface 26 positioned on the internal surface of said hollow body 21. The second protruding surface 26 can be integrally made with the hollow body 21 or, as shown in the illustrated embodiment, can be made by a separate element, for instance a retaining ring inserted into a slot formed on the internal surface of the hollow body 21. Then, in the embodiments of Figures 2a-2c, 3a-3c, 4a-4b, 5a-5c, 8a-8b, the coupling element 40 comprises a shaped pin 45 which has a first end 41 which is inserted in a seat on the contact blade 62. The rigid coupling between the pin 45 and the contact blade 62 is obtained with screw means 92 which are fixed on a threaded portion of the first end 41 of the pin 45.

**[0078]** The pin 45 is provided, on the second end 42 of its body, with a first protruding surface 46 which is a flat surface extending transversally from the longitudinal development of the shaped body of the pin 45. In this case, the pin 45 is inserted into the cylindrical hollow body 21 so that the first protruding surface 46 is positioned in correspondence of the closed base of the cylindrical hollow body 21.

**[0079]** In the embodiments of Figures 2a-2c, 3a-3c, 4a-4b, 5a-5c, 8a-8b, the elastic element 30 is a compression spring which is housed inside the hollow body 21 and which is interposed between the first protruding surface 46 on the pin 45 and second protruding surface 26 on the hollow body 21.

**[0080]** In particular, the compression spring 30 has a first operative end 31 which acts on the first protruding surface 46 (and consequently on the pin 45), and a second operative end 32 which acts on the second protruding surface 26 (and consequently on the hollow body 21), so that the first 46 and second 26 protruding surfaces are pushed in opposite diverging directions. As a result, also the pin 45 and the hollow body 21 are pushed in opposite diverging directions.

**[0081]** In practice, with reference to figures 5a-5c and 8a-8b, the hollow body 21 is subject to a force directed toward the left-hand side of the figures while the pin 45 is subject to a force directed toward the right-hand side of the figures. Consequently, the first contact blade 61 - which is rigidly coupled to the hollow body 21 - is also subject to a force directed toward the left-hand side of the figures, while the second contact blade 62 - which is

rigidly coupled to pin 45 - is also subject to a force directed toward the right-hand side of the figures. As a result of this combination of forces, an overall attractive force between the first 61 and second 62 contact blades is obtained.

**[0082]** In the embodiments of Figures 6a-6c, 7a-7b, the hollow body 210 has a cylindrical shape with one base of the cylinder closed and resting on the internal surface of the contact blade 61. A fixing pin 280 protrudes from such base and is inserted in a seat on the contact blade 61. The rigid coupling between the hollow body 210 and the contact blade 61 is obtained with screw means 91 which are fixed on a threaded portion of the fixing pin 280 protruding from the base of hollow body 210.

**[0083]** On the same side of the hollow body 210 with respect to the fixing pin 280, the hollow body 210 is provided with a second protruding surface 260 positioned on the internal surface of said hollow body 210. In particular, as shown in the illustrated embodiment, the second protruding surface 260 is integrally made on the internal surface of the closed base of the cylinder of the hollow body 210. Alternatively, it can be made by a separate element, for instance a hook or similar fixing means, positioned on the internal surface of the closed base of the cylinder of the hollow body 210.

**[0084]** Then, in the embodiments of Figures 6a-6c and 7a-7b, the coupling element 400 comprises a shaped pin 450 which has a first end 410 which is inserted in a seat on the contact blade 62. The rigid coupling between the pin 450 and the contact blade 62 is obtained with screw means 92 which are fixed on a threaded portion of the first end 410 of the pin 450.

**[0085]** The pin 450 is provided, on the second end 420 of its body, with a first protruding surface 460 which is a surface provided with fixing means, e.g., a hole for inserting the hooking terminal of a spring, extending longitudinally along the development of the shaped body of the pin 450. In this case, the pin 450 is inserted into the cylindrical hollow body 210 so that the first protruding surface 460 is positioned in correspondence of the open base of the cylindrical hollow body 210. As shown in the attached Figures, the second end 420 of the pin 450 can be shaped so as to provide an abutting surface mating the internal surface of the hollow body 210 to impart more stability to the system.

**[0086]** In the embodiments of Figures 6a-6c and 7a-7b, the elastic element 300 is a traction spring which is housed inside the hollow body 210 and which is interposed between the first protruding surface 460 on the pin 450 and second protruding surface 260 on the hollow body 210.

**[0087]** In particular, the traction spring 300 has a first operative end 310 which acts on the first protruding surface 460 (and consequently on the pin 450), and a second operative end 320 which acts on the second protruding surface 260 (and consequently on the hollow body 210), so that the first 460 and second 260 protruding surfaces are pulled in opposite converging directions. As a result, also the pin 450 and the hollow body 210 are pulled in opposite converging directions.

**[0088]** In practice, with reference to figures 6a-6c and 7a-7b, the hollow body 210 is subject to a force directed toward the left-hand side of the figures while the pin 450 is subject to a force directed toward the right-hand side of the figures. Consequently, the first contact blade 61 - which is rigidly coupled to the hollow body 210 - is also subject to a force directed toward the left-hand side of the figures, while the second contact blade 62 - which is rigidly coupled to pin 450 - is also subject to a force directed toward the right-hand side of the figures. As a result of this combination of forces, an overall attractive force between the first 61 and second 62 contact blades is obtained.

**[0089]** Thus, in general embodiments of the invention, the spacer 20, 200 may comprise a hollow body 21, 210 longitudinally developing along a direction transversal to the contact blades and which is rigidly fixed on a first end of its longitudinal development to one on the contact blades; the spacer 20, 200 may further comprise a coupling element 40, 400 longitudinally developing along a direction transversal to the contact blades which is rigidly fixed on a first end of its longitudinal development to the other contact blade. The coupling element 40, 400 and the hollow body 21, 210 may be respectively provided with a first 46, 460 and a second 26, 260 protruding surfaces for operative connection with an elastic element 30, 300.

**[0090]** The design of the coupling element 40, 400 and of the hollow body 21, 210, and the spatial positioning of the elastic element 30, 300, are such that when the elastic element 30, 300 is an elastic element 30 of the compression type, it is spatially interposed between the first protruding surface 46 and the fixing point 41 of the coupling element 40 to the corresponding contact blade and between the second protruding surface 26 and the fixing point 28 of the hollow body 21 to the corresponding contact blade; when the elastic element 30, 300 is an elastic element 300 of the traction type, the second protruding surface 260 is spatially interposed between the elastic element 300 and the fixing point 280 of the hollow body 210 to the corresponding contact blade, and the first protruding surface 460 is spatially interposed between the elastic element 300 and the fixing point 410 of coupling element 400 to the corresponding contact blade.

**[0091]** With reference to the attached Figures, the movable contact assembly 1, 10, 50 of the invention advantageously comprises regulating means for adjusting the preload of the elastic element 30, 300, that can be, e.g., washers 80 as shown in the figures, shims or screw means or other similar regulating means. In practice, the pre-load of the elastic element 30, 300 can be easily adjusted by changing, e.g., the number and/or thickness of the washers 80 interposed, e.g., between the elastic means 30 and the retaining ring 26.

**[0092]** With reference to Figures 4a-4b, 5a-5c, 6a-6c, in particular case when the Medium Voltage switch is

provided with more than one fixed contact, e.g., a first 110 and a second 120 fixed contacts, the movable contact assembly 10, 50 of the invention can be adapted so that the first 61 and second 62 contact blades are provided with a corresponding third 73 and fourth 74 contact element.

**[0093]** The third 73 and fourth 74 contact elements are conveniently positioned facing each other at a second end 611, 621 of the corresponding blade 61, 62, and are adapted to be coupled with a corresponding second fixed contact 120 of a Medium Voltage switch.

**[0094]** In such cases, the movable contact assembly 10, 50 further comprises conveniently a first and a second spacer 20, 200 of the type described hereinabove, which are respectively positioned proximate to the first 71 and second 72 contact element and to said third 73 and fourth 74 contact element.

**[0095]** In the embodiment shown in Figures 4a-4b, 5a-5c, 6a-6c, a central portion 180 of the contact blades 61 and 62 is rotationally mounted on a fixed support so as to allow rotation of the contact blades 61 and 62 between the closed position shown in the Figures - in which the first 71, second 72, third 73 and fourth 74 contact elements are electrically coupled with the corresponding first 110 and second 120 fixed contact of the Medium Voltage switch - and an open position, and vice-versa.

**[0096]** The spacers 20, 200 are conveniently positioned proximate to the contact points, so that the force generated by the elastic elements 30, 300 on the contact systems in the closed position can be maximized.

**[0097]** It is clear from the above description that the arrangement of the movable contact assembly of the present invention, and of a Medium Voltage switch - in particular a disconnector or an earthing switch or a combined disconnector and earthing switch - including the movable contact assembly as described herein, fully achieves the intended aims and solves the above-highlighted problems of the Medium Voltage switches.

**[0098]** Several variations can be made to the movable contact assembly thus conceived all falling within the scope of the attached claims. In practice, the materials used and the contingent dimensions and shapes can be any, according to requirements and to the state of the art.

## Claims

1. A Medium Voltage switch movable contact assembly (1, 10, 50) comprising a first (61) and a second (62) contact blades facing each other at a distance, said first (61) and second (62) contact blades being provided with a corresponding first (71) and second (72) contact element positioned facing each other at a first end (610, 620) of the corresponding blade (61, 62), wherein said first (71) and second (72) contact element are adapted to be coupled with a corresponding first fixed contact (110) of a Medium Voltage switch, **characterized in that** said movable contact assembly (1, 10, 50) comprises at least a spacer (20, 200) interposed between said first (61) and second (62) contact blades, wherein said spacer (20, 200) comprises a hollow body (21, 210) housing an elastic element (30, 300) which has a first operative end (31, 310) operatively connected to one of said first (61) and second (62) contact blades and a second operative end (32, 320) operatively connected to the other of said first (61) and second (62) contact blades, said elastic element (30, 300) exerting an attractive force between said first (61) and second (62) contact blades.

2. The Medium Voltage switch movable contact assembly (1, 10, 50), according to claim 1, wherein said spacer (20, 200) is positioned proximate to said first (71) and second (72) contact element.

3. The Medium Voltage switch movable contact assembly (1, 10, 50), according to claim 1 or 2, wherein said elastic element (30, 300) is positioned substantially perpendicular to said first (61) and second (62) contact blades.

4. The Medium Voltage switch movable contact assembly (1, 10, 50), according to one or more of the previous claims, wherein said spacer (20,200) comprises a coupling element (40, 400) slidingly inserted into said hollow body (21, 210) and having a first end (41, 410) rigidly coupled with one of said first (61) or second (62) contact blades, and wherein said hollow body (21, 210) is rigidly coupled with the other of said first (61) or second (62) contact blades.

5. The Medium Voltage switch movable contact assembly (1, 10, 50), according to claim 4, wherein the first operative end (31, 310) of said elastic element (30, 300) is operatively connected to one between said coupling element (40, 400) or hollow body (21, 210) and the second operative end (32, 320) of said elastic element (30, 300) is operatively connected to the other between said coupling element (40, 400) or hollow body (21, 210).

6. The Medium Voltage switch movable contact assembly (1, 10, 50), according to claim 4 or 5, wherein said coupling element (40, 400) comprises a pin (45, 450) having a first end (41, 410) rigidly coupled with one of said first (61) or second (62) contact blades and a second end (42, 420) operatively connected to said elastic element (30, 300).

7. The Medium Voltage switch movable contact assembly (1, 10, 50), according to claim 6, wherein the second end (42, 420) of said pin (45, 450) comprises a first protruding surface (46, 460) positioned internally to said hollow body (21, 210).

8. The Medium Voltage switch movable contact assembly (1, 10, 50), according to claim 7, wherein the second end (42, 420) of said pin (45, 450) comprises a first protruding surface (46, 460) operatively connected to one of said first (31, 310) or second (32, 320) operative end of said elastic element (30, 300).

9. The Medium Voltage switch movable contact assembly (1, 10, 50), according to claim 8, wherein said hollow body (21, 210) comprises a second protruding surface (26, 260) operatively connected to the other of said first (31, 310) or second (32, 320) operative end of said elastic element (30, 300).

10. The Medium Voltage switch movable contact assembly (1, 10), according to claim 9, wherein said elastic element (30) is a compression spring interposed between said first (46) and second (26) protruding surfaces, and wherein said compression spring (30) has a first operative end (31) resting on said first protruding surface (46) and a second operative end (32) resting on said second protruding surface (26), said compression spring (30) pushing said first (46) and second (26) protruding surfaces in opposite diverging directions.

11. The Medium Voltage switch movable contact assembly (50), according to claim 9, wherein said elastic element (300) is a traction spring interposed between said first (460) and second (260) protruding surfaces, and wherein said traction spring (300) has a first operative end (310) engaged with said first protruding surface (460) and a second operative end (320) engaged with said second protruding surface (260), said traction spring (300) pulling said first (460) and second (260) protruding surfaces in opposite converging directions.

12. The Medium Voltage switch movable contact assembly (1, 10, 50), according to one or more of the previous claims, further comprising regulating means (80) for adjusting the preload of said elastic element (30, 300).

13. The Medium Voltage switch movable contact assembly (10, 50), according to one or more of the previous claims, wherein said first (61) and second (62) contact blades are provided with a corresponding third (73) and fourth (74) contact element positioned facing each other at a second end (611, 621) of the corresponding blade (61, 62), wherein said third (73) and fourth (74) contact elements are adapted to be coupled with a corresponding second fixed contact (120) of a Medium Voltage switch, and wherein the movable contact assembly (10, 50) further comprises a first and a second of said spacer (20, 200) respectively positioned proximate to said first (71) and second (72) contact element and to said third (73) and fourth (74) contact element.

14. A Medium Voltage switch comprising a movable contact assembly (1, 10, 50) according to one or more of the previous claims.

15. The Medium Voltage switch according to claim 14, wherein said switch is a disconnector or an earthing switch or a combined disconnector and earthing switch.

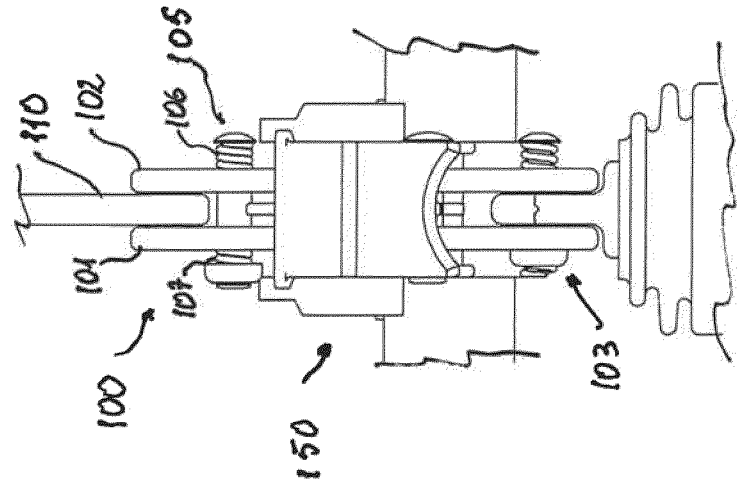



Fig.1b

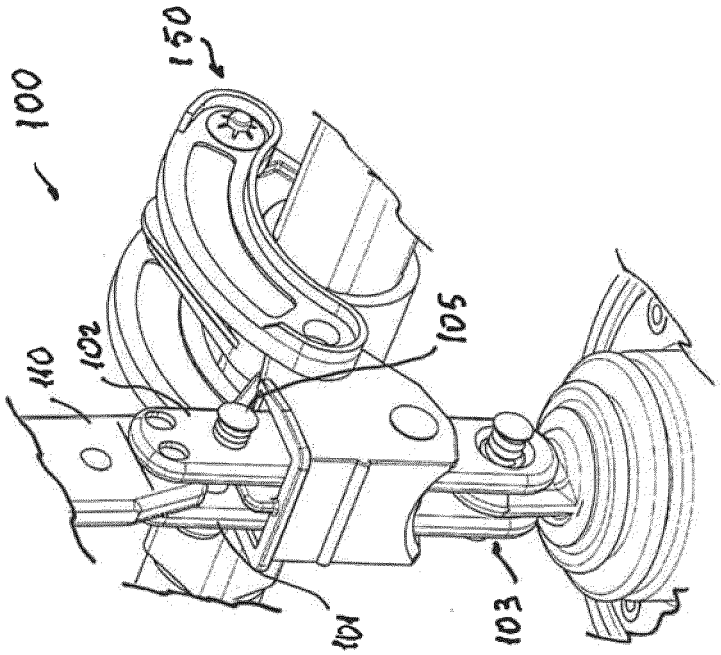
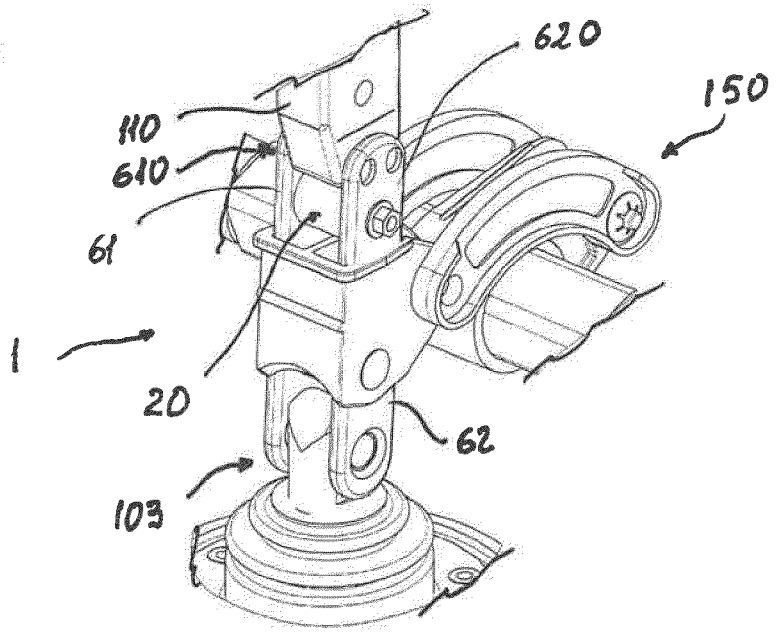



Fig.1a

Fig.2d



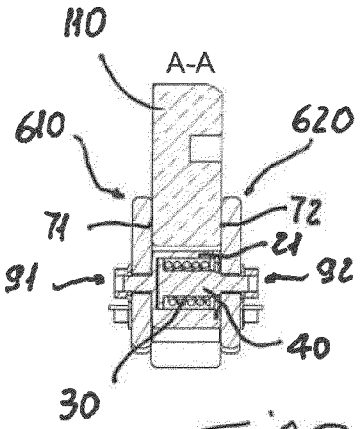




Fig.2c

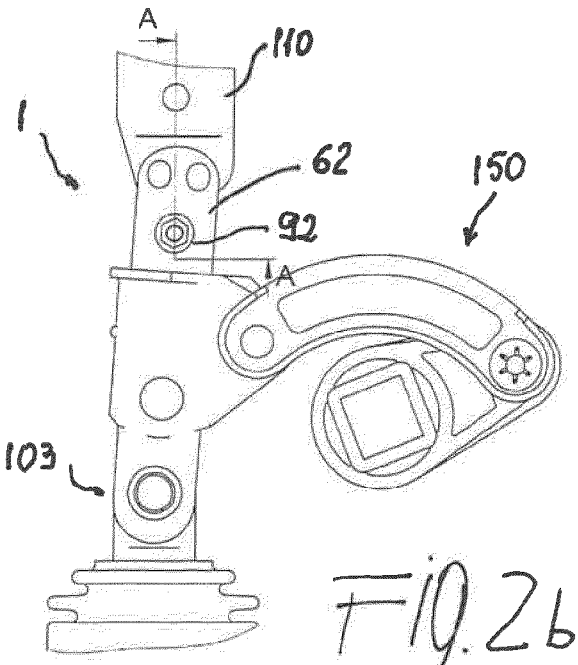



Fig.2b

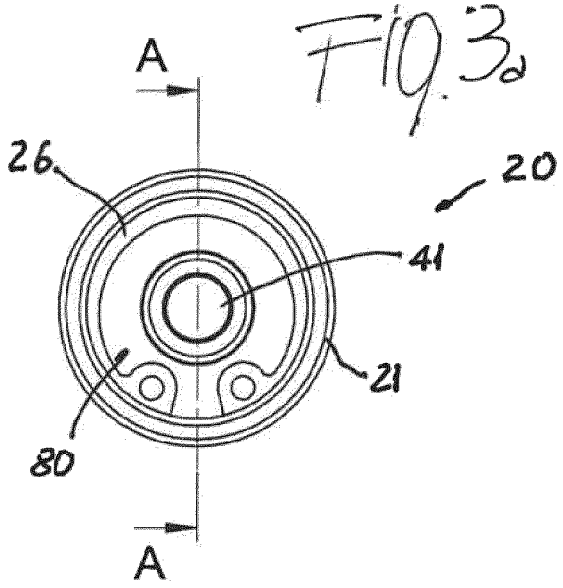



Fig. 3a

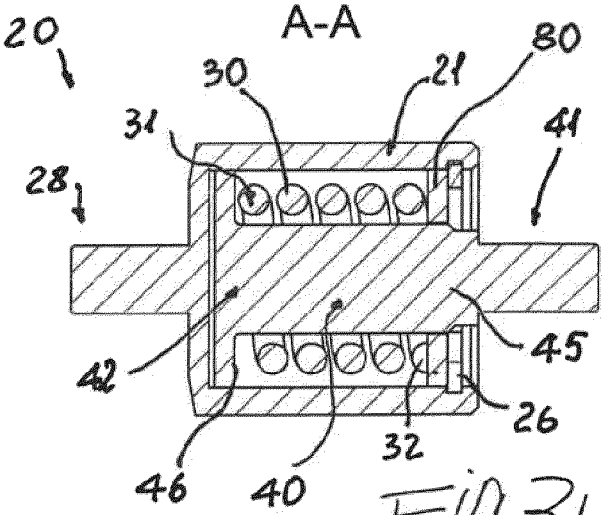



Fig. 3b

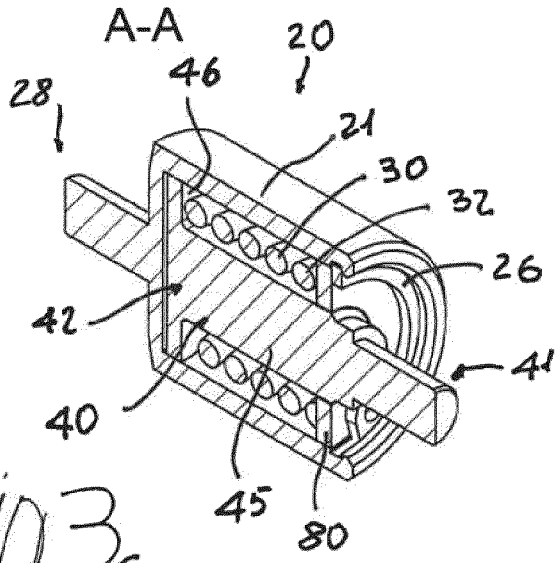



Fig. 3c

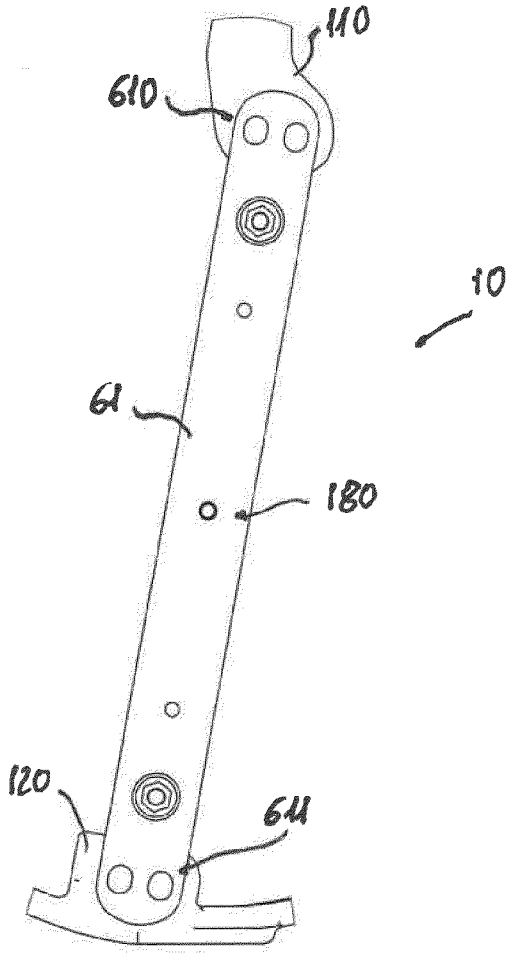
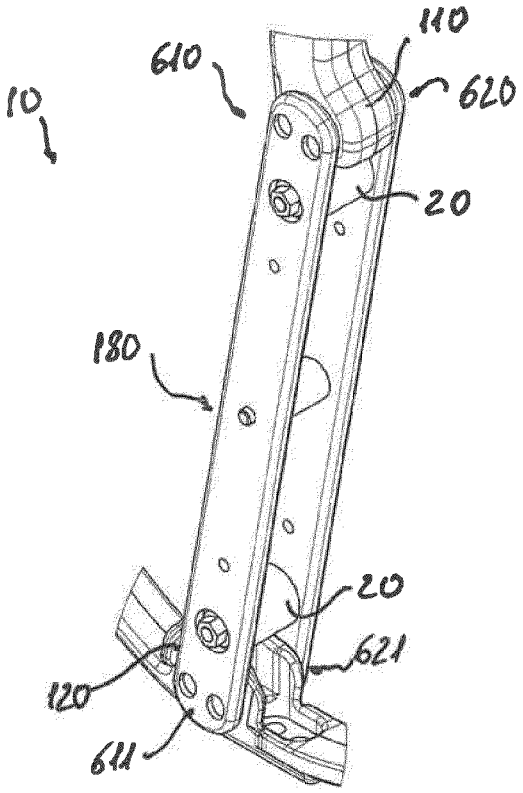



Fig. 4a

Fig. 4b



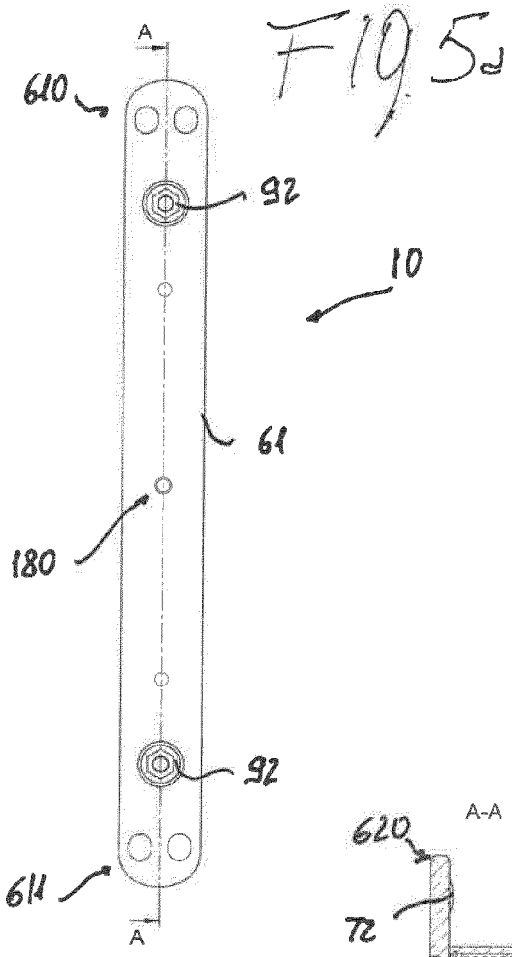



Fig 5a

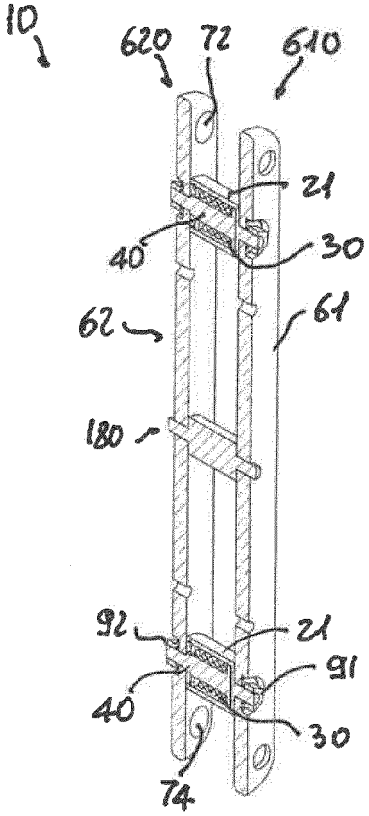



Fig 5c

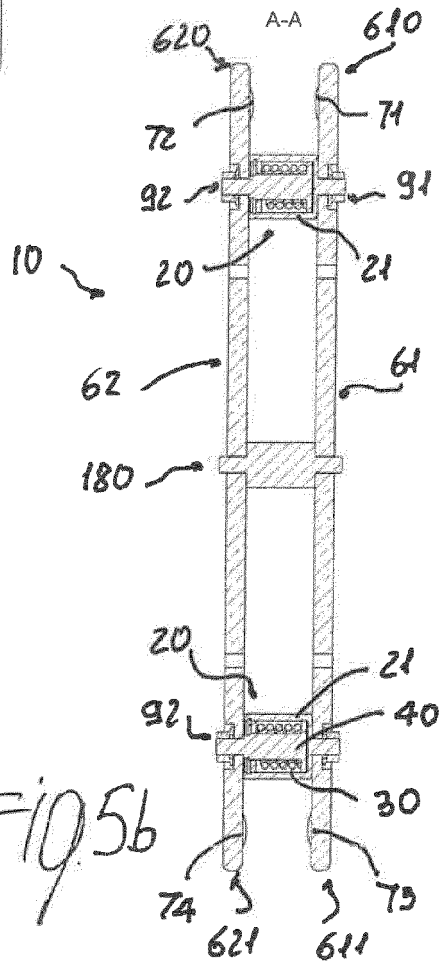



Fig 5b

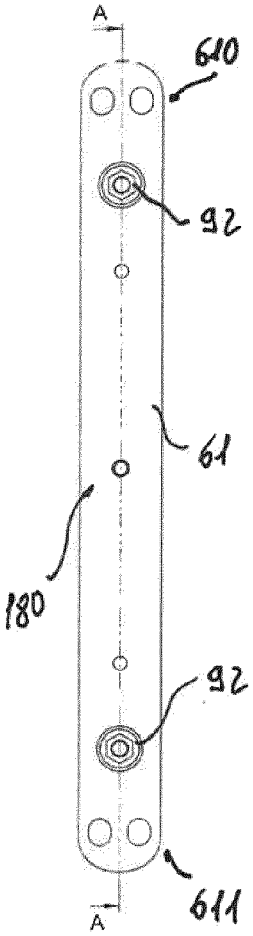



Fig. 6a

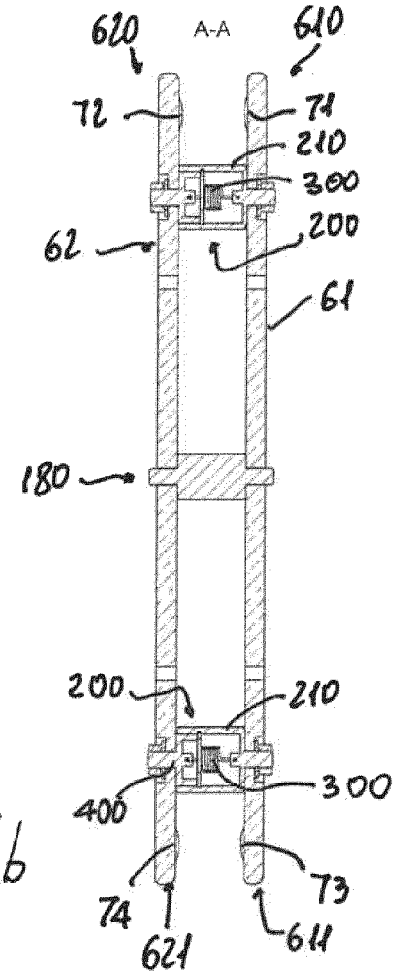



Fig. 6b

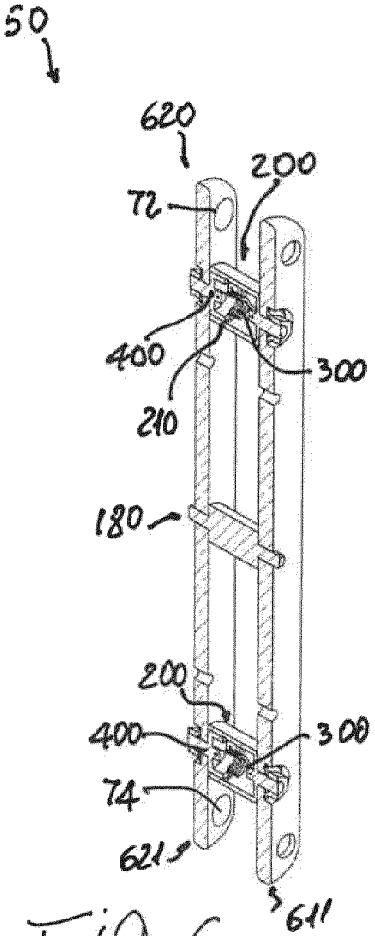
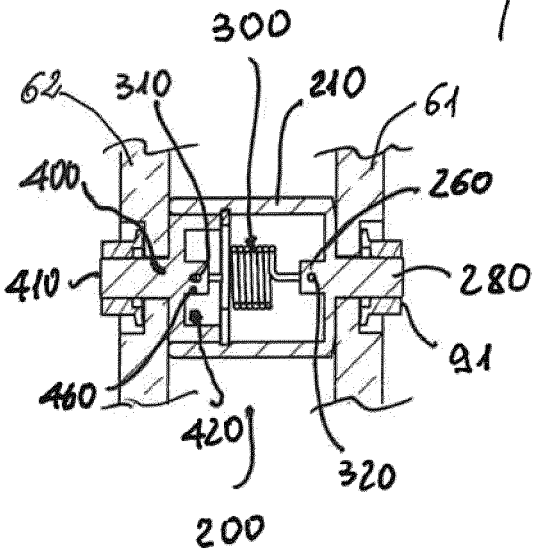



Fig. 6c

Fig. 7a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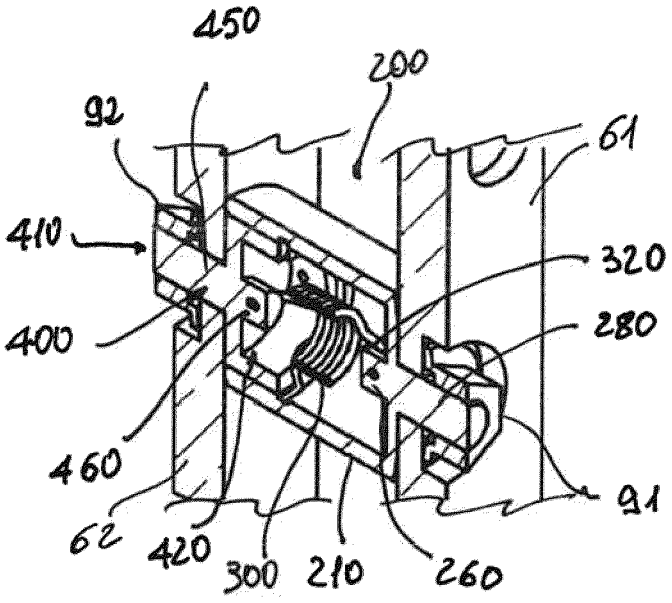
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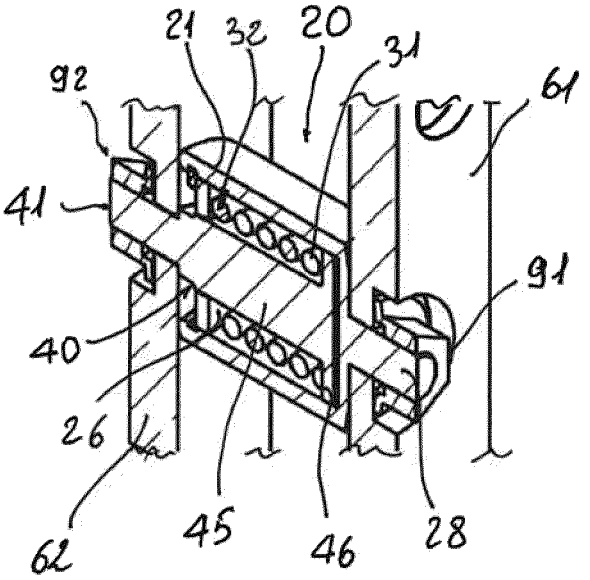
Fig. 7b

Fig 8d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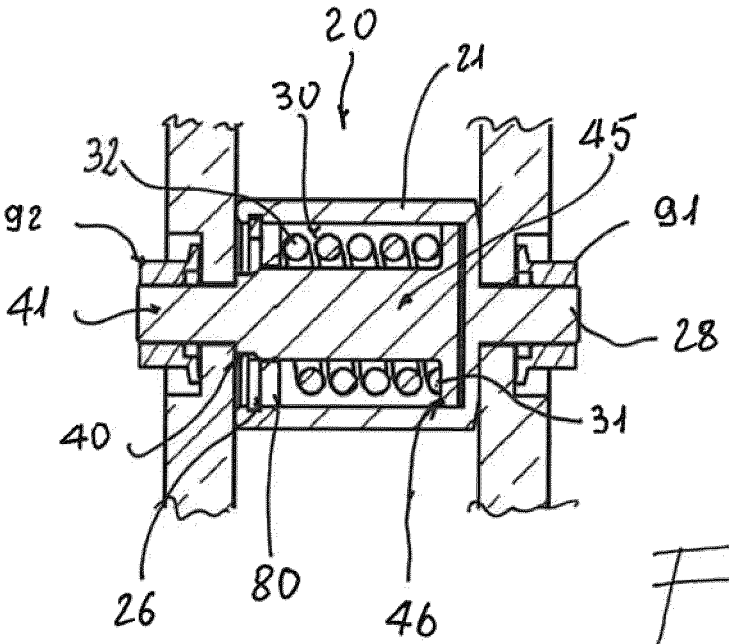
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Fig 8b

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# EUROPEAN SEARCH REPORT

Application Number
EP 23 20 1173

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The present search report has been drawn up for all claims

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| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 15 March 2024 | Ramírez Fueyo, M |

CATEGORY OF CITED DOCUMENTS

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15-03-2024

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