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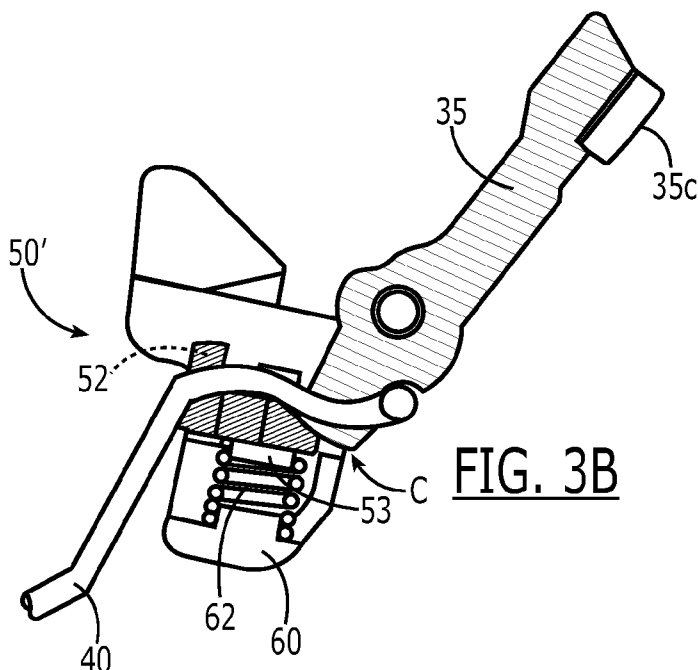
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(54) Title: CIRCUIT BREAKER WITH SHUNT SEPARATING CAM FOLLOWER



(57) Abstract: Circuit breakers with a cam follower having an upper post with the cam follower held by a cross bar to prevent cam/arm misalignment during high interruption shot on the breaker. Related cam followers have an upwardly extending post located on one side edge portion and cooperates with a shunt to provide shunt separation during high interruption breaker shots.

CIRCUIT BREAKER WITH SHUNT SEPARATING CAM FOLLOWER

Related Applications

[0001] This application claims the benefit of and priority to U.S. Patent Application Serial Number 13/923,754, filed June 21, 2013, the contents of which are hereby incorporated by reference as if recited in full herein.

Field of the Invention

[0002] The present invention relates to circuit breakers.

Background of the Invention

[0003] Circuit breakers are one of a variety of overcurrent protection devices used for circuit protection and isolation. The circuit breaker provides electrical protection whenever an electric abnormality occurs. In a circuit breaker, current enters the system from a power line and passes through a line conductor to a stationary contact fixed on the line conductor, then to a movable contact. The movable contact can be fixedly attached to a pivoting arm. As long as the stationary and movable contacts are in physical contact, current passes from the stationary contact to the movable contact and out of the circuit breaker to down line electrical devices.

[0004] In the event of an overcurrent condition (e.g., a short circuit), extremely high electromagnetic forces can be generated. The electromagnetic forces repel the movable contact away from the stationary contact. As shown by an example of a prior art circuit breaker in **Figures 1A and 1B**, the circuit breaker **10** includes a stationary contact **30**, a moveable arm **35**, a cam follower **50**, a crossbar **60** and a shunt **40**. Because the movable contact **35c** is fixedly attached to the rotating arm **35**, the arm **35** pivots and physically separates the stationary **30** and movable contacts **35c**, and the current is stopped as the breaker mechanism moves to the tripped position.

[0005] Upon separation of the contacts and blowing open the circuit, an arcing condition occurs. The breaker's trip unit will trip the breaker which will cause the contacts to separate. Also, arcing can occur during normal "ON/OFF" operations on the breaker.

[0006] During a high interruption shot on the breaker (e.g., an EG breaker, where "E" reflects breaker size, and "G" represents the breaker is part of the "G" or global series), the shunts are pulled together by the electrically generated magnetic fields. The contact arm also rotates during the high interruption shot. As shown by the desired normal off configuration of the crossbar **60** and arm **35** in **Figure 1A** compared to the configuration in **Figure 1B**, sometimes the shunt **40** undesirably travels to a position on top of the contact arm **35** which prevents the arm from fully resetting after the interruption terminates and the mechanism rotates the crossbar **60** to the tripped position. This then prevents the breaker from making contact when the breaker is closed.

Summary of Embodiments of the Invention

[0007] Embodiments of the present invention are directed to circuit breakers with a rotating arm having a cam follower with an upper post.

[0008] Embodiments of the invention provide circuit breakers with a cam follower having an upper post with the cam follower held by a cross bar to prevent cam/arm misalignment during high interruption shot on the breaker.

[0009] Embodiments of the invention provide cam followers that have an upwardly extending post located on one side edge portion and that cooperates with a shunt to provide shunt separation during high interruption breaker shots.

[0010] Embodiments of the invention are directed to circuit breakers. The circuit breakers include a housing having a movable arm, cross bar and cam follower in the housing. The cam follower includes an upper post.

[0011] The upper post can reside on an outer edge portion of one side of the cam follower.

[0012] The cam follower can have a substantially rectangular primary body with two opposing long sides connected by two opposing short sides. The upper post can reside on a medial portion of one of the long sides.

[0013] The upper post can have an upwardly extending outer surface that is parallel to an upwardly extending outer surface of adjacent portions of the long side of the primary body.

[0014] The cam follower can have a lower post that has an axially extending centerline that is offset from a longitudinally extending centerline of the upper post.

[0015] The cam follower can include a lower post. The cam follower with the upper and lower posts can be a unitary monolithic member.

[0016] The cam follower can have a primary body that comprises a material. The upper post may be the same or different material as the primary body.

[0017] The circuit breaker can include at least one shunt in the housing that has a length that extends from a location outside the cross bar to travel past the upper post over an upper surface of the cam follower whereby the post keeps shunts separated during high interruption breaker shots.

[0018] The cam follower can have a substantially rectangular shape with opposing long sides connected by opposing short sides, and an upper surface having a flat medial segment that extends in a width direction corresponding to the long sides. The upper post can reside laterally centered with respect to the width direction. The upper surface can have a front end portion that tapers down from the medial segment, and the short sides of the cam follower can each comprises a recess.

[0019] The arm can have a width and the cam follower can have a corresponding width.

[0020] The upper post can be substantially rectangular and can have an upper surface with an outer edge portion that tapers down at an angle that is between about 15-30 degrees.

[0021] Other embodiments are directed to cam followers for a circuit breaker. The cam followers include a primary body and an upwardly extending post that resides on an outer edge portion of one side of the primary body.

[0022] The primary body can have two opposing long sides connected by two opposing short sides. The upwardly extending post can reside on a medial portion of one of the long sides.

[0023] The upper post can have an upwardly extending wall with an outer surface that is parallel to an upwardly extending outer surface of adjacent side wall portions of the long side of the primary body.

[0024] The cam follower can include a lower post that extends down from the primary body. The lower post can have an axially extending centerline that is offset from a longitudinally extending centerline of the upper post.

[0025] The primary body and the upper and lower posts can be configured as a unitary monolithic member of steel powdered metal or zinc die cast material.

[0026] The material may comprise a zinc alloy.

[0027] The primary body can have a substantially rectangular shape with opposing long sides connected by opposing short sides, and an upper surface having a flat medial segment that extends in a width direction corresponding to a direction of the long sides, with the upper post residing laterally centered with respect to the long sides. The upper surface can have a front end portion that tapers down from the medial segment.

[0028] The upper post can be substantially rectangular and can have an upper surface with an outer edge portion that tapers down at an angle that is between about 15-30 degrees.

[0029] Still other embodiments are directed to circuit breakers that include: a housing, a movable contact arm in the housing, a cross bar in the housing in cooperating alignment with the arm, and a cam follower held by the cross bar in communication with the arm. The cam follower has an upper surface. The circuit breakers also include first and second shunts in the housing that have a length that extends from a location outside the cross bar to travel over the upper surface of the cam follower. The cam follower includes an upper surface that is configured to maintain shunt separation and prevent shunt travel onto a top of the contact arm during a high interruption shot.

[0030] Still other embodiments are directed to methods of fabricating cam followers for circuit breakers. The methods include fabricating a cam follower with an upwardly extending post on one side thereof. Optionally, the fabricating can be carried out by die casting a material to form a monolithic component with the upwardly extending post. Also optionally, the fabricating can be carried out to form a cam follower primary body with a substantially rectangular shape with a pair of spaced apart long sides connected by a pair of spaced apart short sides, with the upwardly extending post being substantially centered along one of the one sides.

[0031] Further features, advantages and details of the present invention will be appreciated by those of ordinary skill in the art from a reading of the figures and the

detailed description of the preferred embodiments that follow, such description being merely illustrative of the present invention.

[0032] It is noted that aspects of the invention described with respect to one embodiment, may be incorporated in a different embodiment although not specifically described relative thereto. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination. Applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to be able to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner. These and other objects and/or aspects of the present invention are explained in detail in the specification set forth below.

Brief Description of the Drawings

[0033] **Figures 1A and 1B** are a side partial cutaway views of an exemplary prior art circuit breaker.

[0034] **Figure 2** is a side partial cutaway view of a circuit breaker according to embodiments of the present invention.

[0035] **Figure 3A** is an enlarged side view of the arm, cam follower and shunt shown in **Figure 2** according to embodiments of the present invention.

[0036] **Figure 3B** is an enlarged side view of the arm, cam follower and shunt shown in **Figure 3A**, illustrating the arm in an "OFF" configuration according to embodiments of the present invention.

[0037] **Figure 3C** is a side perspective view of a portion of a circuit breaker showing side-by-side cam followers and respective posts according to embodiments of the present invention.

[0038] **Figure 3D** is a perspective view of the portion of the circuit breaker shown in **Figure 3C**.

[0039] **Figure 4A** is a greatly enlarged side perspective view of an exemplary cam follower for a circuit breaker according to embodiments of the present invention.

[0040] **Figure 4B** is a side view of the cam follower shown in **Figure 4A**.

[0041] **Figure 4C** is a scaled side view of the cam follower shown in **Figure 4A** according to embodiments of the present invention.

[0042] **Figure 4D** is an end view of the cam follower shown in **Figure 4C**.

[0043] **Figure 4E** is a bottom view of the cam follower shown in **Figure 4C**.

[0044] **Figure 5** is a flow chart of exemplary operations that can be used to control shunt position in a circuit breaker during a high shot action according to embodiments of the present invention.

Detailed Description of Embodiments of the Invention

[0045] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which illustrative embodiments of the invention are shown. Like numbers refer to like elements and different embodiments of like elements can be designated using a different number of superscript indicator apostrophes (e.g., 40, 40', 40'', 40''').

[0046] In the drawings, the relative sizes of regions or features may be exaggerated for clarity. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0047] It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

[0048] Spatially relative terms, such as "beneath", "below", "lower", "above", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90° or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0049] The term "about" refers to numbers in a range of +/-20% of the noted value.

[0050] As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless expressly stated otherwise. It will be further understood that the terms "includes," "comprises," "including" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. It will be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0051] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of this specification and the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0052] Turning now to the figures, **Figures 1A** and **1B** illustrate a circuit breaker **10** with a housing **10h**. As is well known, in the housing **10h**, the circuit breaker **10** includes at least one arc chamber **11** having an arc chute **25** with arc plates, a rotating arm **35** with a contact **35c** (e.g., a "contact arm") and a line conductor assembly comprising a stationary contact **30**. The arc plates can be stacked and are typically configured as closely spaced plates as shown. As is also known by those of skill in the art, the circuit breaker **10** can also include a shunt **40**, a cam **C** (**Figures 2, 3A, 3B**), a cam follower **50** and a crossbar **60**. The cam follower **50** typically resides in a channel of the crossbar over a spring **62** or other biasing member, allowing the cam follower **50** to travel up and down a distance. **Figure 1B** illustrates that the conventional cam follower **50** was configured such that the arm **35** could undesirably move out of proper cooperating position with the cam **C** after a high shot interruption.

[0053] As shown in **Figures 2, 3A-3D**, in some embodiments a new cam follower **50'** can include an upper surface configured to engage at least one shunt and provide positive shunt separation. The cam follower **50'** can include an upwardly extending member that projects a distance above a primary body **50b** such as an upper post **52**. The upper member can provide lateral spacing between shunts (**Figures 3C, 3D**). The upper post **52** can reside along one side portion of the cam follower **50'** on the side that resides away from the arm **35**. In some embodiments, such as where the primary body of the cam **50b** has a substantially rectangular shape (**Figure 4A**), the post **52** can be substantially centered on one long side of the follower body **50b**.

[0054] Although shown as a single upper post **52**, more than one upper post **52** may be used. If more than one upper post **52** is used, they can be spaced apart or abutting and may reside along one side or two or three sides of the cam follower primary body as long as they do not interfere with the cam/cam follower operation.

[0055] The upper post **52** can be sized and configured to keep the shunt(s) **40** separated during high interruption breaker shots. Stated differently, the post **52** can maintain the proper position of the arm **35** with the cam **C** and prevent the arm from improperly moving out of cooperating alignment with the cam **C** after a high shot interruption to allow the breaker to have a normal "OFF" configuration to fully reset to make contact with the breaker is closed as shown in **Figure 2**.

[0056] **Figures 4A-4E** illustrate an example of the cam follower **50'** with the upper post **52**. The upper post **52** can be integral with the primary body of cam follower **50b** such that the cam follower with the upper post **52** (and, where used, a lower post **53**) is a unitary monolithic component.

[0057] In other embodiments, the upper post **52** can be a separate component that is mechanically and/or adhesively attached to the cam follower primary body **50b**, e.g., one or more of brazed, welded, adhesively attached, screwed, pinned or matably attached such as via a tongue and groove configuration, snap-fit features, bayonet features, frictional engagement and the like.

[0058] Although the cam follower **50'** is shown in the figures as including a single lower post **53**, in other embodiments, the cam follower **50'** may include a different lower body configuration that does not require the lower post **53** or the lower post **53** may have a different configuration (and may be provided as more than one lower post) or placed at a different position but, where used, is typically configured to cooperate with the spring **62** or other biasing member in the cross bar **60**.

[0059] The cam follower primary body **50b** and post **52** can comprise the same or different material or formulations (e.g., alloys). The primary body of the cam follower **50b** can have the same material as the post **52**. In other embodiments, the upper post **52** can comprise a different material.

[0060] The upper post **52** and the primary body of the cam follower **50b** can both be formed of a die cast zinc alloy or powdered metal. The upper post **52** and cam follower **50b** can, in some embodiments, comprise steel powdered metal and/or zinc die cast. The upper post **52** can be integral with the cam body **50b** and the cam follower can be powdered metal.

[0061] Still referring to **Figures 4A-4E**, for example, the primary body of the cam follower **50b** can have a width **W** and a length **L**. The width **W** of the primary body of the cam follower **50b** can be about the same or substantially the same as the width of the arm **35**.

[0062] Referring again to **Figures 3A** and **3B**, the arm **35** can include a back end **36** and a recess **37** on a lower surface proximate the back end **36**. When the arm **35** is down, as shown in **Figure 3A**, the top of the upper post **52** resides proximate but under the cross bar. When raised in a normal OFF position as shown in **Figure 3B**, the shunt passes through the arm recess **37**. A portion of the arm **35** can define the cam **C** (**Figures 2, 3A, 3B**). The back end **36** can rotate to face downward to contact the upper surface of the forward end **50f** of the cam follower **50'**, which presses the cam follower **50'** down, compressing the spring **62** and tilting the cross bar slightly forward, typically at an angle from vertical that is between about 10-30 degrees.

[0063] As shown in **Figure 4B**, the axially extending centerline C/L of the lower post **53** can be laterally offset from the longitudinally extending centerline C/L of the upper post **52**.

[0064] As shown in **Figures 4B, 4C** and **4E** the lower post **53** (where used) can reside closer to a front edge **50f** of the cam follower. The upper post **52** can reside adjacent a rear edge **50r** of the cam follower **50'**.

[0065] The primary body of the cam follower **50b** can have a substantially rectangular shape with a middle peak region **55** and a perimeter with two opposing long sides **58** connected by two opposing short sides **59**. The short sides **59** can include center recesses **59r**. The recesses **59r** can cooperate with molded or other formed features of adjacent components for alignment/positioning in the housing. The peak region **55** can taper down to the long sides **58**. In position, the arm **35** and

upper post **52** can both be laterally centered with respect to each other and such that their width dimensions are centered.

[0066] The height of the upper post **52** can be any suitable height without hitting the crossbar **60** when the arm **35** is in a normal "OFF" position. In some embodiments, the upper post **52** can have a height that is between about 2X to 10X times that of the lower post **53**, typically between 2X to about 4X that of the lower post **53**. The upper post **52** may have a width W that is less than a width (e.g. diameter) of the lower post **53**. In other embodiments, the upper post **52** and lower post **53** may have about the same width and/or height. In some particular embodiments, the post **52** can have a width W that is between about 0.1-0.2 inches.

[0067] The upper post **52** can be substantially rectangular. However, the upper post **52** can have other geometric configurations.

[0068] As shown in **Figure 4B**, for example, the post **52** can have an outer upper edge portion **52e** that tapers down at an angle α that can be between about 10-45 degrees, such as between about 10-30 degrees, typically about 23 degrees.

[0069] As shown in **Figures 4B, 4C and 4E**, the upper post **52** can be configured to extend a short distance "d" outside the perimeter or bounds of the long side **58** of the primary body **50b**. However, in other embodiments, the post **52** can be flush with or even recessed inside the long side boundary.

[0070] In some embodiments, the circuit breakers **10** can be DC circuit breakers, AC circuit breakers, or both AC and DC circuit breakers, if the circuit breakers employ cam followers and shunts.

[0071] In some embodiments, the circuit breakers **10** can be EG circuit breakers.

[0072] The circuit breakers **10** can be rated for voltages between about 1 V to about 5000 volts (V) DC and/or may have current ratings from about 15 to about 2,500 Amperes (A). However, it is contemplated that the circuit breakers **10** and components thereof can be used for any voltage, current ranges and are not limited to any particular application as the circuit breakers can be used for a broad range of different uses.

[0073] The circuit breakers **10** can be a bi-directional direct current (DC) molded case circuit breaker (MCCB). *See, e.g.*, US Patent Nos. 5,131,504 and 8,222,983, the contents of which are hereby incorporated by reference as if recited in

full herein. The DC MCCBs can be suitable for many uses such as data center, photovoltaic, and electric vehicles applications.

[0074] As is known to those of skill in the art, Eaton Corp. has introduced a line of molded case circuit breakers (MCCBs) designed for commercial and utility scale photovoltaic (PV) systems. Used in solar combiner and inverter applications, Eaton PVGard™ circuit breakers are rated up to 600 amp at 1000 Vdc and can meet or exceed industry standards such as UL 489B, which requires rigorous testing to verify circuit protection that meets the specific requirements of PV systems. However, it is contemplated that the circuit breakers **10** can be used for various applications with corresponding voltage capacity/rating.

[0075] **Figure 5** illustrates operations that can be used to fabricate a cam follower for a circuit breaker. As shown, material can be provided (block **100**). A cam follower with an upwardly extending post for a circuit breaker is fabricated using the material (block **110**).

[0076] The cam follower and upper post can be formed of the same material (block **115**).

[0077] The fabrication can be carried out by die casting the cam follower in a casting mold defining a monolithic body having the upper post and a lower post (block **120**).

[0078] The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the invention.

THAT WHICH IS CLAIMED:

1. A circuit breaker, comprising:
 - a housing;
 - a movable arm in the housing;
 - a cross bar in the housing in cooperating alignment with the arm; and
 - a cam follower held by the cross bar in communication with the arm, wherein the cam follower comprises an upper post.
2. The circuit breaker of Claim 1, wherein the upper post resides on an outer edge portion of one side of the cam follower and is configured to keep adjacent shunts separated.
3. The circuit breaker of Claim 1 or 2, wherein the cam follower has a substantially rectangular primary body with two opposing long sides connected by two opposing short sides, and wherein the upper post resides on a medial portion of one of the long sides.
4. The circuit breaker of any of Claims 1-3, wherein the upper post has an upwardly extending outer surface that is parallel to an upwardly extending outer surface of adjacent portions of the long side of the primary body.
5. The circuit breaker of any of Claims 1-4, wherein the cam follower has a lower post that has an axially extending centerline that is offset from a longitudinally extending centerline of the upper post.
6. The circuit breaker of any of Claims 1-5, wherein the cam follower further comprises a lower post, and wherein the cam follower with the upper and lower posts is a unitary monolithic member.
7. The circuit breaker of any of Claims 1-6, wherein the cam follower has a primary body and the primary body and upper post are integrally formed and are steel powdered metal or zinc die cast.

8. The circuit breaker of any of Claims 1-7, further comprising at least one shunt in the housing that has a length that extends from a location outside the cross bar to travel past the upper post over an upper surface of the cam follower whereby the post keeps shunts separated during high interruption breaker shots.

9. The circuit breaker of any of Claims 1-8, wherein the cam follower has a substantially rectangular shape with opposing long sides connected by a opposing short sides, and an upper surface having a flat medial segment that extends in a width direction corresponding to the long sides, with the upper post residing laterally centered with respect to the width direction, wherein the upper surface has a front end portion that tapers down from the medial segment, and wherein the short sides of the cam follower each comprises a recess.

10. The circuit breaker of any of Claims 1-9, wherein the arm has a width and the cam follower has a corresponding width.

11. The circuit breaker of any of Claims 1-10, wherein the upper post is substantially rectangular and has an upper surface with an outer edge portion that tapers down at an angle that is between about 15-30 degrees.

12. A cam follower for a circuit breaker, comprising:
a primary body; and
an upwardly extending post that resides on an outer edge portion of one side of the primary body.

13. The cam follower of Claim 12, wherein the primary body has two opposing long sides connected by two opposing short sides, and wherein the upwardly extending post resides on a medial portion of one of the long sides.

14. The cam follower of Claim 12 or 13, wherein the upper post has an upwardly extending wall with an outer surface that is parallel to an upwardly extending outer surface of adjacent side wall portions of the long side of the primary body.

15. The cam follower of any of Claims 12-14, further comprising a lower post that extends down from the primary body, wherein the lower post has an axially extending centerline that is offset from a longitudinally extending centerline of the upper post.

16. The cam follower of any of Claims 12-14, wherein the primary body and the upper and lower posts are configured as a unitary monolithic member of steel powdered metal or zinc die cast material.

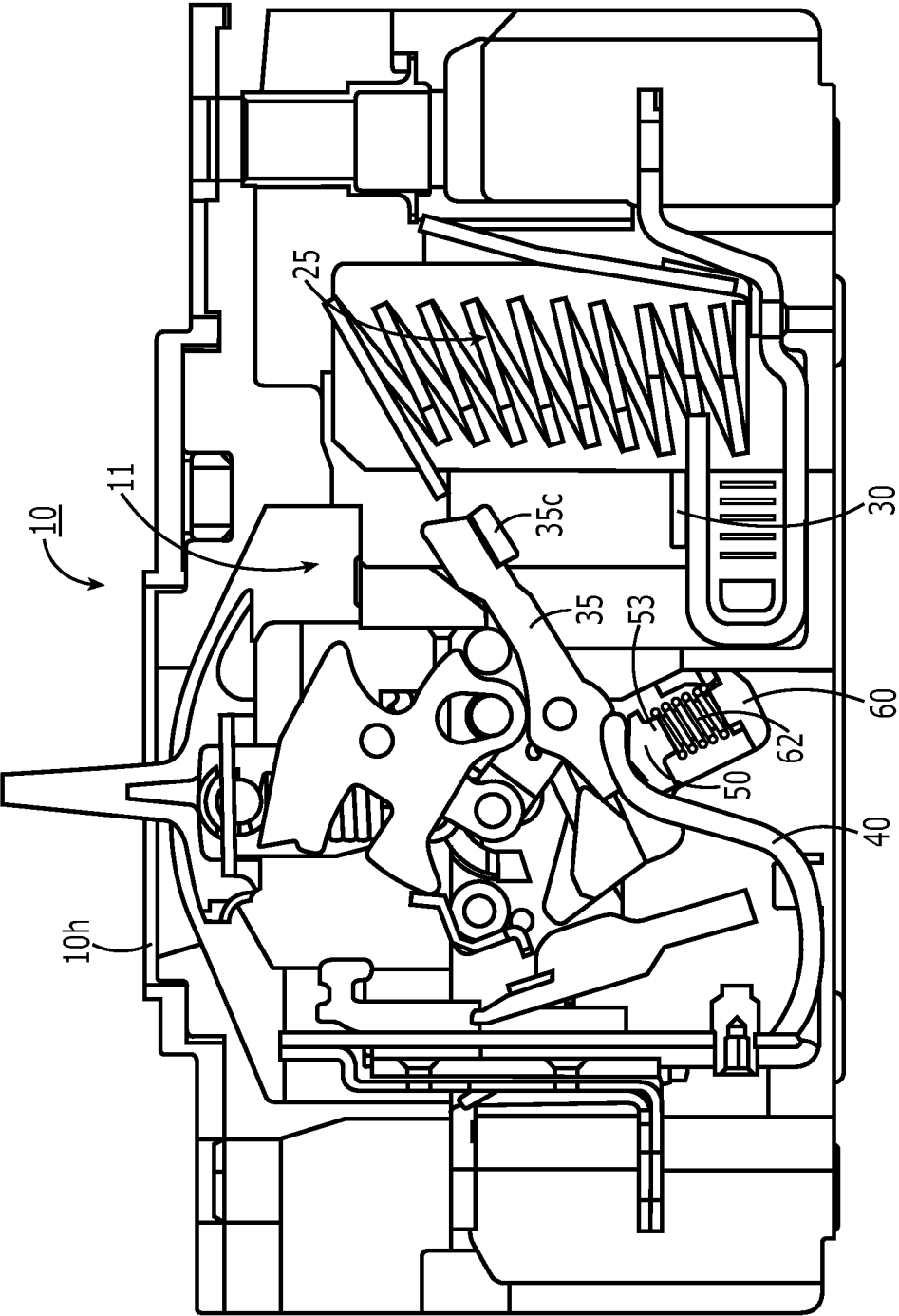
17. The cam follower of any of Claims 12-16, wherein the primary body and the upper and lower posts are configured as a unitary monolithic member comprising zinc alloy.

18. The cam follower of any of Claims 12-17, wherein the primary body has a substantially rectangular shape with opposing long sides connected by opposing short sides, and an upper surface having a flat medial segment that extends in a width direction corresponding to a direction of the long sides, with the upper post residing laterally centered with respect to the long sides, and wherein the upper surface has a front end portion that tapers down from the medial segment.

19. The cam follower of any of Claims 12-18, wherein the upper post is substantially rectangular and has an upper surface with an outer edge portion that tapers down at an angle that is between about 15-30 degrees.

20. A circuit breaker, comprising:
a housing;
a movable contact arm in the housing;
a cross bar in the housing in cooperating alignment with the contact arm;
a cam follower held by the cross bar in communication with the contact arm,
the cam follower having an upper surface; and
first and second shunts in the housing that have a length that extends from a location outside the cross bar to travel over the upper surface of the cam follower,

wherein the cam follower comprises an upper surface that is configured to maintain shunt separation to thereby prevent shunt travel onto a top of the contact arm during a high interruption shot.



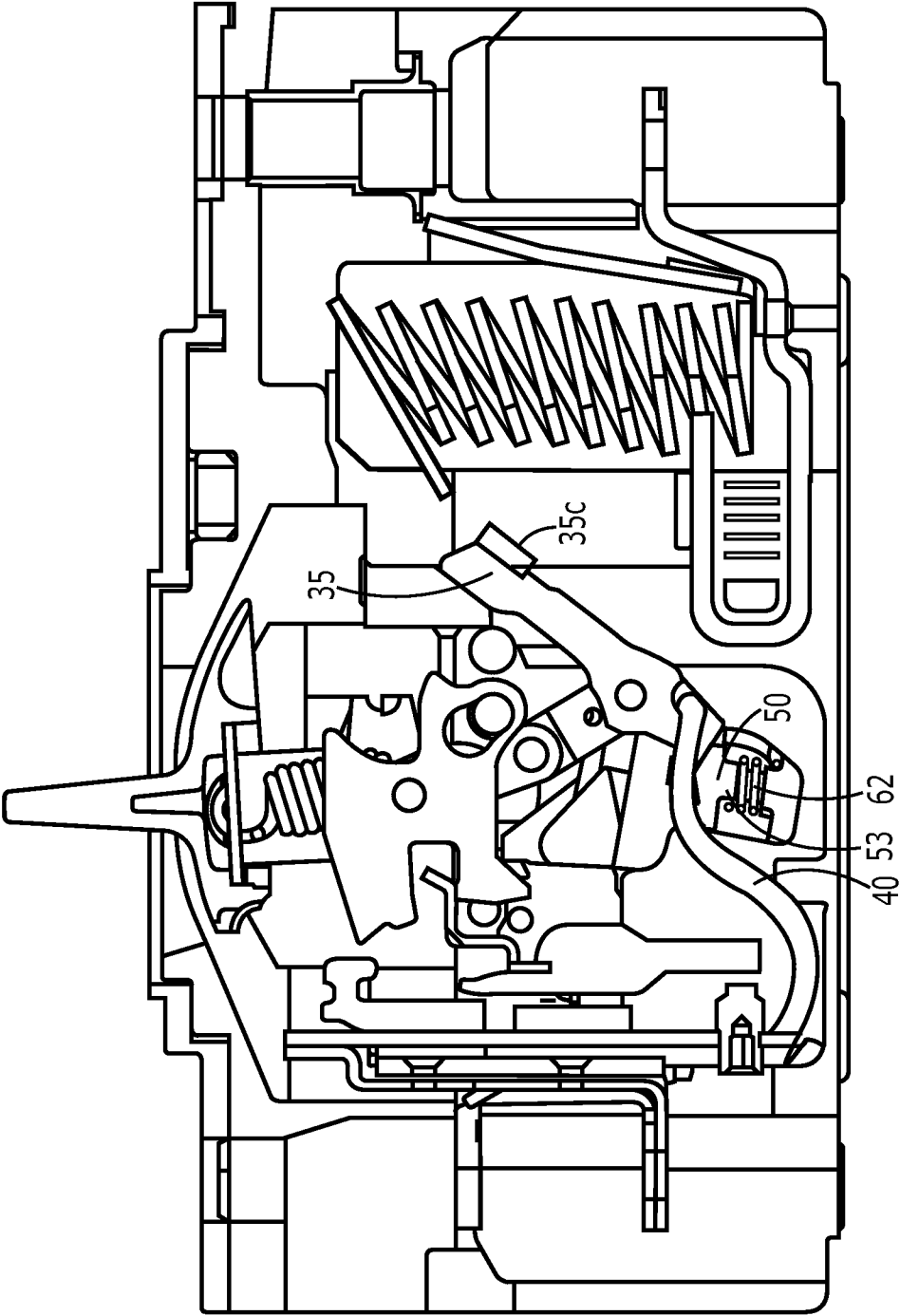


FIG. 1B
(PRIOR ART)

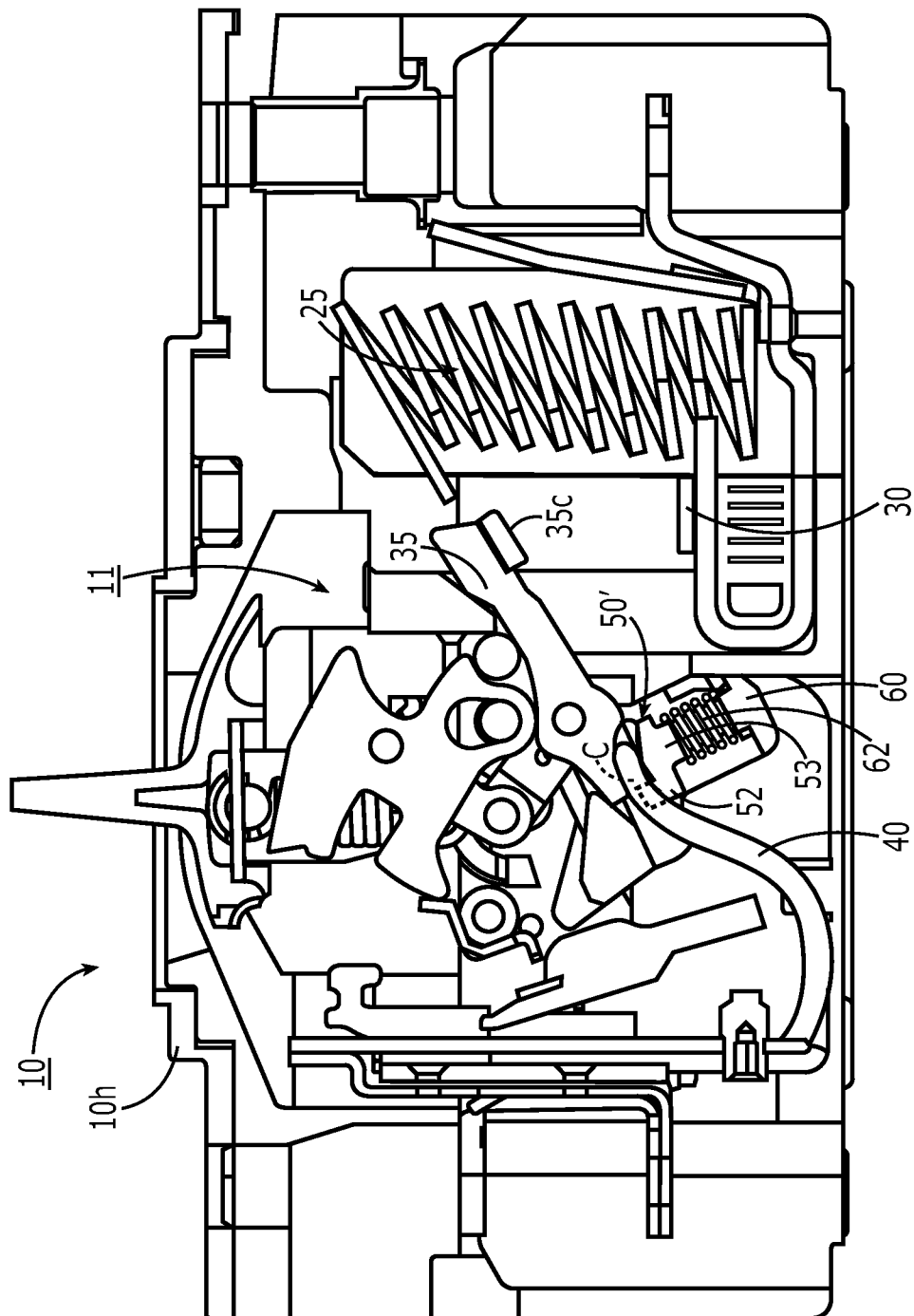
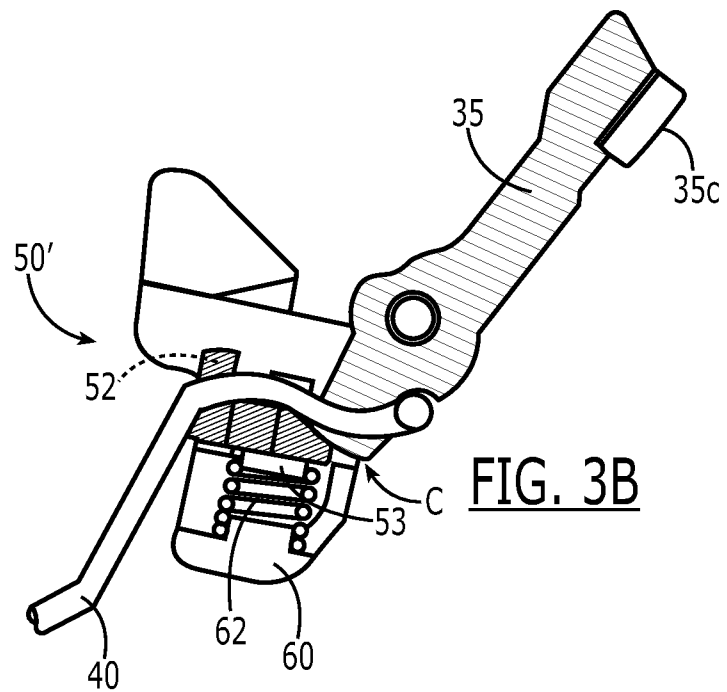
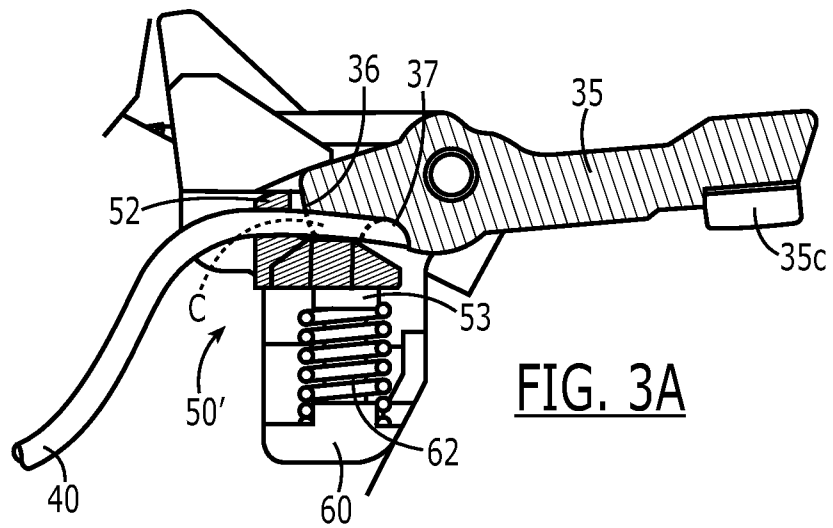


FIG. 2

4/8



5/8

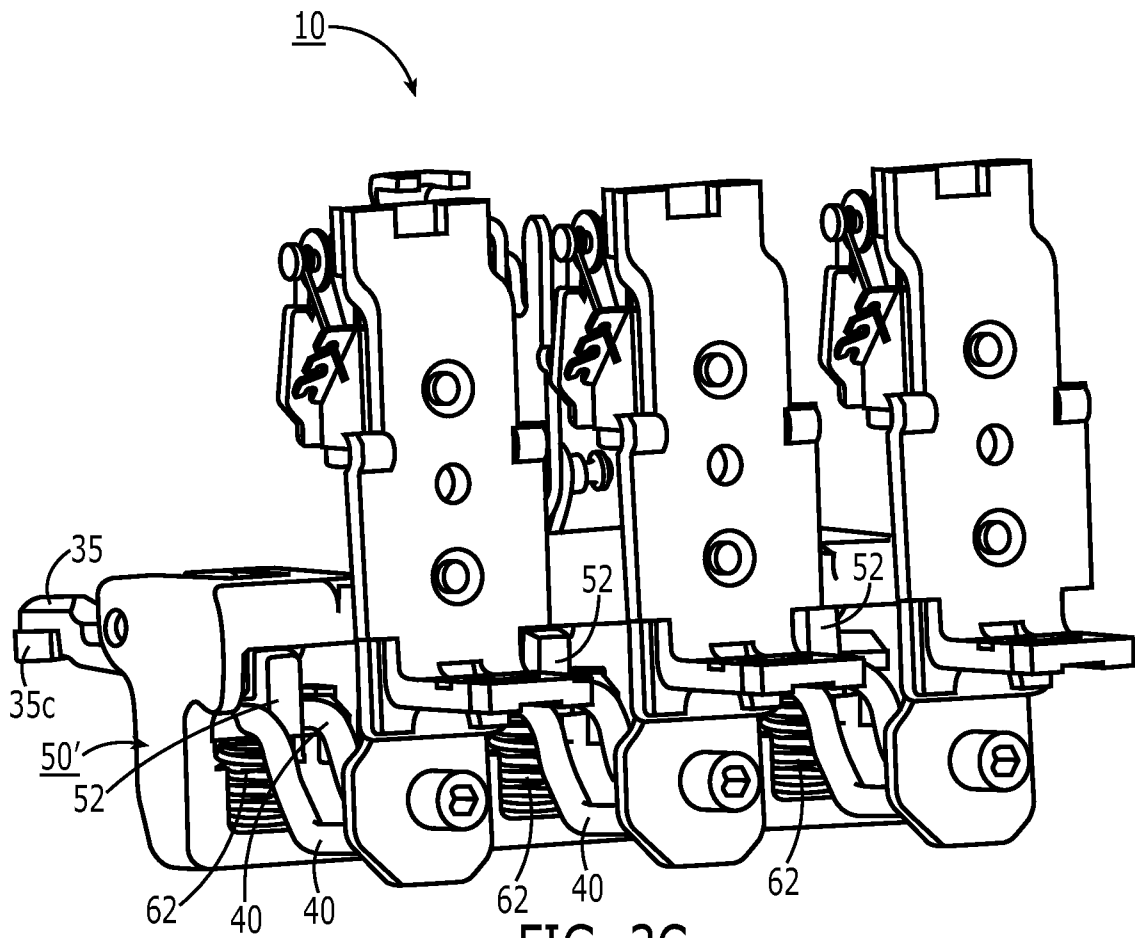


FIG. 3C

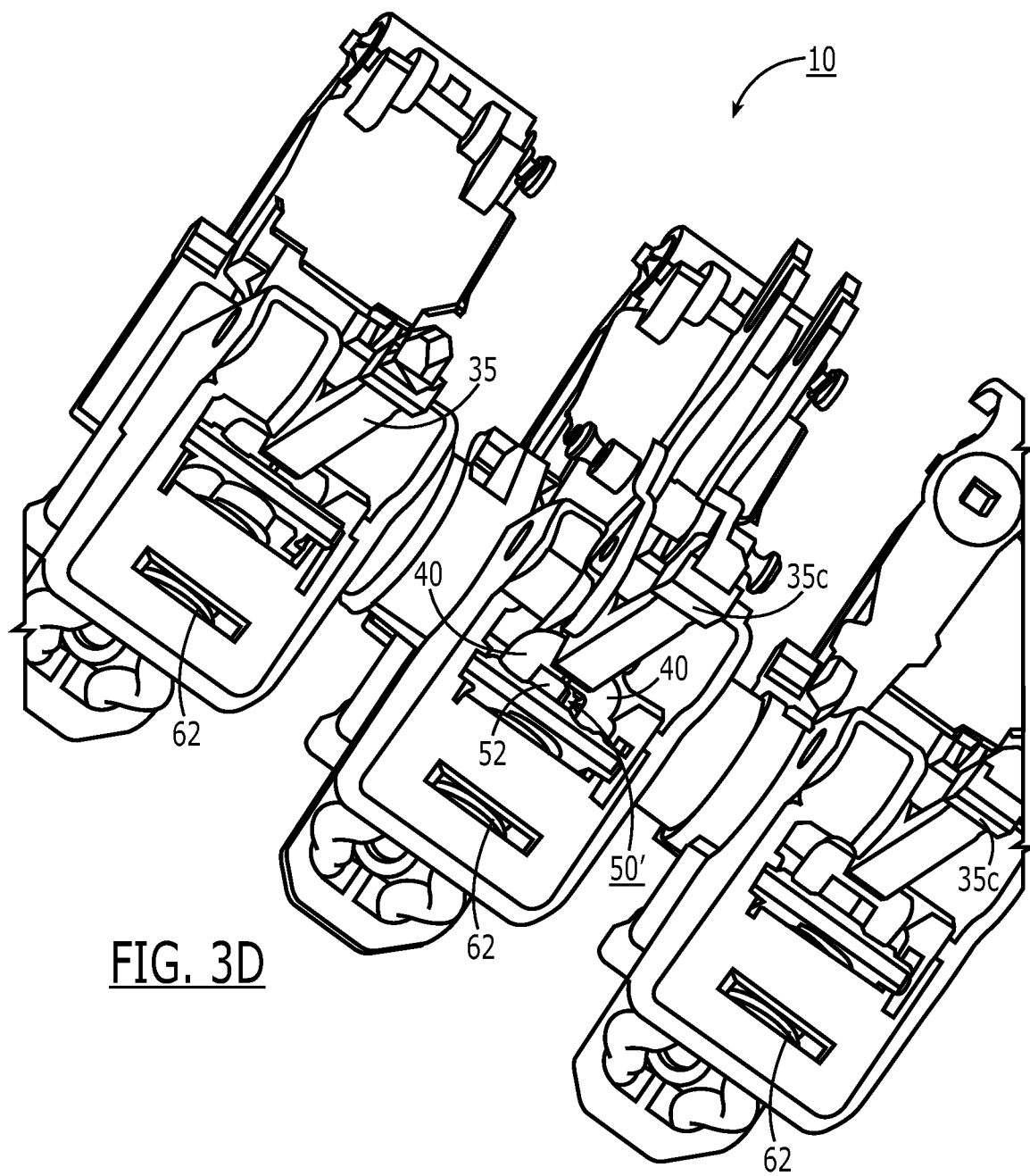


FIG. 3D

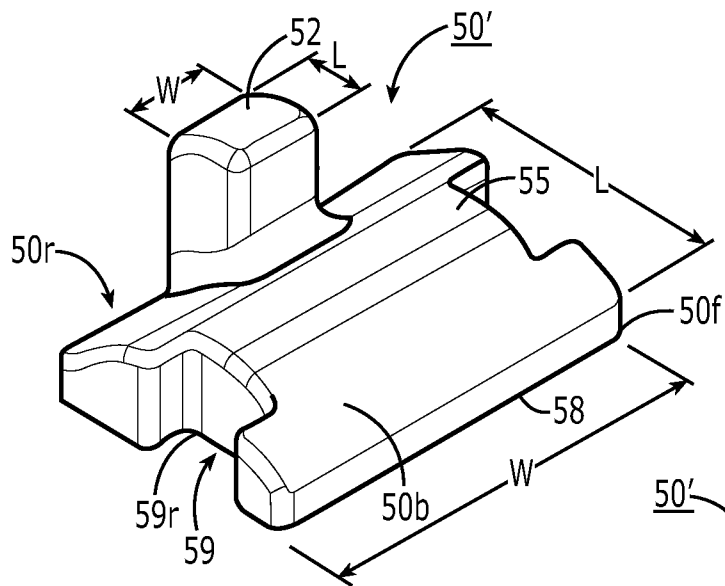


FIG. 4A

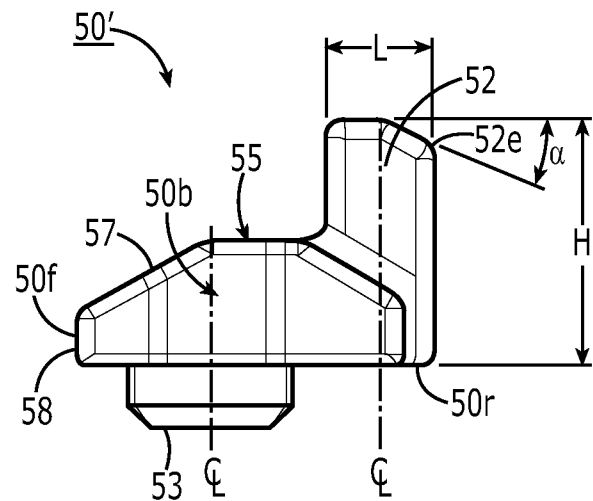


FIG. 4B

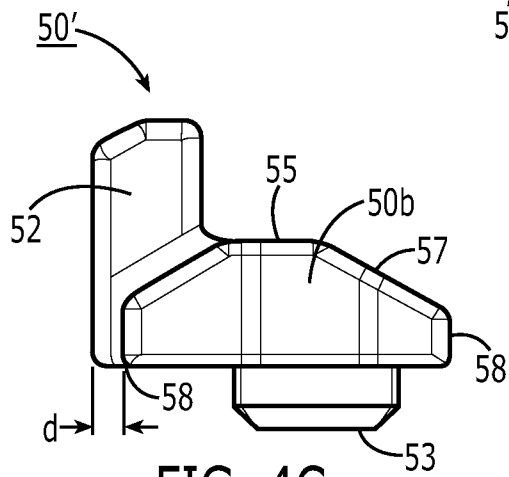


FIG. 4C

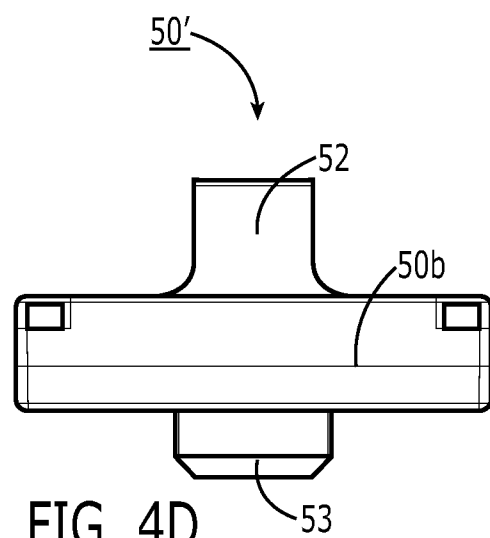
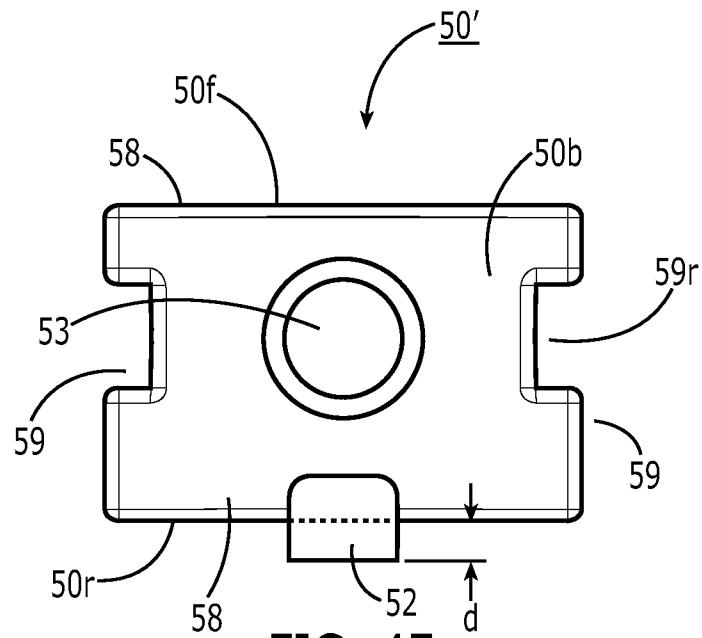
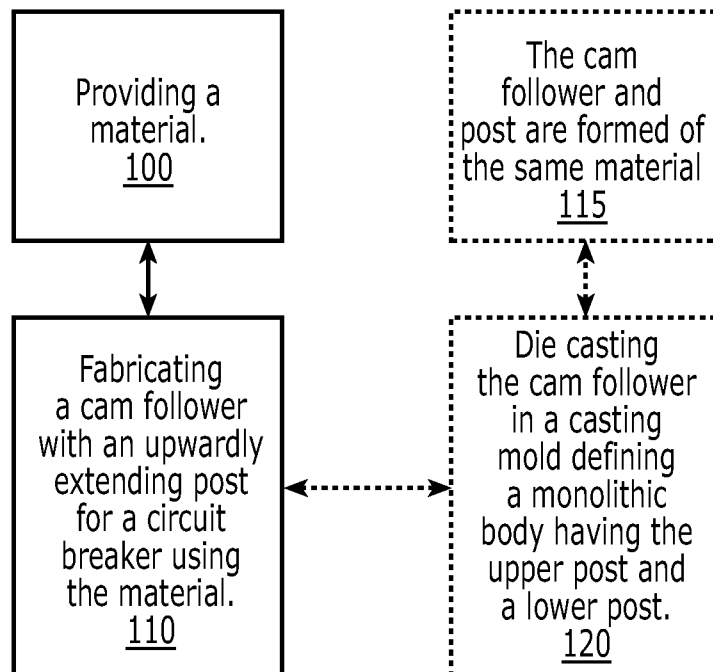


FIG. 4D

8/8

FIG. 4EFIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/038558

A. CLASSIFICATION OF SUBJECT MATTER INV. H01H71/02 H01H1/58 H01H71/74 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) H01H		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 565 827 A (GULA LANCE [US] ET AL) 15 October 1996 (1996-10-15) column 2, line 66 - column 3, line 20; figures 1, 3, 4 column 3, line 66 - column 4, line 46 -----	1-4,9, 11-14, 18-20
X	US 5 874 699 A (BECK HENRY RICHARD [US] ET AL) 23 February 1999 (1999-02-23) column 4, lines 28-67; figures 2, 4A, 5 column 6, lines 9-30 column 7, line 48 - column 9, line 56 -----	1,5-7, 10,12, 15-17
A	US 2003/222739 A1 (KOLBERG KENNETH DANIEL [US] ET AL) 4 December 2003 (2003-12-04) paragraphs [0017] - [0024]; figures 3-7 ----- -/-	1-20
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 8 August 2014	Date of mailing of the international search report 01/09/2014	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Bräckelmann, Gregor	

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PCT/US2014/038558

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 489 867 B1 (TURNER DAVID CURTIS [US] ET AL) 3 December 2002 (2002-12-03) column 2, line 13 - column 3, line 31; figures 3, 4 -----	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/038558

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5565827	A	15-10-1996	NONE

US 5874699	A	23-02-1999	CA 2247606 A1 18-03-1999
		CN 1220476 A	23-06-1999
		EP 0903764 A2	24-03-1999
		ID 20880 A	18-03-1999
		TW 451237 B	21-08-2001
		US 5874699 A	23-02-1999

US 2003222739	A1	04-12-2003	NONE

US 6489867	B1	03-12-2002	NONE
