July 12, 1966 W. I. STEPHENSON, JR., ET AL 3,260,822

CIRCUIT BREAKER WITH IMPROVED ARMATURE ADJUSTMENT MEANS AND ARMATURE PIVOT MEANS

Original Filed March 2, 1960 6 Sheets-Sheet 1

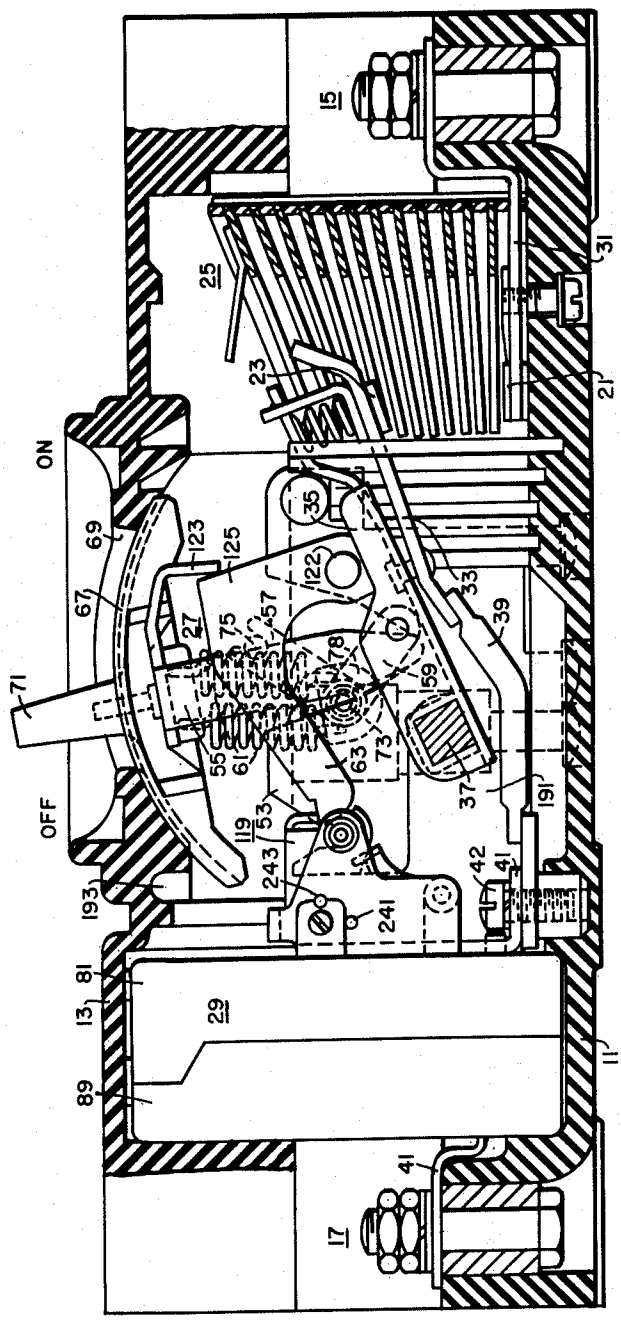


FIG. 1.

Fig. 2.

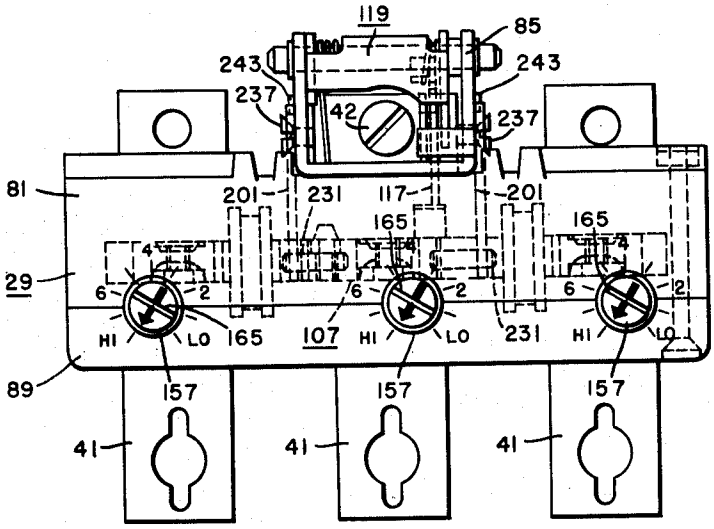

119
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243
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42
237
81
201
231
117
201
165
165
29
6
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6
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165
107
HI
LO
231
HI
LO
89
157
157
157
41
41
41

Fig. 3.

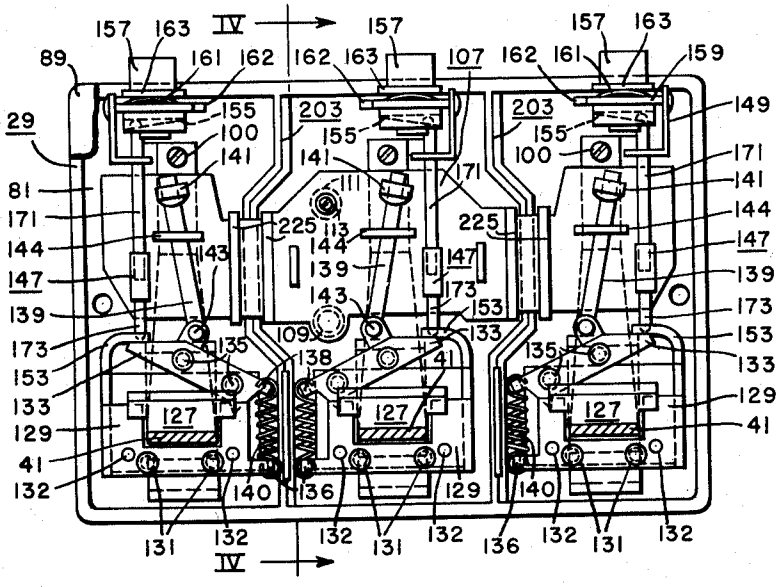
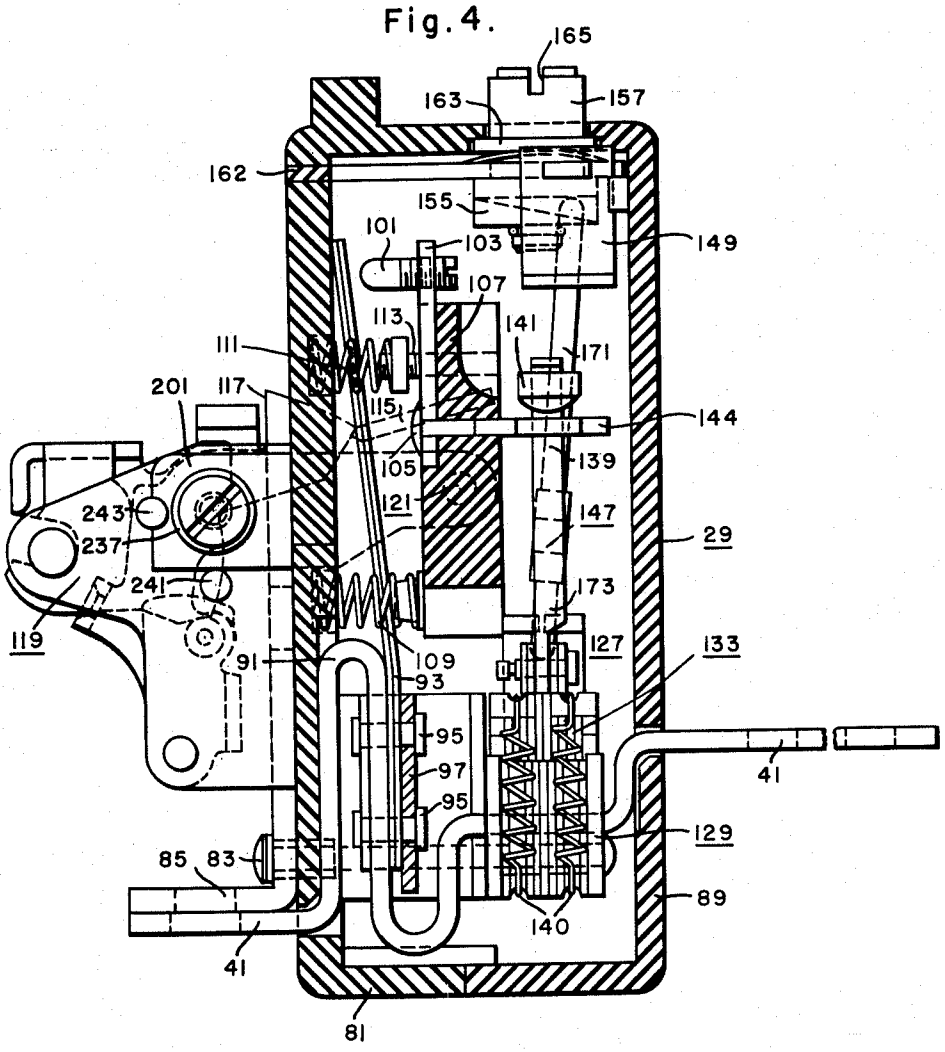

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Fig. 4.


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83
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140
41
81

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CIRCUIT BREAKER WITH IMPROVED ARMATURE ADJUSTMENT MEANS AND ARMATURE PIVOT MEANS

Original Filed March 2, 1960 6 Sheets-Sheet 4

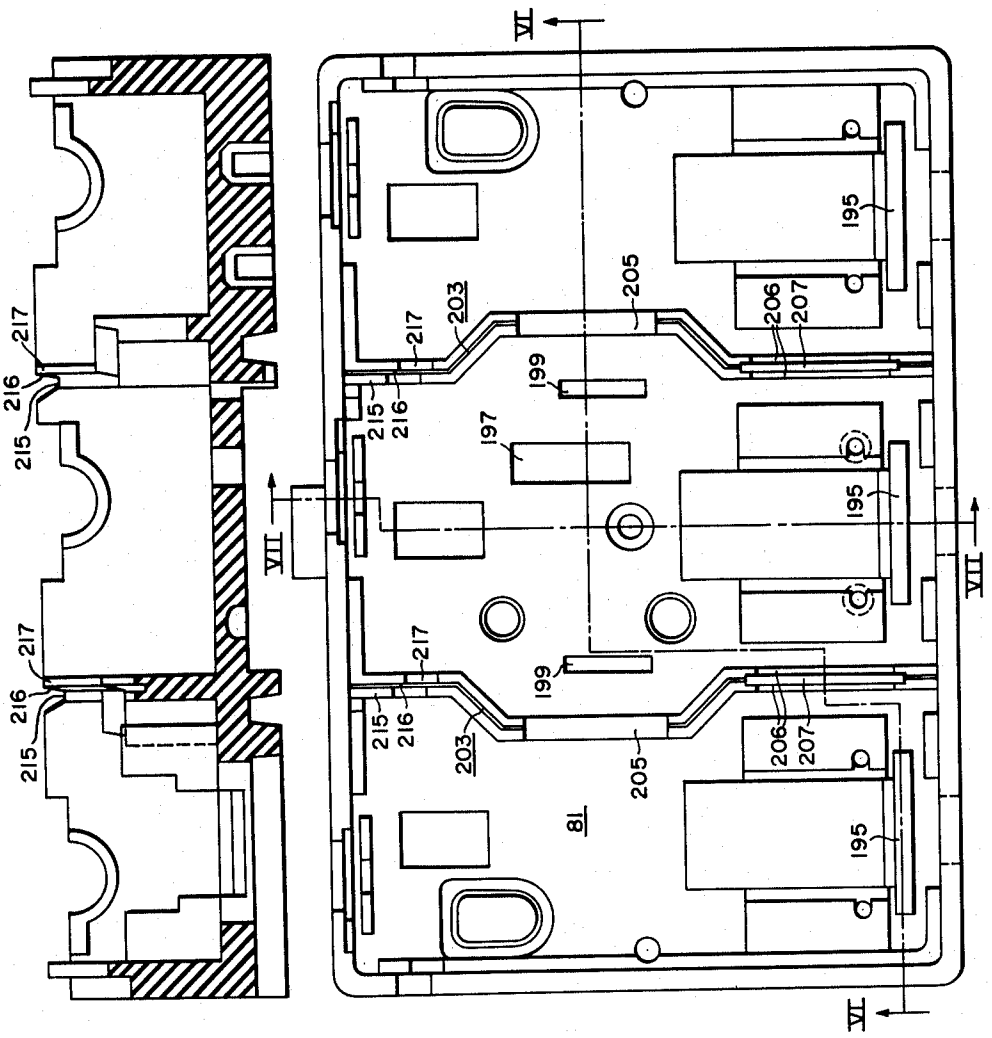


Fig. 5.

Fig. 6.

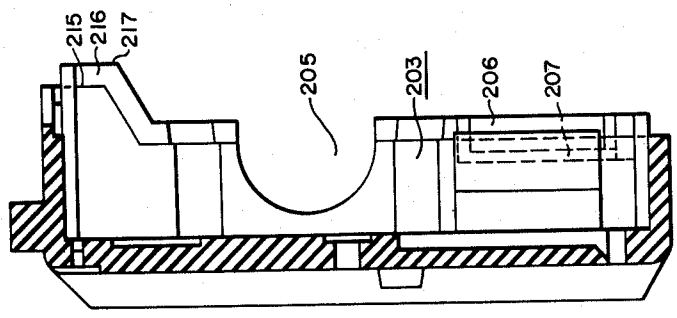


Fig. 7.

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CIRCUIT BREAKER WITH IMPROVED ARMATURE ADJUSTMENT MEANS AND ARMATURE PIVOT MEANS

Original Filed March 2, 1960 6 Sheets-Sheet 5

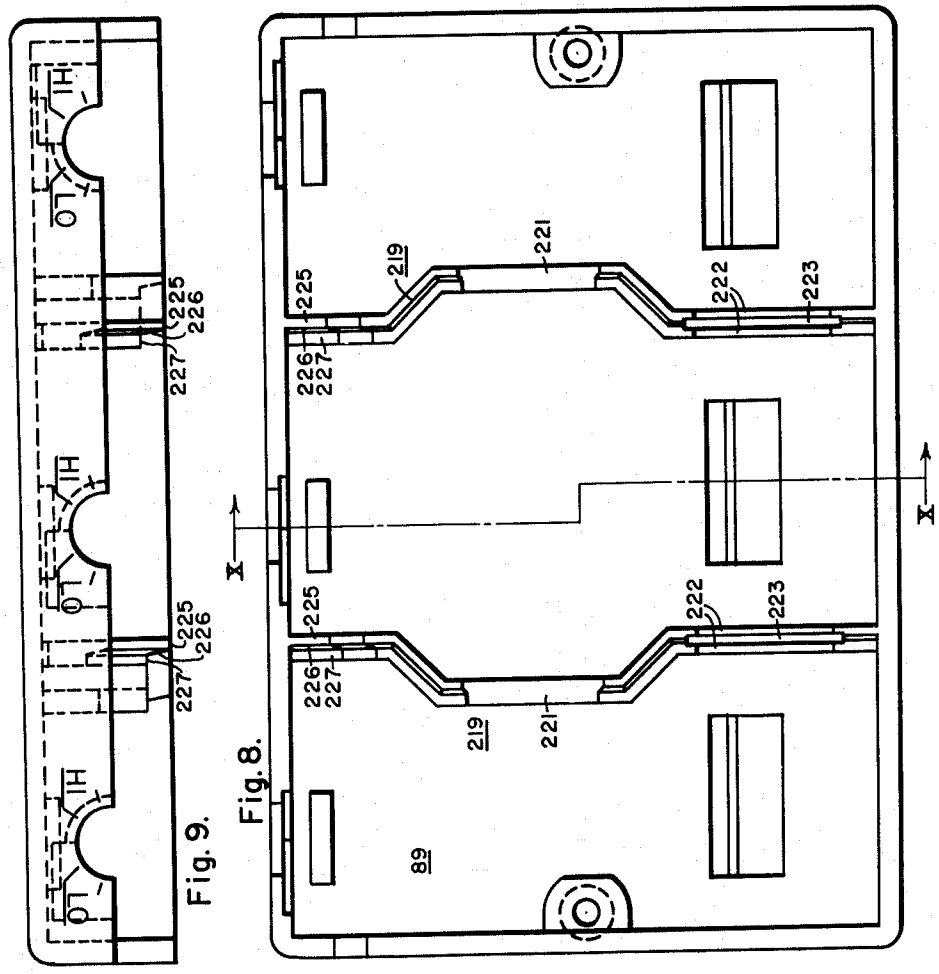


Fig. 9.

Fig. 8.

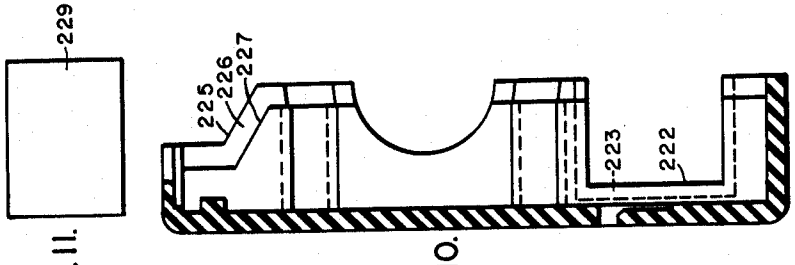


Fig. 11.

Fig. 10.

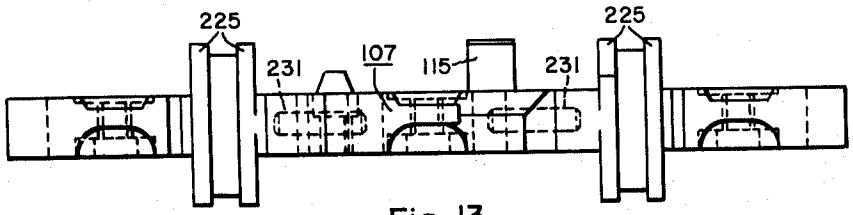
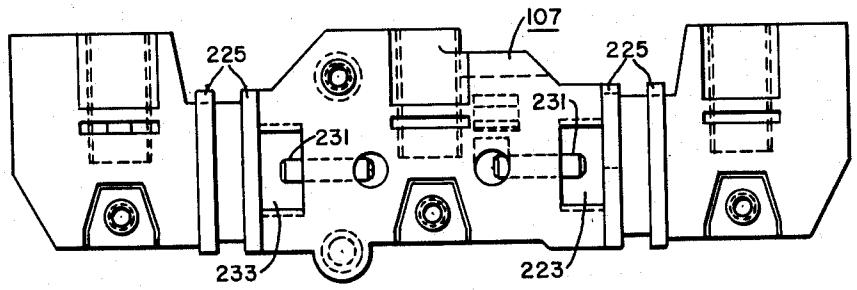


Fig. 13

Fig. 12



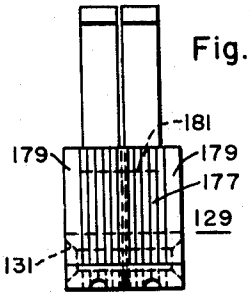


Fig. 15

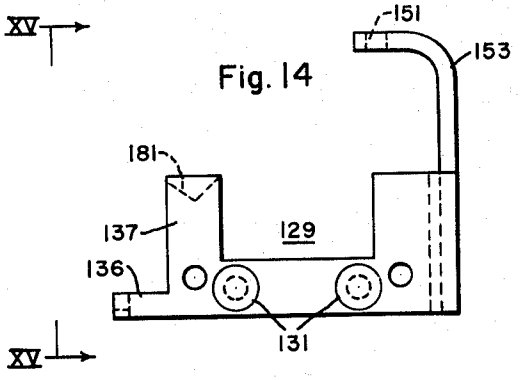


Fig. 14

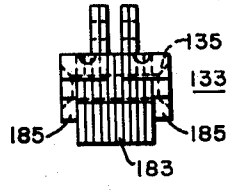


Fig. 17

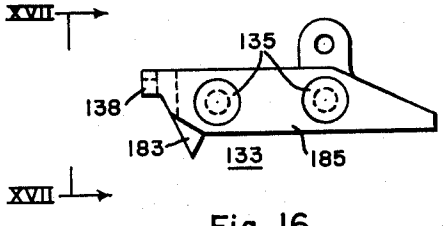


Fig. 16

United States Patent Office 3,260,822 Patented July 12, 1966

3,260,822

CIRCUIT BREAKER WITH IMPROVED ARMATURE ADJUSTMENT MEANS AND ARMATURE PIVOT MEANS

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Original application Mar. 2, 1960, Ser. No. 12,379, now Patent No. 3,211,860, dated Oct. 12, 1965. Divided and this application Feb. 3, 1965, Ser. No. 430,116

8 Claims. (Cl. 200—88)

This application is a division of the parent application Serial No. 12,379, filed March 2, 1960, now Patent No. 3,211,860, issued October 12, 1965.

This invention relates, generally, to circuit breakers and, more particularly, to enclosed circuit breakers with automatic tripping means.

One object of the invention is to provide an improved circuit breaker of compact construction which is simple and inexpensive to manufacture and safe and reliable in operation.

Another object of the invention is to provide a circuit breaker having a rotatable trip bar with improved means for rotatably supporting the trip bar within the circuit breaker.

Another object of the invention is to provide a circuit breaker having an adjustable trip device with improved means for achieving an initial adjustment or calibration during the assembly of the trip device.

A still further object of the invention is to provide a circuit breaker having an electro-magnetic trip device with improved means for supporting the armature on the magnetic yoke of the trip device.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of one embodiment thereof when read in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side view in section of a circuit breaker constructed in accordance with the invention, the breaker being shown in the open position;

FIG. 2 is a plan view, on an enlarged scale, of the removable trip device of the breaker shown in FIG. 1;

FIG. 3 is a front view, with almost all of the cover broken away, of the trip device;

FIG. 4 is an enlarged sectional view taken along lines IV—IV of FIG. 3;

FIG. 5 is an elevational view on an enlarged scale of the insulating and supporting base of the trip device;

FIG. 6 is a sectional view taken along line VI—VI of FIG. 5;

FIG. 7 is a sectional view taken along line VII—VII of FIG. 5;

FIG. 8 is an elevational view on an enlarged scale of the insulating cover of the trip device;

FIG. 9 is a plan view of the trip device cover shown in FIG. 8;

FIG. 10 is a sectional view taken along lines X—X of FIG. 8;

FIG. 11 is an elevational view of a barrier that cooperates with the partition portions of the insulating trip device base and cover to enable isolation of the pole units of the trip device;

FIG. 12 is an elevational detailed view, on an enlarged scale, of the trip bar shown in FIG. 3;

FIG. 13 is a plan view of the trip bar shown in FIG. 12;

FIG. 14 is an elevational view on an enlarged scale of one of the magnetic yokes of the trip device shown in FIG. 3;

FIG. 15 is an end view of the magnetic yoke shown in FIG. 14 looking in the direction of the arrows;

FIG. 16 is an elevational view on an enlarged scale of one of the armatures for the trip device shown in FIG. 3; and

FIG. 17 is an end view of the armature shown in FIG. 16 looking in the direction of the arrows.

Referring to FIG. 1 of the drawings, the circuit breaker shown therein comprises, generally, a base **11** and a removable cover **13** both of which may be molded from a suitable insulating composition. The breaker is of the three-pole type, each pole being provided with terminals at opposite ends of the base **11** indicated generally at **15** and **17**.

The circuit breaker includes a stationary contact **21**, a movable contact **23** and an arc extinguisher indicated generally at **25**, for each pole unit. A common operating mechanism indicated generally at **27** is provided for simultaneously actuating the three movable contacts to open and closed positions. A trip device indicated generally at **29** serves to effect automatic opening of the breaker contacts in response to predetermined over-load conditions in a circuit through any pole unit of the breaker.

The terminal **15** is disposed at the outer end of a conducting strip **31** which extends into the housing and rigidly supports the stationary contact **21**. The movable contact **23** for each pole unit is mounted on a rigid contact arm **33** which is supported on a switch arm **35** secured to a tie bar **37** which extends across all of the pole units of the breaker and supports the switch arms for the several pole units for unitary movement to open and closed positions. The contact arm **33** is connected by means of a flexible conductor **39** to an intermediate or trip unit terminal member or conductor **41** which is secured at one end thereof to the base **11** by a screw **42**. The conducting member **41** extends through the trip unit **29** and is connected at its outer end to the terminal structure **17**.

The operating mechanism **27** is disposed in the center compartment of the housing and is supported by a pair of spaced frame members **53** (only one being shown) which are secured to the base **11**. The operating mechanism comprises a pivoted forked operating lever **55**, a toggle comprising toggle links **57** and **59**, over-center spring means **61** and a pivoted releasable cradle **63** which is controlled by the trip device **29**. An arcuate insulating shield **67** for substantially closing an opening **69** in the cover **13** is mounted on the end of the operating lever **55** and has an integral handle portion **71** extending out through the opening **69** to permit manual operation of the breaker.

The toggle links **57** and **59** are pivotally connected together by a knee pivot pin **73**. One end of the toggle link **57** is bifurcated to straddle a pin **75** which is integral with the cradle **63**. The toggle link **59** is pivotally connected to the switch arm **35** for the center pole unit, by a pin **77**. The over-center springs **61** are connected under tension between the outer end of the operating lever **55** and a plate member **78** which is attached to the knee pin **73** of the toggle **57, 59**.

The circuit breaker is manually operated to the open position by movement of the handle **71** in a counter-clockwise direction to the "off" position, which movement actuates the over-center springs **61** to cause collapse of the toggle **57, 59** and opening movement of the switch arms **35** for all of the pole units of the breaker in a well-known manner. The breaker is shown in the open position in FIG. 1.

The circuit breaker is manually closed by reverse movement of the handle **71** from the "off" to the "on"

position, which movement causes the over-center springs **61** to straighten the toggle **57, 59**, thereby moving the switch arms **35**, for all of the pole units, to the closed position in a manner well-known in the art.

Referring to FIGS. 2, 3 and 4, the trip device **29** comprises an insulating base or support member **81** secured by means of rivets **83** (only one being shown in FIG. 4), or other suitable means, to a bracket **85** which is, in turn, secured to the base **11** of the circuit breaker by means of the screw **42** (FIG. 1). A cover **89** of insulating material cooperates with the insulating base **81** to enclose the trip device **29**. The electro-responsive tripping means for the three pole units are the same, therefore, only the means for the center pole will be specifically described. The conducting member **41** for each pole unit has a looped portion **91** one leg of which is disposed adjacent to the base **81** and secured to the base by means of the rivets **83**. A bimetallic element **93** has one end secured by means of rivets **95** to the other leg of the loop **91** of the conducting member **41**. The rivets **95** also serve to secure the loop **91** and bimetal **93** to a bracket **97** that is secured to the trip unit base **81** by means (not shown) and that also supports the electro-magnetic trip means which will be hereinafter described. The free end of the bimetal **93** is disposed adjacent an adjusting screw **101** which is threaded into a tapped opening in a supporting member **103** that is attached by means of a rivet **105** to a trip bar **107**. The trip bar **107** is rotatably supported in the trip device by means of the bracket **85** in a manner which will be hereinafter described. Spring means **109** and **111** are provided on opposite sides of the pivot of the trip bar **107** to keep the trip bar from rotating when the circuit breaker is jarred or jolted, thereby acting as an anti-shock device. The bias of the spring **111** against the base **81** is adjusted by means of screw **113** in order to adjust the trip bar **107** to give the proper latch engagement which will be later described. In the normal position of the trip bar **107**, a latch member **115** rigidly imbedded therein, engages a latch portion **117** of a latching mechanism which is indicated generally at **119** and which restrains the cradle **63** in the latched position shown in FIG. 1. The high expansion side of the bimetal element **93** is to the left as viewed in FIG. 4. When this element is heated a predetermined amount in response to over-load currents, it deflects to the right to engage the adjusting screw **101** to rotate the trip bar **107** clockwise, as viewed in FIG. 4, about its pivot indicated generally at **121** causing the latch **115** to release the latch portion **117** of the latching mechanism **119**, thus freeing the cradle **63** (FIG. 1). Although the breaker is shown in the open position in FIG. 1, it can be understood that the electro-responsive trip device **29** will operate only when the contacts are closed and a circuit is energized through the breaker. When the breaker is closed and the bimetal **93** operates to effect release of the latching mechanism **119** to release the cradle **63** (FIG. 1), the springs **61** rotate the cradle **63** in a clockwise direction, as viewed in FIG. 1, about its pivot **122** to cause collapse of the toggle **57, 59** and movement of the switch arms **35** and movable contacts **23** for all of the pole units of the breaker to the open circuit position. This movement also effects movement of the handle portion **71** to an intermediate position to indicate that the circuit breaker has tripped open. The breaker cannot be closed after a tripping operation until the handle **71** is moved to the fully open position during which movement a projection **123** of the bracket **55** engages a shoulder **125** of the cradle **63** rotating the cradle in a counterclockwise direction about its pivot **122** until the cradle re-engages the latching mechanism **119**. After the cradle **63** has been relatched, the operating handle **71** can then be moved to the "on" position to effect closing of the contacts for all of the pole units in the same manner previously described.

The trip device **29** is also provided with electro-magnetic tripping means, indicated generally at **127**, for each of the pole units of the breaker. The electro-magnetic tripping means **127** operates in response to over-loads above a predetermined value, or in response to short circuits, to instantaneously actuate the trip bar **107** to trip the circuit breaker. Each electro-magnet comprises a fixed U-shaped laminated magnetic core member or yoke indicated generally at **129** and best illustrated in FIGS. 14 and 15, the laminations being secured together by means of rivets **131** (FIGS. 3 and 14). Each core member **129** is supported on the bracket **97** (FIG. 4) by means of two rivets **132** (FIG. 3). An armature indicated generally at **133** (FIGS. 16 and 17), which comprises a number of laminations secured together by means of rivets **135** (FIG. 16), is pivotally supported on one leg **137** (FIGS. 3 and 14) of the magnetic yoke **129** in a V-shaped pivot which will be hereinafter described. Referring to FIGS. 3 and 4, each of the armatures **133** is biased to the open position by means of two springs **140** which are supported under tension between a projection **136** of the magnetic yoke **129** and a projection **138** of the armature **133**. An operating rod **139** having a head portion **141** is pivotally attached at its lower end to the armature **133** by means of a pin **143**. The operating rod **139** extends through an opening in a metallic bracket **144** that is rigidly secured to the trip bar **107**. Upon the occurrence of an over-load current above a predetermined value or in response to short circuits, in any of the pole units, the current in the conducting member **41**, which passes through the opening defined by the legs of the U-shaped magnetic yoke **129** (FIG. 3), energizes the magnetic yoke causing the yoke to attract the armature **133**. The armature **133** thereupon pivots, about the leg **137** of the yoke **129**, against the bias of the springs **140**, pulling the operating rod **139** downward whereupon the head portion **141** of the operating rod engages the bracket **144** on the trip bar **107** rotating the trip bar in a clockwise direction as viewed in FIG. 4 to effect release of the cradle **63** (FIG. 1) and tripping of the breaker in the manner previously described.

The electromagnetic is adjusted by means of an adjusting rod or cam follower indicated generally at **147** (FIGS. 3 and 4) which extends at its upper end through an opening in a bracket **149**, that is attached to the trip unit base **81**. The cam follower **147** extends, at its lower end, through an opening **151** (shown in dotted lines in FIG. 14) in a bracket **153** of magnetic material which extends from one leg of the magnetic yoke **129** and which functions not only to support the cam follower **147** but to exert a back pull on the armature **133**. The upper end of the cam follower **147** engages a cam surface **155** (shown in dotted lines in FIGS. 3 and 4) on an adjusting member **157**.

The adjusting member **157** is biased outwardly by a spring **161** which is disposed between the upper surface of a supporting plate **162** and a lower surface of a flange **163** which is molded integral with the adjusting member **157**. There are a number of detents (not shown) in the cam surface **155** which receive the upper end of the cam follower **147** in order to positively position the member **147** to permit accurate adjustment of the electro-magnetic trip device **127**. The adjusting member **157** is provided with a slot **165** (FIGS. 2 and 4) into which a screwdriver or other tool can be inserted to permit manual adjustment of the electro-magnetic trip device **127**. The magnetic air gap between the armature **133** and the magnetic yoke **129** in each pole unit, is varied by rotation of the adjusting member **157** which movement rotates the cam surface **155** to move the cam follower **147** vertically, as seen in FIGS. 3 and 4, to thereby move the armature **133** about its pivot against the bias of the springs **140**. As seen in FIG. 2, there are markings on the trip unit cover **89** that indicate the positions of the rotatable adjusting members **157** to thereby indicate the minimum amount of over-load

current through any pole unit that will effect a magnetic tripping operation.

Improved means are provided for permitting an accurate and fine calibration of the electro-magnetic trip device **127**. Because the trip unit parts are manufactured and assembled in mass production, it can be understood that additional adjusting means is required in order to permit a fine calibration of each individual electro-magnetic trip device. As best illustrated in FIG. 3, the cam follower **147** is comprised of two parts **171** and **173**. The upper portion of the lower part **173** is tapped to receive the lower portion of the upper part **171** which is threaded so that the length or vertical dimension of the cam follower **147** can be varied by rotating one of the parts **171** or **173** with respect to the other. During the assembly of the trip unit **29**, a worker can test the unit and vary the length of the cam follower **147** until the electromagnet **127** effects a tripping operation upon the occurrence of a selected predetermined over-load current indicated by the position of the adjusting member **157** in relation to the markings (FIG. 2) on the trip unit cover **89**. The joint between the members **171** and **173** can be cemented fast when the cam follower **147** is the correct length. Thus, an accurate, fine calibration of each individual pole unit can be readily effected.

In electromagnets embodying a clapper-type armature, there is a tendency for the armature to walk out of the pivot, i.e., to move in a direction normal to the plane in which the armature rotates, until the armature falls out of position. On the circuit breakers presently in use, side plates or brackets are provided to keep the armature in place. Improved means are provided for keeping the armature in position on the magnetic yoke without the use of any additional parts other than the armature and the magnetic yoke. Referring to FIG. 15, it will be seen that the magnetic yoke **129** comprises a plurality of inner laminations **177** which are sandwiched between two thicker outer laminations **179**. As seen in dotted lines in FIGS. 14 and 15, a V-shaped slot **181** is provided in the inner laminations **177**; the two outermost laminations **179** forming side walls at opposite ends of the slot **181**. Referring to FIG. **17**, the armature **133** comprises a plurality of inner laminations **183** sandwiched between two thicker outer laminations **185**. The inner laminations **183** form a V-shaped pivoting portion at one end of the armature **133**, the outer laminations **185** being cut away as shown in FIGS. 16 and 17. As best illustrated in FIGS. 3 and 4, the V-shaped or knife-edge pivoting portion of the inner laminations **183**, of the armature **133**, is positioned in the V-shaped pivot of the inner laminations **177** of the magnetic yoke **129** when the parts are in place. The magnetic yoke outer laminations **179** keep the armature **133** from moving or walking out of position during operation of the electro-magnet **127**.

The circuit breaker insulating base **11** and cover **13** (FIG. 1) are provided with two sets of partition walls **191** and **193** (only one set being shown in FIG. 1) which cooperate to isolate the pole units of the portions of the circuit breaker adjacent the operating mechanism **27** and arc chutes **25** so that gases formed upon the extinction of the arcs, during an opening operation, will not cause flashovers between the pole units. The heat and pressure generated upon arc extinction force gases back into the enclosed trip device **29** through openings to be hereinafter described, and these gases could cause flashover between the pole units of the trip device.

Means, therefore, are provided for preventing the passage of gases between the pole units of the enclosed trip device **29**. As seen in FIG. 5, there is an opening **195**, for each pole unit, provided in the trip unit base **81** to permit passage of the conducting member **41** (FIG. 4). An opening **197** (FIG. 5) is provided in the center pole unit portion of the base **81** to allow passage of the latch portion **117** (FIG. 4) which is part of the latching mechanism **119**. Two openings **199** (FIG. 5) are also provided in the center pole unit portion of the trip unit base **81** to allow passage of two arm members **201** (FIGS. 2 and 4) which members rotatably support the trip bar **107** in a manner to be hereinafter described. The openings **195**, **197** and **199** are large enough to permit easy and quick assembly of the trip device **29** and to permit easy and quick mounting of the trip device in the circuit breaker. These openings, therefore, are not completely closed when the trip device is assembled, and gases, formed upon the extinction of the arcs during an opening operation, pass back into the trip device. Means therefore, are provided for preventing passage of these gases between the pole units of the trip device.

Referring to FIGS. 5, 6 and 7, there are two partition portions **203**, molded integral with the insulating trip unit base **81**, that divide the base into three compartments for the three pole units of the trip device. A semicircular opening **205** is provided in each of the partition portions **203**. A rectangular opening **206** is also provided in each of the partition portions **203**. A slot **207** is provided in the partition portions **203** adjacent each of the openings **206**. The edges of the partition portions **203** comprise three surfaces **215**, **216** and **217**. As best seen in FIG. 6, the surfaces **215** and **217** are in different planes, and they are connected by the slanting surface **216**.

Referring to FIGS. 8, 9 and 10 there are two partition portions **219**, molded integral with the insulating trip unit cover **89**, that divide the cover into three compartments corresponding to the three compartments in the trip unit base **89**. A semicircular opening **221** is provided in each of the partition portions **219**. A generally rectangular opening **222** is provided in each of the partition portions **219** and a slot **223** is provided in the partition portions adjacent each of the openings **222**. The edges of the partition portions **219** comprise three surfaces **225**, **226** and **227**. The surfaces **225** and **227** are in different planes, and they are connected by the slanting surface **226**.

When the cover **89** is placed over the base **81**, the partition portions **219** of the cover **89** cooperate with the partition portions **203** of the base **81** to form partition walls between the compartments of the trip device. The surfaces **225**, **226** and **227** of the edges of the partition portions **219** mate with the surfaces **215**, **216** and **217**, respectively, of the edges of the partition portions **203** providing irregular mating connecting surfaces that are lapped together to provide an effective seal between the compartments of the trip device.

The openings **205** in the base **81** cooperate with the openings **221** in the cover **89** to permit extension of the common trip bar **107** (FIG. 3) into each of the three pole units of the trip device **29**. As seen in FIGS. 2, 3, 12 and 13, the trip bar **107** is provided with cylindrical flanges **225** which fit on opposite sides of the partitions that separate the trip unit compartments. The flanges **225** cooperate with the general mass of the trip bar **107** to close the openings **205**, **221** in the trip unit partition walls.

The openings **206**, **222** are provided to permit easy assembly of the springs **140** (FIG. 3) in the trip device. An insulating barrier **229** (FIG. 11) is provided for each of the partition walls **203**, **219**, (FIGS. 5–10) to fit into the slots **207** and **223** adjacent the openings **206**, **222** to thereby close off each of the openings **206**, **222** in the trip unit partition walls.

It can be understood that the irregular mating surfaces of the edges of the partition walls **203**, **219**, the flanges **225** on the trip member **107**, and the barriers **229** all cooperate to effectively isolate the three pole units of the trip device **29** preventing passage of gases between the compartments and providing insulation between the live parts of the different pole units.

As was previously mentioned, when the trip bar **107** is in place in the trip device, the flanges **225** are positioned on opposite sides of each of the partition walls **203**, **219** to cooperate with the general mass of the trip bar to

thereby close the openings **205**, **221** in the partition walls. It can be understood that during the assembly of the trip device **29**, the amount of side movement of the trip bar **107** should be kept to a minimum in order that the flanges **225** on the trip bar **107** can be molded closely together so that they will be positioned close to the partition walls **203**, **219** to more effectively close the openings **205**, **221**. It can be understood also that the trip bar **107** must be positively positioned in the trip device for proper latch engagement between the latch member **115** (FIG. 4) and the latch portion **117** of the latching mechanism **119**.

Improved means, therefore, are provided for rotatably supporting the trip bar **107** within the trip device **29**. Referring to FIG. 12, the trip bar **107** is provided with two metallic pins **231** that are rigidly embedded in the molded trip bar during the molding operation. An opening **233** is provided in the trip bar **107** near the outer end of each of the pins **231**. As best illustrated in FIG. 2, these openings **233** provide access to the two independent supporting arms **201** (FIGS. 2 and 4) each of which has an opening near its inner end to receive one of the pins **231** whereby the trip bar **107** is rotatably supported on the supporting arms **201**. Each of the supporting arms **201** extends through one of the openings **199** (FIG. 5) in the trip unit base **81** and is supported at its outer end on the bracket **85** (FIGS. 2 and 4) by means of a screw **237**. Each of the supporting arms **201** is positively positioned with respect to the supporting bracket **85** by means of two dowels **241** and **243** (FIG. 4) in the bracket **85**. Each of the arms **201** rests on top of one of the dowels **241** and receives the other dowel **243** in a semicircular opening in the end of the arm. During the assembly of the trip device **29**, the supporting arms **201** are placed over the pins **231** in the trip bar **107** and, with the trip unit cover **89** removed, the two arms **201** are placed through the openings **199** in the trip unit base **81** (FIG. 5). Each of the arms **201** is then positively positioned with respect to the bracket **85** by means of two dowels **241** and **243** (FIG. 4). The arms are then fastened securely to the bracket **85** by means of the screws **237**. It can be understood that there is no side movement required of the trip bar **107**, with respect to the trip unit base **81**, during the assembly of the trip device **29**, and therefore, the flanges **225** on the trip bar **107** can be molded close enough together to more effectively function as barriers aiding to isolate the compartments of the trip device.

Having described the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the structural details and combinations of elements without departing from some of the essential features of the invention.

We claim as our invention:

1. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, electro-magnetic trip means including a core member and an armature, said armature upon the occurrence of an over-load current above a predetermined value moving towards said core member to close an air gap therebetween to effect release of said releasable means, adjusting means for adjusting said trip means by varying the dimension of said air gap, said adjusting means comprising a cam member and a cam follower, said cam follower being disposed between said cam member and said armature and being movable by movement of said cam member to move said armature to vary said magnetic air gap, and said cam follower being adjustable to vary said magnetic air gap to permit calibration of said electro-magnetic trip means.

2. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, electro-magnetic trip means including a core member and an armature, said armature upon the occurrence of an over-load current above a predetermined value moving towards said core member to close an air gap between said armature and core member to effect release of said releasable means, adjusting means for adjusting said trip means by varying the dimension of said air gap, said adjusting means comprising a cam member and a cam follower, said cam follower being disposed between said cam member and said armature and being movable by movement of said cam member to thereby move said armature to vary said magnetic air gap, and means for varying the length of said cam follower to thereby vary said magnetic air gap.

3. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, electro-magnetic trip means including a core member and an armature, said armature upon the occurrence of an over-load current above a predetermined value moving towards said core member to close an air gap therebetween to effect release of said releasable means, adjusting means comprising a cam member having a cam surface and supported a distance away from said armature, an elongated member disposed between said cam member and said armature, means biasing said armature against said elongated member, said elongated member upon movement of said cam member following said cam surface to effect movement of said armature relative to said core member to vary said air gap to thereby vary the minimum amount of over-load current that will effect a magnetic tripping operation, and said elongated member being adjustable to vary said air gap to permit calibration of said electro-magnetic trip means.

4. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, electro-magnetic trip means including a core member and an armature, said armature upon the occurrence of an over-load current above a predetermined value moving towards said core member to close an air gap between said armature and core member to effect release of said releasable means, adjusting means including a manually rotatable cam member having a cam surface and supported a distance away from said armature, an adjustable member supported between said cam member and said armature, means biasing said armature against said adjustable member, said adjustable member upon rotation of said cam member following said cam surface to effect movement of said armature relative to said core member to vary said air gap to thereby vary the minimum amount of over-load current that will effect a magnetic tripping operation, said adjustable member including a first part having a tapped end and a second part having a threaded end screwed into said tapped end of said first part whereby rotation of one of said parts relative to the other will change the length of said adjustable member to enable calibration of said electro-magnetic trip means.

5. A trip device for a circuit interrupter operable to effect opening of said interrupter, said trip device comprising an energizing winding, a U-shaped core member disposed to be energized by said winding, said core member comprising two outermost laminations and at least one inner lamination, a V-shaped pivot formed in one leg of said inner lamination, said outermost laminations forming side walls adjacent the opening defined by the legs of said V-shaped pivot, a movable armature comprising two outermost laminations and at least one inner lamination, a knife-edge pivoting portion formed by said armature inner lamination and disposed in said core member V-shaped pivot to pivotally support said armature on said one leg of said core member, and said armature upon the occurrence of over-load currents above a predetermined amount pivotally moving towards the other leg of said U-shaped core member to effect automatic opening of said circuit interrupter.

6. A trip device for a circuit interrupter operable to effect opening of said interrupter comprising an energizing winding, a U-shaped core member disposed to be energized by said winding, said core member comprising

two outermost laminations and a plurality of inner laminations, a V-shaped pivot formed in one leg of said inner laminations, said outermost laminations forming side walls adjacent the opening defined by the legs of said V-shaped pivot, a movable armature comprising two outermost laminations and a plurality of inner laminations, a knife-edge pivoting portion formed by said armature inner laminations and disposed in said core member V-shaped pivot to pivotally support said armature on said one leg of said core member, and said armature upon the occurrence of over-load currents above a predetermined amount pivoting to effect automatic opening of said circuit interrupter.

7. A circuit breaker having relatively movable contacts and a trip device for effecting automatic opening of said contacts, said trip device comprising an energizing winding, a U-shaped core member disposed to be energized by said winding, said core member comprising two outermost laminations and at least one inner lamination, a V-shaped pivot formed on one leg of said inner lamination, said outermost laminations forming sidewalls adjacent the opening defined by the legs of said V-shaped pivot, a movable armature comprising two outermost laminations and at least one inner lamination, said inner lamination comprising a knife-edge pivoting portion pivotally supported on said V-shaped pivot on said one leg of said core member, said armature extending over the other leg of said core member and being spaced from said other leg whereby there is an air gap between said armature and said other leg, said armature upon the occurrence of an overload current above a predetermined value through said energizing winding pivoting toward said other leg to close said air gap to effect automatic opening of said contacts, said side walls of said core member engaging said pivoting portion of said armature to prevent movement of said armature in a direction normal to a plane generated by said pivotal movement of said armature, means for adjusting said trip device by varying the dimension of said air gap, said adjusting means comprising a cam member and a cam follower, said cam follower being disposed between said cam member and said armature and being movable by movement of said cam member to move said armature to vary said magnetic air gap, and said cam follower being aljustable to vary said magnetic air gap to permit calibration of said trip device.

8. A circuit breaker comprising relatively movable contacts and a trip device for effecting automatic opening of said contacts, said trip device comprising an energizing winding, a U-shaped core member disposed to be energized by said winding, said core member comprising two outermost laminations and at least one inner lamination, a V-shaped pivot formed in one leg of said inner lamination, said outermost laminations forming sidewalls adjacent the opening defined by the legs of said V-shaped pivot, a movable armature comprising a V-shaped pivoting portion disposed in said core member V-shaped pivot to pivotally support said armature on said one leg of said core member with said armature extending over the other leg of said core member spaced from said other leg whereby a magnetic air gap is formed between said armature and said other leg, said armature upon the occurrence of over-load currents above a predetermined amount pivotally moving toward said other leg to close said air gap to effect automatic opening of said circuit breaker, said sidewalls of said core member engaging said V-shaped pivoting portion of said armature to prevent movement of said armature on said core member in a direction normal to a plane generated by said pivotal movement of said armature, adjusting means comprising a cam member having a cam surface, said cam member being supported a distance away from said armature, an elongated member disposed between said cam member and said armature, means biasing said armature against said elongated member to provide said air gap between said armature and said other leg, said elongated member upon movement of said cam member following said cam surface to effect movement of said armature relative to said other leg to vary said air gap to thereby vary the minimum amount of over-load current that will effect a magnetic tripping operation, said elongated member comprising a first part having a tapped end and a second part having a threaded end screwed into said tapped end of said first part whereby rotation of one of said parts relative to the other will change the length of said elongated member to vary said air gap to thereby calibrate said trip device.

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