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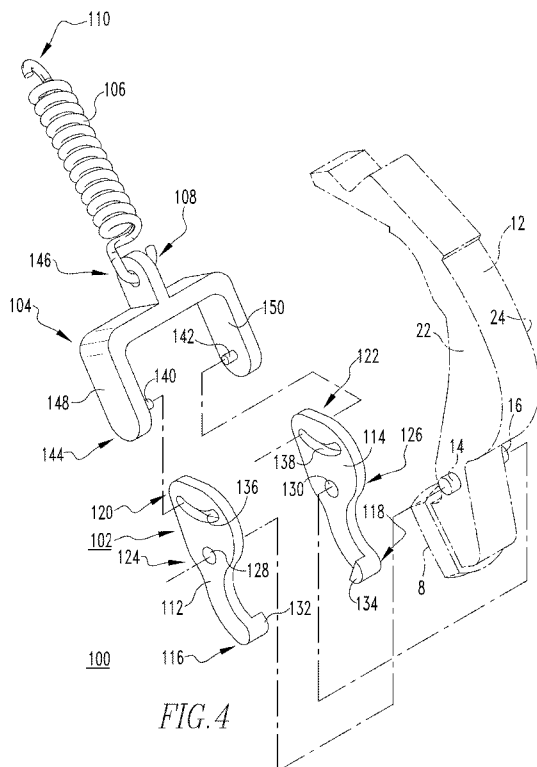
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(54) Title: ELECTRICAL SWITCHING APPARATUS AND LINK ASSEMBLY THEREFOR



(57) Abstract: A link assembly (100) is for an electrical switching
apparatus, such as a circuit breaker (2). The circuit breaker (2) in-
cludes a housing (4), separable contacts (6,8) enclosed by the hous-
ing (4), and an operating mechanism (10) for opening and closing
the separable contacts (6,8). The operating mechanism (10) includes
a movable contact arm (12). The separable contacts comprise a sta-
tionary contact (6) and a movable contact (8). The movable contact
(8) is disposed on the movable contact arm (12). The link assembly
(100) includes a pivot assembly (102) pivotably coupled to the mov-
able contact arm (12), a link element (104) pivotably coupled to the
pivot assembly (102), and a biasing element, such as a spring (106).
A first end (108) of the spring (106) is coupled to the link element
(104), and a second end (110) of the spring (106) is coupled to the
circuit breaker (2) housing (4).



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ELECTRICAL SWITCHING APPARATUS AND LINK ASSEMBLY THEREFOR

CROSS-REFERENCE TO RELATED APPLICATION

5 This application claims priority from and claims the benefit of U.S. Patent Application Serial No. 13/789,732, filed March 8, 2013, which is incorporated by reference herein.

BACKGROUND

10 Field

The disclosed concept relates generally to electrical switching apparatus and, more particularly, to electrical switching apparatus, such as circuit breakers. The disclosed concept also relates to link assemblies for electrical switching apparatus.

15 Background Information

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
20 opens electrical contact assemblies to interrupt the flow of current through the conductors of an electrical system in response to such fault conditions. The electrical contact assemblies include stationary electrical contacts and corresponding movable electrical contacts that are typically mounted on movable (e.g., pivotable) arms. The stationary and movable contacts are in physical and electrical contact with one
25 another when it is desired that the circuit breaker provide electrical current therethrough to a load. When it is desired to interrupt the power circuit, the movable contact arm is pivoted, thereby moving the movable contact away from the stationary contact creating a space therebetween. The opening distance (i.e., space) between the separable contacts can be undesirably limited by a number of factors, such as for
30 example, size restrictions, and restrictions on the movement and mechanical interaction of assembly components.

There is, therefore, room for improvement in electrical switching apparatus, such as circuit breakers, and in link assemblies therefor.

SUMMARY

These needs and others are met by embodiments of the disclosed concept, which are directed to a link assembly for circuit breakers, which among other benefits, provides for increased break distance between separable contacts.

5 As one aspect of the disclosed concept a link assembly is provided for an electrical switching apparatus. The electrical switching apparatus includes a housing, separable contacts enclosed by the housing, and an operating mechanism for opening and closing the separable contacts. The operating mechanism includes a movable contact arm. The separable contacts comprise a stationary contact and a
10 movable contact. The movable contact is disposed on the movable contact arm. The link assembly comprises: a pivot assembly structured to be pivotably coupled to the movable contact arm; a link element pivotably coupled to the pivot assembly; and a biasing element including a first end coupled to the link element and a second end structured to be coupled to the housing of the electrical switching apparatus.

15 The pivot assembly may comprise at least one pivot member having a first portion, a second portion, and a third portion disposed between the first portion and the second portion. The first portion may be structured to engage and cooperate with the housing, the second portion may be coupled to the link element, and the third portion may be structured to be pivotably coupled to the movable contact arm. The
20 second portion may include a first movement element, wherein the link element comprises a number of second movement elements, and wherein the first movement element of the second portion cooperates with a corresponding one of the second movement elements of the link element. The first movement element may be an elongated slot, and the number second movement elements may be a number of
25 protrusions, wherein a corresponding one of the protrusions is movably disposed in the elongated slot.

The link element may further comprise a first segment and a second segment disposed opposite and distal from the first segment. The number of protrusions may extend outwardly from the first segment, and the biasing element
30 may be coupled to the second segment. The movable contact arm may further comprise a first side and a second side, and the at least one pivot member may be a first pivot member and a second pivot member. The first pivot member may be structured to be pivotably coupled to the first side of the movable contact arm, and the

second pivot member may be structured to be pivotably coupled to the second side of the movable contact arm.

The first segment of the link element may include a first extension and a second extension disposed opposite and spaced from the first extension, wherein
5 number of protrusions is a first protrusion extending inwardly from the first extension and a second protrusion extending inwardly from the second extension. The first protrusion may be movably disposed within the elongated slot of the first pivot member, and the second protrusion may be movably disposed within the elongated slot of the second pivot member.

10 An electrical switching apparatus employing the aforementioned link assembly is also disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Figure 1 is a side elevation view of a circuit breaker and link assembly therefor, in accordance with an embodiment of the disclosed concept, showing the circuit breaker in the ON position;

20 Figure 2 is a side elevation view of the circuit breaker and link assembly therefor of Figure 1, showing the circuit breaker in the OFF position;

Figure 3 is a side elevation view of the circuit breaker and link assembly therefor of Figure 2, showing the circuit breaker in the TRIPPED position; and

25 Figure 4 is an exploded isometric view of the link assembly of Figure 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Directional phrases used herein, such as, for example, clockwise,
30 counterclockwise, left, right and derivatives thereof, relate to the orientation of the elements shown in the drawings and are not limiting upon the claims unless expressly recited therein.

As employed herein, the terms “opening distance” and “break distance” are used substantially interchangeably to refer to the maximum available

distance or space between separable contacts (i.e., a stationary contact and the corresponding movable contact).

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

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

Figure 1 shows a link assembly 100 (best shown in the exploded isometric view of Figure 4) for an electrical switching apparatus, such as for example
10 and without limitation, the circuit breaker 2, shown. The circuit breaker 2 includes a housing 4, separable contacts 6,8 enclosed by the housing 4, and an operating mechanism 10 for opening and closing the separable contacts 6,8. The operating mechanism 10 includes a movable contact arm 12. The separable contacts 6,8, include a stationary contact 6 and a movable contact 8, which is disposed on the end
15 of the movable contact arm 12, as shown. Thus, it will be appreciated that the movable contact arm 12 is movable (e.g., without limitation, pivotable) to move the movable contact 8 away from the stationary contact 6, in order to electrically disconnect the contacts 6,8 to turn the circuit breaker OFF, as shown in Figure 2, or when the circuit breaker 2 trips in response to an electrical fault condition, as shown
20 in Figure 3.

The opening distance or break distance between separable contacts (not shown) of conventional circuit breakers (not shown) is limited by a number of factors, such as for example and without limitation, size restrictions, and restrictions on the movement and mechanical interaction of assembly components. As will be
25 described in greater detail herein, the disclosed link assembly 100 is designed to address and overcome these disadvantages by enabling an increase in the break distance.

Continuing to refer to Figures 1-3, and also to Figure 4, the example link assembly 100 will now be described in greater detail. In the example shown and
30 described herein, the link assembly 100 includes a pivot assembly 102, a link element 104, and a biasing element 106 having opposing first and second ends 108,110. The pivot assembly 102 is pivotably coupled to the movable contact arm 12. The link element 104 is pivotably coupled to the pivot assembly 102. In the example shown and described herein, the biasing element is a spring 106. The first end 108 of the

spring 106 is coupled to the link element 104, and the second end 110 of the spring 106 is coupled to the circuit breaker housing 4.

As best shown in Figure 4, the pivot assembly 102 preferably includes first and second pivot members 112,114 each having a first portion 116,118, a second portion 120,122, and a third portion 124,126, respectively. The first portions 116,118 cooperate with the circuit breaker housing 4 (Figures 1-3), the second portions 120,122 are coupled to the link element 104, and the third portions 124,126 are pivotably coupled to the movable contact arm 12. It will be appreciated that, while the pivot assembly 102 shown and described herein includes two pivot members 112,114, any known or suitable alternative number and/or configuration (not shown) of different pivot members (not shown) could be employed, without departing from the scope of the disclosed concept.

The third portions 124,126 include first pivot elements 128,130, and the movable contact arm 12 includes second pivot elements 14,16, which cooperate with the first pivot elements 128,130, respectively, to pivotably couple the pivot members 112,114 to the movable contact arm 12. In the non-limiting example shown herein, the first pivot elements 128,130 of the first and second pivot members 112,114 are holes 128,130 (best shown in Figure 4). The second pivot elements 14,16 of the movable contact arm 12 are first and second projections 14,16 extending outwardly from the opposing first and second sides 22,24, respectively, of the movable contact arm 12. Thus, the first projection 14 is pivotably disposed within the first hole 128, and the second projection 16 is pivotably disposed within the second hole 130, thereby enabling the first and second pivot members 112,114 to pivot with respect to the movable contact arm 12. It will be appreciated, however, that any known or suitable alternative type, number and/or configuration (not shown) of different pivot elements (not shown) could be employed on the pivot members 112,114 and/or movable contact arm 12. For example and without limitation, the pivot members 112,114 could include projections (not shown), which cooperate with corresponding holes or recesses (not shown) on the movable contact arm 12. Yet another non-limiting alternative would be to employ a pin member (not shown) extending through holes 128 and 130 of pivot members 112 and 114, respectively, as well as a corresponding hole (not shown) extending through the movable contact arm 12.

Similarly, it will be appreciated that the link element 104 could have any known or suitable alternative configuration other than the non-limiting

embodiment shown and described herein. The example link element 104 includes a first segment 144 and a second segment 146 disposed opposite and distal from the first segment 144. The second portions 120,122 of the first and second pivot members 112,114 include first movement elements 136,138, and the first segment 144 of the link element 104 includes a number of second movement elements 140,142. The first movement elements 136,138 cooperate with the corresponding second movement elements 140,142 (all shown in Figure 4). In the example shown, the first movement elements are first and second elongated slots 136,138 disposed in the first and second pivot members 112,114 (best shown in Figure 4), and the second movement elements are a pair of opposing protrusions 140,142 each structured to be movably disposed in the corresponding one of the elongated slots 136,138.

The first segment 144 of the example link element 104 further includes a first extension 148 and a second extension 150 disposed opposite and spaced from the first extension 148. The aforementioned first protrusion 140 extends inwardly from the first extension 148, and the aforementioned second protrusion 142 extends inwardly from the second extension 150. Thus, the first protrusion 140 is movably disposed within the elongated slot 136 of the first pivot member 112, and the second protrusion 142 is movably disposed within the elongated slot 138 of the second pivot member 114, as shown (in exploded form) in Figure 4. The aforementioned spring 106 is coupled to the second segment 146 of the link element 104, as shown. It will be appreciated, however, that the link element 104 could have any known or suitable alternative configuration (not shown) and/or movement elements (not shown) other than the non-limiting embodiment shown and described herein, without departing from the scope of the disclosed concept. Likewise, the pivot members 112,114 could have any known or suitable alternative number, type and/or configuration of corresponding movement elements (not shown) other than the elongated slots 136,138 shown and described herein.

In view of the foregoing, it will be appreciated that the disclosed link assembly 100 provides a multiple component design structured to facilitate movement of the movable contact arm 12, and ultimately increase separation of (i.e., distant between) the movable contact 8 from the separable contact 6 (both shown in Figures 1-3). In other words, the link assembly 100 advantageously increases the break distance between the separable contacts 6,8.

Specifically, in operation, when the movable contact arm 12 pivots or rotates from the ON position of Figure 1 to the OFF position of Figure 2, the first portions 116,118 (both shown in Figure 4) of the pivot members 112,114 (both shown in Figure 4), respectively, engage a portion (see, for example and without limitation, molded protrusion 20) of the circuit breaker housing 4, as shown in Figure 1. As shown in the example of Figure 4, the first and second pivot members 112,114 include first and second lateral projections 132,134 extending inwardly from the first portions 116,118, respectively, thereof. Such lateral projections 132,134 function as a “kicker” that, upon engagement with the molded protrusion 20 of the circuit breaker housing 4, forces the pivot members 112,114 to pivot (e.g., clockwise from the perspective of Figures 1-3), thereby moving the protrusions 140,142 of link element 104 within the corresponding elongated slots 136,138 of the pivot members 112,114, respectively. That is, the protrusions 140,142 move toward the center position of the elongated slots 136,138 (see Figure 3). Then, as the movable contact arm 12 continues to rotate or pivot (e.g., clockwise from the perspective of Figures 1-3), the protrusions 140,142 move further to the extreme end (e.g., left end from the perspective of Figure 2) of the corresponding elongated slots 136,138, respectively. Accordingly, when the protrusions 140,142 (e.g., without limitation, pins) are disposed in the left most extreme position, as shown in Figure 2, the final resting position of the movable contact arm 12 is such that the breaker distance, or distance between the stationary contact 6 and movable contact 8, is greater than it would otherwise be. That is, the breaker distance is exaggerated or increased. Such increase in breaker distance will be further appreciated with comparison of the OFF position of Figure 2 to the TRIPPED position of Figure 3.

Accordingly, among other benefits, the disclosed link assembly 100 provides for greater break distance between the separable contacts 6,8 of the circuit breaker 2. This, in turn, advantageously increases the voltage the circuit breaker 2 can withstand before it dielectrically breaks down.

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 link assembly (100) for an electrical switching apparatus (2), said electrical switching apparatus (2) including a housing (4), separable contacts (6,8) enclosed by the housing (4), and an operating mechanism (10) for opening and closing said separable contacts (6,8), said operating mechanism (10) including a movable contact arm (12), said separable contacts comprising a stationary contact (6) and a movable contact (8), the movable contact (8) being disposed on said movable contact arm (12), said link assembly (100) comprising:

a pivot assembly (102) structured to be pivotably coupled to said movable contact arm (12);

a link element (104) pivotably coupled to said pivot assembly (102);

and

a biasing element (106) including a first end (108) coupled to said link element (104) and a second end (110) structured to be coupled to the housing (4) of said electrical switching apparatus (2).

2. The link assembly (100) of claim 1 wherein said pivot assembly (102) comprises at least one pivot member (112,114) having a first portion (116,118), a second portion (120,122), and a third portion (124,126) disposed between the first portion (116,118) and the second portion (120,122); wherein the first portion (116,118) is structured to engage and cooperate with the housing (4); wherein the second portion (120,122) is coupled to said link element (104); and wherein the third portion (124,126) is structured to be pivotably coupled to said movable contact arm (12).

3. The link assembly (100) of claim 2 wherein the third portion (124,126) includes a first pivot element (128,130); wherein said movable contact arm (12) includes a second pivot element (14,16); and wherein said first pivot element (128,130) of the third portion (124,126) is structured to cooperate with said second pivot element (14,16) of said movable contact arm (12).

4. The link assembly (100) of claim 2 wherein the first portion (116,118) includes a lateral projection (132,134); and wherein said lateral projection (132,134) is structured to engage and cooperate with a portion (20) of the electrical switching apparatus housing (4), thereby pivoting said at least one pivot member (112,114) with respect to said movable contact arm (12).

5. The link assembly (100) of claim 2 wherein the second portion (120,122) includes a first movement element (136,138); wherein said link element (104) comprises a number of second movement elements (140,142); and wherein said first movement element (136,138) of the second portion (120,122) cooperates with a corresponding one of said second movement elements (140,142) of said link element (104).

6. The link assembly (100) of claim 5 wherein said first movement element is an elongated slot (136,138); wherein said number second movement elements is a number of protrusions (140,142); and wherein a corresponding one of said protrusions (140) is movably disposed in said elongated slot (136).

7. The link assembly (100) of claim 6 wherein said link element (104) further comprises a first segment (144) and a second segment (146) disposed opposite and distal from the first segment (144); wherein said number of protrusions (140,142) extend outwardly from the first segment (144); and wherein said biasing element (106) is coupled to the second segment (146).

8. The link assembly (100) of claim 7 wherein said biasing element is a spring (106); wherein the first end (108) of said spring (106) is coupled to the second segment (146); and wherein second end (110) is structured to be coupled to the housing (4).

9. The link assembly (100) of claim 7 wherein said movable contact arm (12) further comprises a first side (22) and a second side (24); wherein said at least one pivot member is a first pivot member (112) and a second pivot member (114); wherein the first pivot member (112) is structured to be pivotably coupled to the first side (22) of said movable contact arm (12); and wherein the second pivot member (114) is structured to be pivotably coupled to the second side (24) of said movable contact arm (12).

10. The link assembly (100) of claim 9 wherein the first segment (144) of said link element includes a first extension (148) and a second extension (150) disposed opposite and spaced from the first extension (148); wherein number of protrusions is a first protrusion (140) extending inwardly from the first extension (148) and a second protrusion (142) extending inwardly from the second extension (150); wherein said first protrusion (140) is movably disposed within said elongated slot (136) of said first pivot member (112); and wherein said second protrusion (142)

is movably disposed within said elongated slot (138) of said second pivot member (114).

11. An electrical switching apparatus (2) comprising:
 - a housing (4);
 - separable contacts (6,8) enclosed by the housing (4);
 - an operating mechanism (10) for opening and closing said separable contacts (6,8), said operating mechanism (10) including a movable contact arm (12), said separable contacts comprising a stationary contact (6) and a movable contact (8), the movable contact (8) being disposed on said movable contact arm (12); and
 - a link assembly (100) according to any of claims 1-10.

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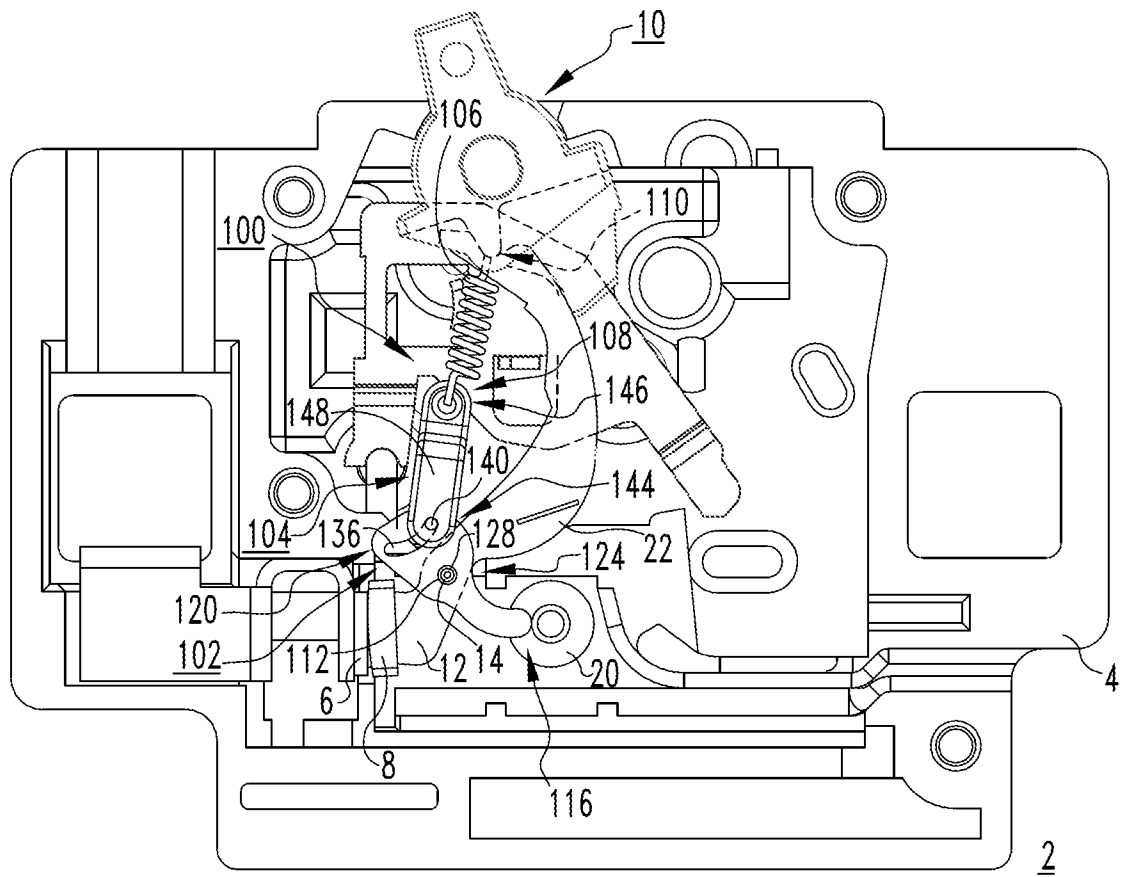


FIG. 1

2/3

