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(54) SELECTOR SWITCH FOR ON-LOAD TAP CHANGER

WAHLSCHALTERANORDNUNG FÜR LASTSTUFENSCHALTER

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Description

TECHNICAL FIELD

[0001] The disclosure relates to a selector switch for an on-load tap changer.

BACKGROUND ART

[0002] An on-load tap changer is part of a power transformer and used to switch a tapping of the transformer to regulate an output high voltage when the power transformer is in full operation, i.e. in an on-load condition. With the use of an on-load tap changer, the output power, or power supply, need not be interrupted, resulting in a substantially continuous supply of output power even when the output voltage has to be regulated. The tap changer includes a set of fixed contacts, each fixed contact being connectable to a number of taps of a regulating winding of the power transformer. By selecting the taps to be connected or disconnected as needed, the output voltage of the transformer can be regulated. On-load tap changers may be configured for single-phase operation; other on-load tap changers may have a configuration for simultaneously changing the tapping of multiple phases, e.g. three phases in a star connection configuration of the transformer windings.

[0003] Publication document US 2014/0159847 discloses an on-load tap changer comprising vacuum switching tubes and contacts being selectively connectable to fixed tap contacts and arranged to be moved vertically during a tap change. The vacuum switching tubes are separated from the contact arms.

[0004] Publication documents JP 2003 188031 A, JP S61 160918 A, JP 2002 124422 A, CN 104 952 603 A and the article by Dieter Dohnal: "On-Load Tap-Changers for Power Transformers", 1 September 2013 (2013-09-01), XP055433140 disclose different types of on-load tap changers.

[0005] In some types of conventional selector switches, two vacuum interrupters (VI) are provided, one having a low resistivity for carrying a nominal current and one resistor type vacuum interrupter. Conventional selector switches are based on a two-step working principle for one coordinated switching operation of the low resistivity VI and the resistor VI, the switching operation performed via a driving mechanism. This approach needs a very accurate coordination of the components driven by the driving mechanism. In addition, the driving mechanism uses different insulation sectors, or regions of insulation, for fastening the vacuum interrupters on the one hand and for fastening the resistor vacuum interrupter on the other hand. Thus, it is difficult to achieve a stable system.

[0006] Hence, there is a desire for a selector switch having a comparatively simple drive mechanism and/or having a simplified insulation.

DESCRIPTION OF THE INVENTION

[0007] According to claim 1, a selector switch for an on-load tap changer is provided. The selector switch comprises a stationary insulation tube that encloses an insulation compartment, a central insulation tube disposed inside the insulation compartment, and a drive mechanism. The central insulation tube has, per each phase, a main vacuum interrupter (VI), a resistor vacuum interrupter (VI), an actuation device, a main sliding arm, and a resistor sliding arm. The main VI has one end which comprises a movable contact, and the main VI has a fixed end. The resistor VI has one end which comprises a movable contact, and the resistor VI has a fixed end. The main vacuum interrupter and the resistor vacuum interrupter are mounted and arranged coaxially and opposed with respect to one another, such that their respective ends having the movable contacts face each other. The actuation device is provided in between the ends having the movable contacts of the vacuum interrupters and is configured to commonly actuate the movable contacts of the VIs. The main sliding arm extends from the fixed end of the main VI. The resistor sliding arm extends from the fixed end of the resistor VI. The drive mechanism is configured to rotationally drive the central insulation tube such that, by the rotation, a switching sequence is performed. The switching sequence comprises: Moving the main sliding arm from a current tap to a next tap; and - after a time delay has passed - moving the resistor sliding arm from a current tap to a next tap.

[0008] Thus, a simple system can control the vacuum interrupters. Since the common insulation tube carries all pairs of main VI and resistor VI for each phase, a compact configuration is achieved. Since per each phase, two sliding contact arms (the main sliding arm and the resistor sliding arm) are mounted, the insulation does not need different insulation sectors. Also, an idle run movement of the resistor arm provides the time delay, which makes the drive mechanism comparatively simple.

[0009] According to another aspect, an on-load tap changer is provided. The on-load tap changer comprises the selector switch as described herein.

[0010] According to yet another aspect, a power transformer is provided. The power transformer includes an on-load tap changer. The on-load tap changer comprises the selector switch as described herein.

[0011] Further embodiments and aspects are apparent from the detailed description, as well as from the dependent claims.

[0012] In embodiments, the resistor sliding arm is mounted on the fixed end of the resistor vacuum interrupter by means of a movable joint that provides the time delay in the switching sequence. Thus, the idle run rotation is angularly defined, which eliminates the need for coordinated driving in the drive mechanism.

[0013] According to an embodiment, the movable contacts of the main vacuum interrupter and the resistor-type vacuum interrupter are arranged such as to face the ac-

tuation device. Typically, the movable contacts are arranged substantially on a common axis.

[0014] In yet further embodiments, wherein the switching sequence includes, in the stated order: Opening the main VI by means of the actuation device. Moving the main sliding arm from a current tap to a next tap. Closing the main VI by means of the actuation device. Opening the resistor VI by means of the actuation device. Moving the resistor sliding arm from a current tap to a next tap. Closing the resistor VI by means of the actuation device.

[0015] Typically, the movement of the main sliding arm and that of the resistor sliding arm is performed via the rotation of the central insulation tube through an angular definition that includes an idle run in between the movement of the main sliding arm and the movement of the resistor sliding arm. In other words: In a tap changing sequence, moving the resistor sliding arm is started a certain time period after the moving of the main sliding arm by means of angularly defined elements.

[0016] In this connection, the actuation device may comprise a control cam ring. The actuation device, or common lever, is controlled by means of the control cam ring. Typically, the cam ring is made of metal and serves as an electric terminal. Here, the control cam ring may carry a nominal, or rated, current.

[0017] Typically, the switching sequence is performed commonly for each phase. That is, in typical configurations of a multi-phase selector, the switching sequence steps are performed substantially simultaneously on each of the phases, e.g. three phases.

[0018] In further embodiments, the drive mechanism comprises a Geneva drive that is configured to rotationally drive the central insulation tube in a step-wise manner. Thus, the drive mechanism can be simplified. For example, the central tube may be mechanically connected, on one side thereof, to a Geneva wheel of the Geneva drive, and fixed, on the other side thereof, to a metal bottom part of the selector. Typically, a spring accumulator is provided for activating the Geneva wheel of the Geneva drive for starting the rotation of the central tube.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] In the following, embodiments of the present disclosure will be described with reference to the drawings in which:

Fig. 1 is a schematic perspective illustration of details of a selector switch according to an embodiment;

Fig. 2 is a schematic perspective illustration of the selector switch of Fig. 1 at a different scaling.

DETAILED DESCRIPTION

[0020] Fig. 1 shows parts of one phase of a selector switch for a multi-phase tap changer of the column type. In Fig. 1, a main vacuum interrupter (VI) 110 and a resistor vacuum interrupter (VI) 120 are mounted and arranged opposed to one another, such that their respective movable contact ends face each other. In other words: Their movable contacts are oriented to each other, and coaxially mounted with respect to one another. The fixed ends of the main VI 110 and the resistor VI 120 are respectively mounted on a supporting frame. In between the movable ends, an actuation device 150 is provided that is configured to commonly actuate the movable contacts of the VIs 110, 120.

[0021] As apparent from Fig. 2, which shows the selector switch of Fig. 1 in a different scaling, a main sliding arm 115 is provided that extends from the fixed end of the main VI 110. Furthermore, a resistor sliding arm 125 is provided that extends from the fixed end of the resistor VI 120. "Resistor" in "resistor sliding arm", as used herein, is to be understood as a reference term only, in order to distinguish the arms 115 and 125 from each other. It does not imply that the sliding arm 125 itself has a resistive function, but rather that it refers to the resistor-type VI 120.

[0022] The main VI 110, the resistor VI 120, the actuation device 150, the main sliding arm 115, and the resistor sliding arm 125 are members of a central insulation tube (not shown) that is disposed inside an insulation compartment of a stationary insulation tube. A drive mechanism (not shown) is configured to rotationally drive the central insulation tube.

[0023] By the rotation, a switching sequence is performed that involves opening the main vacuum interrupter (110) by means of the actuation device (150), moving the main sliding arm (115) from a current tap to a next tap (not shown), closing the main vacuum interrupter (110) by means of the actuation device (150), opening the resistor vacuum interrupter (120) by means of the actuation device (150), moving the resistor sliding arm (125) from a current tap to a next tap, and closing the resistor vacuum interrupter (120) by means of the actuation device (150). Details on the switching according to the switching sequence are discussed below.

[0024] In the switching sequence, the resistor sliding arm 125 is moved from the current tap to the next tap after a time delay has passed from the movement of the main sliding arm 115 from the current tap to the next tap.

[0025] It is noted that Figs. 1 and 2 only show one phase of the selector switch; in a typical embodiment, mounted in the insulation tube are three pairs of sliding arms 115, 125, namely, one pair thereof per phase. The common insulation tube supports all pairs of vacuum interrupters 110, 120. The main sliding contact arm 115 is connected to the main VI 110, fixed on the central insulation tube. Likewise, the resistor sliding contact arm 125 is connected to the resistor VI 120. The arms 115, 125, or levers, may also be configured to perform a bi-direction operation. On each phase, the two sliding arms 115, 125 are attached; the respective first arm, or main sliding arm, 115 is connected to the main VI 110; the respective second arm, or resistor sliding arm, 125 is connected to the

resistor VI 120 and provides an idle run movement to achieve the time delay in the switching sequence.

[0026] In the embodiment, the actuation device 150 further comprises a control cam ring 151. The cam ring 151 is made of metal and is configured to provide a rated, or nominal, current; in other words: The cam ring 151 forms an electric terminal. In the embodiment, the drive mechanism comprises a Geneva drive (not shown). The central insulation tube is, on one side thereof, mechanically connected to a Geneva wheel of the Geneva drive, and on the other side thereof, to a bottom part. The actuation device 150, or common lever, works as a bidirectional guiding system. The common lever is controlled by the cam ring 151, e.g. with a grove guiding means or a planar guiding means.

[0027] The contact arms 115, 125 are mounted on the central insulation tube. Three of them, one per each phase, are assigned to operate the respective main VIs 110, and they are fixedly joined to the central insulation tube. Another three of them, one per each phase, are assigned to operate the respective resistor VIs 110, and they are joined to the central insulation tube through intermediation of a movable joint 126. The movable joint 126 provides an idle run and thus the time delay in the switching sequence. The idle run rotation is defined by the turning angle of the central insulation tube.

[0028] In order to initiate a switching sequence, a spring accumulator (not shown) activates the Geneva wheel of the Geneva drive. The central insulation tube starts rotating. For each phase, the main VIs 110 breaks the current. Then, the main sliding contact arms 115 change the contact tap. Subsequently, the main VIs 110 are closing. Due to the contact transfer of the main sliding contact arms 115, the resistor sliding contact arms 125 each remain at the previous tap first. Then, the resistor VIs 120 open and the resistor sliding arms 125 change the tap. Finally, the resistor VIs 120 are closed.

[0029] It is noted that while the above description refers to specific embodiments, the skilled person will recognize that the features described therein may be combined as appropriate, and/or that one or more features thereof may be altered or omitted as appropriate, without departing from the gist of the present application whose scope is defined by the claims.

Claims

1. A selector switch for an on-load tap changer, the selector switch comprising

a stationary insulation tube enclosing an insulation compartment;
a central insulation tube disposed inside the insulation compartment, the central insulation tube having, per each phase

a main vacuum interrupter (110) including one end having a movable contact and including a fixed end;
a resistor vacuum interrupter (120) including one end having a movable contact and including a fixed end; wherein
the main vacuum interrupter (110) and the resistor vacuum interrupter (120) are mounted and arranged coaxially and opposed with respect to one another, such that their respective ends having the movable contacts face each other; and
an actuation device (150) is provided in between the ends having the movable contacts of the vacuum interrupters, configured to commonly actuate the movable contacts of the vacuum interrupters;
a main sliding arm (115) extending from the fixed end of the main vacuum interrupter; and
a resistor sliding arm (125) extending from the fixed end of the resistor vacuum interrupter;

and a drive mechanism configured to rotationally drive the central insulation tube such that by the rotation a switching sequence is performed, the switching sequence including moving the main sliding arm (115) from a current tap to a next tap and, after a time delay has passed, moving the resistor sliding arm (125) from a current tap to a next tap.

2. The selector switch according to claim 1, wherein the resistor sliding arm (125) is mounted
on the fixed end of the resistor vacuum interrupter by means of a movable joint providing the time delay in the switching sequence.

3. The selector switch according to any one of the preceding claims, wherein the movable contacts of the main vacuum interrupter (110) and the resistor-type vacuum interrupter (120) are arranged such as to face the actuation device.

4. The selector switch according to claim 3, wherein the movable contacts are arranged substantially on a common axis.

5. The selector switch according to any one of the preceding claims, wherein the switching sequence includes, in the stated order,

i. opening the main vacuum interrupter (110) by means of the actuation device (150);
ii. moving the main sliding arm (115) from a current tap to a next tap;
iii. closing the main vacuum interrupter (110) by means of the actuation device (150);

iv. opening the resistor vacuum interrupter (120) by means of the actuation device (150);
v. moving the resistor sliding arm (125) from a current tap to a next tap;
vi. closing the resistor vacuum interrupter (120) by means of the actuation device (150).

6. The selector switch according to any one of the preceding claims, wherein the actuation device comprises a control cam ring (151).

7. The selector switch according to any one of the preceding claims, wherein the drive mechanism comprises a Geneva drive configured to rotationally drive the central insulation tube in a step-wise manner.

8. The selector switch according to any one of the preceding claims, wherein the switching sequence is performed commonly for each phase.

9. An on-load tap changer comprising the selector switch according to any one of the preceding claims.

10. A power transformer including an on-load tap changer, the on-load tap changer comprising the selector switch according to any one of claims 1-8.

Patentansprüche

1. Wahlschalter für einen Laststufenschalter, wobei der Wahlschalter Folgendes umfasst:

ein stationäres Isolierrohr, das eine Isolierkammer umschließt;
ein zentrales Isolierrohr, das innerhalb der Isolierkammer angeordnet ist, wobei das zentrale Isolierrohr pro Phase Folgendes aufweist:

einen Haupt-Vakuumunterbrecher (110), der ein Ende mit einem beweglichem Kontakt und ein festes Ende aufweist;
einen Widerstand-Vakuumunterbrecher (120), der ein Ende mit einem beweglichem Kontakt und ein festes Ende aufweist; wobei
der Haupt-Vakuumunterbrecher (110) und der Widerstand-Vakuumunterbrecher (120) koaxial und einander gegenüberliegend angeordnet sind, sodass ihre jeweiligen Enden mit den beweglichen Kontakten einander zugewandt sind; und
zwischen den Enden mit den beweglichen Kontakten der Vakuumunterbrecher eine Betätigungsvorrichtung (150) bereitgestellt ist, die dazu ausgelegt ist, die beweglichen Kontakte der Vakuumunterbrecher gemeinsam zu betätigen;
einen Haupt-Schiebearm (115), der sich vom festen Ende des Haupt-Vakuumunterbrechers erstreckt; und
einen Widerstand-Schiebearm (125), der sich vom festen Ende des Widerstand-Vakuumunterbrechers erstreckt;
und einen Antriebsmechanismus, der dazu ausgelegt ist, das zentrale Isolierrohr derart drehend anzutreiben, dass durch die Drehung eine Schaltsequenz ausgeführt wird, wobei die Schaltsequenz das Bewegen des Haupt-Schiebearms (115) von einem aktuellen Abgriff zu einem nächsten Abgriff und, nach Ablauf einer Zeitverzögerung, das Bewegen des Widerstand-Schiebearms (125) von einem aktuellen Abgriff zu einem nächsten Abgriff beinhaltet.

2. Wahlschalter nach Anspruch 1, wobei der Widerstand-Schiebearm (125) mittels einer beweglichen Verbindung am festen Ende des Widerstand-Vakuumunterbrechers montiert ist, die die Zeitverzögerung in der Schaltsequenz bereitstellt.

3. Wahlschalter nach einem der vorhergehenden Ansprüche, wobei die beweglichen Kontakte des Haupt-Vakuumunterbrechers (110) und des Widerstand-Vakuumunterbrechers (120) derart angeordnet sind, dass sie der Betätigungsvorrichtung zugewandt sind.

4. Wahlschalter nach Anspruch 3, wobei die beweglichen Kontakte im Wesentlichen auf einer gemeinsamen Achse angeordnet sind.

5. Wahlschalter nach einem der vorhergehenden Ansprüche, wobei die Schaltsequenz Folgendes in der angegebenen Reihenfolge beinhaltet:

i. Öffnen des Haupt-Vakuumunterbrechers (110) mittels der Betätigungsvorrichtung (150);
ii. Bewegen des Haupt-Schiebearms (115) von einem aktuellen Abgriff zu einem nächsten Abgriff;
iii. Schließen des Haupt-Vakuumunterbrechers (110) mittels der Betätigungsvorrichtung (150);
iv. Öffnen des Widerstand-Vakuumunterbrechers (120) mittels der Betätigungsvorrichtung (150);
ii. Bewegen des Widerstand-Schiebearms (125) von einem aktuellen Abgriff zu einem nächsten Abgriff;
iii. Schließen des Widerstand-Vakuumunterbrechers (120) mittels der Betätigungsvorrichtung (150).

6. Wahlschalter nach einem der vorhergehenden Ansprüche, wobei die Betätigungsvorrichtung einen

Steuernockenring (151) umfasst.

7. Wahlschalter nach einem der vorhergehenden Ansprüche, wobei der Antriebsmechanismus ein Malteserkreuzgetriebe umfasst, das dazu ausgelegt ist, das zentrale Isolierrohr schrittweise drehend anzutreiben.

8. Wahlschalter nach einem der vorhergehenden Ansprüche, wobei die Schaltsequenz gemeinsam für jede Phase ausgeführt wird.

9. Laststufenschalter, der den Wahlschalter nach einem der vorhergehenden Ansprüche umfasst.

10. Leistungstransformator mit einem Laststufenschalter, wobei der Laststufenschalter den Wahlschalter nach einem der Ansprüche 1-8 umfasst.

Revendications

1. Commutateur sélecteur pour un combinateur à prises, le commutateur sélecteur comprenant

un tube d'isolation fixe renfermant un compartiment d'isolation ;
un tube d'isolation central disposé à l'intérieur du compartiment d'isolation, le tube d'isolation central ayant, pour chaque phase
un interrupteur à vide principal (110) comportant une extrémité ayant un contact mobile et comportant une extrémité fixe ;
un interrupteur à vide résistance (120) comportant une extrémité ayant un contact mobile et comportant une extrémité fixe ;
l'interrupteur à vide principal (110) et l'interrupteur à vide résistance (120) étant montés et agencés de manière coaxiale et opposés l'un à l'autre, de telle sorte que leurs extrémités respectives ayant les contacts mobiles se font face ; et
un dispositif d'actionnement (150) étant prévu entre les extrémités ayant les contacts mobiles des interrupteurs à vide, configuré pour activer de manière commune les contacts mobiles des interrupteurs à vide ;
un bras coulissant principal (115) s'étendant depuis l'extrémité fixe de l'interrupteur à vide principal ; et
un bras coulissant résistance (125) s'étendant depuis l'extrémité fixe de l'interrupteur à vide résistance ;
et un mécanisme d'entraînement configuré pour entraîner en rotation le tube d'isolation central de telle sorte que, par la rotation, une séquence de commutation est réalisée, la séquence de commutation comportant la mobilité du bras coulissant principal (115) d'une prise actuelle à une prise suivante et, après qu'un délai s'est écoulé, la mobilité du bras coulissant résistance (125) d'une prise actuelle à une prise suivante.

2. Commutateur sélecteur selon la revendication 1, le bras coulissant résistance (125) étant monté sur l'extrémité fixe de l'interrupteur à vide résistance au moyen d'une articulation mobile fournissant le délai dans la séquence de commutation.

3. Commutateur sélecteur selon l'une quelconque des revendications précédentes, les contacts mobiles de l'interrupteur à vide principal (110) et de l'interrupteur à vide de type résistance (120) étant agencés de telle manière à faire face au dispositif d'actionnement.

4. Commutateur sélecteur selon la revendication 3, les contacts mobiles étant agencés sensiblement sur un axe commun.

5. Commutateur sélecteur selon l'une quelconque des revendications précédentes, la séquence de commutation comportant, dans l'ordre indiqué,

i. l'ouverture de l'interrupteur à vide principal (110) au moyen du dispositif d'actionnement (150) ;
ii. la mobilité du bras coulissant principal (115) d'une prise actuelle à une prise suivante ;
iii. la fermeture de l'interrupteur à vide principal (110) au moyen du dispositif d'actionnement (150) ;
iv. l'ouverture de l'interrupteur à vide résistance (120) au moyen du dispositif d'actionnement (150) ;
v. la mobilité du bras coulissant résistance (125) d'une prise actuelle à une prise suivante ;
vi. la fermeture de l'interrupteur à vide résistance (120) au moyen du dispositif d'actionnement (150).

6. Commutateur sélecteur selon l'une quelconque des revendications précédentes, le dispositif d'actionnement comprenant un anneau à cames de commande (151).

7. Commutateur sélecteur selon l'une quelconque des revendications précédentes, le mécanisme d'entraînement comprenant une entraînement à croix de Malte configuré pour entraîner en rotation le tube d'isolation central par étapes.

8. Commutateur sélecteur selon l'une quelconque des revendications précédentes, la séquence de commutation étant réalisée de manière commune pour chaque phase.

9. Combinateur à prises comprenant le commutateur sélecteur selon l'une quelconque des revendications précédentes.

10. Transformateur de puissance comportant un combinateur à prises, le combinateur à prises comprenant le commutateur sélecteur selon l'une quelconque des revendications 1 à 8.

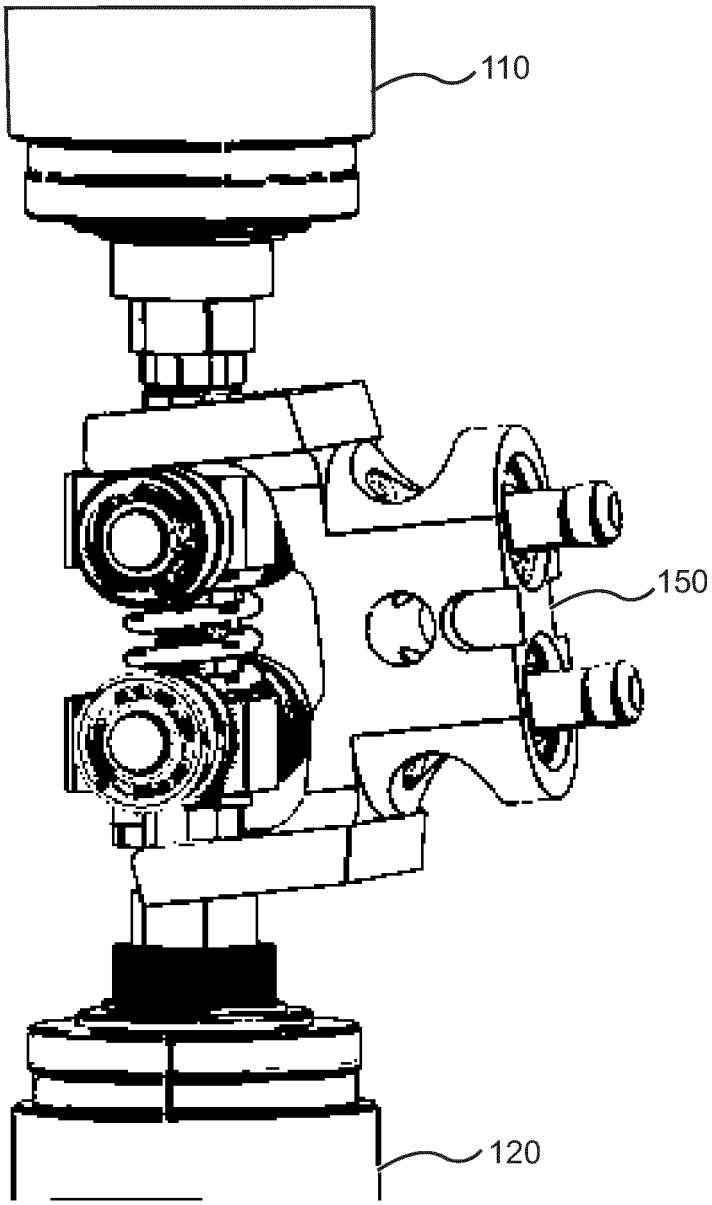

Fig. 1

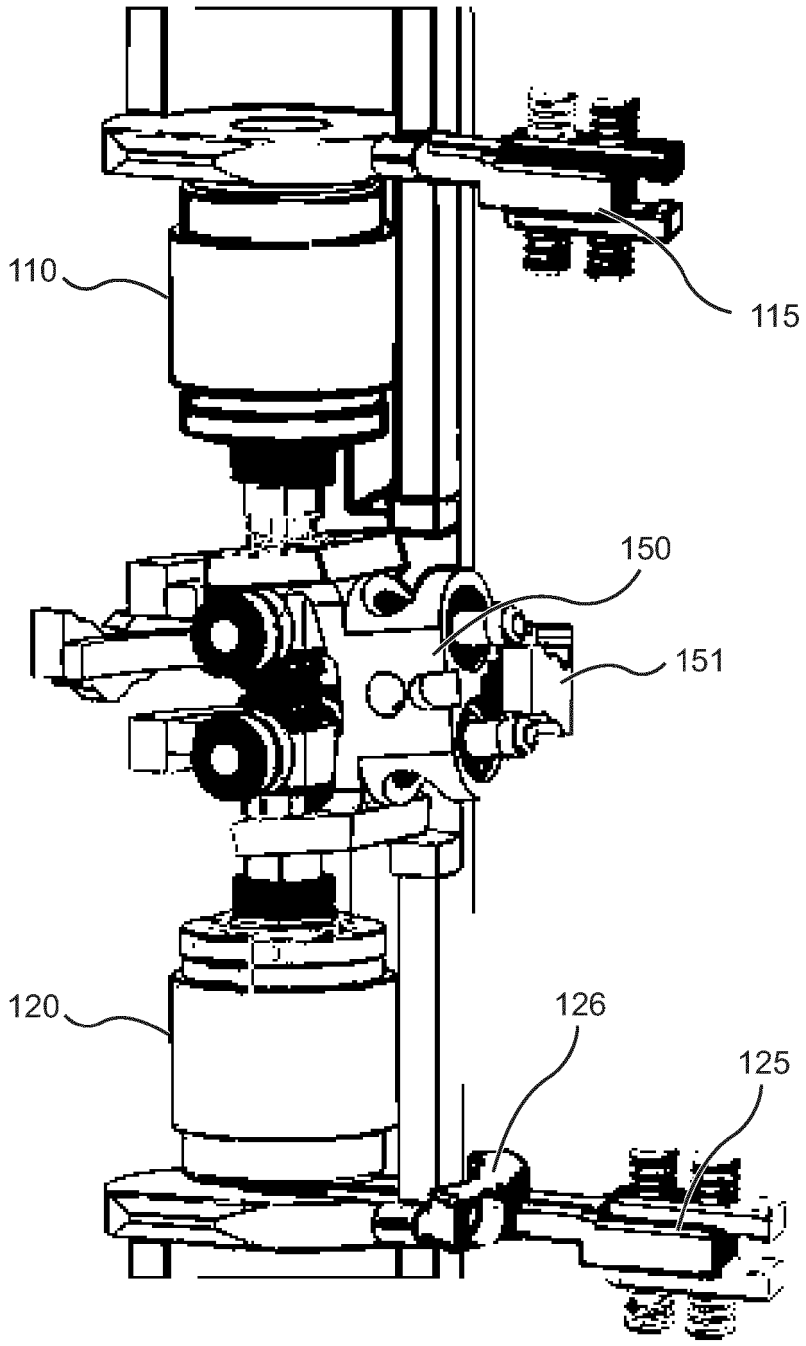

Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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