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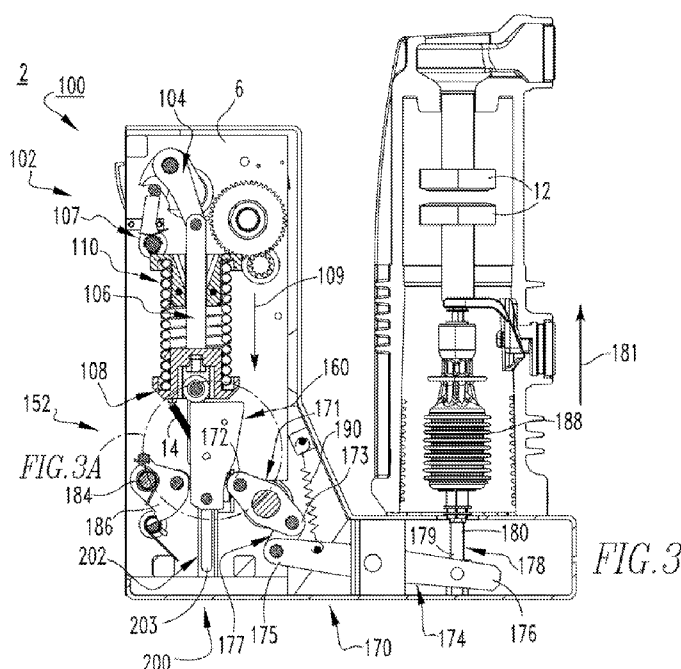
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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

[Continued on next page]

(54) Title: ELECTRICAL SWITCHING APPARATUS AND TRANSMISSION ASSEMBLY THEREFOR



(57) Abstract: A transmission assembly (100) is for an electrical switching apparatus (2). The electrical switching apparatus includes a housing (4), a mount (6), at least one charging mechanism (8, 10), and a pair of separable contacts (12). The transmission assembly has a drive assembly (102) and a transfer assembly (152). The drive assembly includes a rotary driving member (104), a stored energy mechanism (110), and a linear driving member (108) partially extending into the stored energy mechanism and being coupled to the rotary driving member. The transfer assembly cooperates with the drive assembly and the separable contacts and includes a sliding transfer component (160). The transmission assembly moves between a LOADED OPEN position, an UNLOADED CLOSED position, a LOADED CLOSED position, and an UNLOADED OPEN position. When the transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, the linear driving member drives the sliding transfer component in a generally linear direction (109), thereby closing the separable contacts.



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ELECTRICAL SWITCHING APPARATUS AND TRANSMISSION ASSEMBLY THEREFOR

CROSS-REFERENCE TO RELATED APPLICATION

- 5 This application claims priority from and claims the benefit of U.S. Patent Application Serial No. 14/518,059, filed October 20, 2014, which is incorporated by reference herein.

BACKGROUND

Field

- 10 The disclosed concept pertains generally to electrical switching apparatus and, more particularly, to electrical switching apparatus such as for example, circuit breakers. The disclosed concept also pertains to transmission assemblies for electrical switching apparatus.

Background Information

- 15 Electrical switching apparatus, such as circuit breakers, provide protection for electrical systems from electrical fault conditions such as, for example, current overloads, short circuits, abnormal voltage and other fault conditions. Typically, circuit breakers include an operating mechanism which opens electrical contact assemblies to interrupt the flow of current through the conductors of an
20 electrical system in response to such fault conditions as detected, for example, by a trip unit.

- The operating mechanism of some medium voltage circuit breakers, for example, typically includes a cam assembly that allows the electrical contacts to open and close. The individual cams are expensive and difficult to manufacture.
25 Additionally, the cam assembly requires significant labor time to assemble.

 There is thus room for improvement in electrical switching apparatus and in transmission assemblies therefor.

SUMMARY

- 30 These needs and others are met by embodiments of the disclosed concept wherein a transmission assembly is provided which among other benefits,

economically and efficiently allows a pair of separable contacts of an electrical switching apparatus to be opened and closed.

In accordance with one aspect of the disclosed concept, a transmission assembly for an electrical switching apparatus is provided. The electrical switching apparatus includes a housing, a mount coupled to the housing, at least one charging mechanism coupled to the mount, and a pair of separable contacts disposed within the housing. The transmission assembly comprises: a drive assembly comprising: a rotary driving member structured to be coupled to the charging mechanism, a stored energy mechanism, and a linear driving member partially extending into the stored energy mechanism and being coupled to the rotary driving member, a transfer assembly cooperating with the drive assembly and structured to cooperate with the separable contacts, the transfer assembly comprising a sliding transfer component structured to be disposed on the mount. The transmission assembly is structured to move between a LOADED OPEN position, an UNLOADED CLOSED position, a LOADED CLOSED position, and an UNLOADED OPEN position. When the transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, the linear driving member drives the sliding transfer component in a generally linear direction, thereby closing the separable contacts.

As another aspect of the disclosed concept, an electrical switching apparatus is provided. The electrical switching apparatus comprises: a housing; a mount coupled to the housing; at least one charging mechanism coupled to the mount; a pair of separable contacts disposed within the housing, and a transmission assembly comprising: a drive assembly comprising: a rotary driving member coupled to the charging mechanism, a stored energy mechanism, and a linear driving member partially extending into the stored energy mechanism and being coupled to the rotary driving member, a transfer assembly cooperating with each of the drive assembly and the separable contacts, the transfer assembly comprising a sliding transfer component disposed on the mount. The transmission assembly is structured to move between a LOADED OPEN position, an UNLOADED CLOSED position, a LOADED CLOSED position, and an UNLOADED OPEN position. When the transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED

position, the linear driving member drives the sliding transfer component in a generally linear direction, thereby closing the separable contacts.

BRIEF DESCRIPTION OF THE DRAWINGS

5 A full understanding of the disclosed concept can be gained from the following description of the preferred embodiments when read in conjunction with the accompanying drawings in which:

 Figure 1 is a simplified view of an electrical switching apparatus, and a portion of a transmission assembly therefor, in accordance with an embodiment of the
10 disclosed concept;

 Figure 2 is a front isometric view of a portion of the electrical switching apparatus and transmission assembly therefor of Figure 1;

 Figure 3 is a side elevation view of the electrical switching apparatus and transmission assembly therefor, showing the transmission assembly in the LOADED
15 OPEN position;

 Figure 3A is an enlarged view of a portion of the electrical switching apparatus and transmission assembly therefor of Figure 3;

 Figure 4 is a side elevation view of the electrical switching apparatus and transmission assembly therefor, showing the transmission assembly in the UNLOADED
20 CLOSED position;

 Figure 5 is a side elevation view of the electrical switching apparatus and transmission assembly therefor, showing the transmission assembly in the LOADED
CLOSED position;

 Figure 6 is a side elevation view of the electrical switching apparatus and
25 transmission assembly therefor, showing the transmission assembly in the UNLOADED
OPEN position; and

 Figure 7 is a front isometric view of a portion of the electrical switching apparatus of Figure 1, shown with a portion of the mount removed to show hidden
structures.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

As employed herein, the term “number” shall mean one or an integer greater than one (*i.e.*, a plurality).

As employed herein, the statement that two or more parts are
5 “connected” or “coupled” together shall mean that the parts are joined together either directly or joined through one or more intermediate parts.

As employed herein, the statement that two or more parts or components “engage” one another shall mean that the parts touch and/or exert a force against one another either directly or through one or more intermediate parts or
10 components.

Figure 1 shows an electrical switching apparatus (e.g., without limitation, medium voltage vacuum circuit breaker 2) in accordance with a non-limiting embodiment of the disclosed concept. In the example of Figure 1, the circuit breaker 2 includes a housing 4 (shown in simplified form in phantom line drawing), a
15 mount 6 coupled to the housing 4, a charging mechanism (e.g., without limitation, motor 8) coupled to the mount 6, and a transmission assembly 100. The circuit breaker 2 may also include a manual charging mechanism 10 in addition to the motor 8, as shown in Figure 2. As will be discussed hereinbelow, the circuit breaker 2 further includes a pair of separable contacts 12 (Figures 3, 4, 5 and 6). Among other
20 benefits, the disclosed transmission assembly 100 efficiently and economically allows the separable contacts 12 to be opened and closed.

Referring to Figure 3, the transmission assembly 100 includes a drive assembly 102 and a transfer assembly 152. The drive assembly 102 cooperates with the charging mechanisms 8,10 (Figure 2) and the transfer assembly 152. The transfer
25 assembly 152 cooperates with the drive assembly 102 and the separable contacts 12. The drive assembly 102 has a rotary driving member 104 and a number of linear driving members 106,108 (two are shown) coupled to the rotary driving member 104. It will be appreciated that the rotary driving member 104 is further coupled to the motor 8 and the manual charging mechanism 10. The drive assembly 102 also
30 includes a control member 107 that is coupled to the mount 6 and cooperates with the linear driving member 108. Additionally, the drive assembly 102 has a stored energy

mechanism (e.g., without limitation, compression spring 110). Each of the linear driving members 106,108 at least partially extends into the spring 110, as shown.

The transfer assembly 152 includes a sliding transfer component 160 and a linkage assembly 170. The sliding transfer component 160 cooperates with
5 each of the drive assembly 102 and the linkage assembly 170. Furthermore, the linkage assembly 170 cooperates with the separable contacts 12. As seen, the linkage assembly 170 has a number of rotary link members 171,174 (two are shown) and a number of coupling link members 177,178 (two are shown). The rotary link members 171,174 and the coupling link member 178 have respective end portions
10 172,173,175,176, and 179,180. The end portion 172 of the rotary link member 171 is structured to engage the sliding transfer component 160, and the coupling link member 177 couples the end portion 173 of the rotary link member 171 to the end portion 175 of the rotary link member 174. Additionally, the end portion 179 of the coupling link member 178 is coupled to the end portion 176 of the rotary link member
15 174, and the end portion 180 of the coupling link member 178 is coupled to the separable contacts 12.

As seen in the enlarged view of Figure 3A, the sliding transfer component 160 has a number of base edges 161,162 and a number of sliding edges 163,165, which are located between the base edges 161,162. The base edge 161 is
20 spaced from and parallel to the base edge 162. The sliding edge 163 is disposed opposite and spaced from the sliding edge 165. The sliding transfer component 160 further includes a connecting edge 164 connecting the sliding edge 163 to the base edge 162. In the example shown and described herein, the sliding edge 165 has a curved portion 166 and a linear portion 167.

Referring again to Figure 3, the transfer assembly 152 includes a base
25 assembly 200 coupled to the mount 6. The base assembly 200 has a base component 202 coupled to the mount 6. The base component 202 has an elongated linear slot 203. The sliding transfer component 160 is located in the elongated linear slot 203. It will be appreciated that Figures 3 and 3A show the transmission assembly 100 in a
30 LOADED OPEN position corresponding to the linkage assembly 170 being in a RETRACTED position.

In operation, the control member 107 is configured to be actuated (e.g., without limitation, by a manual push button (not shown) located on the circuit breaker 2). Upon being actuated, the control member 107 releases the linear driving member 108 and the spring 110. When this happens, the rotary driving member 104 rotates and the linear driving members 106, 108 move in a generally linear direction 109 in order to drive the sliding transfer component 160. As the sliding transfer component 160 begins to move, the sliding transfer component 160 slides within the slot 203 and the transmission assembly 100 moves from the LOADED OPEN position (Figure 3) to an UNLOADED CLOSED position (Figure 4), thereby closing the separable contacts 12.

Referring to Figures 3 and 4, it will be appreciated that when the transmission assembly 100 moves from the LOADED OPEN position (Figure 3) to the UNLOADED CLOSED position (Figure 4), the linkage assembly 170 moves from the RETRACTED position (Figure 3) to an EXTENDED position (Figure 4). Furthermore, when the transmission assembly 100 moves from the LOADED OPEN position (Figure 3) to the UNLOADED CLOSED position (Figure 4), the coupling link member 178 moves in a direction 181 generally opposite and parallel to the direction 109. Additionally, the end portion 172 of the rotary link member 171 slides from the curved portion 166 of the sliding transfer component 160 to the linear portion 167 of the sliding transfer component 160. In this manner, the transmission assembly 100 efficiently allows the spring 110 to cause the separable contacts 12 to be closed. Accordingly, among other benefits, the disclosed transmission assembly 100 eliminates cam assemblies required by the prior art and, therefore, is significantly less expensive and easier to manufacture than traditional transmission assemblies (not shown).

Referring to Figures 4 and 5, the transmission assembly 100 also includes a LOADED CLOSED position (Figure 5). When the transmission assembly 100 moves from the UNLOADED CLOSED position (Figure 4) to the LOADED CLOSED position (Figure 5), the linear driving member 108 moves away from the sliding transfer component 160. The LOADED CLOSED position (Figure 5) is the position of the transmission assembly 100 when the circuit breaker 2 is operational.

Continuing to refer to Figure 5, the transfer assembly 152 further includes a rotary shaft component 184 and a hatchet component 186 coupled to the rotary shaft component 184. The rotary shaft component 184 is coupled to the mount 6 of the circuit breaker 2. The hatchet component 186 engages the sliding edge 163 of the sliding transfer component 160. Additionally, the transfer assembly 152 has a contact spring 188 and an opening spring 190 that are each coupled to the rotary link member 174. As seen, the contact spring 188 is further coupled to the separable contacts 12 and the opening spring 190 is coupled to the mount 6.

Referring to Figures 5 and 6, the transmission assembly 100 also includes an UNLOADED OPEN position (Figure 6). When the transmission assembly 100 moves from the LOADED CLOSED position (Figure 5) to the UNLOADED OPEN position (Figure 6), the contact spring 188 and the opening spring 190 each release energy, thereby allowing the linkage assembly 172 to move from the EXTENDED position to the RETRACTED position. Furthermore, the sliding transfer component 160 is advantageously structured to tilt, such that the end portion 172 of the rotary link member 171 is able to slide on the linear portion 167 of the sliding edge 165, rather than being obstructed by a fixed sliding transfer component 160. When the transmission assembly 100 moves from the LOADED CLOSED position (Figure 5) to the UNLOADED OPEN position (Figure 6), the rotary shaft component 184 rotates and the hatchet component 186 slides on the sliding edge 163 of the sliding transfer component 160. In this manner, the transmission assembly 100 advantageously allows the separable contacts 12 to be opened.

As seen in Figure 7, the base assembly 200 further includes a locking component 204 coupled to the base component 202. When the transmission assembly 100 moves from the LOADED OPEN position (Figure 3) to the UNLOADED CLOSED position (Figure 4), the linear driving member 108 drives the sliding transfer component 160 to a DRIVEN position. When the transmission assembly 100 is in the UNLOADED CLOSED position (Figure 4), the locking component 204 advantageously maintains the sliding transfer component 160 in the DRIVEN position. In this manner, the locking component 204 provides a suitable mechanism for the sliding transfer component 160 to keep the separable contacts 12 closed.

Continuing to refer to Figure 7, the circuit breaker 2 further includes a reset spring 14 that is coupled to the linear driving member 108 and the sliding transfer component 160. When the transmission assembly 100 moves from the UNLOADED OPEN position (Figure 6) to the LOADED OPEN position (Figure 3), the reset spring 14 advantageously enables the sliding transfer component 160, the hatchet member 186, and the rotary shaft component 184 to move to the position shown in Figure 3. In this manner, the circuit breaker 2 is reset and ready for the separable contacts 12 to be closed.

Accordingly, it will be appreciated that the disclosed concept provides for an improved (e.g., without limitation, less expensive, easier to manufacture) electrical switching apparatus (e.g., without limitation, medium voltage vacuum circuit breaker 2), and transmission assembly 100 therefor, which among other benefits, provides an improved mechanism to allow a pair of separable contacts 12 to be opened and closed.

Additionally, although the disclosed concept has been described in association with the sliding transfer component 160 having the base edges 161, 162 and the sliding edges 163, 165, it will be appreciated that a sliding transfer component (not shown) may have any suitable alternative shape and/or configuration in order to perform the desired function of allowing the linear driving member 108 to cooperate with the linkage assembly 170 to open and close the separable contacts 12 in a similar manner as described herein. Furthermore, it is within the scope of the disclosed concept for a linkage assembly (not shown) to have any suitable alternative number and/or configuration of link members (not shown) in order to perform the desired function of allowing the sliding transfer component 160 to cooperate with the separable contacts 12.

While specific embodiments of the disclosed concept have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the disclosed concept which is to be given the full breadth of the claims appended and any and all equivalents thereof.

What is Claimed is:

1. A transmission assembly (100) for an electrical switching apparatus (2), said electrical switching apparatus comprising a housing (4), a mount (6) coupled to said housing, at least one charging mechanism (8,10) coupled to said mount, and a pair of separable contacts (12) disposed within said housing, said transmission assembly comprising:

a drive assembly (102) comprising:

a rotary driving member (104) structured to be coupled to said at least one charging mechanism,

a stored energy mechanism (110), and

a linear driving member (108) partially extending into said stored energy mechanism and being coupled to said rotary driving member,

a transfer assembly (152) cooperating with said drive assembly and structured to cooperate with said separable contacts, said transfer assembly comprising a sliding transfer component (160) structured to be disposed on said mount,

wherein said transmission assembly is structured to move between a LOADED OPEN position, an UNLOADED CLOSED position, a LOADED CLOSED position, and an UNLOADED OPEN position, and

wherein, when said transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, said linear driving member drives said sliding transfer component in a generally linear direction (109), thereby closing said separable contacts.

2. The transmission assembly (100) of Claim 1 wherein said transfer assembly (152) further comprises a linkage assembly (170); wherein said linkage assembly cooperates with said sliding transfer component (160) and is structured to cooperate with said separable contacts (12); and wherein, when said transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, said linkage assembly moves from a RETRACTED position to an EXTENDED position, thereby closing said separable contacts.

3. The transmission assembly (100) of Claim 2 wherein said linkage assembly (170) comprises a first coupling link member (177), a second coupling link member (178), a first rotary link member (171), and a second rotary link member (174); wherein each of said second coupling link member, said first rotary link member, and said second rotary link member has a first end portion (179,172,175) and a second end portion (180,173,176); wherein the first end portion of said first rotary link member is structured to engage said sliding transfer component (160); wherein said first coupling link member couples the second end portion of said first rotary link member to the first end portion of said second rotary link member; wherein the second end portion of said second rotary link member is coupled to the first end portion of said second coupling link member; and wherein the second end portion of said second coupling link member is structured to be coupled to said separable contacts (12).

4. The transmission assembly (100) of Claim 3 wherein, when said transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, said linear driving member (108) moves in a first direction (109); and wherein, when said linkage assembly (170) moves from the RETRACTED position to the EXTENDED position, said second coupling link member (178) moves in a second direction (181) generally parallel and opposite the first direction (109).

5. The transmission assembly (100) of Claim 3 wherein said sliding transfer component (160) comprises a first base edge (161), a second base edge (162), a first sliding edge (165), and a second sliding edge (163); wherein the first base edge is parallel to and spaced from the second base edge; wherein the first sliding edge is opposite and spaced from the second sliding edge; wherein each of the first sliding edge and the second sliding edge is located between the first base edge and the second base edge; wherein the first sliding edge comprises a curved portion (166) and a linear portion (167); and wherein, when said transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, the first end portion (172) of said first rotary link member (171) slides on the first sliding edge from the curved portion to the linear portion.

6. The transmission assembly (100) of Claim 5 wherein said transfer assembly (152) further comprises a rotary shaft component (184) and a hatchet component (186) coupled to said rotary shaft component; wherein said rotary shaft component is structured to be coupled to said mount (6); wherein said hatchet component engages the second sliding edge (163) of said sliding transfer component (160); and wherein, when said transmission assembly moves from the LOADED CLOSED position to the UNLOADED OPEN position, said rotary shaft component rotates and said hatchet component slides on the second sliding edge of said sliding transfer component.

7. The transmission assembly (100) of Claim 3 wherein, when said transmission assembly moves from the UNLOADED CLOSED position to the LOADED CLOSED position, said linear driving member (108) moves away from said sliding transfer component (160).

8. The transmission assembly (100) of Claim 7 wherein said transfer assembly (152) further comprises an opening spring (190) and a contact spring (188); wherein said opening spring is coupled to said second rotary link member (174) and is structured to be coupled to said mount (6); wherein said contact spring is coupled to said second coupling link member (178) and is structured to be coupled to said separable contacts (12); and wherein, when said transmission assembly moves from the LOADED CLOSED position to the UNLOADED OPEN position, each of said opening spring and said contact spring releases energy.

9. The transmission assembly (100) of Claim 7 wherein, when said transmission assembly moves from the LOADED CLOSED position to the UNLOADED OPEN position, said linkage assembly (170) moves from the EXTENDED position to the RETRACTED position.

10. The transmission assembly (100) of Claim 1 wherein said transfer assembly (152) further comprises a base assembly (200) comprising a base

component (202); wherein said base component is structured to be coupled to said mount (6); wherein said base component has an elongated linear slot (203); and wherein, when said transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, said sliding transfer component (160) slides within the slot.

11. The transmission assembly (100) of Claim 10 wherein said sliding transfer component (160) has a DRIVEN position; wherein, when said transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, said linear driving member (108) drives said sliding transfer component to the DRIVEN position; wherein said base assembly (200) further comprises a locking component (204) coupled to said base component; and wherein, when said transmission assembly is in the UNLOADED CLOSED position, said locking component maintains said sliding transfer component in the DRIVEN position.

12. The transmission assembly (100) of Claim 1 wherein said drive assembly (102) further comprises a control member (107) cooperating with said linear driving member (108); wherein said control member is structured to be coupled to said mount (6); and wherein said control member is structured to release said linear driving member, thereby moving said transmission assembly from the LOADED OPEN position to the UNLOADED CLOSED position.

13. An electrical switching apparatus (2) comprising:
a housing (4);
a mount (6) coupled to said housing;
at least one charging mechanism (8,10) coupled to said mount;
a pair of separable contacts (12) disposed within said housing, and
a transmission assembly (100) comprising:
a drive assembly (102) according to any of Claims 1-12.

14. The electrical switching apparatus (2) of Claim 13 wherein said sliding transfer component (160) has a DRIVEN position; wherein, when said transmission

assembly (100) moves from the LOADED OPEN position to the UNLOADED CLOSED position, said linear driving member (108) drives said sliding transfer component to the DRIVEN position; wherein said transfer assembly further comprises a base assembly (200) comprising a base component (202) and a locking component (204) coupled to said base component; wherein said base component is coupled to said mount (6); wherein said base component has an elongated linear slot (203); wherein, when said transmission assembly moves from the LOADED OPEN position to the UNLOADED CLOSED position, said sliding transfer component slides within the slot; and wherein, when said transmission assembly is in the UNLOADED CLOSED position, said locking component maintains said sliding transfer component in the DRIVEN position.

15. The electrical switching apparatus (2) of Claim 13 wherein said electrical switching apparatus is a medium voltage vacuum circuit breaker (2); wherein said at least one charging mechanism (8,10) is selected from the group consisting of a manual charging mechanism (10) and a motor (8); wherein said drive assembly (102) further comprises another linear driving member (106) extending into said stored energy mechanism (110) and coupling said linear driving member (108) to said rotary driving member (104); and wherein said stored energy mechanism (110) is a compression spring (110).

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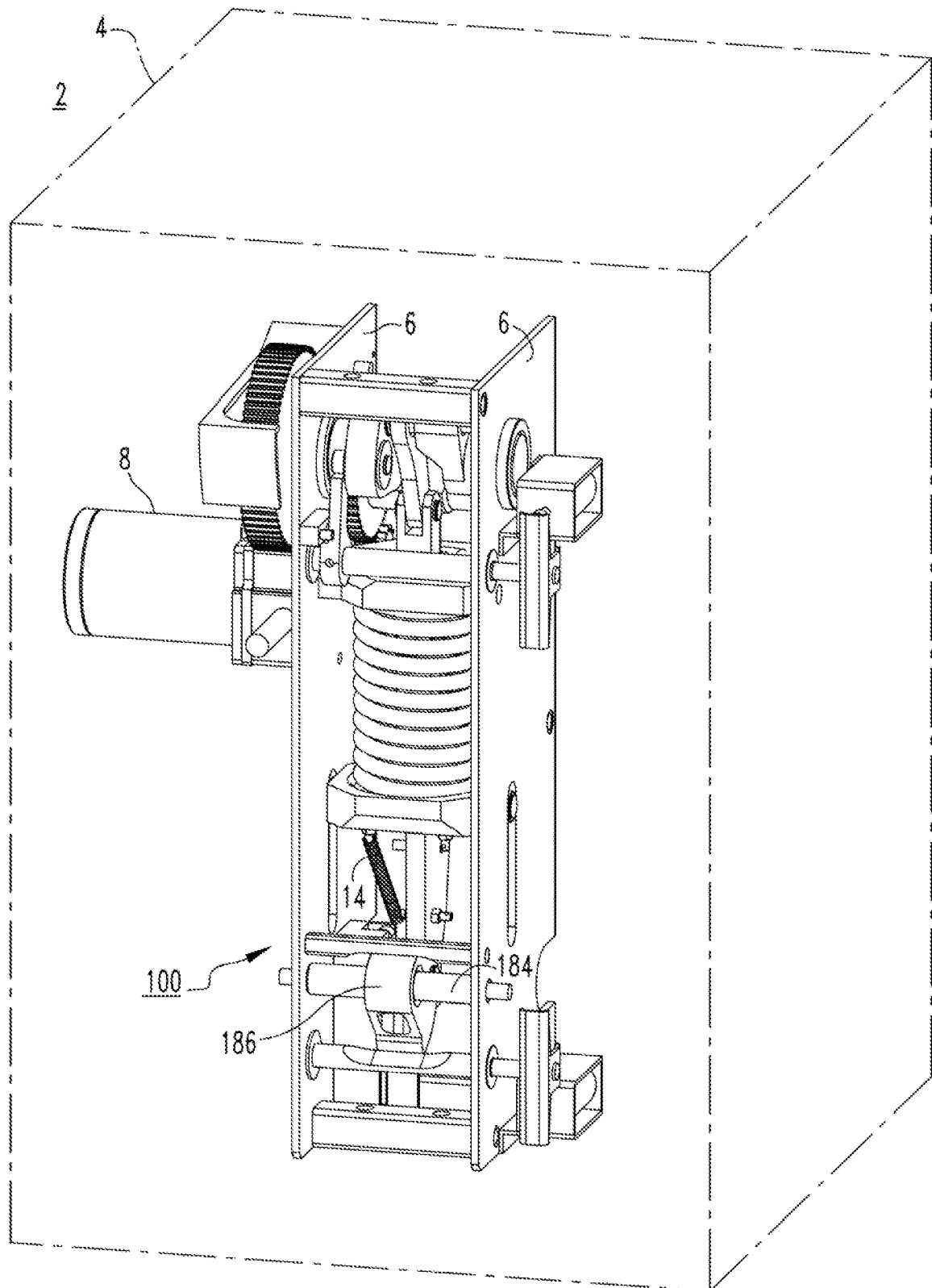


FIG. 1

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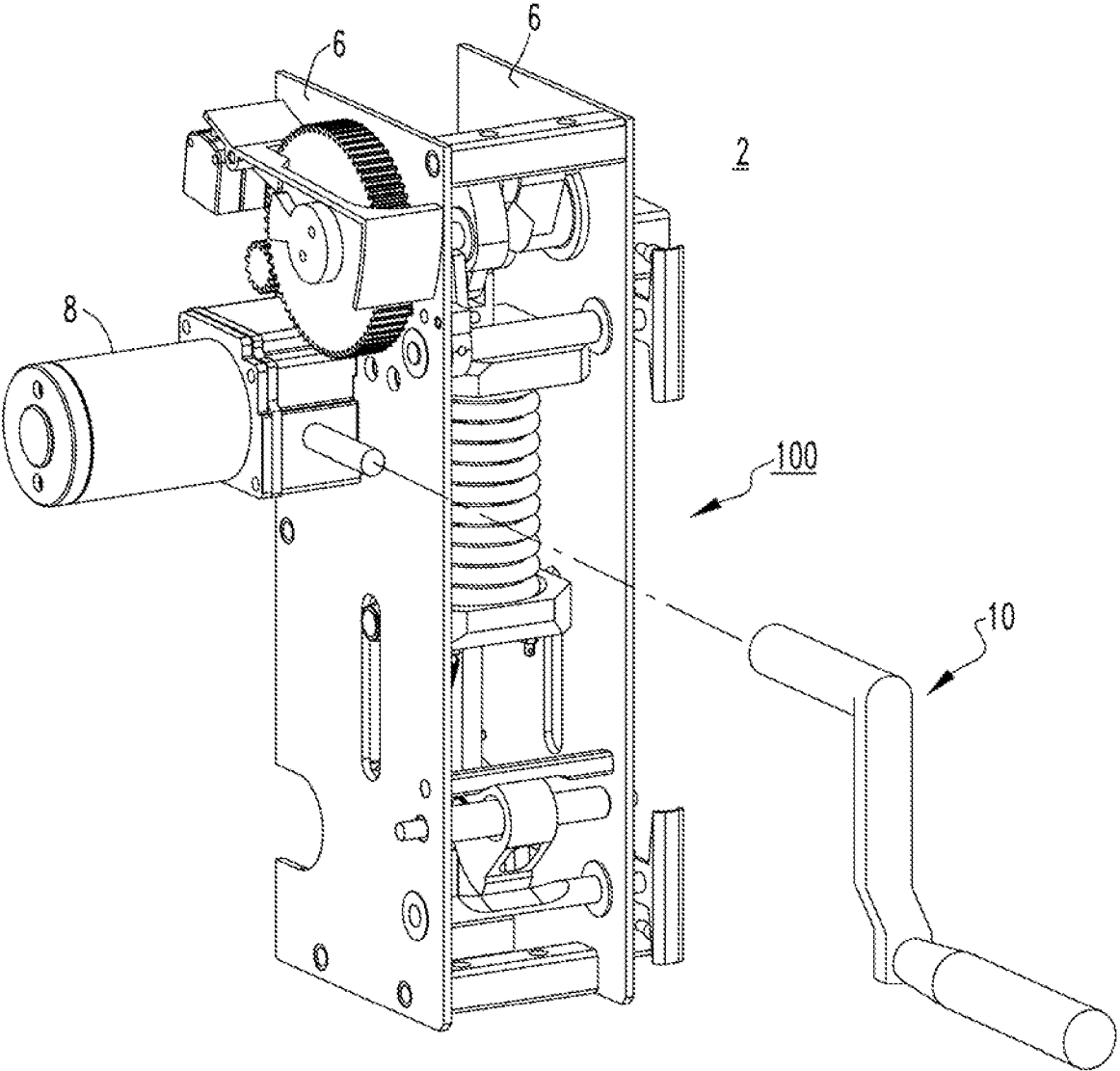
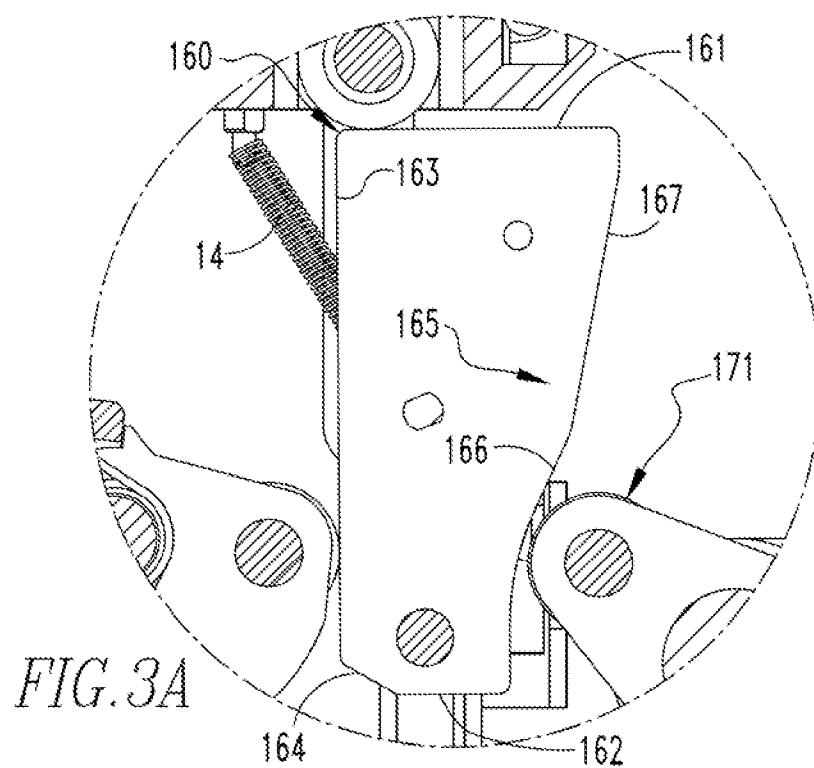
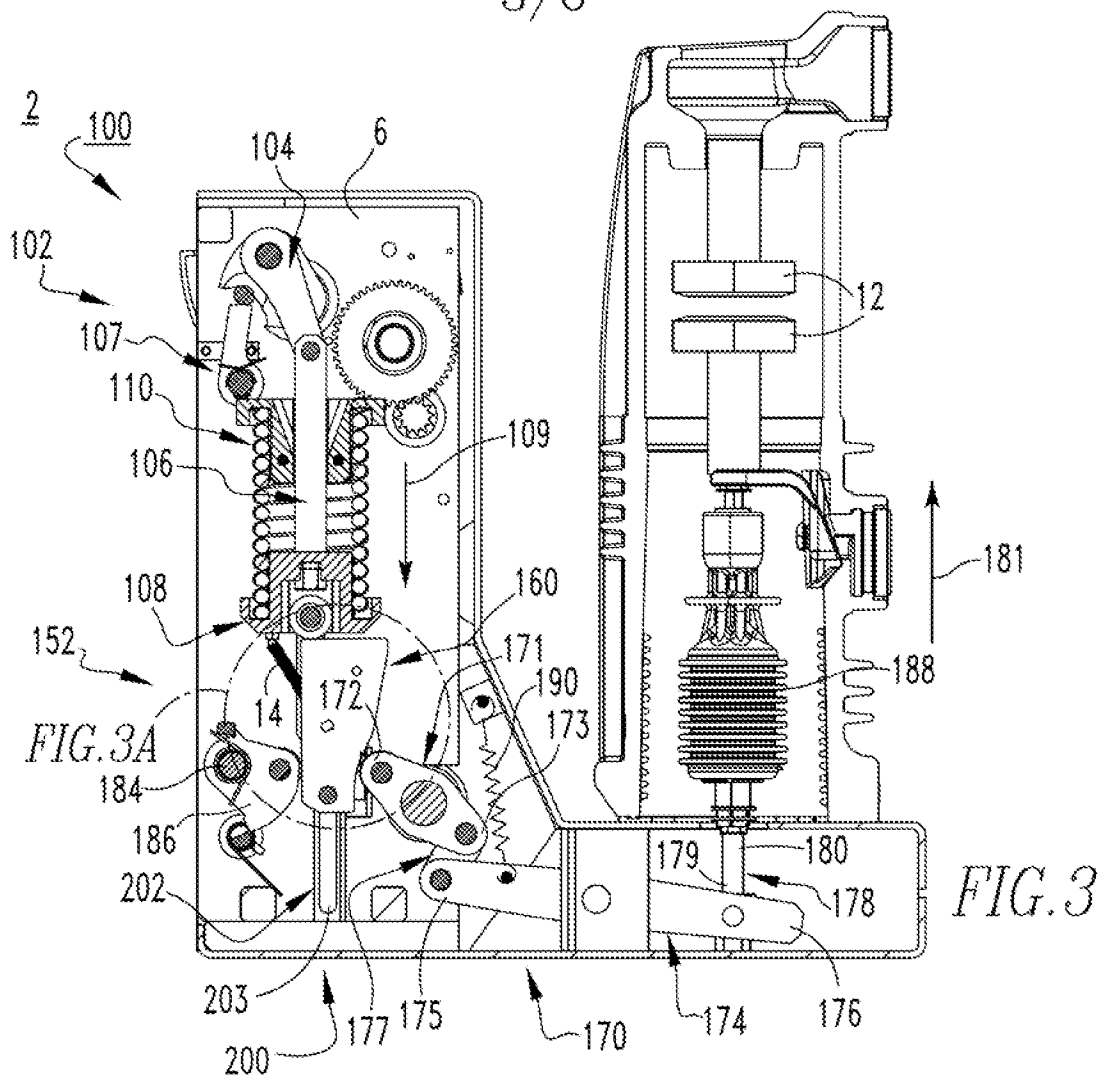
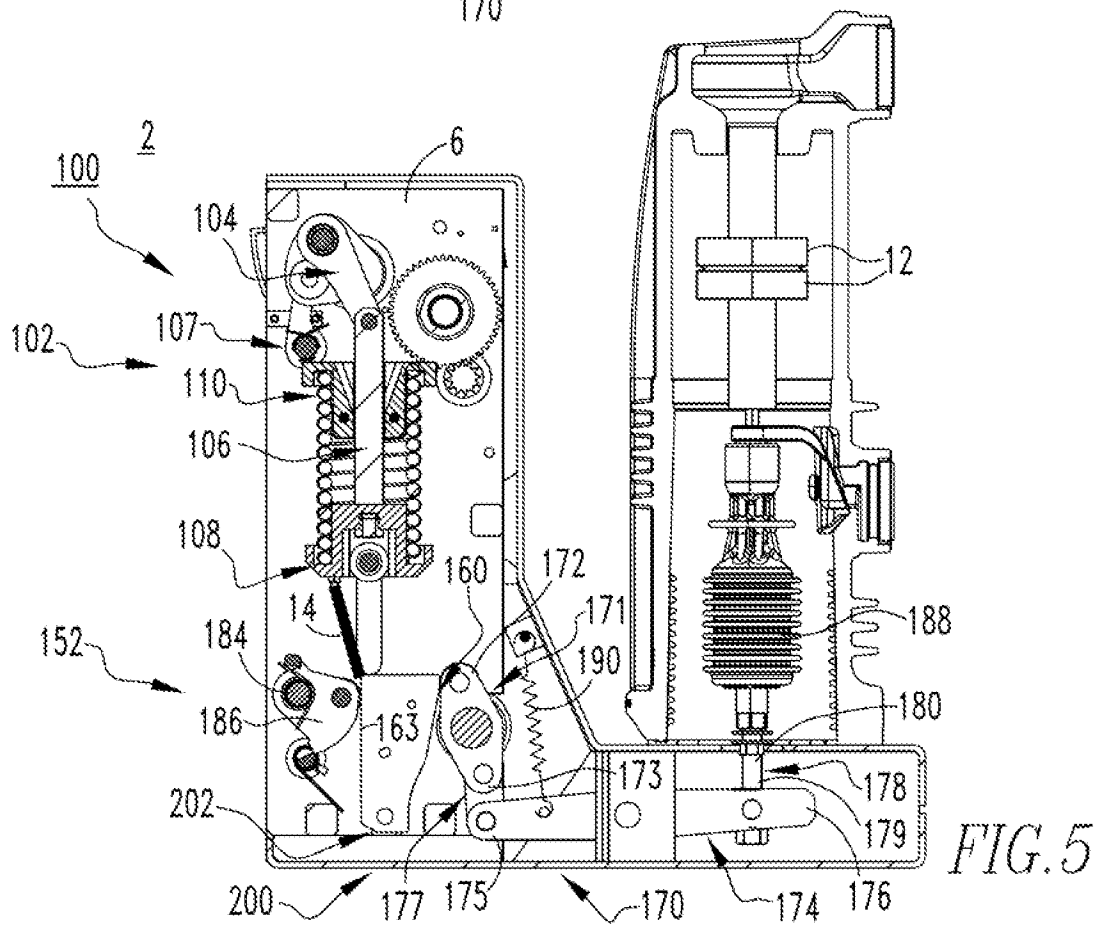
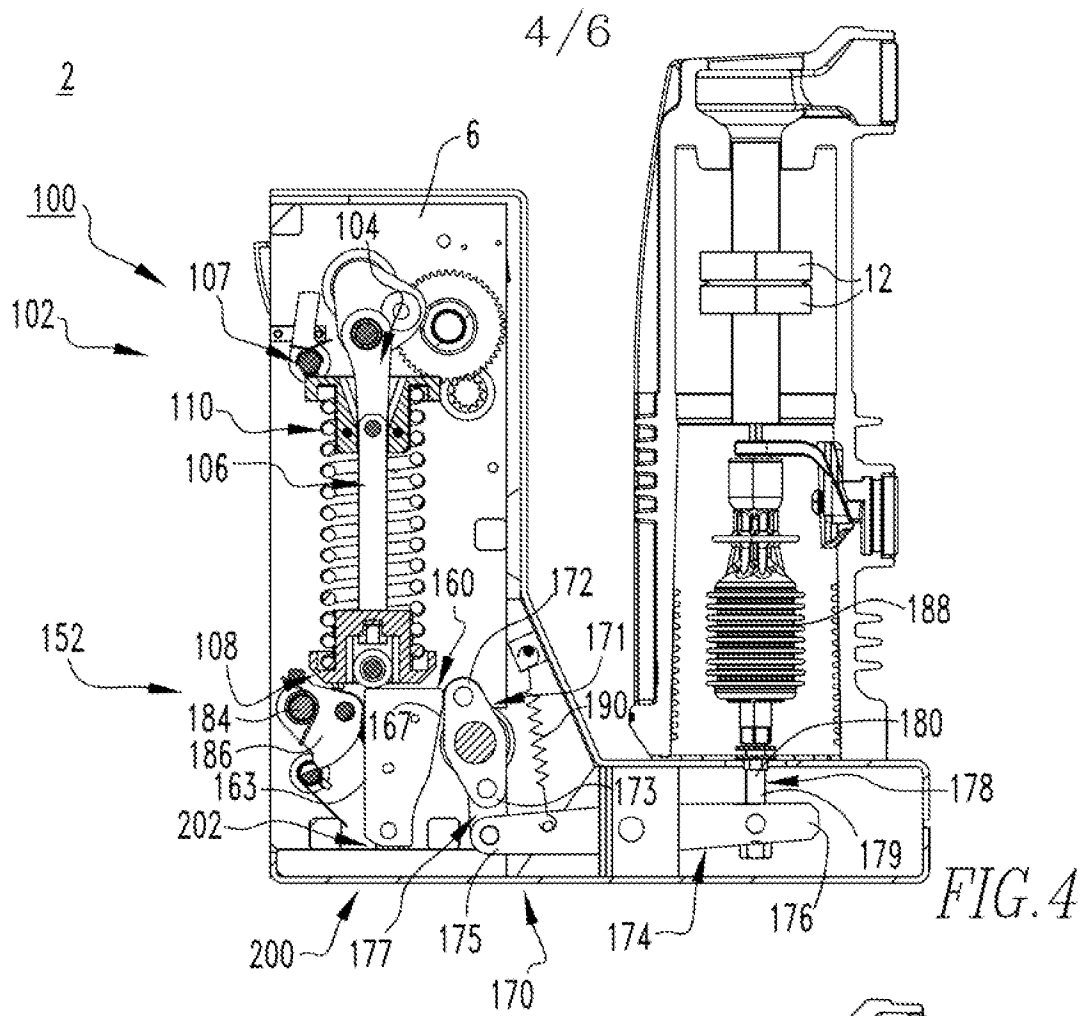


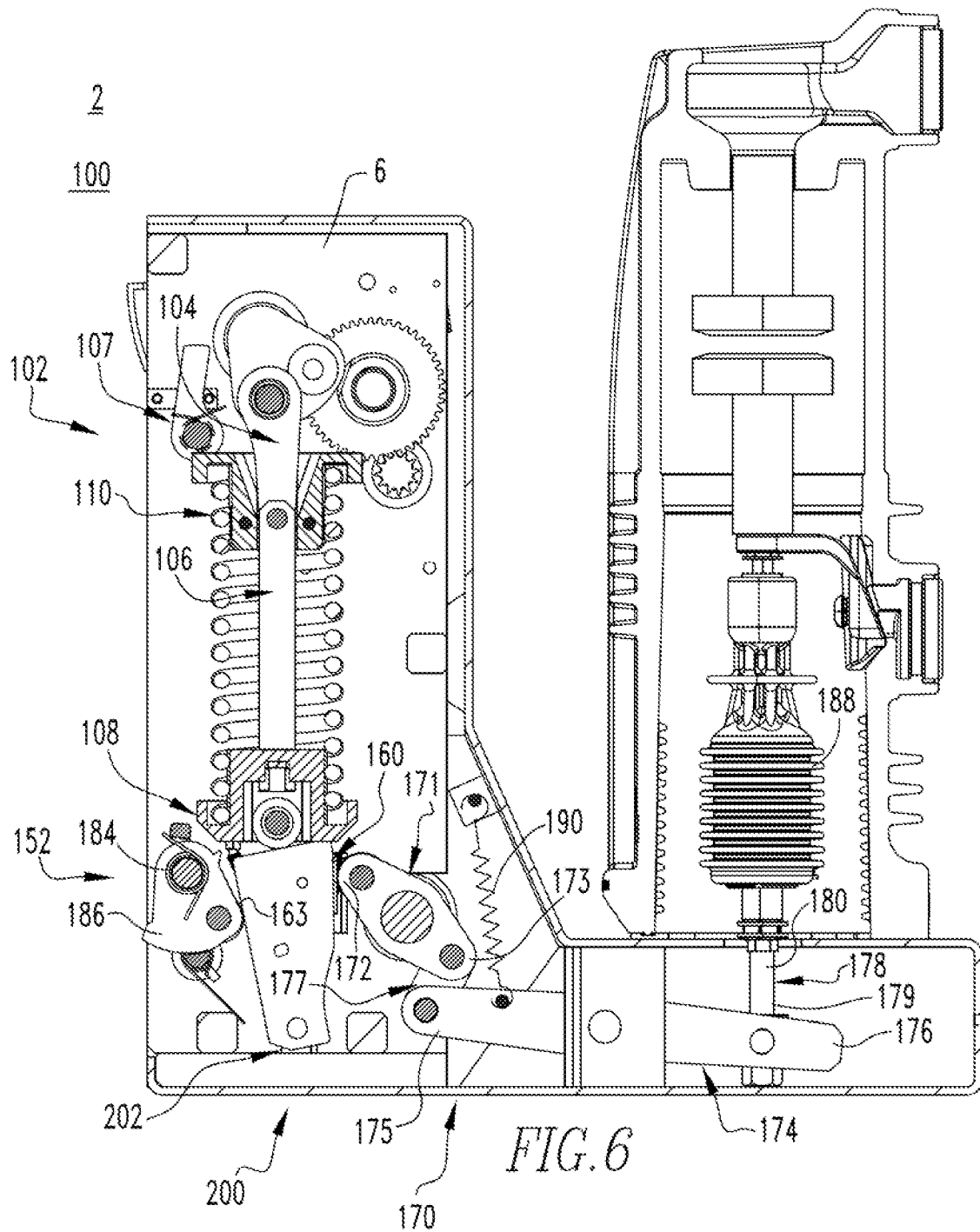
FIG. 2

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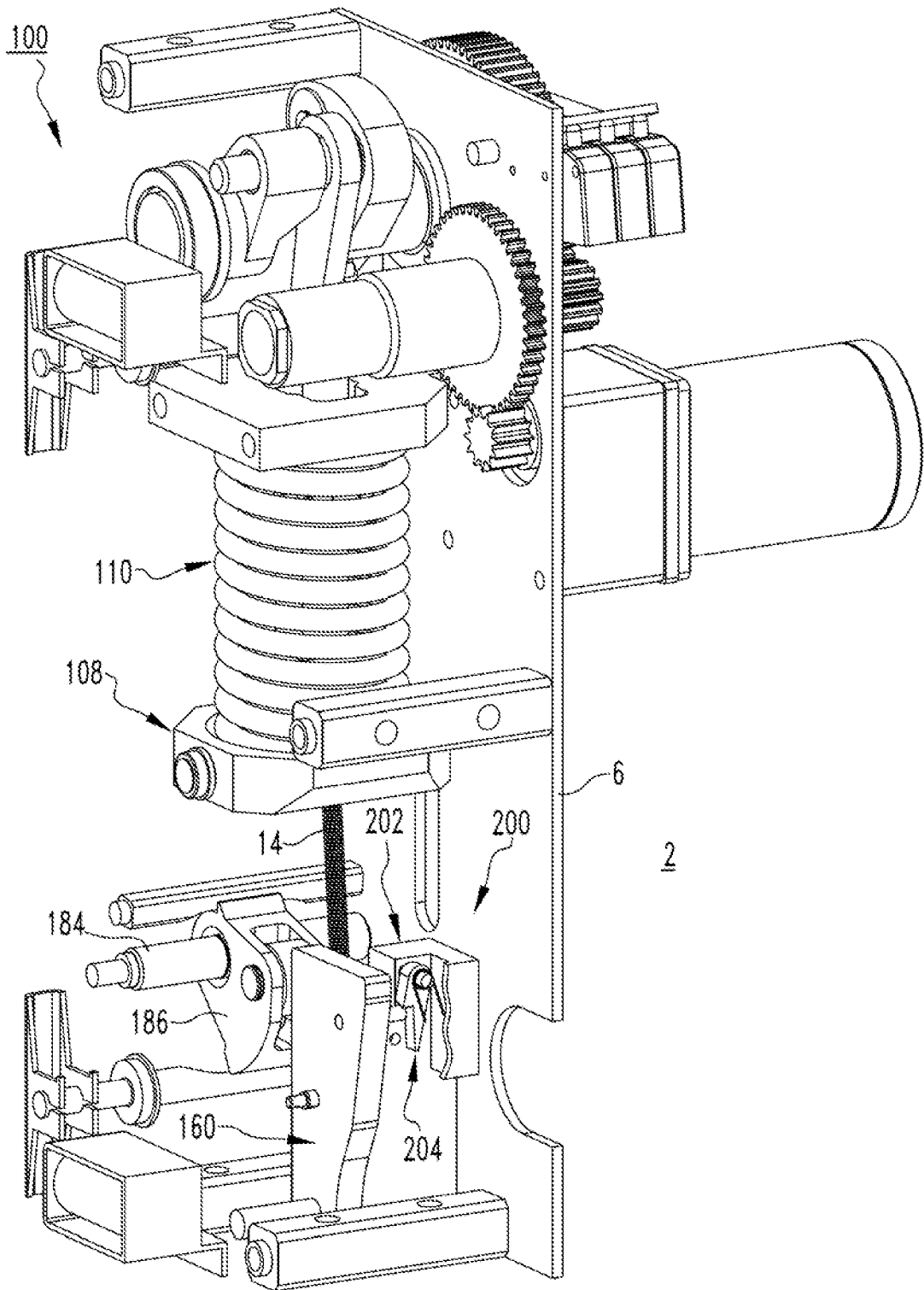


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/048828

A. CLASSIFICATION OF SUBJECT MATTER INV. H01H33/42 H01H33/40 H01H3/42 ADD. H01H33/666 H01H3/30 H01H3/46		
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		
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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012/125752 A1 (YAMAMOTO YOHEI [JP] ET AL) 24 May 2012 (2012-05-24) paragraphs [0024] - [0026] paragraphs [0056] - [0060] figures 1,5,9-13 -----	1-15
A	US 7 186 937 B1 (RICCIUTI ANTHONY THOMAS [US] ET AL) 6 March 2007 (2007-03-06) column 3, lines 4-66 column 4, line 63 - column 5, line 34 figures 1,2,6a,6b -----	1-15
A	DE 198 48 195 A1 (ABB PATENT GMBH [DE]) 27 April 2000 (2000-04-27) column 2, lines 7-64; figure -----	1
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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