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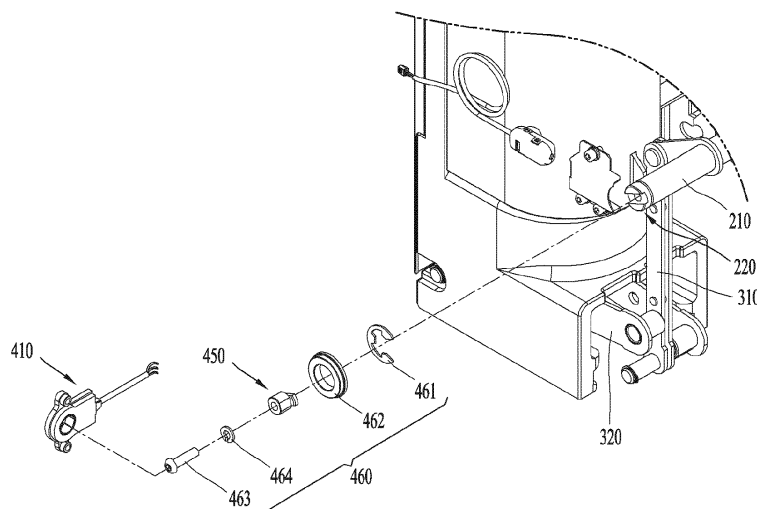
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(54) **VACUUM CIRCUIT BREAKER**

(57) The present invention relates to a vacuum circuit breaker, and provides a vacuum circuit breaker comprising: a mechanism assembly for generating an operation load by means of a signal; a shaft assembly, which rotates while the operation load generated from the mechanism assembly is transferred thereto; a link unit, which

moves in the vertical direction according to the rotation of the shaft assembly; and an operation detection sensor unit which is provided at one side of the shaft assembly and which can detect the rotation angle of the shaft assembly.

FIG. 10



EP 4 383 305 A1

Description

Technical field

[0001] The present disclosure relates to a vacuum circuit breaker, and more specifically, to a vacuum circuit breaker that is capable of monitoring in real time operating characteristics of a vacuum circuit breaker, which plays a role of controlling power transport in a power system and protecting the power system.

Background Art

[0002] In general, a switchboard is a device that is installed at a power plant, a substation, or a place with an electrical utility to monitor, control, protect, etc. an electrical system.

[0003] For an operation or control of the power plant and the substation and an operation of a motor, various electric devices such as a vacuum circuit breaker, a safety device, an instrument, a display lamp, a relay, and the like are disposed within the switchboard, to facilitate opening/closing of lines or a device control.

[0004] A vacuum circuit breaker is used by being received inside a vacuum circuit breaker room of a switchboard. The vacuum circuit breaker may have a terminal which is connected to a terminal disposed on a rear surface of the switchboard such that current is supplied to a load through a main circuit part of the vacuum circuit breaker.

[0005] At this time, in order for the vacuum circuit breaker to supply the current to the load through the main circuit part, a connection operation may be performed through a contact between a movable contactor and a fixed contactor. In addition, when a situation such as overload, short circuit, or ground fault occurs in the process of supplying current to the load through the main circuit part, the vacuum circuit breaker may perform a trip operation to separate the movable contactor and the fixed contactor that were in contact with each other.

[0006] In this process, a shaft assembly disposed inside the vacuum circuit breaker rotates. However, the related art vacuum circuit breaker did not have a function of regularly monitoring the operating characteristics of the vacuum circuit breaker. In other words, a user could not perceive changes in operating characteristics due to a breakdown or deterioration inside the vacuum circuit breaker. Accordingly, it was impossible for the user to determine voluntary maintenance.

[0007] If the operating characteristics of the vacuum circuit breaker exceed the limit in a normal operating state range, the vacuum circuit breaker experiences short-term performance decline, short-circuit performance deterioration, and electrical-connection performance deterioration. This may cause an accident of the vacuum circuit breaker, and in particular, if an opening operation cannot be normally performed during the opening operation, it may bring about a serious accident.

Disclosure of Invention

Technical Problem

[0008] Therefore, the present disclosure has been derived to solve the above problems, and an aspect of the present disclosure is to provide a vacuum circuit breaker that is capable of monitoring an operating characteristic state thereof every time the vacuum circuit breaker is operated, to enable a user to analyze and determine current status and maintenance time of the vacuum circuit breaker.

Solution to Problem

[0009] To achieve the aspect of the present disclosure, there is provided a vacuum circuit breaker that includes a mechanism assembly that generates an operation load by a signal, a shaft assembly that is rotated by receiving the operation load generated from the mechanism assembly, a link unit that is moved in a vertical direction in response to the rotation of the shaft assembly, and an operation detection sensor unit that is disposed on one side of the shaft assembly to detect rotation information related to the shaft assembly.

[0010] The shaft assembly may include a shaft that is disposed to pass through a plurality of links, a connection insert insertion part that is disposed in one end of the shaft and connected to the operation detection sensor portion, and a plurality of connection links that are disposed to be spaced apart from one another on the shaft.

[0011] The operation detection sensor unit may include an operation detection sensor body that is connected to the connection insert insertion part to detect rotation information related to the shaft, a bracket that is connected to the operation detection sensor body and coupled to an outer surface of the vacuum circuit breaker, and an Electromagnetic Compatibility (EMC) part that is connected to the bracket and has EMC therein.

[0012] The operation detection sensor body may be configured to measure an output voltage over time while the shaft rotates.

[0013] The operation detection sensor unit may further include a wire that is connected to another end of the EMC part, and a connection terminal that is disposed on an end portion of the wire.

[0014] The operation detection sensor unit may further include a wireless module that is connected to the connection terminal to communicate with an external terminal.

[0015] A concave groove may be formed inside the operation detection sensor body, and have an inner surface formed of a flat surface and a curved surface, and the operation detection sensor unit may further include an insert that has one side coupled to the connection insert insertion part and another side inserted into the concave groove.

[0016] The insert may include blades that extend long

in both directions, and a protrusion that protrudes from a front surface of the blades to be insertable into the concave groove, and the protrusion may include a flat portion corresponding to the flat surface of the concave groove, and a curved portion corresponding to the curved surface of the concave groove.

[0017] The connection insert insertion part may include an insertion groove formed to be concave such that the blades are insertable, protrusions protrude from both sides of the insertion groove, and a through hole may be formed through a center of the insertion groove such that a coupling member is insertable.

Advantageous Effects of Invention

[0018] As described above, according to one embodiment of the present disclosure, an operation detection sensor unit may monitor an operating state of a vacuum circuit breaker at any time and at the same time quantify characteristics that are exhibited when the vacuum circuit breaker operates, thereby analyzing a current status of the vacuum circuit breaker and determining whether or not maintenance is necessary.

[0019] According to one embodiment of the present disclosure, a protrusion may include a flat portion and a curved portion, and a concave groove of an operation detection sensor body may include a flat surface and a curved surface corresponding to the flat portion and the curved portion of the protrusion, so that the protrusion can be inserted into the concave groove without clearance. Accordingly, rotation characteristics of the shaft can be intactly transmitted to the operation detection sensor body through the concave groove of the operation detection sensor body.

[0020] In a vacuum circuit breaker according to one embodiment of the present disclosure, an operation detection sensor unit may include an EMC part to suppress electromagnetic interference by other devices inside the vacuum circuit breaker. In addition, the operation detection sensor unit may suppress electromagnetic interference from affecting a voltage detected by the operation detection sensor body through the EMC even if the electromagnetic interference is caused by the other devices inside the vacuum circuit breaker. That is, the operation detection sensor body may remove other noises that may affect values such as an output voltage value and the like, which are detected during the rotation of the shaft.

Brief Description of Drawings

[0021]

FIG. 1 is a view illustrating a side surface of a vacuum circuit breaker, from which an external case is removed, in accordance with one embodiment of the present disclosure.

FIG. 2 is a view illustrating the vacuum circuit breaker of FIG. 1, viewed from an opposite side.

FIG. 3 is a perspective view illustrating the vacuum circuit breaker of FIG. 1.

FIG. 4 is a perspective view illustrating the vacuum circuit breaker of FIG. 3, viewed in another direction.

FIG. 5 is a front view illustrating the vacuum circuit breaker, from which a portion of an outer case of FIG. 1 removed.

FIG. 6 is a perspective view illustrating a mechanism assembly in accordance with one embodiment of the present disclosure.

FIG. 7 is a perspective view illustrating a shaft assembly in accordance with one embodiment of the present disclosure.

FIG. 8 is a perspective view illustrating an operation detection sensor unit in accordance with one embodiment of the present disclosure.

FIG. 9 is a perspective view illustrating an insert in accordance with one embodiment of the present disclosure.

FIG. 10 is a partially-exploded perspective view for explaining the shaft assembly and the operation detection sensor unit of FIG. 4.

FIG. 11 is a view for explaining that the shaft assembly, the insert, and an operation detection sensor body of FIG. 10 are coupled.

FIG. 12 is a time-current graph detected by an operation detection sensor unit when a vacuum circuit breaker is tripped in accordance with one embodiment of the present disclosure.

Mode for the Invention

[0022] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the attached drawings, so as to be easily implemented by those skilled in the art.

[0023] In the following description, a description of some components will be omitted to help understanding of the present disclosure.

[0024] The term "electrical connection" used in the following description refers to that current or an electrical signal is transmitted between one or more members.

[0025] The term "switchboard or distribution board" used in the following description refers to a device in which switches, instruments, relays, etc. are fixedly inserted and managed. On a front surface of the switchboard, may be disposed an operating lever that opens and closes a vacuum circuit breaker of a high-voltage main circuit, an air switch (air vacuum circuit breaker) of a low-voltage main circuit, a voltmeter, an ammeter, a power meter, an integrated power meter, an eddy current relay, etc. may be placed.

[0026] The term "vacuum circuit breaker" used in the following description refers to a vacuum circuit breaker designed to cut off current of a power supply line in a hermetic space in a vacuum state. Each configuration described below is assumed to be applied to a vacuum circuit breaker.

[0027] However, each configuration described below may also be applied to air blast circuit breakers, compressed air circuit breakers, gas circuit breakers, oil circuit breakers, and the like.

[0028] FIG. 1 is a view illustrating a side surface of a vacuum circuit breaker, from which an external case is removed, in accordance with one embodiment of the present disclosure. FIG. 2 is a view illustrating the vacuum circuit breaker of FIG. 1, viewed from an opposite side. FIG. 3 is a perspective view illustrating the vacuum circuit breaker of FIG. 1. FIG. 4 is a perspective view illustrating the vacuum circuit breaker of FIG. 3, viewed in another direction. FIG. 5 is a front view illustrating the vacuum circuit breaker, from which a portion of an outer case of FIG. 1 removed.

[0029] A vacuum circuit breaker 1000 according to one embodiment of the present disclosure may include a mechanism assembly 100, a shaft assembly 200, a link unit 300, and an operation detection sensor unit 400.

[0030] The vacuum circuit breaker 1000 may be disposed inside a switchboard. The vacuum circuit breaker 1000 includes a connection terminal 20 that can be connected to an external terminal, and may be pushed into and pulled out of a switchboard case 10. The vacuum circuit breaker 20 may be pushed into and drawn out of the switchboard case using a vacuum circuit breaker moving part 30. The internal components 10 of the vacuum circuit breaker 1000, from which a portion of an outer case of the vacuum circuit breaker 1000 is removed are as illustrated in FIG. 1.

[0031] The mechanism assembly 100 may generate an operation load by a signal. Specifically, the mechanism assembly 100 may generate an operation load according to a trip signal or an access signal.

[0032] And, the operation load generated by the signal during operation is transmitted to the shaft assembly 200 through an internal structure.

[0033] The shaft assembly 200 is rotated by receiving the operation load generated from the mechanism assembly 100.

[0034] Specifically, the operation load generated from the mechanism assembly 100 is transmitted to the shaft assembly 200, and a shaft 210 of the shaft assembly 200 rotates. Accordingly, a plurality of connection links fixed to the shaft 210 may rotate.

[0035] The link unit 300 moves in a vertical direction as the shaft assembly 200 rotates.

[0036] Specifically, referring to FIG. 1 and the like, the link unit 300 may include a first link 310 connected to the shaft assembly 200 and a second link 320 connected to the first link 310.

[0037] When the shaft assembly 200 rotates in one direction, the link unit 300 may move upward in the vertical direction. On the other hand, when the shaft assembly 200 rotates in another direction, the link unit 300 may move downward in the vertical direction.

[0038] Additionally, the vacuum circuit breaker 1000 according to one embodiment of the present disclosure

may include a vacuum interrupter (VI) 500.

[0039] The vacuum interrupter 500 may include a fixed contactor 510, a movable contactor 520, a push rod 530, and a connection rod 540.

[0040] At this time, when the link unit 300 moves upward in the vertical direction in response to the rotation of the shaft assembly 200 in the one direction, the connection rod 540 may move upward, such that the fixed contactor 510 and the movable contactor 520 are brought into contact with each other (are closed). Accordingly, the fixed contactor 510 and the movable contactor 520 are electrically connected to each other.

[0041] Then, when the link unit 300 moves downward in the vertical direction in response to the rotation of the shaft assembly 200 in the another direction, the connection rod 540 may move downward, such that the fixed contactor 510 and the movable contactor 520 are separated from each other.

[0042] Hereinafter, the operation of the shaft assembly 200 and resulting electrical connection and trip operation will be described.

[0043] For example, when the shaft assembly 200 is connected, a second connection link 240 connected to the shaft assembly 200 moves upward. Accordingly, the first link 310 connected to the second connection link 240 moves upward. As the first link 310 moves upward, the second link 320 connected to the first link 310 moves upward. Responsively, the connection rod 540 connected to the second link 320 moves upward. As the connection rod 540 moves upward, the push rod 530 connected to the connection rod 540 moves upward. As the push rod 530 moves upward, the fixed contactor 510 and the movable contactor 520 inside the vacuum interrupter 500 may be brought into contact with each other.

[0044] Meanwhile, when the shaft assembly 200 performs a trip operation, operations may be performed opposite to the above-described operations. The second connection link 240 connected to the shaft assembly 200 moves downward. Then, the first link 310 descends. As the first link 310 descends, the second link 320 connected to the first link 310 moves downward. Accordingly, the connection rod 540 connected to the second link 320 moves downward. As the connection rod 540 moves downward, the push rod 530 connected to the connection rod 540 moves downward. As the push rod 530 moves downward, the fixed contactor 510 and the movable contactor 520 inside the vacuum interrupter 500 may be separated (tripped) from each other.

<Operation detection sensor unit 400>

[0045] The operation detection sensor unit 400 is disposed on one side of the shaft assembly 200. Additionally, the operation detection sensor unit 400 is capable of detecting rotation information related to the shaft assembly 200.

[0046] Referring to FIG. 2, the operation detection sensor unit 400 is disposed on one side of the shaft assembly

200. And, the operation detection sensor unit 400 is fixed to an outer surface of the vacuum circuit breaker 1000.

[0047] The operation detection sensor unit 400 detects the rotation of the shaft assembly 200 when the shaft assembly 200 rotates. At this time, the operating characteristics of the shaft assembly 200 may be determined by measuring time for which the shaft assembly 200 rotates and an output voltage value associated with the shaft assembly 200.

[0048] FIG. 6 is a perspective view illustrating a mechanism assembly 100 in accordance with one embodiment of the present disclosure. FIG. 7 is a perspective view illustrating a shaft assembly 200 in accordance with one embodiment of the present disclosure. FIG. 8 is a perspective view illustrating an operation detection sensor unit 400 in accordance with one embodiment of the present disclosure. FIG. 9 is a perspective view illustrating an insert 450 in accordance with one embodiment of the present disclosure. FIG. 10 is a partially-exploded perspective view for explaining the shaft assembly 200 and the operation detection sensor unit 400 of FIG. 4. FIG. 11 is a view for explaining that the shaft assembly 200, the insert 450, and an operation detection sensor body 410 of FIG. 10 are coupled. FIG. 12 is a time-current graph detected by the operation detection sensor unit 400 when the vacuum circuit breaker 1000 in accordance with one embodiment of the present disclosure is tripped.

[0049] A mechanism assembly 100 according to one embodiment of the present disclosure may include a handle 110, a rotating unit 120, a rotating shaft pin 130, and an inner connection link 140.

[0050] Specifically, referring to FIG. 6, the handle 110 may be configured to operate the mechanism assembly 100 when it moves. Alternatively, the handle 110 may be moved when the mechanism assembly 100 operates.

[0051] The rotating unit 120 is connected to the handle 110. Therefore, when the handle 110 moves, the rotating unit 120 rotates. As the rotating unit 120 rotates, the rotating shaft pin 130 inserted inside the rotating unit 120 may rotate. As the rotating shaft pin 130 rotates, the inner connection link 140 connected to the rotating shaft pin 130 may move.

[0052] When the inner connection link 140 moves, the first connection link 230, one end of which is connected to the inner connection link 140 and another end of which is connected to the shaft 210, may move.

[0053] Therefore, when the mechanism assembly 100 operates through the above-described operation, the inner connection link 140 rotates, and the first connection link 230 rotates accordingly, thereby rotating the shaft 210.

[0054] The shaft assembly 200 according to one embodiment of the present disclosure may include a shaft 210, a connection insert insertion part 220, and a plurality of connection links.

[0055] The shaft 210 is disposed to pass through a plurality of links.

[0056] Specifically, referring to FIG. 7, the shaft 210 is

formed to be long, and the plurality of links are fitted through the shaft 210. Accordingly, when the shaft 210 rotates, the plurality of links rotate simultaneously.

[0057] As described above, when the mechanism assembly 100 operates, a link connecting the mechanism assembly 100 and the shaft 210 rotates. As the link connecting the mechanism assembly 100 and the shaft 210 rotates, the shaft 210 may rotate.

[0058] As the shaft 210 rotates, other links connected to the shaft 210 also rotate simultaneously. Accordingly, the movable contactor 520 and the fixed contactor 510 of the vacuum interrupter 500 may be spaced apart (blocked) from each other or may be in contact (electrically conducted) with each other.

[0059] The plurality of connection links are disposed to be spaced apart from each other on the shaft 210.

[0060] Specifically, the shaft assembly 200 may include a first connection link 230, a second connection link 240, a third connection link 250, and a fourth connection link 260. Additionally, other connection links may further be included. As the shaft 210 rotates, the first to fourth connection links 230 to 260 may rotate together.

[0061] The first connection link 230 may connect the shaft assembly 200 and the mechanism assembly 100 to each other. Accordingly, when the mechanism assembly 100 operates, the first connection link 230 may rotate so that the shaft 210 rotates.

[0062] The second connection link 240 may connect the shaft assembly 200 and the link unit 300 to each other. Accordingly, when the shaft 210 rotates, the second connection link 240 may move upward or downward, and accordingly, the link unit 300 may move upward or downward in the vertical direction.

[0063] The third connection link 250 and the fourth connection link 260 may be connected to other components in the vacuum circuit breaker 1000. The third connection link 250 and the fourth connection link 260 may be connected to other components in the vacuum circuit breaker 1000 to control operations of the other components or to fix and support the shaft assembly 200 inside the vacuum circuit breaker 1000.

<Operation detection sensor unit 400>

[0064] The operation detection sensor unit 400 may include an operation detection sensor body 410, a bracket 420, and an Electromagnetic Compatibility (EMC) part 430.

[0065] Referring to FIG. 8, the operation detection sensor body 410 is connected to the connection insert insertion part 220 to detect the rotation of the shaft 210.

[0066] Specifically, referring to FIG. 11, the insert 450 is inserted into the connection insert insertion part 220 disposed in an end portion of the shaft 210. Then, the insert 450 may rotate with being inserted into a concave groove 410a formed in the operation detection sensor body 410.

[0067] The bracket 420 is connected to the operation

detection sensor body 410 and is coupled to an outer surface of the vacuum circuit breaker 1000. Specifically, referring to FIG. 2, the bracket 420 is coupled to an outer surface 12a of a vacuum circuit breaker case 12. At this time, the bracket 420 is disposed on the side where the connection insert insertion part 220 of the shaft 210 is disposed.

[0068] The EMC part 430 is connected to the bracket 420 and includes EMC (Electromagnetic Compatibility) therein.

[0069] EMC is a configuration that does not cause electromagnetic interference with other devices and maintains original performance even when the other devices cause electromagnetic interference.

[0070] In the vacuum circuit breaker 1000 according to one embodiment of the present disclosure, the operation detection sensor unit 400 may include the EMC part 430 to suppress electromagnetic interference by other devices inside the vacuum circuit breaker 1000. In addition, the operation detection sensor unit 400 may suppress electromagnetic interference from affecting a voltage detected by the operation detection sensor body 410 through the EMC even if the electromagnetic interference is caused by the other devices inside the vacuum circuit breaker 1000. That is, the operation detection sensor body 410 may remove other noises that may affect values such as an output voltage value and the like, which are detected during the rotation of the shaft 210.

[0071] In addition, the operation detection sensor unit 400 may further include a wire 440 and a connection terminal 445.

[0072] The wire 440 may be connected to another end of the EMC part 430. In addition, the connection terminal 445 may be disposed on an end portion of the wire 440, and may transmit information related to the characteristic of the vacuum circuit breaker 1000, which is detected by the operation detection sensor body 410, to a wireless module, a memory, or a control unit.

[0073] Meanwhile, the operation detection sensor unit 400 may further include a wireless module. The wireless module may be connected to the connection terminal 445 described above and may communicate with an external terminal. Accordingly, the wireless module may transmit information obtained from the operation detection sensor unit 400 to an externally constructed server or a user terminal.

[0074] The operation detection sensor body 410 may have therein a concave groove 410a whose inner surface is made of a flat surface 411 and a curved surface 412.

[0075] Specifically, referring to FIG. 11, a concave groove 410a having an inner surface in which a flat surface 411 and a curved surface 412 are alternately connected may be formed inside the operation detection sensor body 410. The flat surface 411 and the curved surface 412 of the concave groove 410a may be formed to correspond to a flat portion 453 and a curved portion 455 of a protrusion 454 of the Insert 450. Through this, the insert 450 may be easily inserted into the concave groove 410a.

In addition, while the insert 450 rotates, a distance between the insert 450 and the inner surface of the concave groove 410a may decrease, and thus a rotation amount of the insert 450 may be accurately calculated in the concave groove 410a.

[0076] Meanwhile, a portion defining the concave groove 410a of the operation detection sensor body 410 may rotate. Accordingly, as the insert 450 rotates, the concave groove 410a also rotates. The operation detection sensor body 410 may determine the rotation amount of the insert 450 through the rotation of the portion defining the concave groove 410a.

<Insert 450>

[0077] In addition, the operation detection sensor unit 400 may further include an insert 450 which has one side coupled to the connection insert insertion part 220 and another side inserted into the concave groove 410a.

[0078] The insert 450 may include blades 452 and a protrusion 454.

[0079] The blades 452 may be formed to extend long to both sides in any one direction. That is, the blades 452 may extend in both directions from a center of the protrusion 454. The blades 452 are inserted into an insertion groove 222 formed in one end of the shaft 210. Accordingly, when the shaft 210 rotates, the connection insert insertion part 220 formed in the end portion of the shaft 210 rotates. As the connection insert insertion part 220 rotates, the portion of the insertion groove 222 of the connection insert insertion part 220 also rotates. Accordingly, the insert 450 rotates. The rotation of the insert 450 is then transmitted to the concave groove 410a of the operation detection sensor body 410, and thus the rotation of the shaft 210 may be sensed by the operation detection sensor.

[0080] The protrusion 454 protrudes toward a front of the blades 452. The protrusion 454 includes a flat portion 453 corresponding to the flat surface 411 of the concave groove 410a, and a curved portion 455 corresponding to the curved surface 412 of the concave groove 410a. Accordingly, the protrusion 454 may be inserted into the concave groove 410a of the operation detection sensor body 410 described above.

[0081] According to one embodiment of the present disclosure, the protrusion 454 may include the flat portion 453 and the curved portion 455, and the concave groove 410a of the operation detection sensor body may include the flat surface 411 and the curved surface 412 corresponding to the flat portion 453 and the curved portion 455 of the protrusion 454, so that the protrusion 454 can be inserted into the concave groove 410a without clearance. Accordingly, the rotation characteristics of the shaft 210 can be intactly transmitted to the operation detection sensor body 410 through the concave groove 410a of the operation detection sensor body 410.

<Connection insert insertion part 220>

[0082] The connection insert insertion part 220 may be disposed in one end of the shaft 210 and connected to the operation detection sensor unit 400. An insertion groove 222 may be formed concavely in the connection insert insertion part 220 so that the blades 452 can be inserted.

[0083] Referring to FIG. 11, the insertion groove 222 is formed to be long in one direction to have a shape corresponding to the blades 452. At this time, the blades 452 may be fitted into the insertion groove 222 without protruding to an outer surface of the shaft 210.

[0084] Protrusions 221 for gripping the blades 452 of the insert 450 may protrude from both sides of the insertion groove 222. Through this, as the shaft 210 rotates, the protrusions 221 press the blades 452 of the insert 450. Accordingly, the insert 450 may rotate.

[0085] As the insert 450 rotates, the rotating unit 120 surrounding the concave groove 410a of the operation detection sensor body 410, into which the insert 450 is inserted, may rotate. Accordingly, information related to the rotation of the shaft 210 may be determined through the operation detection sensor unit 400.

[0086] A through hole 223 into which a coupling member 460 can be inserted may be formed through the center of the insertion groove 222. Additionally, a through hole 454a may be formed through the center of the protrusion 454 of the insert 450.

[0087] The coupling member 460 may include a rotation preventing member 461, a pad 462, a bolt 463, and a washer 464.

[0088] The pad 462 and the rotation preventing member 461 may play a role of fixing the operation detection sensor body 410 to the outer surface of the vacuum circuit breaker 1000, so as to prevent the operation detection sensor body 410 from rotating when the operation detection sensor body 410 is pressed toward the shaft 210. Through this, as the shaft 210 rotates, the operation detection sensor body 410 can be prevented from rotating even if the inside of the concave groove 410a rotates.

[0089] The bolt 463 may be inserted through the through hole 454a of the insert 450 and is coupled to the connection insert insertion part 220 of the shaft 210, such that the insert 450 can be firmly coupled to the connection insert insertion part 220.

<Detection of rotation of shaft 210 through operation detection sensor unit 400>

[0090] The operation detection sensor unit 400 may measure a voltage over time while the shaft 210 rotates.

[0091] A detailed description thereof will be given as follows with reference to FIG. 12.

[0092] For example, Section A shows a state before the fixed contactor 510 and the movable contactor 520 of the vacuum interrupter 500 come into contact with each other. In other words, Section A shows a state where the

fixed contactor 510 and the movable contactor 520 are not electrically connected to each other.

[0093] At this time, a voltage refers to an output voltage value of the operation detection sensor unit 400 that changes according to the rotation of the shaft 210. That is, as the shaft 210 rotates, the output voltage value detected by the operation detection sensor unit 400 may change.

[0094] Section B is a section in which the movable contactor 520 moves toward the fixed contactor 510 as the shaft 210 rotates. At this time, as the shaft 210 rotates, the output voltage value of the operation detection sensor unit 400 begins to increase.

[0095] Section C refers to an initial period of rotation of the shaft 210. At this time, a rising slope of a voltage increases. In other words, the increase in the output voltage value of the operation detection sensor unit 400 may increase faster over time.

[0096] Section D is a middle period of rotation of the shaft 210. In Section D, the rising slope of the voltage may increase and then change to gradually decrease. In other words, Section D may be an inflection point of the rising slope of the voltage.

[0097] Section E is the last period of rotation of the shaft 210. The rising slope of the voltage may gradually decrease in Section E. However, the voltage continuously increases.

[0098] Section F is an end section of rotation of the shaft 210. Excessive rotation may occur in Section F. Specifically, physical resistance may occur in the process of contact between the fixed contactor 510 and the movable contactor 520. Therefore, in order for the fixed contactor 510 and the movable contactor 520 to be in stable contact with each other, greater rotational force of the shaft 210 may be required. Accordingly, the output voltage value detected by the operation detection sensor unit 400 may further increase.

[0099] Section G is a section after the rotation of the shaft 210 ends. In this case, a voltage value that is stable and has no change may be output.

[0100] In the process, the operation detection sensor unit 400 may measure and analyze time taken to reach Section F from Section B and a difference between the voltage in Section A and the voltage in Section G.

[0101] In addition, the operation detection sensor unit 400 may measure and analyze differences in time and voltage before and after a trip operation even when the trip operation is performed in the vacuum circuit breaker 1000.

[0102] The operation detection sensor unit 400 of the vacuum circuit breaker 1000 according to one embodiment of the present disclosure may continuously monitor time for which the shaft assembly 200, that is, the shaft 210 rotates, and a voltage output at this time. Therefore, according to one embodiment of the present disclosure, the operation detection sensor unit 400 may monitor the operating state of the vacuum circuit breaker 1000 at any time and at the same time quantify characteristics that

are exhibited when the vacuum circuit breaker 1000 operates, thereby analyzing the current status of the vacuum circuit breaker 1000 and determining whether or not maintenance is necessary.

[0103] Meanwhile, the vacuum circuit breaker 1000 according to the present disclosure may further include a control unit (not shown). Information monitored by the operation detection sensor unit 400 may be transmitted to the control unit.

[0104] When the rotation time of the shaft 210 required for performing a trip operation or a connection operation becomes longer or shorter, or when the output voltage value output according to the rotation of the shaft 210 deviates from a normal state, the control unit may analyze and notify it.

[0105] The user can check whether it is necessary to repair the vacuum circuit breaker 1000 based on data detected by the operation detection sensor unit 400.

[0106] So far, the embodiments of the present disclosure have been described above. However, the scope of the present disclosure is not limited to the above-described embodiments, and various modifications and variations are made by those skilled in the art using the basic concept of the present disclosure as defined in the appended claim, without departing from the scope of the present disclosure.

[Description of Reference Numerals]

[0107]

1000 Vacuum circuit breaker
 10 Internal components of vacuum circuit breaker
 12 Outer case of vacuum circuit breaker
 12a Outer surface of outer case of vacuum circuit breaker
 20 Connection terminal
 30 Moving part of vacuum circuit breaker
 100 Mechanism assembly
 110 Handle
 120 Rotating unit
 130 Rotating shaft pin
 140 Inner connection link
 200 Shaft assembly
 210 Shaft
 220 Connection insert insertion part
 221 Protrusion
 222 Insertion groove
 223 Through hole
 230 First connection link
 240 Second connection link
 250 Third connection link
 260 Fourth connection link
 300 Link unit
 310 First link
 320 Second link
 400 Operation detection sensor unit
 410 Operation detection sensor body

410a Concave groove
 411 Flat surface
 412 Curved surface
 420 Bracket
 430 EMC part
 440 Wire
 445 Connection terminal
 450 Insert
 452 Blade
 453 Flat portion
 454 Protrusion
 454a Through hole
 455 Curved portion
 460 Coupling member
 461 Rotation preventing member
 462 Pad
 463 Bolt
 464 Washer
 500 Vacuum interrupter
 510 Fixed contactor
 520 Movable contactor
 530 Push rod
 540 Connection rod

Claims

1. A vacuum circuit breaker comprising:

a mechanism assembly that generates an operation load by a signal;
 a shaft assembly that is rotated by receiving the operation load generated from the mechanism assembly;
 a link unit that is moved in a vertical direction in response to the rotation of the shaft assembly; and
 an operation detection sensor unit that is disposed on one side of the shaft assembly to detect rotation information related to the shaft assembly.

2. The vacuum circuit breaker of claim 1, wherein the shaft assembly comprises:

a shaft that is disposed to pass through a plurality of links;
 a connection insert insertion part that is disposed in one end of the shaft and connected to the operation detection sensor portion;
 a plurality of connection links that are disposed to be spaced apart from one another on the shaft.

3. The vacuum circuit breaker of claim 2, wherein the operation detection sensor unit comprises:

an operation detection sensor body that is con-

- nected to the connection insert insertion part to detect rotation information related to the shaft; a bracket that is connected to the operation detection sensor body and coupled to an outer surface of the vacuum circuit breaker; and
an Electromagnetic Compatibility (EMC) part that is connected to the bracket and has EMC therein. 5
4. The vacuum circuit breaker of claim 3, wherein the operation detection sensor body is configured to measure an output voltage over time while the shaft rotates. 10
5. The vacuum circuit breaker of claim 3, wherein the operation detection sensor unit further comprises:
a wire that is connected to another end of the EMC part; and
a connection terminal that is disposed on an end portion of the wire. 20
6. The vacuum circuit breaker of claim 5, wherein the operation detection sensor unit further comprises a wireless module that is connected to the connection terminal to communicate with an external terminal. 25
7. The vacuum circuit breaker of claim 3, wherein a concave groove is formed inside the operation detection sensor body, and has an inner surface formed of a flat surface and a curved surface, and the operation detection sensor unit further comprises an insert that has one side coupled to the connection insert insertion part and another side inserted into the concave groove. 30 35
8. The vacuum circuit breaker of claim 7, wherein the insert comprises:
blades that extend long in both directions; and
a protrusion that protrudes to a front of the blades to be insertable into the concave groove, and
the protrusion includes a flat portion corresponding to the flat surface of the concave groove, and
a curved portion corresponding to the curved surface of the concave groove. 40 45
9. The vacuum circuit breaker of claim 8, wherein the connection insert insertion part comprises an insertion groove formed to be concave such that the blades are insertable, 50
protrusions protrude from both sides of the insertion groove, and
a through hole is formed through a center of the insertion groove such that a coupling member is insertable. 55

FIG. 1

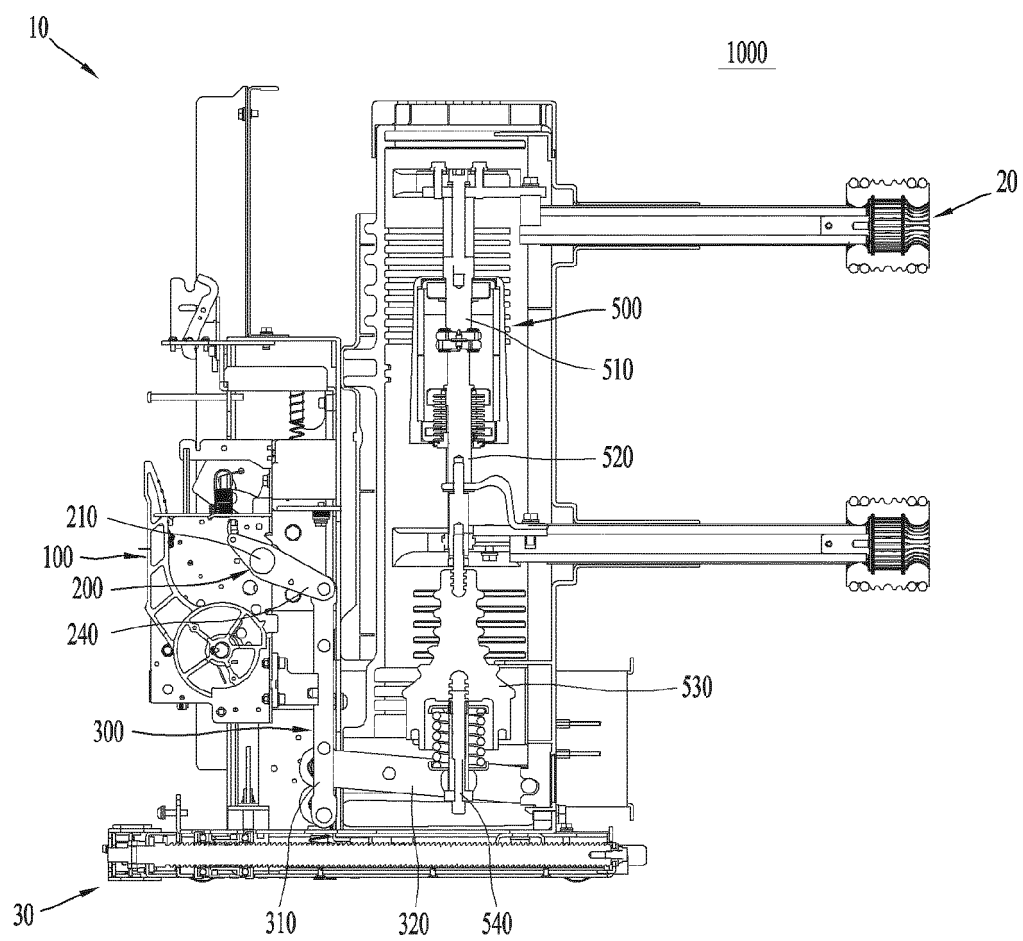


FIG. 2

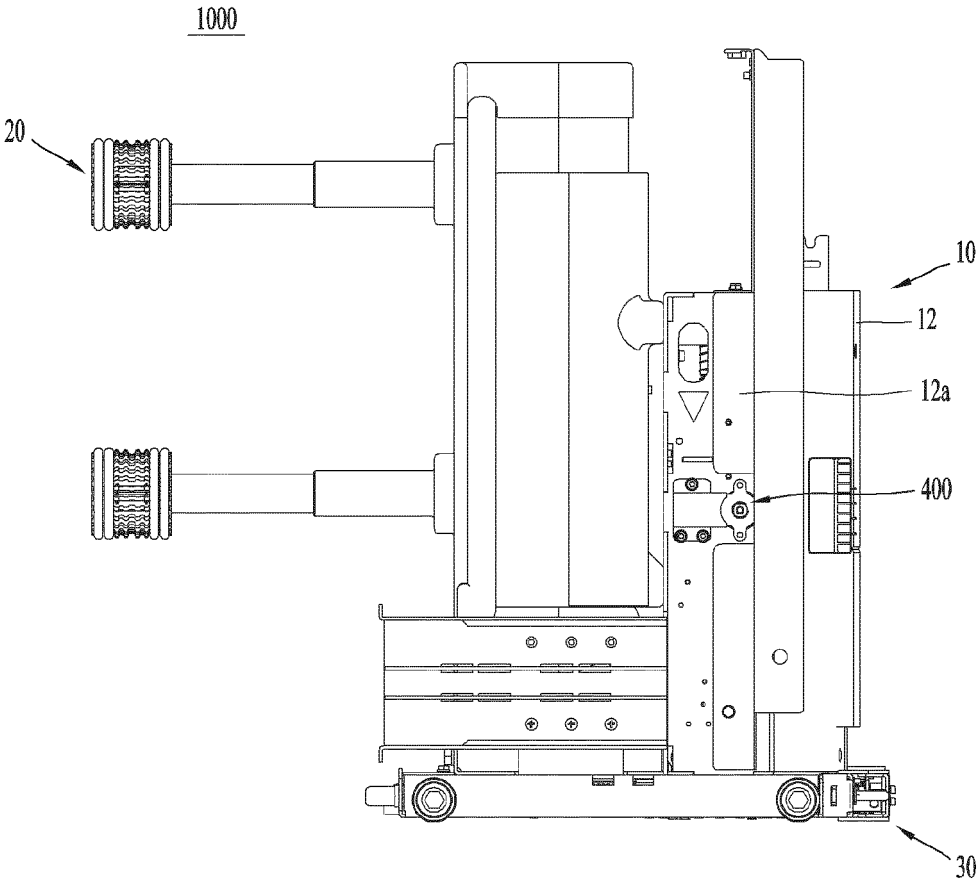


FIG. 3

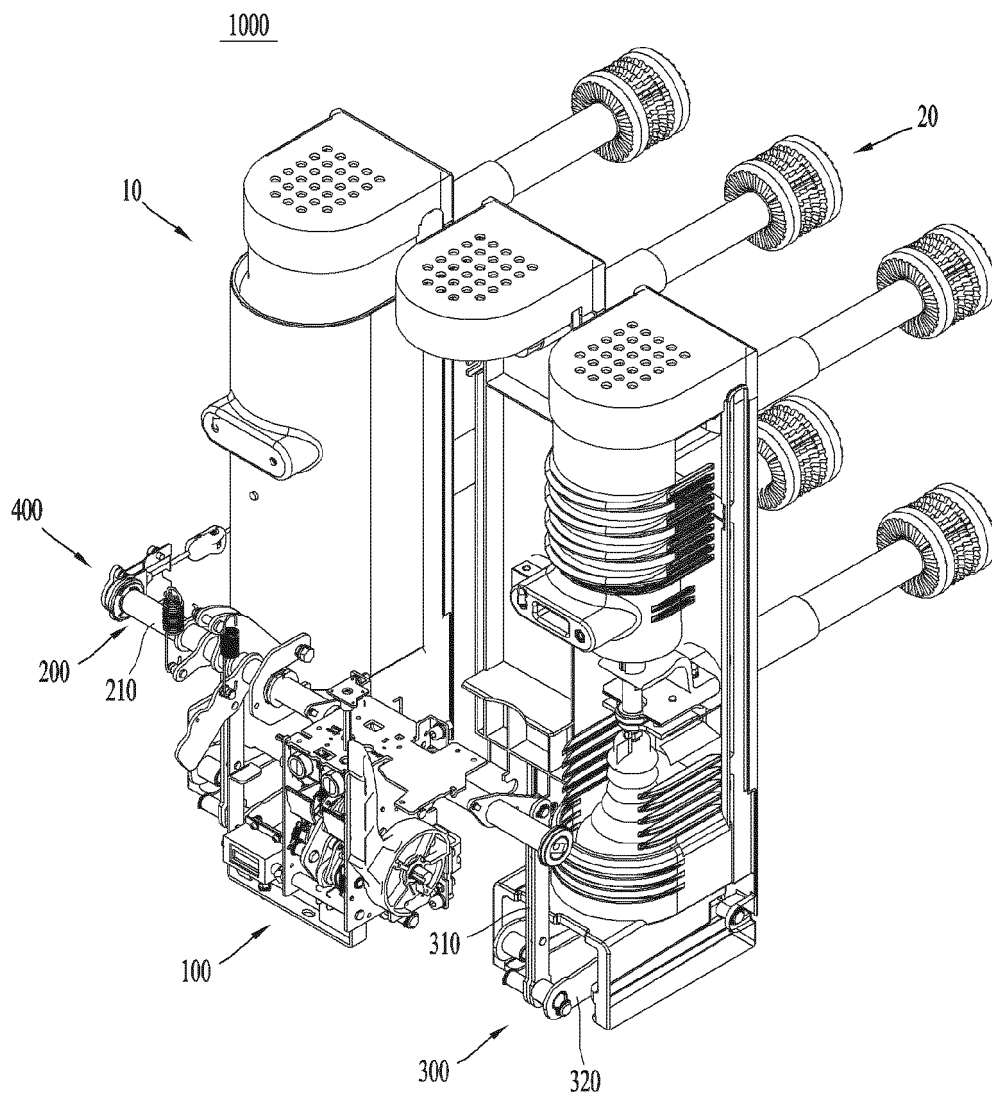


FIG. 4

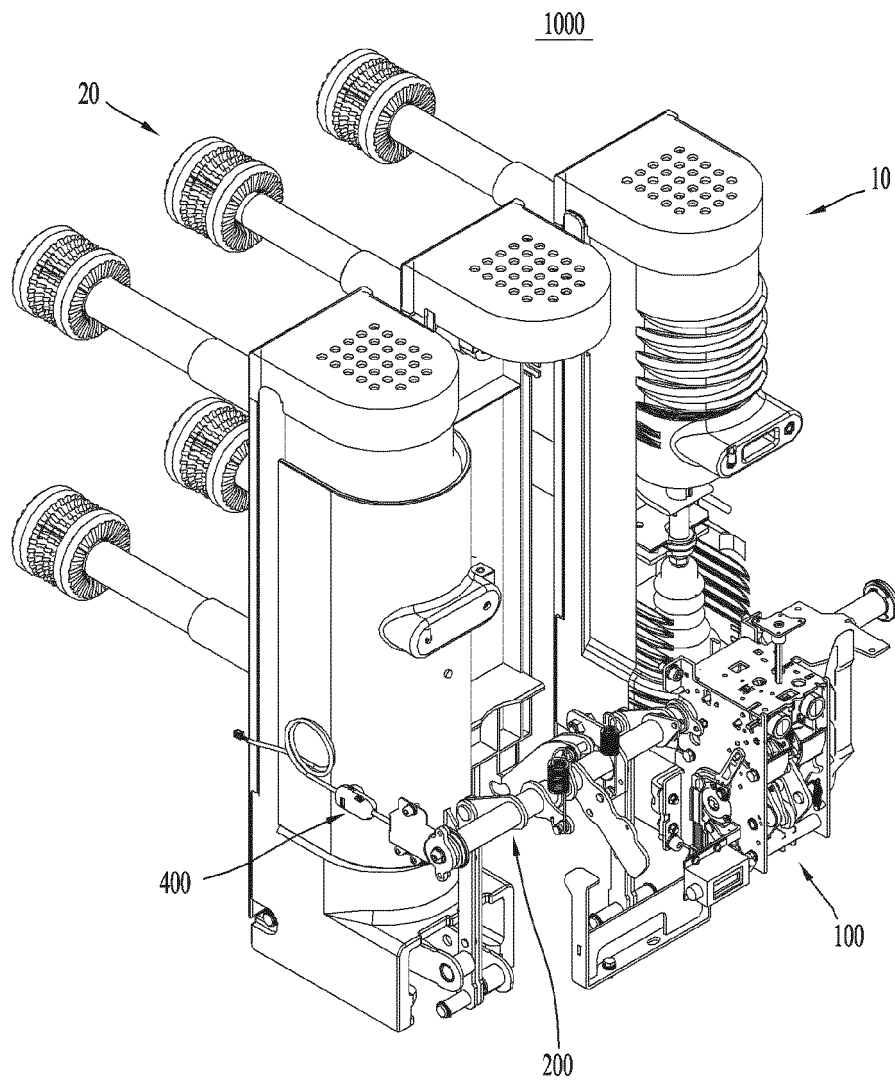


FIG. 5

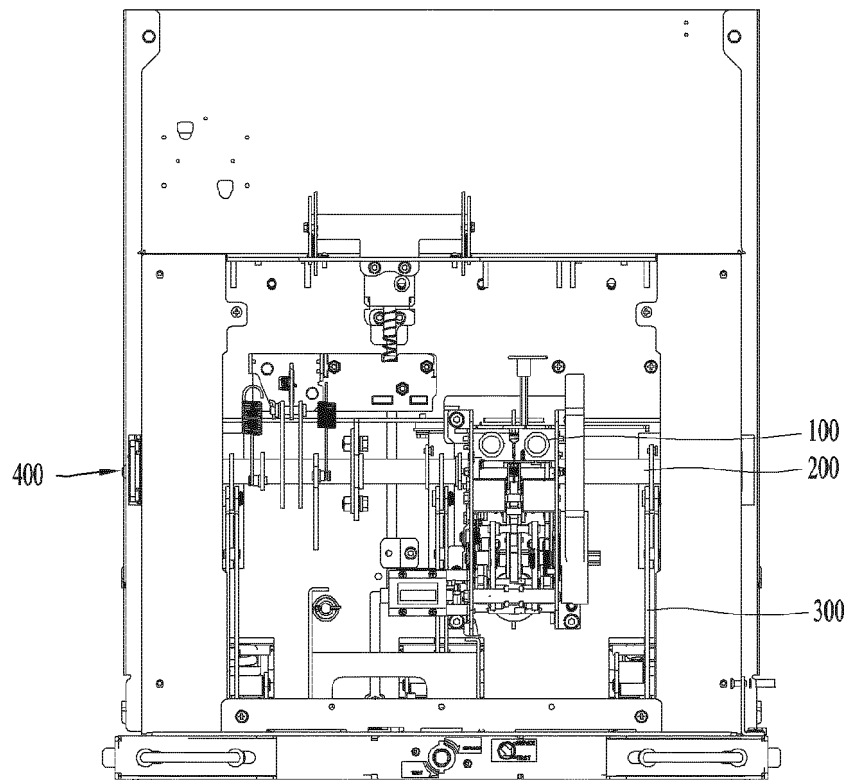


FIG. 6

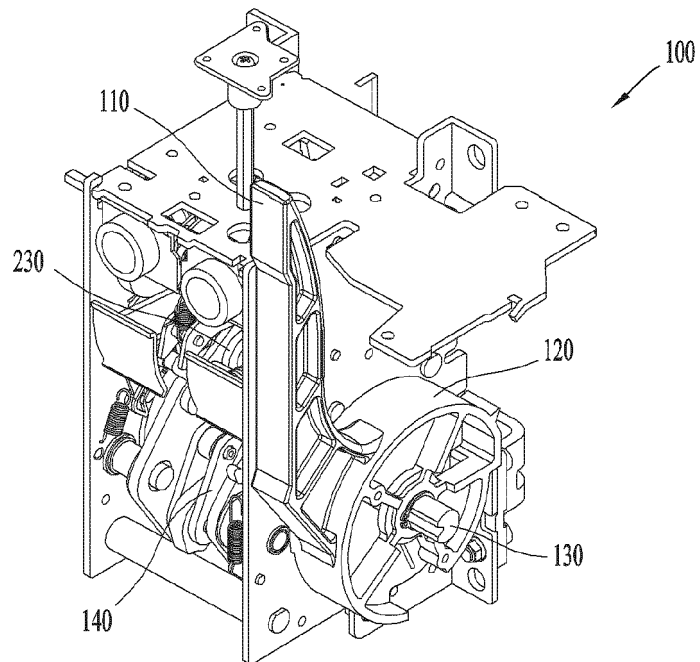


FIG. 7

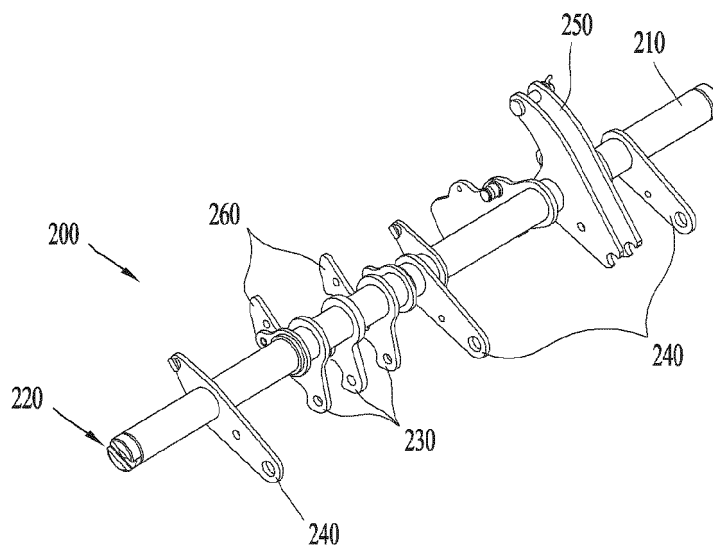


FIG. 8

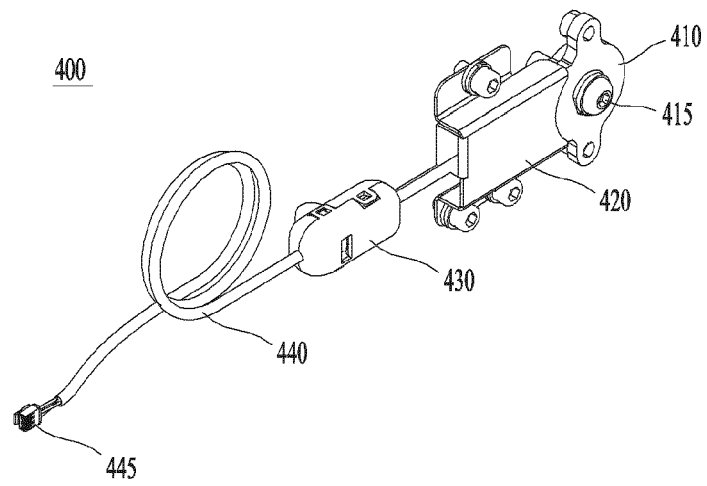


FIG. 9

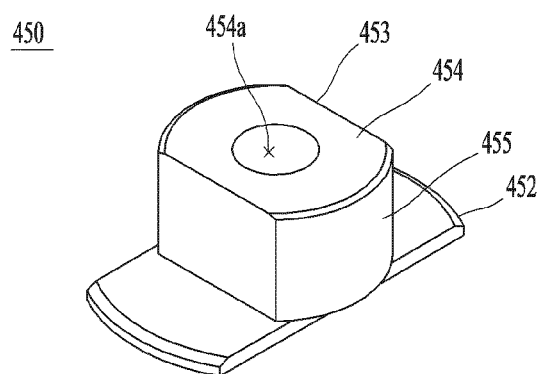


FIG. 10

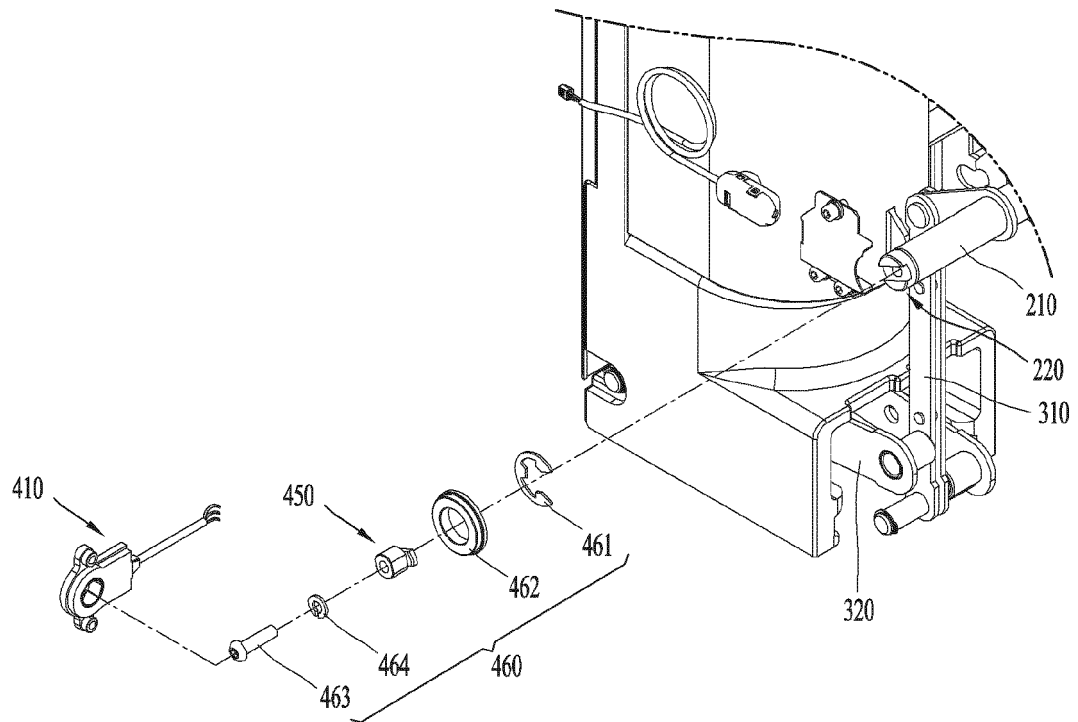


FIG. 11

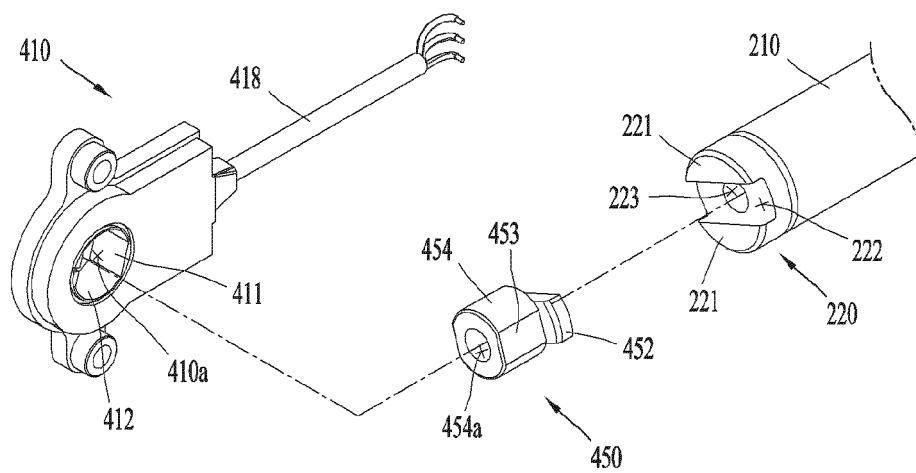
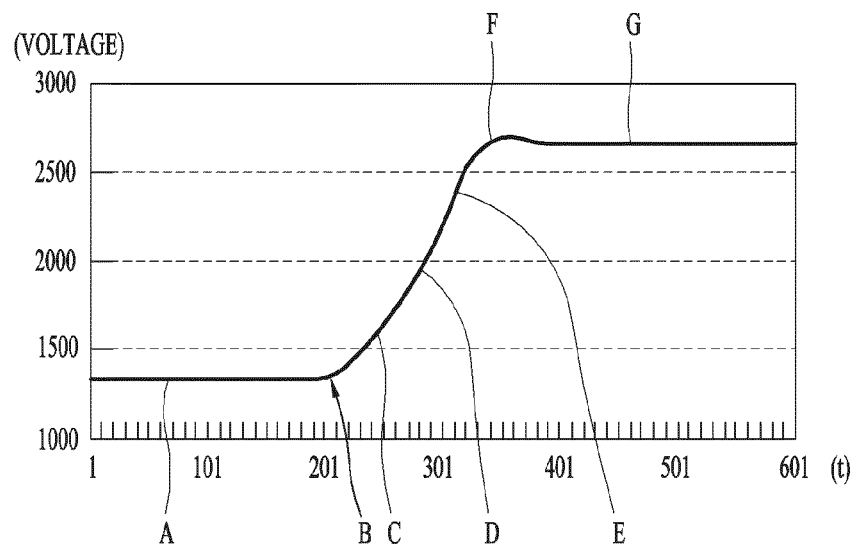


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2022/000077

A. CLASSIFICATION OF SUBJECT MATTER H01H 33/666(2006.01)i; H01H 33/662(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 33/666(2006.01); G01R 31/12(2006.01); H01H 33/66(2006.01); H01H 33/662(2006.01); H01H 33/668(2006.01); H02B 11/127(2006.01) Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean utility models and applications for utility models: IPC as above Japanese utility models and applications for utility models: IPC as above Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS (KIPO internal) & keywords: 진공 차단기(vacuum circuit breaker), 회전(rotation), 샤프트(shaft), 링크(link), 동작 감지 센서(motion sensing sensor)																					
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>KR 10-2020-0100406 A (LS ELECTRIC CO., LTD.) 26 August 2020 (2020-08-26) See paragraphs [0044], [0048] and [0052]; claim 1; and figure 2.</td> <td>1</td> </tr> <tr> <td>A</td> <td></td> <td>2-9</td> </tr> <tr> <td>Y</td> <td>KR 10-1522267 B1 (LSIS CO., LTD.) 21 May 2015 (2015-05-21) See paragraphs [0050], [0064]-[0065], [0069]-[0070] and [0083]; and figure 2.</td> <td>1</td> </tr> <tr> <td>A</td> <td>KR 10-2021-0090937 A (LS ELECTRIC CO., LTD.) 21 July 2021 (2021-07-21) See paragraphs [0026]-[0049]; and figures 2-8.</td> <td>1-9</td> </tr> <tr> <td>A</td> <td>KR 10-2019-0044372 A (KOREA ELECTRIC POWER CORPORATION) 30 April 2019 (2019-04-30) See paragraphs [0018]-[0053]; and figures 1-4.</td> <td>1-9</td> </tr> <tr> <td>A</td> <td>KR 10-1979248 B1 (LEE, Woon Woo) 16 May 2019 (2019-05-16) See claims 1-3; and figure 6.</td> <td>1-9</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	KR 10-2020-0100406 A (LS ELECTRIC CO., LTD.) 26 August 2020 (2020-08-26) See paragraphs [0044], [0048] and [0052]; claim 1; and figure 2.	1	A		2-9	Y	KR 10-1522267 B1 (LSIS CO., LTD.) 21 May 2015 (2015-05-21) See paragraphs [0050], [0064]-[0065], [0069]-[0070] and [0083]; and figure 2.	1	A	KR 10-2021-0090937 A (LS ELECTRIC CO., LTD.) 21 July 2021 (2021-07-21) See paragraphs [0026]-[0049]; and figures 2-8.	1-9	A	KR 10-2019-0044372 A (KOREA ELECTRIC POWER CORPORATION) 30 April 2019 (2019-04-30) See paragraphs [0018]-[0053]; and figures 1-4.	1-9	A	KR 10-1979248 B1 (LEE, Woon Woo) 16 May 2019 (2019-05-16) See claims 1-3; and figure 6.	1-9
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Date of the actual completion of the international search 28 April 2022	Date of mailing of the international search report 28 April 2022																				
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2022/000077

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