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(54) A CIRCUIT BREAKER

(57) Embodiments of the present disclosure provide a circuit breaker. The circuit breaker comprises: a shaft including a first section and a second section; a movable contact assembly arranged on the shaft along an extending direction of the shaft and including a movable contact; and a driving mechanism coupled to the first section and adapted to drive the movable contact assembly to rotate with the shaft, such that the movable contact contacts with or disengages from a stationary contact of the circuit breaker, wherein the shaft further comprises an insulating layer disposed on the first section and the second section. The effective insulation protection for the shaft is achieved by the insulating layer arranged on the first section and second section, thereby avoiding the breakdown of the shaft upon the short circuit and reducing the risk of the inter-phase short circuit.

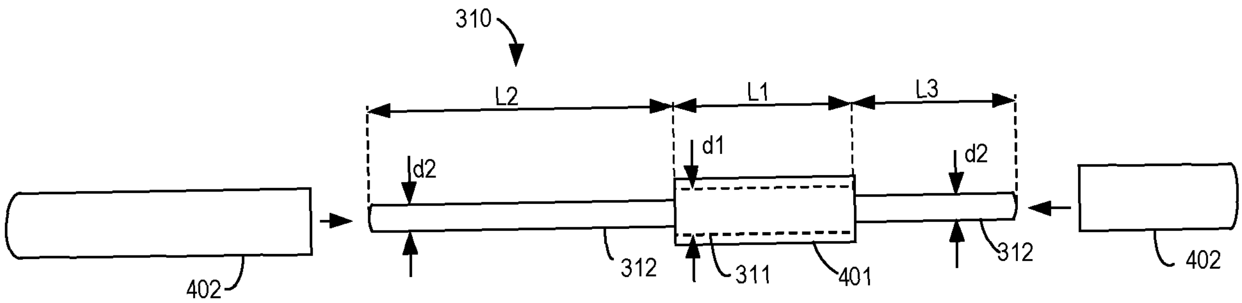

FIG. 4

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Description

FIELD

[0001] Embodiments of the present disclosure generally relate to an electrical device and more particularly to a circuit breaker with a shaft being insulated.

BACKGROUND

[0002] A circuit breaker refers to an electrical device capable of turning on, carrying, and turning off the current under a normal circuit condition, and capable of turning on, carrying for a period of time and automatically turning off the current under a specified abnormal circuit condition (such as a short-circuit current). Circuit breakers are widely used in various electricity scenarios in production and daily life, and are an important guarantee for safe electricity use. The shaft made of a metal in the circuit breaker is prone to breakdown during a short circuit under a high-voltage environment, causing an inter-phase short circuit as well as extremely large hidden safety risks.

SUMMARY

[0003] In conventional circuit breaker products, especially double-breakpoint circuit breakers, one or two shafts made of a metal are usually used to run through the contact support of each phase in order to ensure the synchronization of acts of the contacts and modularized assembling. However, the metal shafts are prone to breakdown upon a short circuit, causing an inter-phase short circuit, and such inter-phase short circuit is particularly likely to occur under an AC/DC high-voltage environment. The inter-phase short circuit will cause serious harms to the circuit breaker itself and the circuit protected by the circuit breaker.

[0004] In order to solve or at least partially solve the above and other potential problems, embodiments of the present disclosure provide a circuit breaker that uses a shaft with an insulating layer, which can implement effective insulation protection without changing the overall structure of the circuit breaker, and reduce the risks of occurrence of the inter-phase short circuit.

[0005] In one aspect of the present disclosure, a circuit breaker is provided. The circuit breaker comprises: a shaft including a first section and a second section; a movable contact assembly arranged on the shaft along an extending direction of the shaft and including a movable contact; and a driving mechanism coupled to the first section and adapted to drive the movable contact assembly to rotate with the shaft such that the movable contact contacts with or disengages from a stationary contact of the circuit breaker, wherein the shaft further comprises an insulating layer disposed on the first section and the second section.

[0006] According to the circuit breaker of the embodiments of the present disclosure, the effective insulation protection for the shaft is achieved by the insulating layer disposed on the first section and second section, thereby avoiding the breakdown of the shaft upon the short circuit and reducing the risk of the inter-phase short circuit. Therefore, such a circuit breaker can be applied more widely and is more suitable for usage under a high-voltage environment.

[0007] In some embodiments, the first section and the second section are made of a metal, and the diameter of the first section is larger than that of the second section. In such embodiments, the shaft main body is made of a metal, which ensures the easy machining and mechanical performance of the shaft itself. Meanwhile, the body of the shaft is made in a stepped shape by setting the diameter of the second section smaller than that of the first section. Accordingly, a thicker insulating layer may be disposed on the second section to further improve the insulation protection for the shaft.

[0008] In some embodiments, the insulating layer comprises a first insulating coating disposed on the first section. In such embodiments, with the insulating coating being disposed on the first section, the insulation protection can be further enhanced without reducing the mechanical performance of the shaft. In addition, since the shaft is coupled to the driving mechanism (such as a linkage) at the first section, a wear-resistant insulating coating may be selected to improve the wear resistance of the shaft and to reduce the loss of overrun.

[0009] In some embodiments, the insulating layer further comprises an insulating sleeve disposed on the second section. In such embodiments, the insulating sleeve may be mounted onto the second section after the first section of the shaft is coupled to the driving mechanism. In this way, the difficulty of installation is reduced, and meanwhile the insulating sleeve is prevented from being worn when passing through the driving mechanism.

[0010] In some embodiments, the insulating layer further comprises a second insulating coating and an insulating sleeve disposed on the second section. In such embodiments, the second insulating coating on the second section may be formed together with the first insulating layer on the first section, and the insulating sleeve can be conveniently installed on the second section. In this way, the insulation protection for the shaft is further improved without increasing the difficulty in installation and manufacture.

[0011] In some embodiments, a thickness of the insulating sleeve is in a range of 0.1 mm to 0.3 mm. In such embodiments, the effective insulation protection is achieved using a thinner insulating sleeve without reducing the strong and tough mechanical performance of the shaft.

[0012] In some embodiments, the insulating layer disposed on the second section is formed by an injection molding process. In such embodiments, the insulating layer integral with the second section may be formed by using the injection molding process, thereby resulting in uniform and reliable insulation protection.

[0013] In some embodiments, the shaft has the same diameter at the first section and the second section. In such embodiments, the synchronization and consistency of acts of the movable contacts of different poles of the circuit breaker may be guaranteed by configuring the shaft to have a uniform diameter at different sections.

[0014] In some embodiments, the first section is located at a middle portion of the shaft, and the second section comprises portions adjacent to both ends of the shaft. In such embodiments, the insulation protection may be achieved for a circuit breaker having more than two poles.

[0015] In some embodiments, the circuit breaker is a four-pole circuit breaker. In such embodiments, a widely useful four-pole circuit breaker with good shaft insulation may be formed.

[0016] In some embodiments, the circuit breaker is a three-pole circuit breaker. In such embodiments, a widely useful three-pole circuit breaker with good shaft insulation may be formed.

[0017] Further features of the present disclosure will become apparent from the following description of exemplary embodiments with reference to the accompanying drawings. It should be appreciated that this Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. Other features of the subject matter described herein will become apparent through the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other objectives, features, and advantages of exemplary embodiments of the present disclosure will become more apparent from the following detailed description with reference to the accompanying drawings, wherein the same reference symbols refer to the same elements in exemplary embodiments of the present disclosure.

FIG. 1 illustrates an overall schematic diagram of a circuit breaker according to an exemplary embodiment of the present disclosure;

FIG. 2 illustrates a partial cross-sectional view of the circuit breaker shown in FIG. 1;

FIG. 3 illustrates a schematic diagram of the internal structure of the circuit breaker shown in FIG. 1;

FIG. 4 illustrates a schematic diagram of forming a circuit breaker shaft according to an exemplary embodiment of the present disclosure; and

FIG. 5 illustrates a schematic diagram of a circuit breaker shaft according to an exemplary embodiment of the present disclosure.

[0019] Throughout the drawings, the same or similar reference symbols refer to the same or similar elements.

DETAILED DESCRIPTION OF EMBODIMENTS

[0020] The present disclosure will now be described with reference to several example embodiments. It should be understood that these embodiments are described only to enable those skilled in the art to better understand and thereby implement the present disclosure, not to suggest any limitation on the scope of the technical solutions of the present disclosure.

[0021] As used herein, the term "includes" and its variants are to be read as open-ended terms that mean "includes, but is not limited to." The term "based on" is to be read as "based at least in part on." The term "one example implementation" and "an example implementation" are to be read as "at least one example implementation." The term "another implementation" is to be read as "at least one other implementation." Terms "a first", "a second" and others can denote different or identical objects. The following text may also contain other explicit or implicit definitions. Unless otherwise expressly specified in the context, the definitions of terms are consistent throughout the specification.

[0022] As mentioned above, currently, the shaft made of a metal in the circuit breaker is prone to breakdown upon a short circuit, causing an inter-phase short circuit, particularly under a high-voltage (> AC 690V) or DC (> DC 1000V) environment. In the case of a normal short circuit, the current flows through the poles of the circuit breaker sequentially. However, when a dielectric breakdown occurs between the metal shaft and other components in the circuit breaker (such as a stationary contact), the inter-phase short circuit is caused. In the case of the inter-phase short circuit, the path of the current is greatly reduced, and even damages are caused to the circuit breaker. Therefore, the inter-phase short circuit causes extreme harms.

[0023] In some traditional solutions, in order to reduce the risk of the inter-phase short circuit, the shaft of the circuit breaker is formed as a complete plastic shaft, or the shaft is formed by the docking or mating a metal segment with a plastic member. In such traditional solutions, although the insulation of the shaft is improved, the difficulty in manufacturing the shaft is increased and the mechanical performance is reduced.

[0024] Embodiments of the present disclosure provide a circuit breaker including a shaft with an insulating layer so as to solve or at least partially solve the above and other potential problems. Some example embodiments will now be described with reference to FIG. 1 to FIG. 5.

[0025] First, the overall structure of a circuit breaker 100 according to an exemplary embodiment of the present disclosure will be described in detail with reference to FIG. 1 to FIG. 3. FIG. 1 illustrates an overall schematic diagram of the circuit breaker 100 according to an exemplary embodiment of the present disclosure; FIG. 2 illustrates a partial cross-sectional view of the circuit breaker 100 shown in FIG. 1; FIG. 3 illustrates a schematic diagram of the internal structure 300 of the circuit breaker shown in FIG. 1.

[0026] As shown in FIG. 1, in general, the circuit breaker 100 described herein is a four-pole circuit breaker including poles 111-114, wherein each pole is adapted to be connected to a phase line or a zero line. The circuit breaker 100 further includes a driving mechanism 105. As shown in FIG. 2, the driving mechanism 105 may include a handle, an operation mechanism, a linkage mechanism, etc. The scope of the present disclosure is not limited to a specific driving mechanism, so it is not described in detail here. The driving mechanism 105 is located at one pole of the circuit breaker, for example, at the pole 112. The pole 112 may also be referred to as a mechanism pole 112.

[0027] Components such as shafts 310, movable contacts 302 and stationary contacts 304 are located within a housing 103 of the circuit breaker 100. As shown in FIG. 3, the circuit breaker 100 includes two shafts 310, and the shaft 310 includes a first section 311 and a second section 312, wherein the first section 311 is located at the mechanism pole 112. Each of the poles 111-114 of the circuit breaker 110 includes a contact circuit composed of the stationary contact 304, the movable contact 302, a contact support 303, and so on. A movable contact assembly including the movable contact 302 and the contact support 303 is arranged on the shaft 310 along an extending direction of the shaft 310.

[0028] The driving mechanism 105 is coupled to the first section 311 of the shaft 310 and is adapted to drive the movable contact assembly to rotate with the shaft 310 such that the movable contact 302 contacts with or disengages from the stationary contact 304 of the circuit breaker 100. In the simplified schematic diagram of FIG. 3, a linkage 305 constituting a part of the driving mechanism 105 is shown. The linkage 305 is coupled to the first section 311. When the linkage 305 is pushed down or pulled up, the shaft 310 will cause the movable contacts 310 of individual poles to simultaneously contact with or disengage from the corresponding stationary contact 304 so as to close or open the corresponding contact circuit.

[0029] It should be understood that showing the circuit breaker 100 as a four-pole circuit breaker is merely exemplary and is not intended to limit the scope of the present disclosure. The embodiments of the present disclosure may be applied to various circuit breakers, such as a two-pole circuit breaker, a three-pole circuit breaker, and the like. In addition, the driving mechanism may be coupled to any pole of the circuit breaker. The circuit breaker 100 is shown as having two shafts in FIG. 1 to FIG. 3 for illustrative purposes only, but it should be understood that the circuit breaker according to embodiments of the present disclosure may have a larger or smaller number of shafts.

[0030] In order to increase the insulation protection of the shaft and reduce the risk of inter-phase short circuit, in addition to the body of the shaft, the shaft 310 further includes an insulating layer disposed on the first section 311 and the second section 312. The insulating layer of the shaft 310 may be formed in any suitable manner, including but not limited to an insulating coating, an insulating sleeve, injection molding, and the like. The insulating layers on the first section 311 and the second section 312 may be formed in the same or different manners, and may have the same or different thicknesses.

[0031] The shaft 310 according to an embodiment of the present disclosure will be described in detail below with reference to FIG. 4 to FIG. 5. FIG. 4 illustrates a schematic diagram of forming the circuit breaker shaft 310 according to an exemplary embodiment of the present disclosure. FIG. 5 illustrates a schematic diagram of a circuit breaker shaft 310 according to an exemplary embodiment of the present disclosure.

[0032] In the example of FIG. 4, the shaft 310 includes a stepped shaft body made of for example a metal, which includes a first section 311 and a second section 312. The diameter d1 of the first section 311 is larger than the diameter d2 of the second section 312. The shaft body made of metal is easy to process and helps to ensure a strong and tough mechanical performance of the shaft. The length L1 of the first section 311 as well as the lengths L2 and L3 of the second section 312 may be set according to actual needs.

[0033] A first insulating coating 401 is disposed on the first section 311. The first insulating coating 401 may be formed in any suitable manner such as coating, spraying, or the like. Since the driving mechanism 105 is coupled to the shaft 310 at the first section 311, a component such as the linkage 305 will cause wear to the first insulating coating 401. Therefore, in some embodiments, the first insulating coating 401 may be formed as a wear-resistant insulating coating, for example, the first insulating coating 401 may be formed as an oxide (such as alumina) coating. In this way, not only the insulation protection of the shaft 310 is enhanced, but also the wear resistance of the shaft 310 is improved, thereby avoiding the loss of overrun.

[0034] In some embodiments, the insulating layer disposed on the second section 312 may be formed using an insulating sleeve 402 such as a thermoplastic sleeve. As shown in FIG. 3, in such a case, after the body of the shaft 310 (for example, an insulating layer has been disposed on the first section) has been installed to the circuit breaker 100, the insulating sleeve 402 may be directly sleeved onto the second section 312. This reduces the difficulty of installation and prevents the thermoplastic sleeve from being worn as it passes through the mechanism.

[0035] The thickness of the insulating sleeve 402 may be selected as needed. An excellent insulating effect may be achieved with a thin thermoplastic sleeve. The thickness of the insulating sleeve 402 may be in a range of 0.1 mm to 0.3 mm. By way of example only, a thermoplastic sleeve with a thickness of 0.15mm can effectively prevent the inter-phase short circuit of the shaft, and increase the creepage distance of the opposed phase. After the test, the breakdown does not occur between dielectric phases under a 3000 Vdc voltage condition for 5 seconds.

[0036] In some embodiments, the insulating layer disposed on the second section 312 may include a second insulating coating, for example, formed together with the first insulating coating 401, and the second insulating coating may have the same thickness as or a different thickness from the first insulating coating 401. In some embodiments, the insulating sleeve 402 may further be disposed on the second insulating coating, which may further improve the insulation protection of the shaft 310.

[0037] In some embodiments, the insulating layer disposed on the first section 311 or the second section 312 may also be formed by an injection molding process. For example, the shaft body including the first section 311 and the second section 312 may be placed in a mold, and then the insulating layer on the first section 311 and the second section 312 may be formed by injection molding. In some embodiments, when the first insulating coating 401 is disposed on the first section 311, both ends of the shaft 310 may be respectively placed in an injection molding mold, to form the insulating layer on the second section 312.

[0038] FIG. 5 schematically illustrates a formed shaft 310 including the insulating layer, which includes the first section 311 and the first insulating coating 401 disposed on the first section 311, the second section 312 and the insulating sleeve 402 disposed on the second section 312. The shaft 310 has a diameter D1 at the first section 311 and a diameter D2 at a second section 312. In some embodiments, the diameter D1 may be substantially equal to diameter D2. The formed shaft with a uniform diameter facilitates the synchronization of the acts of the movable contacts 302 of different poles. However, it should be understood that this is not limiting, and the circuit breaker according to embodiments of the present disclosure may also have different diameters at the first section 311 and the second section 312.

[0039] In the examples described above, the first section 311 is located in a middle portion of the shaft 310, and the second section 312 includes portions close to both ends of the shaft 310. It should be understood that this is merely exemplary and is not intended to limit the scope of the present disclosure. The positions of the first section and the second section may be set according to actual needs. For example, for a two-pole circuit breaker, the first section and the second section may include a left end portion and a right end portion of the shaft, respectively.

[0040] It should be understood that all numerical values described in the above detailed embodiments of the present disclosure are exemplary, and all numerical values are optional.

[0041] It should be understood that the above detailed embodiments of the present disclosure are merely for the purpose of illustrating or explaining the principles of the present disclosure, rather than limiting the present disclosure. Therefore, any modifications, equivalent substitutions and improvements made within the spirit and principles of the present utility model should be included in the protection scope of the present utility model. Meanwhile, the claims appended to the present disclosure are intended to cover all variations and modifications that fall within the scope and boundary of the claims or their equivalents.

Claims

1. A circuit breaker (100), comprising:

    a shaft (310) including a first section (311) and a second section (312);
    a movable contact assembly arranged on the shaft (310) along an extending direction of the shaft (310) and including a movable contact (302); and
    a driving mechanism (105) coupled to the first section (311) and adapted to drive the movable contact assembly to rotate with the shaft (310) such that the movable contact (302) contacts with or disengages from a stationary contact (304) of the circuit breaker (100),
    wherein the shaft (310) further comprises an insulating layer disposed on the first section (311) and the second section (312).

2. The circuit breaker (100) according to claim 1, wherein the first section (311) and the second section (312) are made of a metal, and the diameter (d1) of the first section (311) is larger than the diameter (d2) of the second section (312).

3. The circuit breaker (100) according to claim 1 or 2, wherein the insulating layer comprises a first insulating coating (401) disposed on the first section (311).

4. The circuit breaker (100) according to claim 3, wherein the insulating layer further comprises an insulating sleeve (402) disposed on the second section (312).

5. The circuit breaker (100) according to claim 3, wherein the insulating layer further comprises a second insulating coating and an insulating sleeve (402) disposed on the second section (312).

6. The circuit breaker (100) according to claim 4 or 5, wherein the thickness of the insulating sleeve (402) is in a range of from 0.1 mm to 0.3 mm.

7. The circuit breaker (100) according to any of the pre-

ceding claims, wherein the insulating layer disposed on the second section (312) is formed by an injection molding process.

8. The circuit breaker (100) according to any of the preceding claims, wherein the shaft (310) has the same diameter at the first section (311) and the second section (312).

9. The circuit breaker (100) according to any of the preceding claims, wherein the first section (311) is located at a middle portion of the shaft (310), and the second section (312) comprises portions adjacent to both ends of the shaft (310).

10. The circuit breaker (100) according to any of the preceding claims, wherein the circuit breaker (100) is a four-pole circuit breaker.

11. The circuit breaker (100) according to any of the preceding claims, wherein the circuit breaker (100) is a three-pole circuit breaker.

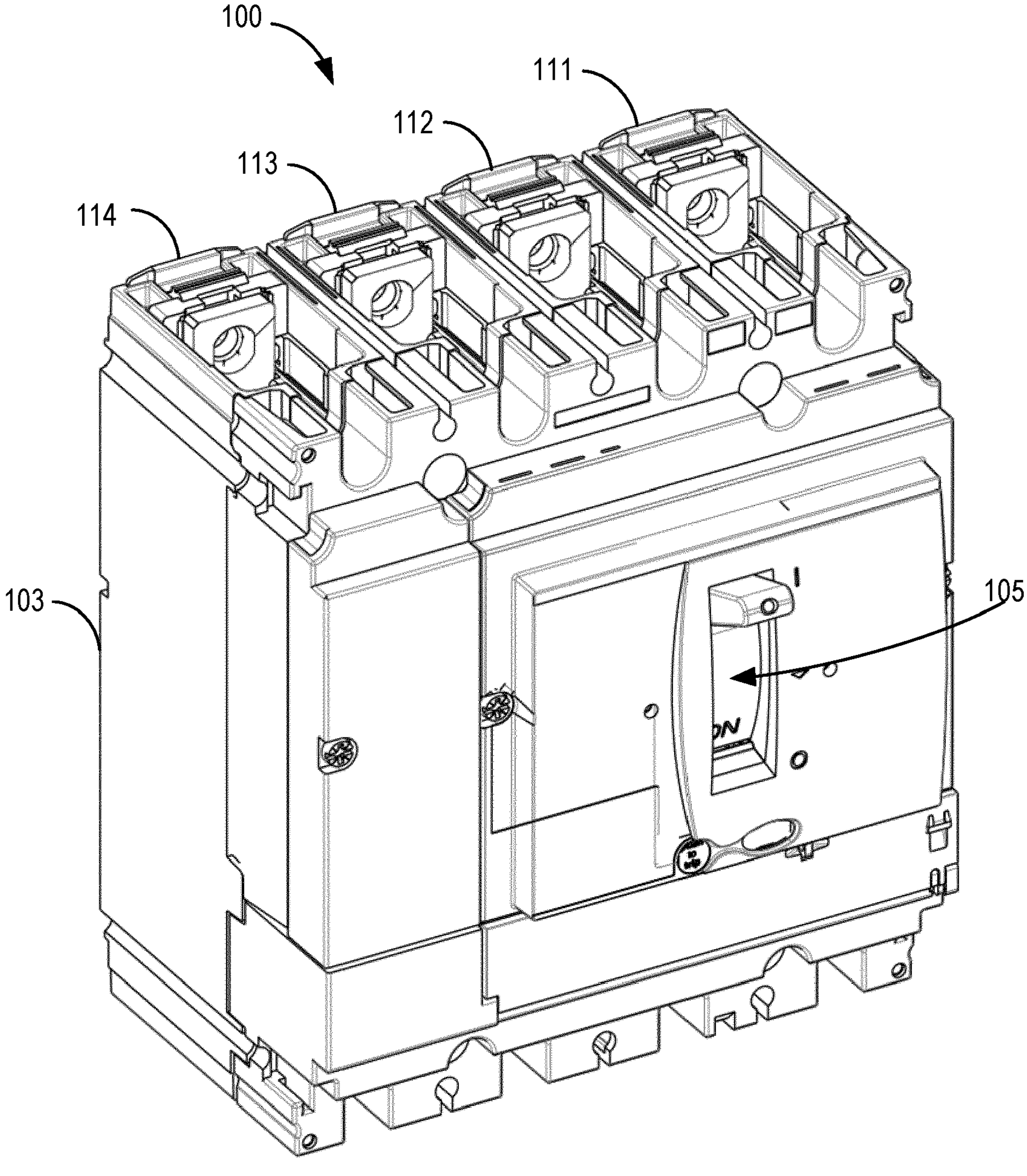

FIG. 1

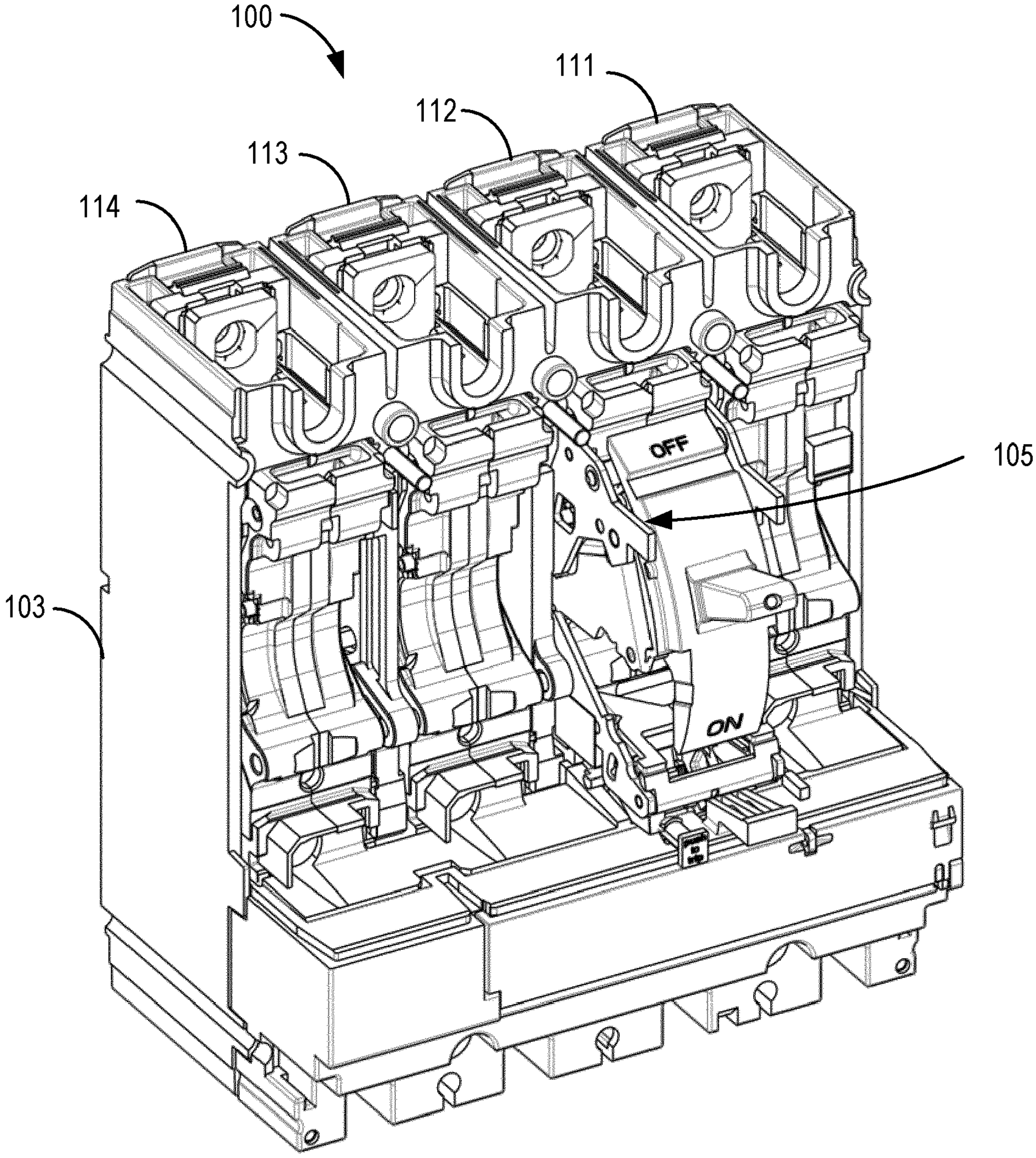

FIG. 2

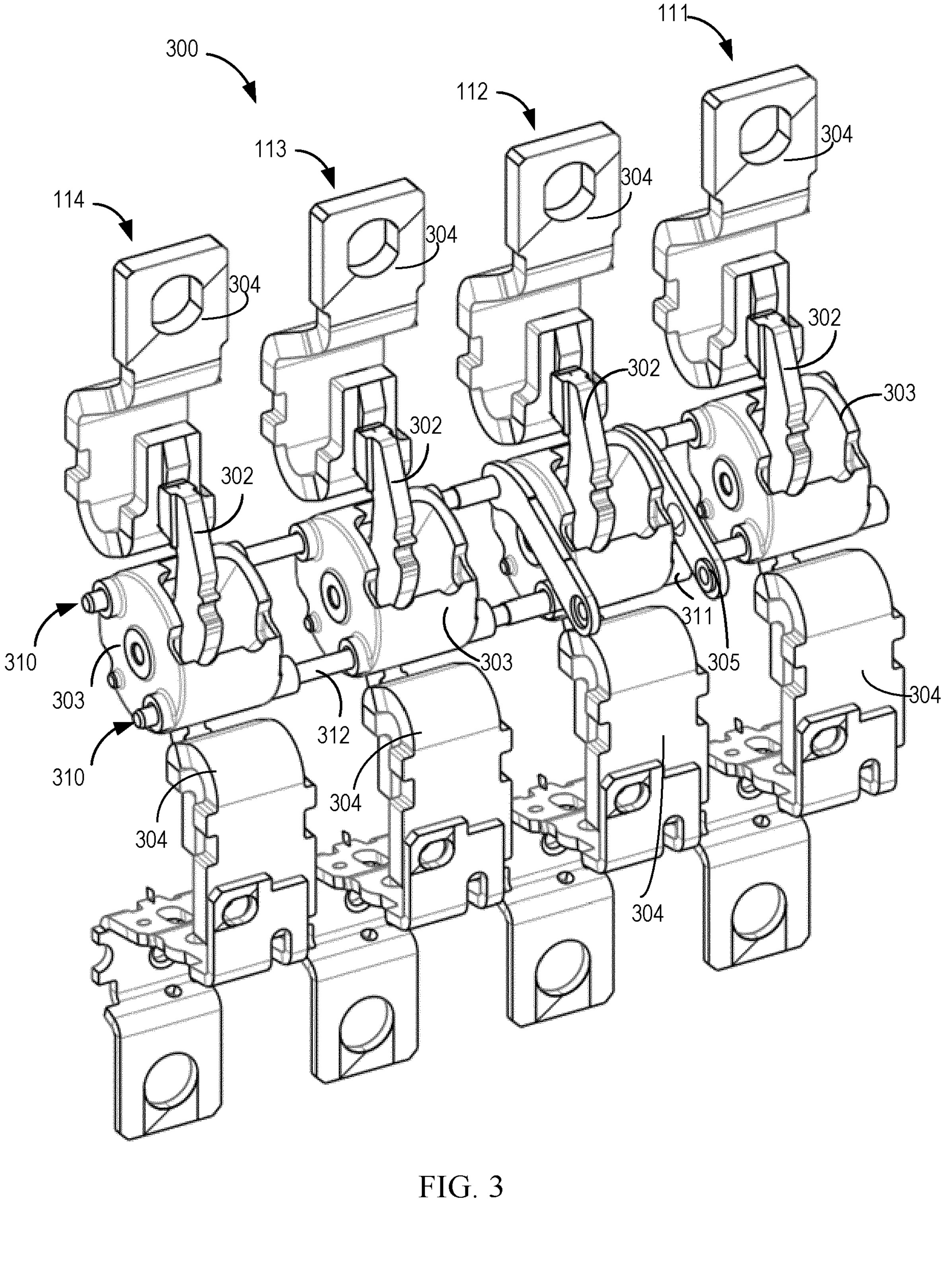
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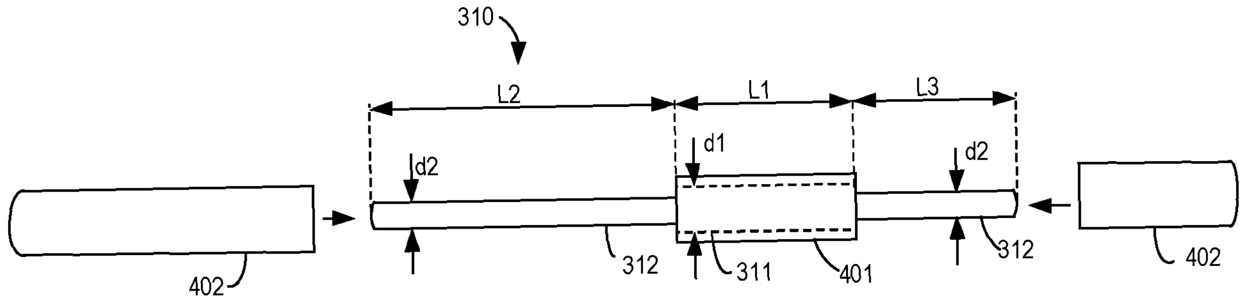
FIG. 3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L2
L1
L3
d2
d1
d2
402
312
311
401
312
402

FIG. 4

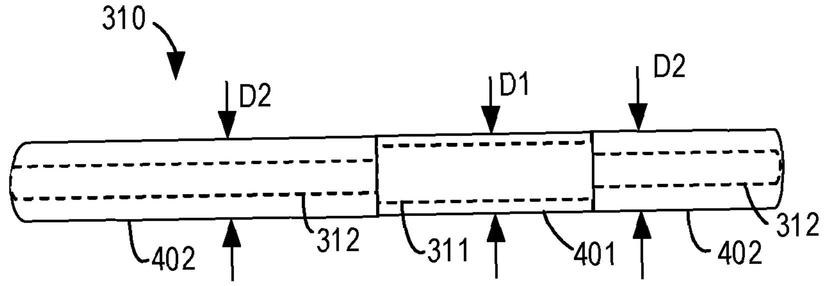
310
D2
D1
D2
402
312
311
401
402
312

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 6458

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			H01H

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	24 June 2020	Findeli, Luc

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 16 6458

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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