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(54) RECIPROCATING SWITCHING MECHANISM HAVING ON-LOAD TAP CHANGER

(57) Disclosed is a reciprocating switching mechanism of an on-load tap changer. The reciprocating switching mechanism of the on-load tap changer includes a connection assembly and at least one switching assembly. The at least one switching assembly includes two switching units, the two switching units are arranged on opposite sides of the connection assembly, the two switching units are connected with the connection assembly through a first connection rod and a second connection rod, the first connection rod and the second connection rod are separated by a preset distance, and the first connection rod is slidable relative to the connection assembly. Each of the switching units includes a movable contact assembly and two static contacts, the two static contacts are located at opposite sides of the movable contact assembly, the movable contact assembly is connectable to the static contacts, and the movable contact assembly is slidable relative to the static contacts. One end of each of the two static contacts is connectable with an external support, the movable contact assembly is connected with the connection assembly through the first connection rod and the second connection rod, and the movable contact assembly is rotatable around a central axis of the second connection rod.

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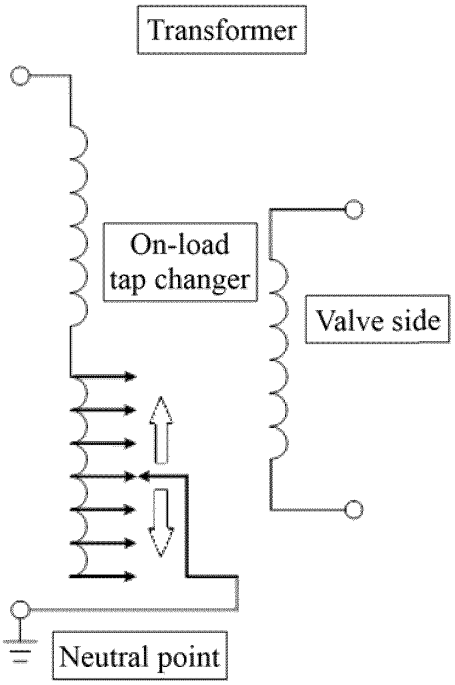

FIG. 1

Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application is filed based on and claims priority to Chinese Patent application No. 202110850706.7 filed on July 27, 2021, the contents of which are hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The disclosure relates to the technical field of an on-load tap changer of a transformer, and in particular to a reciprocating switching mechanism of an on-load tap changer.

BACKGROUND

[0003] An on-load tap changer is a special switch for switching a primary winding tap or a secondary winding tap of a transformer with load to adjust an output voltage of the transformer.

[0004] Currently, a combined vacuum on-load tap changer is generally configured for adjusting the voltage of the transformer with load. The combined vacuum on-load tap changer is generally composed of three major parts: a driving mechanism, a selector and a switch. The driving mechanism includes an electromotor, a hand-operating mechanism, a brake, a counter, a position indicator, a small control switch and a set of complex transmission gears. Here, the driving mechanism is configured for operating the switch. The switch is composed of a fast mechanism, a main on-off contact, a reciprocating mechanical contact and a transition resistor. During the usage of the combined vacuum on-load tap changer, a tap position is preselected by the selector firstly, and then the tap position is switched by the switch. The fast mechanism is connected with the electromotor to drive each of the contacts to complete the switching.

SUMMARY

[0005] For the shortcomings in the related art, a purpose of the present disclosure is to provide a reciprocating switching mechanism of an on-load tap.

[0006] The purpose of the present disclosure is realized by the following technical solutions. A reciprocating switching mechanism of an on-load tap changer includes a connection assembly and at least one switching assembly. The at least one switching assembly includes two switching units, the two switching units are arranged on opposite sides of the connection assembly, the two switching units are connected with the connection assembly through a first connection rod and a second connection rod, the first connection rod and the second connection rod are separated by a preset distance, and the first connection rod is slidable relative to the connection assembly. Each of the switching units includes a movable contact assembly and two static contacts, the two static contacts are located at opposite sides of the movable contact assembly, the movable contact assembly is connectable to the static contacts, and the movable contact assembly is slidable relative to the static contacts. One end of each of the two static contacts is connectable with an external support, the movable contact assembly is connected with the connection assembly through the first connection rod and the second connection rod, and the movable contact assembly is rotatable around a central axis of the second connection rod.

[0007] Preferably, in the reciprocating switching mechanism of the on-load tap changer provided in the present disclosure, the connection assembly includes a fixed disc and a rotatable disc, the fixed disc is provided with a rotation hole, the rotation hole extends through the fixed disc along a central axis direction of the fixed disc, the fixed disc is provided with a fixed hole, the second connection rod goes through the fixed hole, the rotatable disc is provided with at least one slide rail, the at least one slide rail extends along a circumferential direction of the rotatable disc, the first connection rod is slidable along the at least one slide rail, the rotatable disc is inserted in the rotation hole, and the rotatable disc is rotatable relative to the fixed disc.

[0008] Preferably, in the reciprocating switching mechanism of the on-load tap changer provided in the present disclosure, the movable contact assembly includes a rotatable plate and two clamping assemblies, the rotatable plate is connected with the connection assembly through the first connection rod and the second connection rod, the rotatable plate is rotatable around the central axis of the second connection rod, the two clamping assemblies are arranged on the rotatable plate and opposite to each other, the clamping assemblies and the static contacts are arranged in an one-to-one correspondence, and each of the clamping assemblies is configured to clamp a respective one of the static contacts.

[0009] Preferably, in the reciprocating switching mechanism of the on-load tap changer provided in the present disclosure, the switching assembly further includes a slide assembly, the slide assembly is located on a side of the second connection rod away from the first connection rod, the slide assembly goes through the connection assembly, two ends of the slide assembly are respectively inserted in the two switching units, and the slide assembly is slidably connectable with the switching units. Additionally, the slide assembly is slidable relative to the connection assembly.

[0010] Preferably, in the reciprocating switching mechanism of the on-load tap changer provided in the present disclosure, the slide assembly includes a slide rod and two slide blocks which are arranged to opposite to each other, the slide blocks and the switching units are arranged in an one-to-one correspondence, the slide rod goes through the connection assembly, and two ends of the slide rod are inserted in the two slide blocks respectively, and the slide rod is slidable relative to the connec-

tion assembly. The rotatable plate is provided with a slide groove, the slide groove extends through the rotatable plate along a central axis direction of the first connection rod, the slide blocks are inserted in the slide groove, and the slide blocks are slidable along the slide groove.

[0011] Preferably, in the reciprocating switching mechanism of the on-load tap changer provided in the present disclosure, the movable contact assembly further includes an elastic member, an installation hole is provided on a side of the slide groove facing away from the slide blocks, one end of the elastic member is connected with an outer peripheral wall of the second connection rod through the installation hole, and another end of the elastic member is connected with the slide blocks. Additionally, the elastic member is in a compression state, and a restoration force of the elastic member is configured to push the rotatable plate to rotate.

[0012] Preferably, in the reciprocating switching mechanism of the on-load tap changer provided in the present disclosure, for each of the clamping assemblies, the clamping assembly includes two clamping plates which are arranged to opposite to each other, the two clamping plates are arranged at a top end and a bottom end of the rotatable plate respectively, the clamping plates are rotatable relative to the rotatable plate, are spaced by a preset distance, and are configured to connect the clamping assembly with a respective one of the static contacts.

[0013] Preferably, in the reciprocating switching mechanism of the on-load tap changer provided in the present disclosure, for each of the clamping plates, the clamping plates is provided with an arc-shaped spring sheet, a top end of the clamping plate is provided with a groove, the arc-shaped spring sheet is arranged in the groove, the arc-shaped spring sheet is detachably connected with the clamping plates, and the arc-shaped spring sheet is configured to reset the clamping plate.

[0014] Preferably, in the reciprocating switching mechanism of the on-load tap changer provided in the present disclosure, each of the static contacts includes a fixed part, a first connection part and a second connection part, the first connection part and the second connection part are arranged on opposite sides of the fixed part, and the first connection part is connected with the movable contact assembly. Additionally, a thickness of the first connection part gradually increases along a length direction of the fixed part away from the movable contact assembly.

[0015] In summary, the technical effects of the present disclosure are as the following. The reciprocating switching mechanism of the on-load tap changer provided in the present disclosure includes the connection assembly and the at least one switching assembly. The at least one switching assembly includes two switching units, the two switching units are arranged on opposite sides of the connection assembly, the two switching units are connected with the connection assembly through a first connection rod and a second connection rod, the first connection rod and the second connection rod are separated by a preset distance, and the first connection rod is slidable relative to the connection assembly. Each of the switching units includes a movable contact assembly and two static contacts, the two static contacts are located at opposite sides of the movable contact assembly, the movable contact assembly is connectable to the static contacts, and the movable contact assembly is slidable relative to the static contacts. One end of each of the two static contacts is connectable with an external support, the movable contact assembly is connected with the connection assembly through the first connection rod and the second connection rod, and the movable contact assembly is rotatable around a central axis of the second connection rod.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a schematic principle diagram of an on-load tap changer according to an embodiment of the present disclosure.

FIG. 2 is an overall schematic structural diagram of a three-phase reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

FIG. 3 is a first overall schematic structural diagram of a single-phase reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

FIG. 4 is a second overall schematic structural diagram of a single-phase reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

FIG. 5 is a schematic structural diagram of a static contact in a reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

FIG. 6 is a first mechanical principle diagram of a reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

FIG. 7 is a second mechanical principle diagram of a reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

FIG. 8 is a third mechanical principle diagram of a reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

FIG. 9 is a first sequence diagram (switching from an odd tap position to an even tap position) of a reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

FIG. 10 is a second sequence diagram (switching from an even tap position to an odd tap position) of a reciprocating switching mechanism of an on-load

tap-changer according to an embodiment of the present disclosure.

FIG. 11 is a circuit diagram corresponding to a sequence diagram of a reciprocating switching mechanism of an on-load tap-changer according to an embodiment of the present disclosure.

[0017] In the figures, the following are shown: 1, reciprocating switching mechanism; 10, connection assembly; 101, fixed disc; 1011, slide opening; 102, rotatable disc; 1021, slide rail; 20, switching unit; 201, movable contact assembly; 2011, rotatable plate; 20111, slide groove; 2012, clamping plate; 20121, arc-shaped spring sheet; 20122, rotatable shaft; 2013, elastic member; 202, static contact; 2021, fixed part; 2022, first connection part; 2023, second connection part; 30, first connection rod; 40, second connection rod; 50, slide assembly; 501, slide rod; 502, slide block; 2, principle assembly; 21, rotatable table; 211, arc-shaped groove; 22, swinging rod; 221, second slideway; 23, fixed plate; 231, first slideway; 24, first upright rod; 25, second upright rod; 26, third upright rod; 27, spring; 28, fixed block.

DETAILED DESCRIPTION

[0018] The present disclosure is further explained in detail in the combination with the figures below.

[0019] Referring to FIG. 1, an on-load tap changer is configured for adjusting a voltage of a transformer with load. The output voltage of the transformer can be adjusted by changing a turn ratio of windings connected to an electric grid.

[0020] Referring to FIG. 9, in the embodiment, the on-load tap changer takes a total time of 110 seconds(s) to switch from an odd tap to an even tap, and goes through 10 switching states, and each change of switching state corresponds to an action of one contact in the on-load tap changer. As shown in FIGS. 9 and 11, an action sequence for switching from the odd tap to the even tap is as the following: opening MC1, closing V2 and V3, opening V1, connecting Z1 to an end b, closing V1, opening V2 and the V3, connecting Z2 to end d, and closing MC2.

[0021] Referring to FIG. 10, in the embodiment, the on-load tap changer requires a total time of 110s to switch from the even tap to the odd tap, and goes through 10 switching states, and each change of switching state corresponds to an action of one contact in the on-load tap changer. As shown in FIGS. 10 and 11, an action sequence for switching from the even tap to the odd tap is as the following: opening the MC2, closing the V2 and the V3, opening V1, connecting Z1 to end a, closing V1, opening V2 and V3, connecting Z2 to end c, and closing MC1.

[0022] Here, the Z2 is a reciprocating switching mechanism, which is implemented by the present disclosure.

[0023] Referring to FIGS. 2 to 4, a reciprocating switching mechanism 1 of an on-load tap changer is shown. The reciprocating switching mechanism 1 of the on-load tap changer includes a connection assembly 10 and at least one switching assembly. Each switching assembly includes two switching units 20, the two switching units 20 are arranged on opposite sides of the connection assembly 10, the two switching units 20 are connected with the connection assembly 10 through a first connection rod 30 and a second connection rod 40, the first connection rod 30 and the second connection rod 40 are separated by a preset distance, and the first connection rod 30 is slidable relative to the connection assembly 10. Thus, by configuring the first connection rod 30 to be slidable relative to the connection assembly 10, the position of the first connection rod 30 on the connection assembly 10 can be changed.

[0024] Specifically, the two switching units 20 are arranged respectively at a top end and a bottom end of the connection assembly 10, both the first connection rod 30 and the second connection rod 40 go through the connection assembly 10, and two ends of each of the first connection rod 30 and the second connection rod 40 are inserted in the two switching units 20 respectively. As such, the two switching units 20 are connected with the connection assembly 10 through the first connection rod 30 and the second connection rod 40. Here, a central axis of the first connection rod 30 is parallel to a central axis of the second connection rod 40.

[0025] In the embodiment, each of the switching units 20 includes a movable contact assembly 201 and two static contacts 202, the two static contacts 202 are located at opposite sides of the movable contact assembly 201, the movable contact assembly 201 is connectable to the static contacts 202, and the movable contact assembly 201 is slidable relative to the static contacts 202. During the usage, when the movable contact assembly 201 is clamped with one of the static contacts 202, the movable contact assembly 201 is separated from another one of the static contacts 202. Thus, by configuring the movable contact assembly 201 to slide on the static contacts 202, the connection of the movable contact assembly 201 can be switched between the two static contacts 202. One end of each of the two static contacts 202 is connectable with an external support, the movable contact assembly 201 is connected with the connection assembly 10 through the first connection rod 30 and the second connection rod 40, and the movable contact assembly 201 is rotatable around the central axis of the second connection rod 40. Thus, by configuring the movable contact assembly 201 to rotate with the central axis of the second connection rod 40 as the rotation axis, the connection relationship between the movable contact assembly 201 and the two static contacts 202 can be changed.

[0026] It should be noted that, taking an orientation shown in FIG. 3 as an example, when the movable contact assembly 201 rotates counterclockwise around the central axis of the second connection rod 40 to a certain angle, the movable contact assembly 201 is connected with the upper static contact 202 and separated from the

lower static contact 202. When the movable contact assembly 201 rotates clockwise around the central axis of the second connection rod 40 to a certain angle, the movable contact assembly 201 is connected with the lower static contact 202 and separated from the upper static contact 202. As such, the reciprocating motion of the reciprocating switching mechanism 1 can be realized.

[0027] Further, in the embodiment, the connection assembly 10 includes a fixed disc 101 and a rotatable disc 102, the fixed disc 101 is provided with a rotation hole, the rotation hole extends through the fixed disc 101 along a central axis direction of the fixed disc 101, the rotatable disc 102 is inserted in the rotation hole, and the rotatable disc 102 is rotatable relative to the fixed disc 101. Thus, the rotation of the rotatable disc 102 enables the first connection rod 30 to be rotatable relative to the rotatable disc 102, thus facilitating changing the position of the first connection rod 30 on the rotatable disc 102.

[0028] Specifically, the central axis of the rotatable disc 102 is parallel to the central axis of the fixed disc 101. In some possible implementations, the central axis of the rotatable disc 102 is aligned with the central axis of the fixed disc 101. Here, the two switching units 20 are connected with the rotatable disc 102 through the first connection rod 30, and the two switching units 20 are connected with the fixed disc 101 through the second connection rod 40.

[0029] Further referring to FIGS. 2 to 4, in the embodiment, the rotatable disc 102 is provided with at least one slide rail 1021, the at least one slide rail 1021 extends along a circumferential direction of the rotatable disc 102, and the first connection rod 30 is slidable along the at least one slide rail 1021. Thus, by providing the slide rail 1021 on the rotatable disc 102 and causing the first connection rod 30 to be slidable along the slide rail 1021, the slide rail 1021 can guide the first connection rod 30.

[0030] Here, the at least one slide rail 1021 are provided to correspond to the at least one switching assembly, that is, the number of the slide rails 1021 matches the number of the switching assemblies.

[0031] Specifically, the slide rail 1021 has an arc shape, and a central angle of the slide rail 1021 ranges from 80 ° to 100 °. In the embodiment, the central angle of the slide rail 1021 is 92 °. Here, two ends of the slide rail 1021 are arranged as an end A and an end B, the first connection rod 30 is inserted in the slide rail 1021, and two ends of the first connection rod 30 are respectively inserted in two movable contact assemblies 201 which are arranged to opposite to each other.

[0032] Taking a position state and orientation of the movable contact assembly 201 shown in FIG. 3 as an example, during the usage, when the first connection rod 30 slides to the end A of the slide rail 1021, the movable contact assembly 201 rotates to be connected with the lower static contact 202. When the first connection rod 30 slides to the end B of the slide rail 1021, the movable contact assembly 201 rotates to connect with the upper static contact 202. That is, the state shown in FIG. 3 is taken as an initial state. By configuring the rotatable disc 102 to rotate counterclockwise, the first connection rod 30 can slide from the end B of the slide rail 1021 to the end A of the slide rail 1021. During the period, the movable contact assembly 201 is fixed. Then, by configuring the rotatable disc 102 to rotate counterclockwise, the movable contact assembly 201 rotates clockwise around the central axis of the second connection rod 40, and then, the movable contact assembly 201 is separated from the upper static contact 202 and connected with the lower static contact 202.

[0033] Furthermore, in the embodiment, the movable contact assembly 201 includes a rotatable plate 2011 and two clamping assemblies, the rotatable plate 2011 is connected with the connection assembly 10 through the first connection rod 30 and the second connection rod 40. The rotatable plate 2011 is rotatable around the central axis of the second connection rod 40, and the two clamping assemblies are arranged at one end of the rotatable plate 2011 towards the static contacts 202 and opposite to each other. The clamping assemblies and the static contacts 202 are arranged in a one-to-one correspondence. Thus, the rotatable plate 2011 further rotates around the central axis of the second connection rod 40, to further drive the two clamping assemblies to rotate. After the two clamping assemblies rotate a certain angle, one of the clamping assemblies can clamp its corresponding static contact 202 and another one of the clamping assemblies can be separated from its corresponding static contact 202.

[0034] Here, the rotatable plate 2011 is provided with a first through hole and a second through hole, a central axis of the first through hole and a central axis of the second through hole are parallel to the central axis of the fixed disc 101. The first connection rod 30 is inserted in the slide rail 1021, and two ends of the first connection rod 30 are inserted in two first through holes of the two rotatable plates 2011 which are arranged to opposite to each other.

[0035] In the aforementioned embodiment, the fixed disc 101 is provided with a fixed hole, the fixed hole is arranged corresponding to the second through hole. The second connection rod 40 goes through the fixed hole, and two ends of the second connection rod 40 are inserted in two second through holes of the two rotatable plates 2011 which are arranged to opposite to each other.

[0036] Taking the orientation shown in FIG. 3 as an example, during the usage, when the first connection rod 30 slides to the end A of the slide rail 1021, the lower clamping assembly clamps the lower static contact 202. At this time, the rotatable disc 102 rotates clockwise and the first connection rod 30 slides along the slide rail 1021. When the first connection rod 30 slides to the end B of the slide rail 1021, an outer peripheral wall of the first connection rod 30 is pushed against an inner wall of the end B of the slide rail 1021. During the period, the movable contact assembly 201 is fixed. Then, the rotatable disc 102 further rotates clockwise, both the first connec-

tion rod 30 and the rotatable plates 2011 rotate counterclockwise around the central axis of the second connection rod 40, and one end of the upper static contact 202 slides into the upper clamping assembly. The rotatable disc 102 stops the rotation when the rotation angle of the rotatable disc 102 ranges from 100 ° to 120 °, and the upper clamping assembly is connected with the upper static contact 202. In the embodiment, when the rotation angle of the rotatable disc 102 is 110 °, the upper clamping assembly is connected with the upper static contact 202.

[0037] Further referring to FIGS. 2 to 4, in the embodiment, the switching assembly further includes a slide assembly 50. The slide assembly 50 is located on a side of the second connection rod 40 facing away from the first connection rod 30, the slide assembly 50 goes through the connection assembly 10, and two ends of the slide assembly 50 are respectively inserted in the two switching units 20. The slide assembly 50 is slidable relative to the connection assembly 10, and the slide assembly 50 is also slidable relative to the switching units 20. Thus, by rotating the rotatable plates 2011 around the central axis of the second connection rod 40, the slide assembly 50 can be driven to slide relative to the connection assembly 10, and the slide assembly 50 can be also driven to slide relative to the switching units 20.

[0038] Further, the slide assembly 50 includes a slide rod 501 and two slide blocks 502 which are arranged to opposite to each other, the slide blocks 502 and the switching units 20 are arranged in an one-to-one correspondence, the slide rod 501 goes through the connection assembly 10, two ends of the slide rod 501 are inserted in the two slide blocks 502 respectively, and the slide rod 501 is slidable relative to the connection assembly 10. The rotatable plate 2011 is provided with a slide groove 20111, the slide groove 20111 extends through the rotatable plate 2011 along the central axis direction of the first connection rod 30, the slide blocks 502 are inserted in the slide groove 20111, and the slide blocks 502 are slidable along the slide groove 20111. Thus, by providing the slide groove 20111 on the rotatable plate 2011, the slide groove 20111 can guide the slide blocks 502.

[0039] Specifically, the fixed disc 101 is provided with a slide opening 1011, which extends through the fixed disc 101 along the central axis of the fixed disc 101. The slide rod 501 goes through the slide opening 1011, both ends of the slide rod 501 are respectively inserted in the two slide blocks 502, and the rotatable plate 2011 rotates around the central axis of the second connection rod 40. At the time, the slide rod 501 can drive the slide blocks 502 to slide along the slide opening 1011, and the slide blocks 502 can further drive the slide rod 501 to slide along the slide groove 20111.

[0040] Here, the central axis of the slide rod 501 is parallel to the central axis of the fixed disc 101, and the second connection rod 40 is arranged between the first connection rod 30 and the slide assembly 50.

[0041] In order to facilitate the connection between the clamping assemblies and the static contacts 202, the slide groove 20111 is arranged between the two clamping assemblies, and an extension direction of the clamping assemblies is tilted relative to an extension direction of the slide groove 20111.

[0042] Further referring to FIGS. 2 to 4, in the embodiment, the movable contact assembly 201 further includes an elastic member 2013, and an installation hole is provided on a side of the slide groove 20111 facing away from the slide blocks 502. One end of the elastic member 2013 is connected with an outer peripheral wall of the second connection rod 40 through the installation hole, and another end of the elastic member 2013 is connected with the slide blocks 502. Additionally, the elastic member 2013 is in a compression state, and a restoration force of the elastic member 2013 is configured to push the rotatable plate 2011 to rotate. Thus, by providing the elastic member 2013 and configuring the elastic member 2013 to be in the compression state, the restoration force of the elastic member 2013 can act on the slide blocks 502, and the stability of the connection between the clamping assemblies and the static contacts 202 can be improved. Therefore, a stable current through the static contacts 202 and the movable contact assembly 201 can be ensured. At the same time, by providing the elastic member 2013, a rotation speed of the rotatable plate 2011 around the central axis of the second connection rod 40 can be further increased.

[0043] During the usage, when the elastic member 2013 rotates to a middle position between the two static contacts 202 at the same vertical height, the elastic member 2013 has the maximum restoration force, which can push the rotatable plate 2011 to rotate in the direction of one of the static contacts 202. When the clamping assemblies clamp the static contacts 202, the elastic member 2013 has the minimum restoration force.

[0044] Specifically, the central axis of the installation hole is perpendicular to the central axis of the second through hole, and the installation hole is connected with the second through hole. The end of the elastic member 2013 facing away from the slide blocks 502 is connected with the outer peripheral wall of the second connection rod 40 through the installation hole.

[0045] Exemplarily, the elastic member 2013 may be a helical spring 27; of course, the elastic member 2013 may also be a sleeve with elasticity. In a case that the elastic member 2013 is implemented as the helical spring 27, part of the elastic member 2013 is accommodated in the slide groove 20111, one end of the elastic member 2013 is connected with the outer peripheral wall of the slide blocks 502, and the end of the elastic member 2013 facing away from the slide blocks 502 is connected with the outer peripheral wall of the second connection rod 40 through the installation hole. The elastic member 2013 is in the compression state. When the central axis of the elastic member 2013 is perpendicular to the extension direction of the slide opening 1011, the compression

amount of the elastic member 2013 is the largest. Then, the rotatable plate 2011 rotates around the central axis of the second connection rod 40, to drive the movement of the slide assembly 50. During this period, the compression amount of the elastic member 2013 gradually decreases.

[0046] Further referring to FIGS. 2 to 4, in the embodiment, for each of the clamping assemblies, the clamping assembly includes two clamping plates 2012 which are arranged to opposite to each other, the two clamping plates 2012 are arranged at a top end and a bottom end of the rotatable plate 2011 respectively. The clamping plates 2012 are rotatable relative to the rotatable plate 2011, and are spaced by a preset distance. Thus, by configuring the two clamping plates 2012 to be spaced by the preset distance, the two clamping plates 2012 can connect the clamping assembly with the respective one of the static contacts 202.

[0047] Here, the rotatable plate 2011 is provided with an accommodation groove, and the first end of each of the clamping plates 2012 is inserted in the accommodation groove. The first end of each of the clamping plates 2012 is connected with the rotatable plate 2011 through a rotatable shaft 20122, the central axis of the rotatable shaft 20122 is parallel to each of the clamping plates 2012, and each of the clamping plates 2012 is rotatable around the central axis of the rotatable shaft 20122. The second end of each of the clamping plates 2012 extends out of the accommodation groove, and the second ends of the two clamping plates 2012 form a clamping channel. One end of each of the static contacts 202 is inserted in the clamping channel, an outer side wall of each of the static contacts 202 abuts against an inner side wall of the clamping channel, and each of the static contacts 202 is slidable along the clamping channel. On the one hand, the outer side wall of each of the static contacts 202 abuts against the inner side wall of the clamping channel, thus improving the stability of the current through the static contacts 202 and the clamping channel. On the other hand, by rotating each of the clamping plates 2012 around the rotatable shaft 20122, a space size of the clamping channel can be changed, and the static contacts 202 with different thicknesses can be inserted in the clamping channel, thus improving the adaptability of the clamping assemblies.

[0048] Further, in the embodiment, for each of the clamping plates 2012, the clamping plates 2012 is provided with an arc-shaped spring sheet 20121, a top end of the clamping plate 2012 is provided with a groove, the arc-shaped spring sheet 20121 is arranged in the groove, the arc-shaped spring sheet 20121 is detachably connected with the clamping plates 2012, and the arc-shaped spring sheet 20121 is configured to reset the clamping plate 2012. On the one hand, by providing the arc-shaped spring sheet 20121 in the groove, the groove can limit the arc-shaped spring sheet 20121. On the other hand, by providing the arc-shaped spring sheet 20121 on the clamping plate 2012, the stability and compactness between the clamping assemblies and the static contacts 202 can be improved.

[0049] Here, the arc-shaped spring sheet 20121 is convex towards the side facing away from the clamping plate 2012, and thus, the arc-shaped spring sheet 20121 can provide the restoration force on the clamping plate 2012. As such, the compactness between the clamping assemblies and the static contacts 202 can be improved.

[0050] Further referring to FIG. 5, in the embodiment, each of the static contacts 202 includes a fixed part 2021, a first connection part 2022 and a second connection part 2023. The first connection part 2022 and the second connection part 2023 are arranged on opposite sides of the fixed part 2021, and the first connection part 2022 is connected with the movable contact assembly 201. Additionally, a thickness of the first connection part 2022 gradually increases along a length direction of the fixed part 2021. As such, the first connection part 2022 can be connected with the movable contact assembly 201.

[0051] Here, the first connection part 2022 is U-shaped, that is, the first connection part 2022 is configured with rounded corners, and the thickness of the first connection part 2022 gradually increases along the length direction of the fixed part 2021. During the usage, the thickness of the first connection part 2022 sliding into the clamping channel changes from thin to thick successively, and thus, it facilitates the first connection part 2022 to insert into the clamping channel. At the same time, the stability of the connection between the first connection part 2022 and the clamping assemblies can be improved.

[0052] FIGS. 6 to 8 show the mechanical principle of the reciprocating switching mechanism. A principle assembly 2 includes elements corresponding to the elements included in the reciprocating switching mechanism 1 in a one-to-one correspondence. Referring to FIGS. 6 to 8, a rotatable table 21 corresponds to the rotatable disc 102 in the reciprocating switching mechanism 1, an arc-shaped groove 211 corresponds to the slide rail 1021 opened on the rotatable disc 102 in the reciprocating switching mechanism 1, a swinging rod 22 corresponds to the movable contact assembly 201 in the reciprocating switching mechanism 1, a first upright rod 24 corresponds to the first connection rod 30 in the reciprocating switching mechanism 1, a second upright rod 25 corresponds to the second connection rod 40 in the reciprocating switching mechanism 1, a third upright rod 26 corresponds to the slide assembly 50 in the reciprocating switching mechanism 1, a spring 27 corresponds to the elastic member 2013 in the reciprocating switching mechanism 1, a fixed plate 23 corresponds to the fixed disc 101 in the reciprocating switching mechanism 1, a first slideway 231 corresponds to the slide opening 1011 in the reciprocating switching mechanism 1, a second slideway 221 corresponds to the slide groove 20111 in the reciprocating switching mechanism 1, and fixed blocks 28 correspond to the static contacts 202 in the reciprocating switching mechanism 1. Two ends of the arc-shaped groove 211 are respectively arranged as an

end a and an end b. Here, the end a corresponds to the end A and the end b corresponds to the end B. The rotatable table 21 rotates counterclockwise to drive the swinging rod 22 to rotate clockwise until the swinging rod 22 contacts one of the fixed blocks 28, to complete a switching action.

[0053] The reciprocating switching mechanism 1 of the on-load tap changer provided by the present disclosure includes the connection assembly 10 and the at least one switching assembly. The at least one switching assembly includes two switching units 20, the two switching units 20 are arranged on opposite sides of the connection assembly 10, the two switching units 20 are connected with the connection assembly 10 through the first connection rod 30 and the second connection rod 40, the first connection rod 30 and the second connection rod 40 are separated by a preset distance, and the first connection rod 30 is slidable relative to the connection assembly 10. Each of the switching units 20 includes the movable contact assembly 201 and the two static contacts 202, the two static contacts 202 are located at opposite sides of the movable contact assembly 201, the movable contact assembly 201 is connectable to the static contacts 202, and the movable contact assembly 201 is slidable relative to the static contacts 202. One end of each of the two static contacts 202 is connectable with the external support, the movable contact assembly 201 is connected with the connection assembly 10 through the first connection rod 30 and the second connection rod 40, and the movable contact assembly 201 is rotatable around the central axis of the second connection rod 40. Such arrangement improves the stability of the installation, while improving the insulation strength between electrodes.

[0054] The reciprocating switching mechanism 1 of the on-load tap-changer provided by the present disclosure has the following advantages: the device is with a simple structure, easy to be manufactured, and convenient to be operated.

[0055] It should be noted that, in the disclosure, the relational terms such as first, second and the like are only used to distinguish one entity or operation from another, and do not necessarily require or imply an existence of any such actual relationship or order between these entities or operations. Furthermore, the term "include", "comprise" or any other variation thereof is intended to cover non-exclusive inclusion, so that a process, method, article or device including a set of elements includes not only those elements but also other elements not expressly listed, or elements inherent to such process, method, article or device. In the absence of further restrictions, the elements defined by the sentence "including a..." do not exclude an existence of additional identical elements in a process, method, article, or device that includes such elements.

[0056] Finally, it should be noted that, it is clear that the aforementioned embodiments are only examples for the purpose of clearly explaining the present disclosure, but are not any limitation on the implementations of the present disclosure. For those ordinary in the field, other changes or variations in different forms can be made on the basis of the aforementioned description. It is not necessary and cannot be exhaustive herein. The resulting obvious changes or variations are still within the scope of protection of the present disclosure.

Claims

1. A reciprocating switching mechanism of an on-load tap changer, comprising a connection assembly (10) and at least one switching assembly;

   wherein the at least one switching assembly comprises two switching units (20), the two switching units (20) are arranged on opposite sides of the connection assembly (10), the two switching units (20) are connected with the connection assembly (10) through a first connection rod (30) and a second connection rod (40), the first connection rod (30) and the second connection rod (40) are separated by a preset distance, and the first connection rod (30) is slidable relative to the connection assembly (10);
   wherein each of the switching units (20) comprises a movable contact assembly (201) and two static contacts (202), the two static contacts (202) are located at opposite sides of the movable contact assembly (201), the movable contact assembly (201) is connectable to the static contacts (202), and the movable contact assembly (201) is slidable relative to the static contacts (202); and
   wherein one end of each of the two static contacts (202) is connectable with an external support, the movable contact assembly (201) is connected with the connection assembly (10) through the first connection rod (30) and the second connection rod (40), and the movable contact assembly (201) is rotatable around a central axis of the second connection rod (40).

2. The reciprocating switching mechanism of the on-load tap changer of claim 1, wherein the connection assembly (10) comprises a fixed disc (101) and a rotatable disc (102), the fixed disc (101) is provided with a rotation hole, the rotation hole extends through the fixed disc (101) along a central axis direction of the fixed disc (101), the fixed disc (101) is provided with a fixed hole, the second connection rod (40) goes through the fixed hole, the rotatable disc (102) is provided with at least one slide rail (1021), the at least one slide rail (1021) extends along a circumferential direction of the rotatable disc (102), the first connection rod (30) is slidable along the at least one slide rail (1021), the rotatable disc (102) is inserted

in the rotation hole, and the rotatable disc (102) is rotatable relative to the fixed disc (101).

3. The reciprocating switching mechanism of the on-load tap changer of claim 1, wherein the movable contact assembly (201) comprises a rotatable plate (2011) and two clamping assemblies, the rotatable plate (2011) is connected with the connection assembly (10) through the first connection rod (30) and the second connection rod (40), the rotatable plate (2011) is rotatable around the central axis of the second connection rod (40), the two clamping assemblies are arranged on the rotatable plate (2011) and opposite to each other, the clamping assemblies and the static contacts (202) are arranged in an one-to-one correspondence, and each of the clamping assemblies is configured to clamp a respective one of the static contacts (202).

4. The reciprocating switching mechanism of the on-load tap changer of claim 3, wherein the switching assembly further comprises a slide assembly (50), the slide assembly (50) is located on a side of the second connection rod (40) facing away from the first connection rod (30), the slide assembly (50) goes through the connection assembly (10), two ends of the slide assembly (50) are respectively inserted in the two switching units (20), and the slide assembly (50) is slidably connectable with the switching units (20); and
wherein the slide assembly (50) is slidable relative to the connection assembly (10).

5. The reciprocating switching mechanism of the on-load tap changer of claim 4, wherein the slide assembly (50) comprises a slide rod (501) and two slide blocks (502) which are arranged to opposite to each other, the slide blocks (502) and the switching units (20) are arranged in an one-to-one correspondence, the slide rod (501) goes through the connection assembly (10), and two ends of the slide rod (501) are inserted in the two slide blocks (502) respectively, and the slide rod (501) is slidable relative to the connection assembly (10); and
wherein the rotatable plate (2011) is provided with a slide groove (20111), the slide groove (20111) extends through the rotatable plate (2011) along a central axis direction of the first connection rod (30), the slide blocks (502) are inserted in the slide groove (20111), and the slide blocks (502) are slidable along the slide groove (20111).

6. The reciprocating switching mechanism of the on-load tap changer of claim 5, wherein the movable contact assembly (201) further comprises an elastic member (2013), an installation hole is provided on a side of the slide groove (20111) facing away from the slide blocks (502), one end of the elastic member (2013) is connected with an outer peripheral wall of the second connection rod (40) through the installation hole, and another end of the elastic member (2013) is connected with the slide blocks (502); and
wherein the elastic member (2013) is in a compression state, and a restoration force of the elastic member (2013) is configured to push the rotatable plate (2011) to rotate.

7. The reciprocating switching mechanism of the on-load tap changer of claim 3, wherein for each of the clamping assemblies, the clamping assembly comprises two clamping plates (2012) which are arranged opposite to each other, the two clamping plates (2012) are arranged at a top end and a bottom end of the rotatable plate (2011) respectively, the clamping plates (2012) are rotatable relative to the rotatable plate (2011), are spaced by a preset distance, and are configured to connect the clamping assembly with **a respective** one of the static contacts (202).

8. The reciprocating switching mechanism of the on-load tap changer of claim 7, wherein for each of the clamping plates (2012), the clamping plates (2012) is provided with an arc-shaped spring sheet (20121), a top end of the clamping plate (2012) is provided with a groove, the arc-shaped spring sheet (20121) is arranged in the groove, the arc-shaped spring sheet (20121) is detachably connected with the clamping plates (2012), and the arc-shaped spring sheet (20121) is configured to reset the clamping plate (2012).

9. The reciprocating switching mechanism of the on-load tap changer of claim 1, wherein each of the static contacts (202) comprises a fixed part (2021), a first connection part (2022) and a second connection part (2023), the first connection part (2022) and the second connection part (2023) are arranged on opposite sides of the fixed part (2021), and the first connection part (2022) is connected with the movable contact assembly (201); and
wherein a thickness of the first connection part (2022) gradually increases along a length direction of the fixed part (2021) away from the movable contact assembly (201).

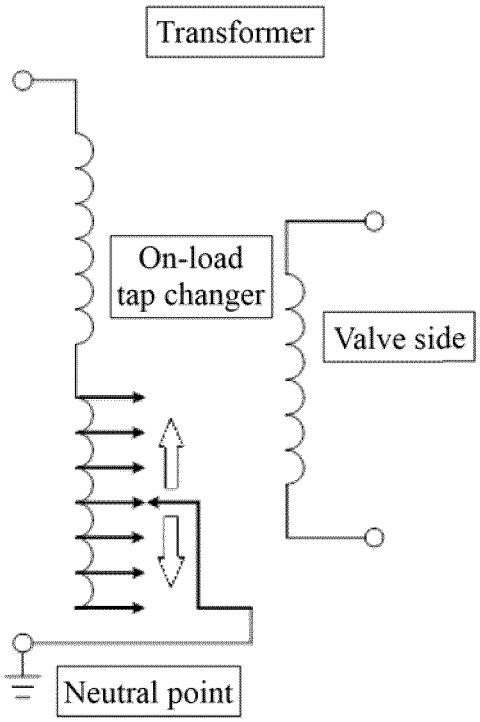
Transformer
On-load tap changer
Valve side
Neutral point

FIG. 1

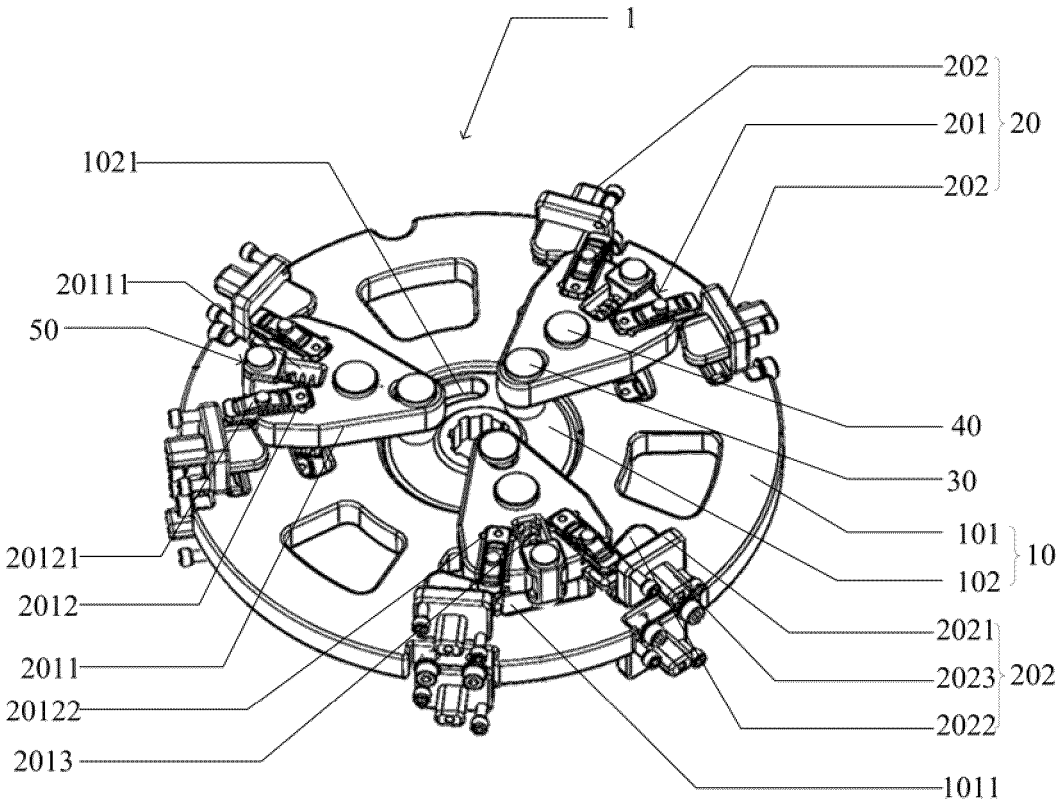
1
202
201
20
202
1021
20111
50
40
30
101
10
102
20121
2012
2021
2011
2023
202
20122
2022
2013
1011

FIG. 2

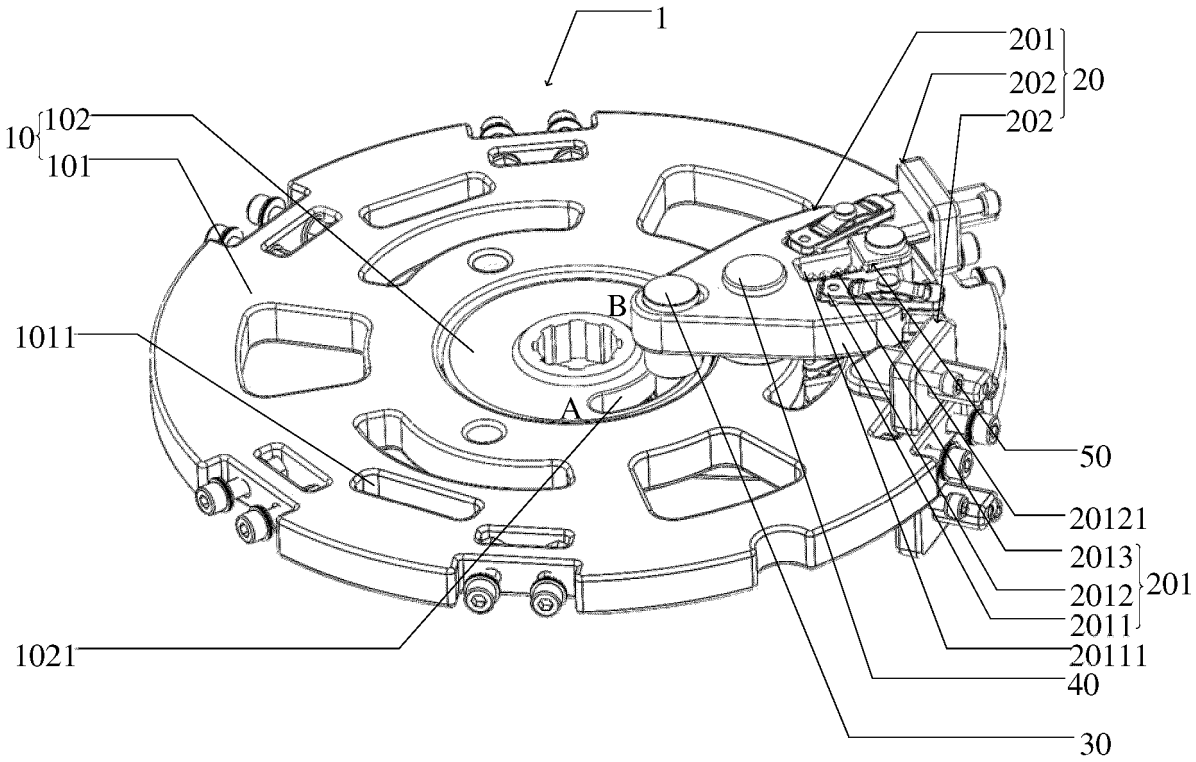
1
201
202
20
202
10
102
101
B
1011
A
50
20121
2013
2012
201
2011
20111
40
1021
30

FIG. 3

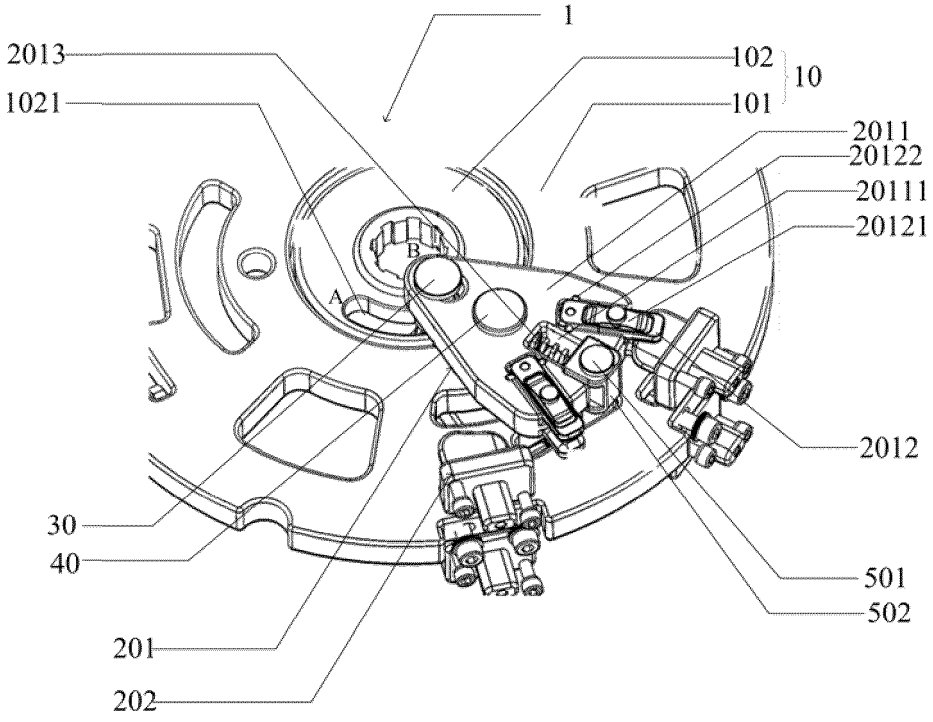
1
2013
102
10
1021
101
2011
20122
20111
20121
B
A
2012
30
40
501
502
201
202

FIG. 4

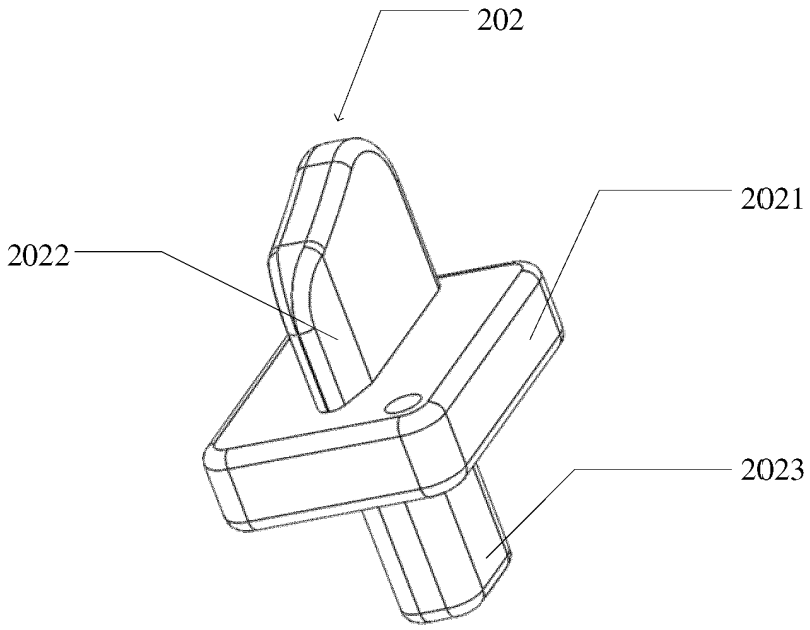

FIG. 5

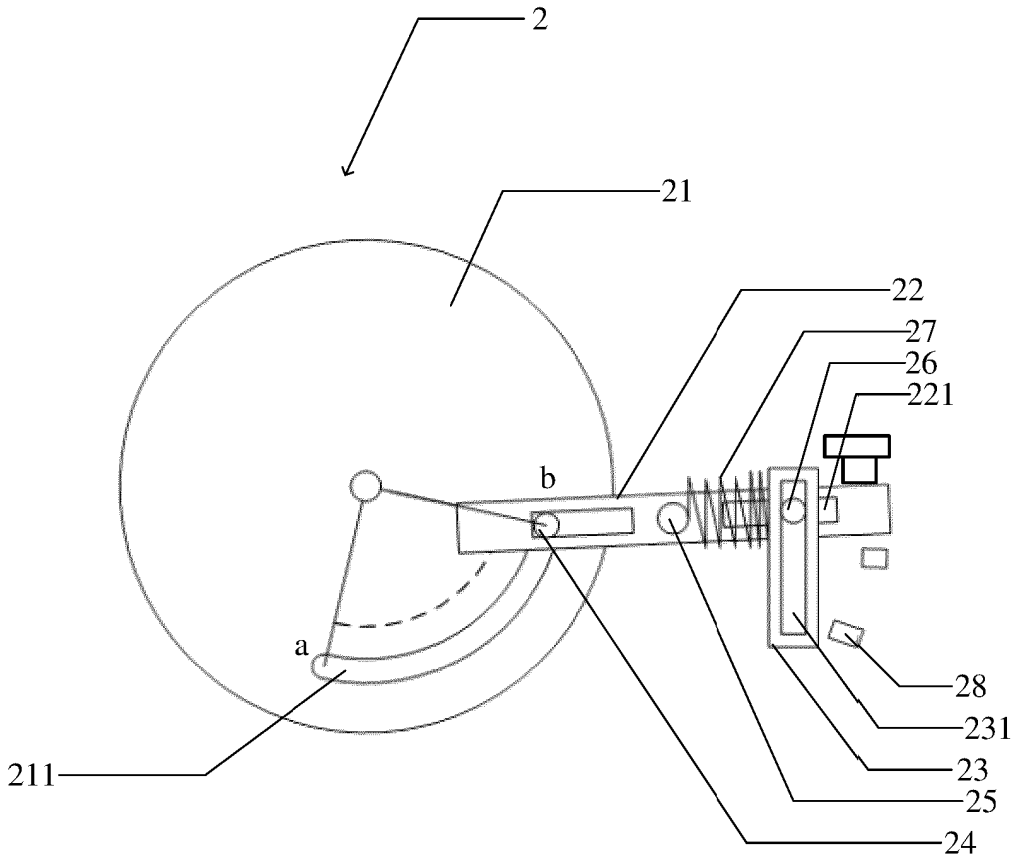

FIG. 6

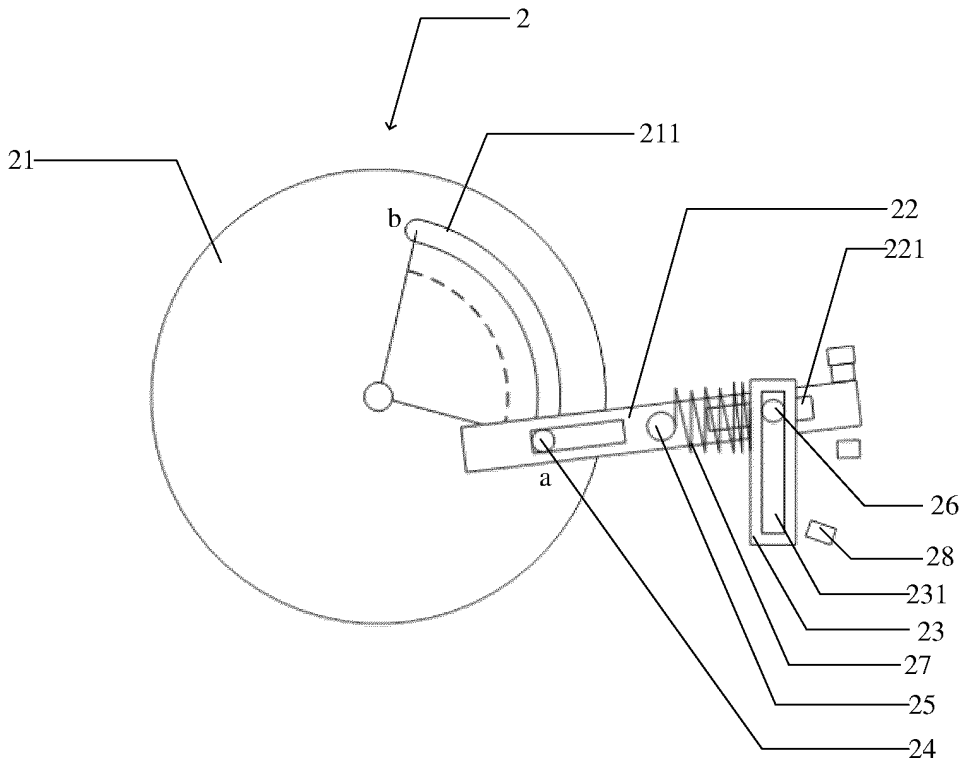
2
211
21
b
22
221
a
26
28
231
23
27
25
24

FIG. 7

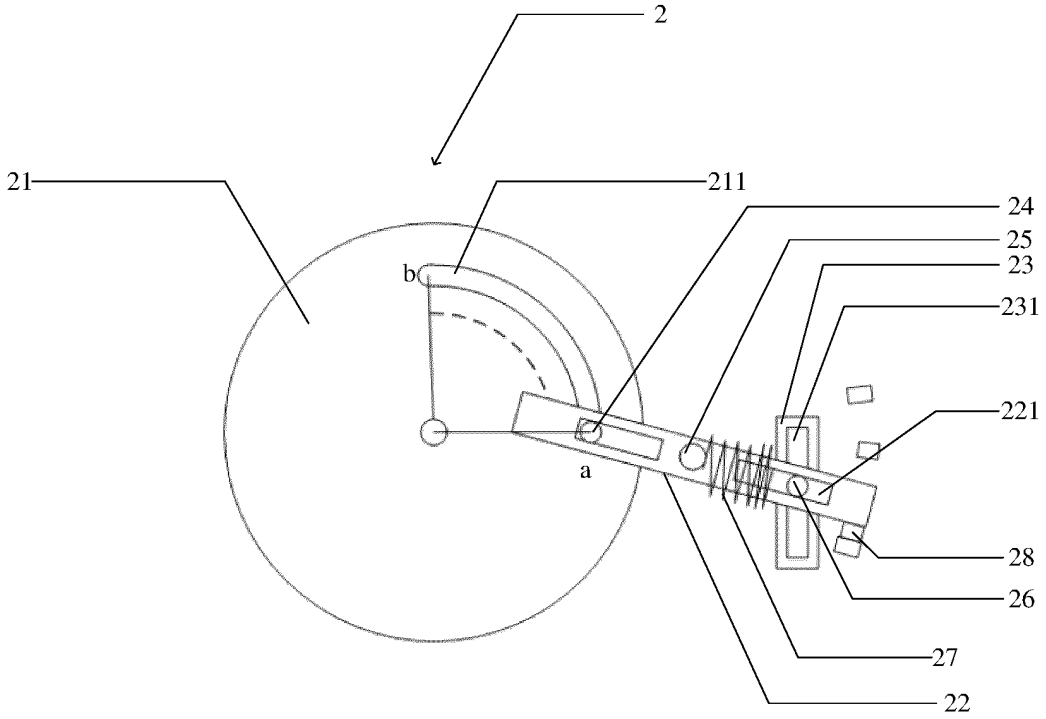
2
21
211
24
25
23
231
b
221
a
28
26
27
22

FIG. 8

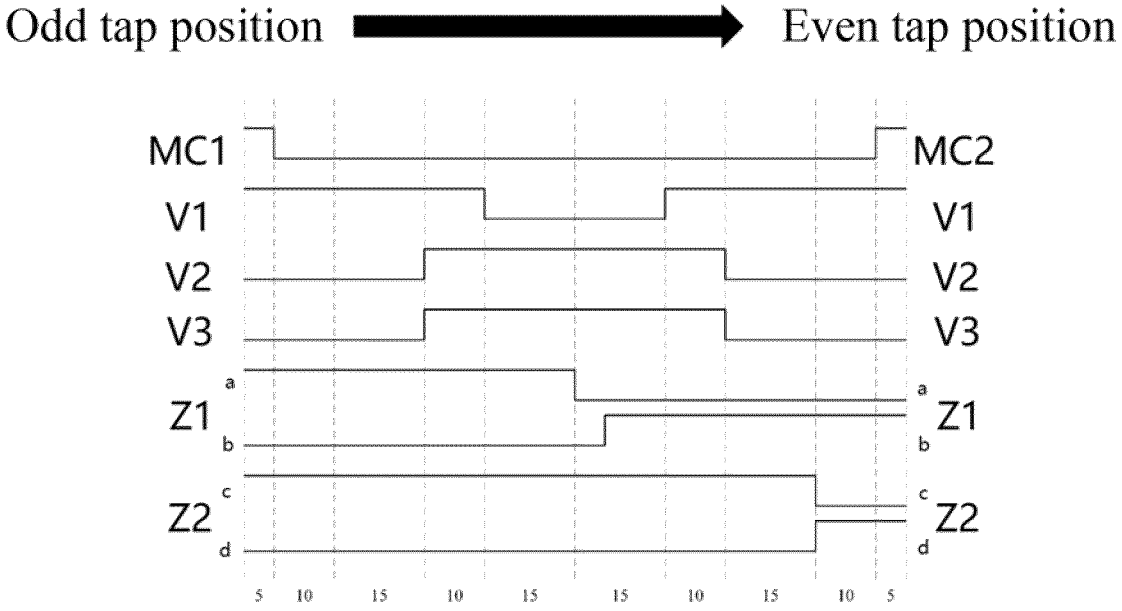
Odd tap position
Even tap position
MC1
MC2
V1
V1
V2
V2
V3
V3
a
Z1
b
a
Z1
b
c
Z2
d
c
Z2
d
5 10 15 10 15 15 10 15 10 5

FIG. 9

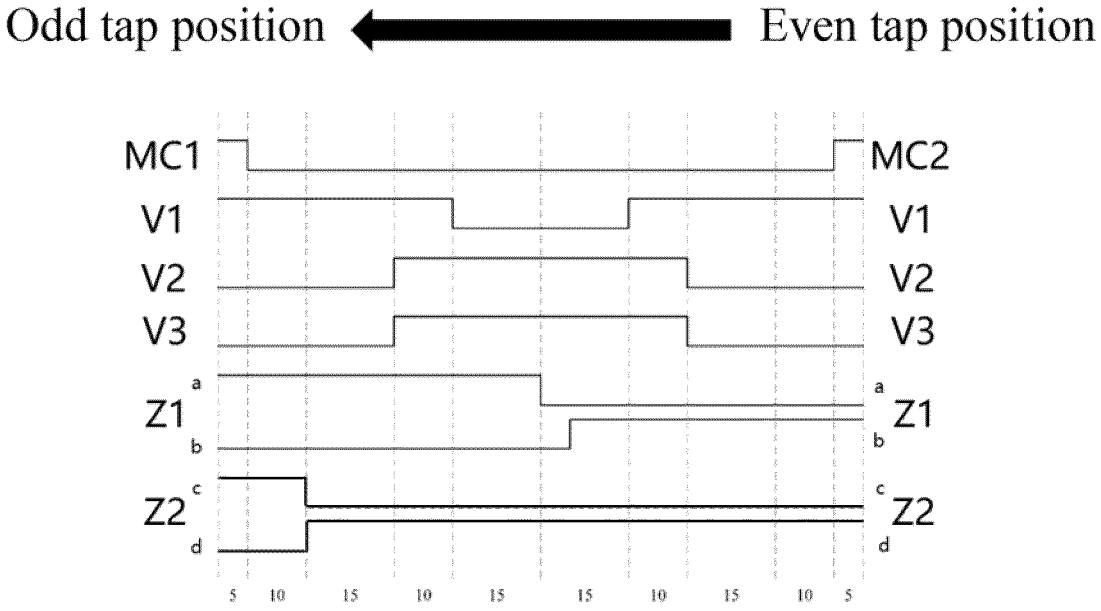
Odd tap position
Even tap position
MC1
MC2
V1
V1
V2
V2
V3
V3
a
Z1
b
a
Z1
b
c
Z2
d
c
Z2
d
5 10 15 10 15 15 10 15 10 5

FIG. 10

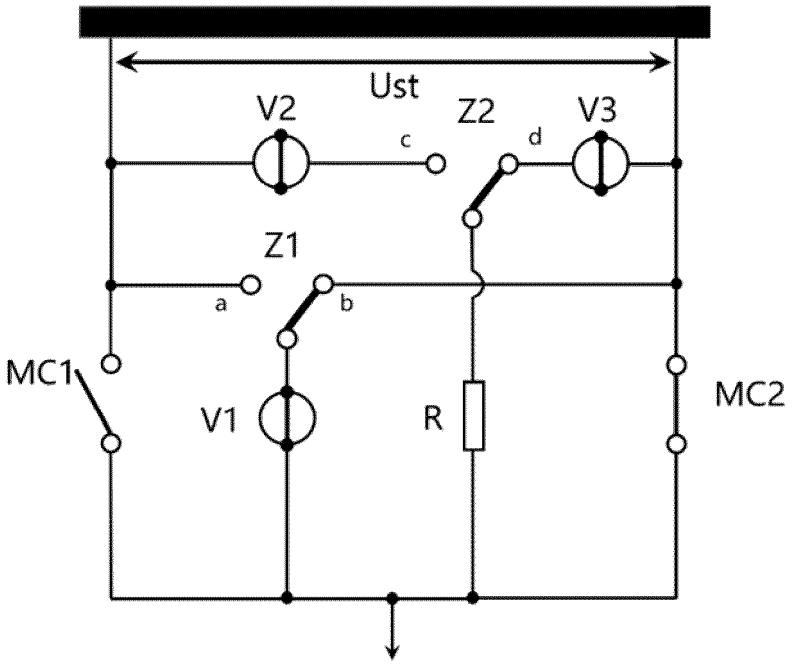

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/076017

A. CLASSIFICATION OF SUBJECT MATTER

H01H 3/02(2006.01)i; H01H 3/32(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01H

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

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

CNTXT; ENTXT; ENTXTC; DWPI; CNKI: 有载分接开关, 动触头, 静触头, 滑动, 转动, 滚动, 切换, 连接, 固定; load tap switch, moving contact, stationary contact, slip, rotate, switch, connect, fix, fasten

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 113745014 A (CHINA ELECTRIC POWER RESEARCH INSTITUTE CO., LTD.) 03 December 2021 (2021-12-03) claims 1-10, and description, paragraphs 30-65	1-9
X	CN 202996615 U (SHANGHAI HUAMING POWER EQUIPMENT CO., LTD. et al.) 12 June 2013 (2013-06-12) description, paragraphs 23-30, and figures 1-5	1, 9
A	CN 104465168 A (STATE GRID CORPORATION OF CHINA et al.) 25 March 2015 (2015-03-25) entire document	1-9
A	US 2015034462 A1 (REINHAUSEN MASCHF SCHEUBECK) 05 February 2015 (2015-02-05) entire document	1-9

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 April 2022	**09 May 2022**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2022/076017

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 113745014 A	03 December 2021	None	
CN 202996615 U	12 June 2013	None	
CN 104465168 A	25 March 2015	None	
US 2015034462 A1	05 February 2015	WO 2013156268 A1	24 October 2013
		JP 2015515139 A	21 May 2015
		EP 2839495 A1	25 February 2015
		CN 104246947 A	24 December 2014
		RU 2014146582 A	10 June 2016
		KR 20140145616 A	23 December 2014
		DE 202012101475 U1	12 September 2013
		HK 1202977 A0	09 October 2015
		HK 1202977 A1	13 October 2017
		KR 102010939 B1	14 August 2019
		IN201407978 P4	01 July 2016
		EP 2839495 B1	19 October 2016
		CN 104246947 B	09 November 2016
		BR112014021580 A2	20 June 2017

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202110850706 **[0001]**