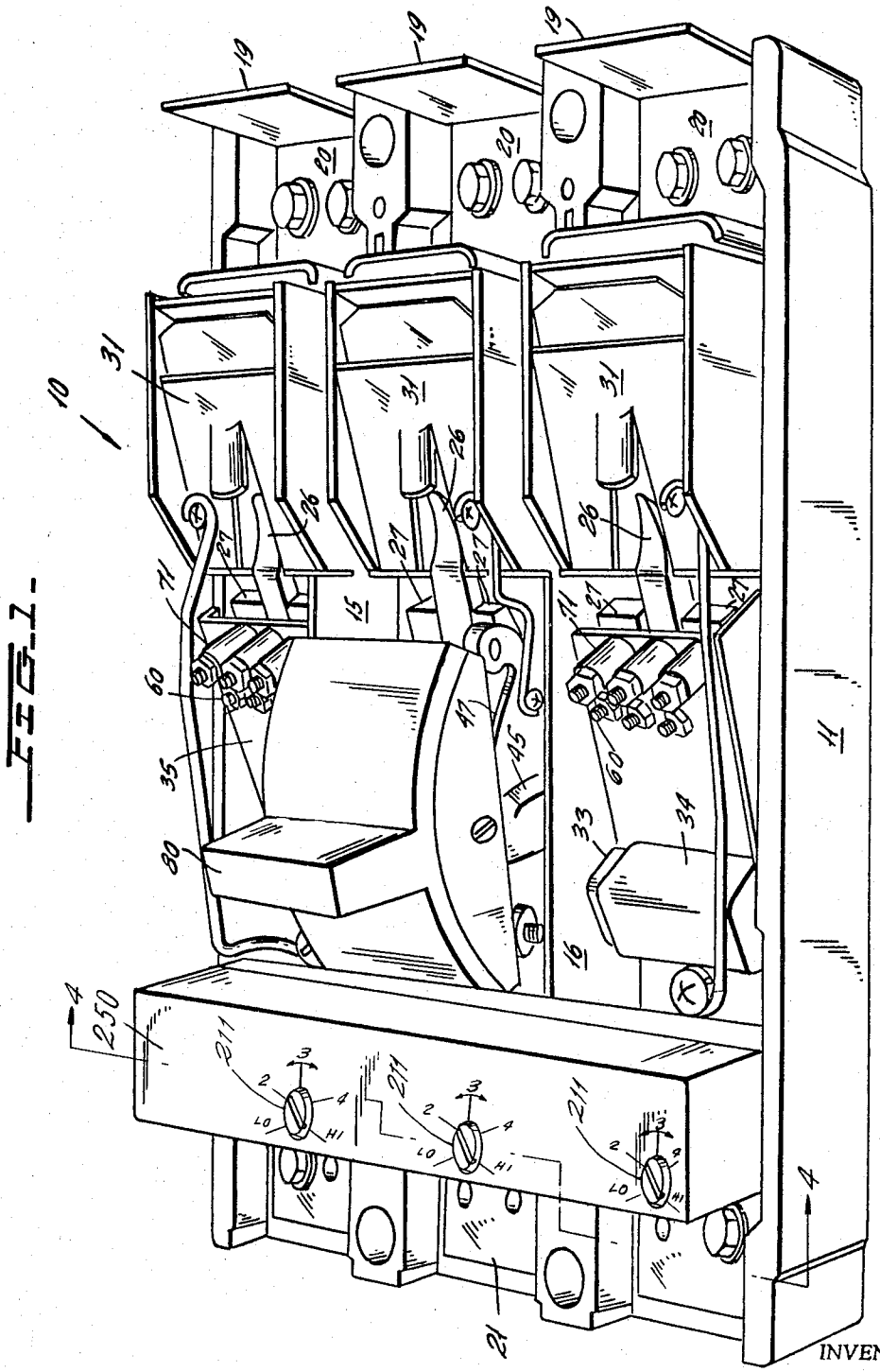
Jan. 31, 1967 A. STROBEL 3,302,140

CIRCUIT BREAKER INSTANTANEOUS TRIP ADJUSTMENT

Filed June 21, 1965 7 Sheets-Sheet 1

FIG. 1



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CIRCUIT BREAKER INSTANTANEOUS TRIP ADJUSTMENT

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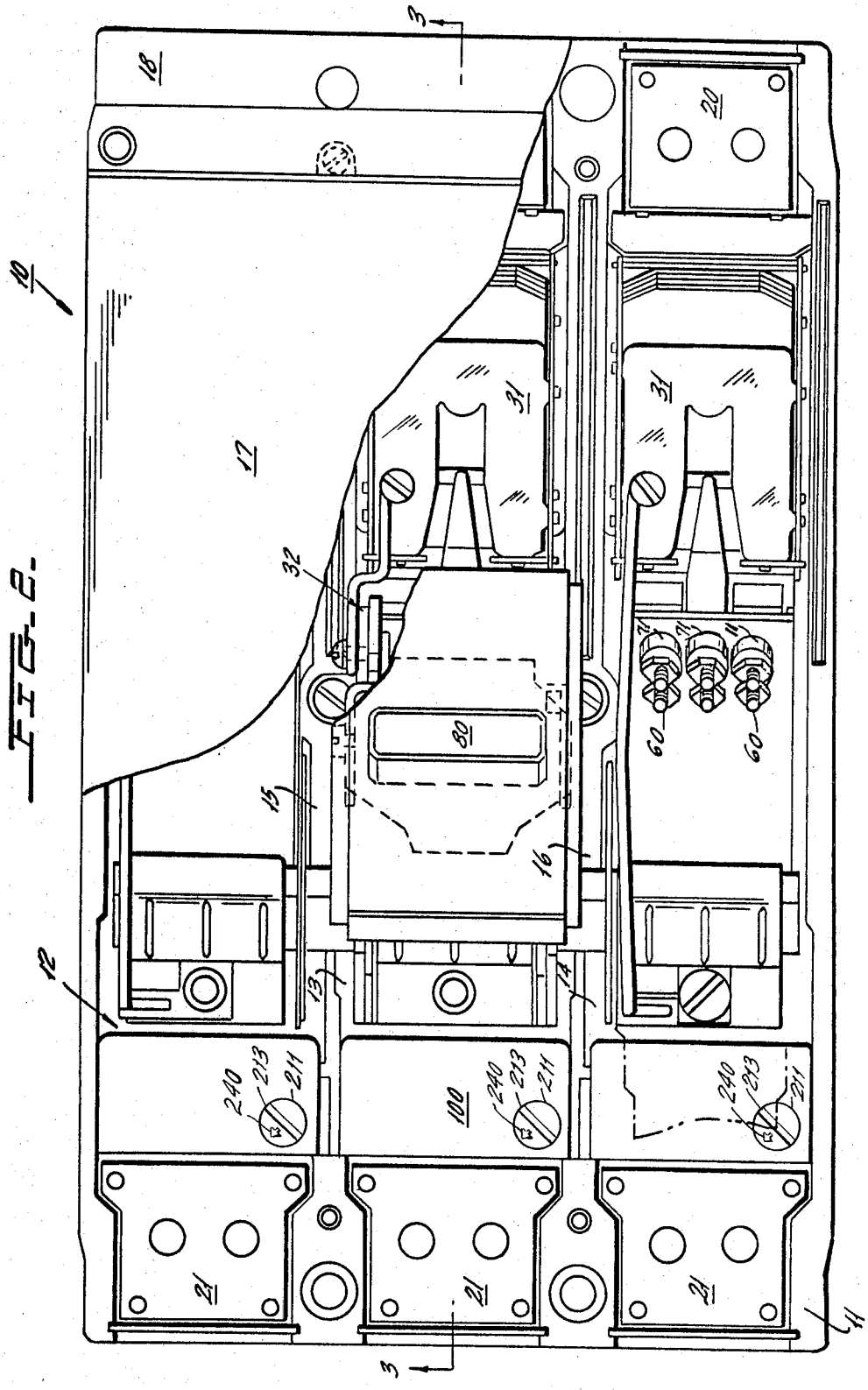


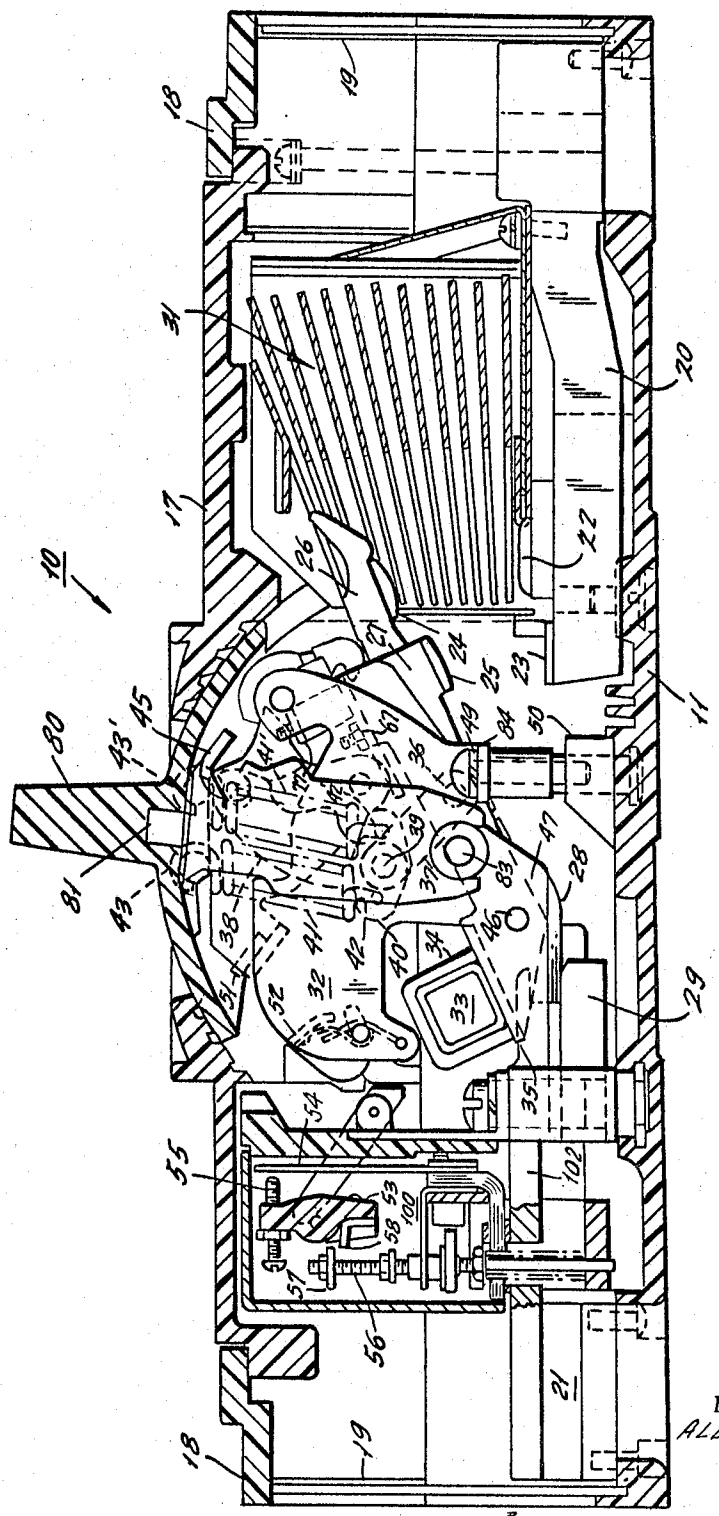
FIG. 2.

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CIRCUIT BREAKER INSTANTANEOUS TRIP ADJUSTMENT

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FIG. 3.



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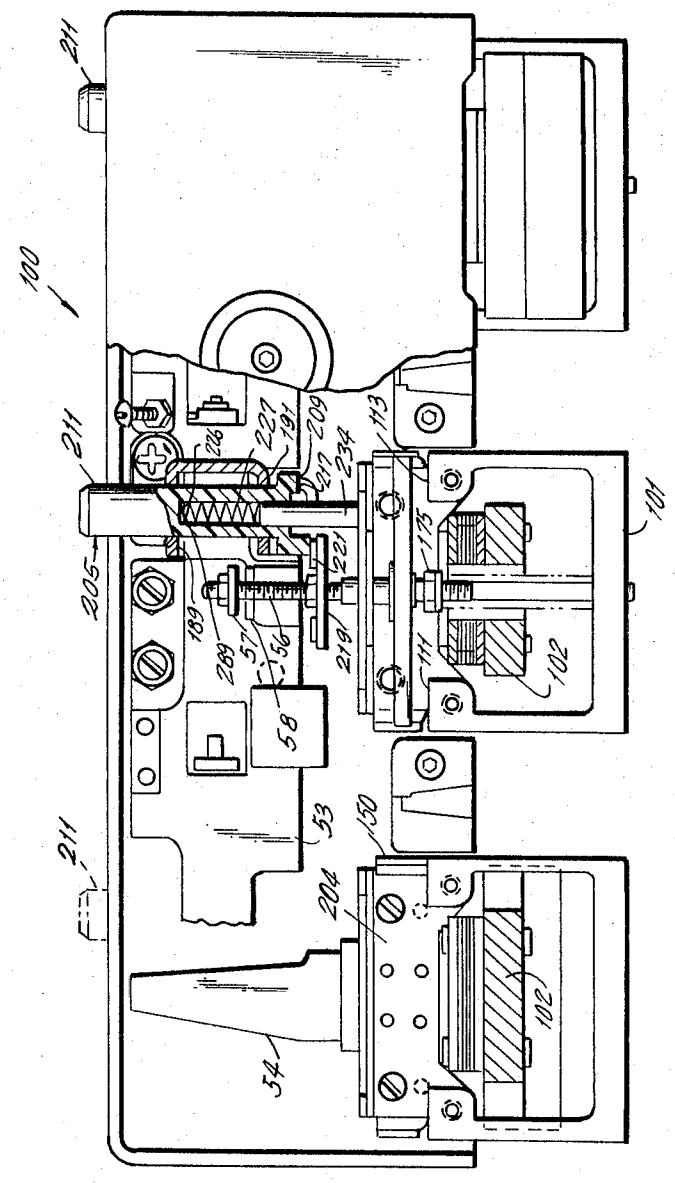
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CIRCUIT BREAKER INSTANTANEOUS TRIP ADJUSTMENT

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FIG. 4.



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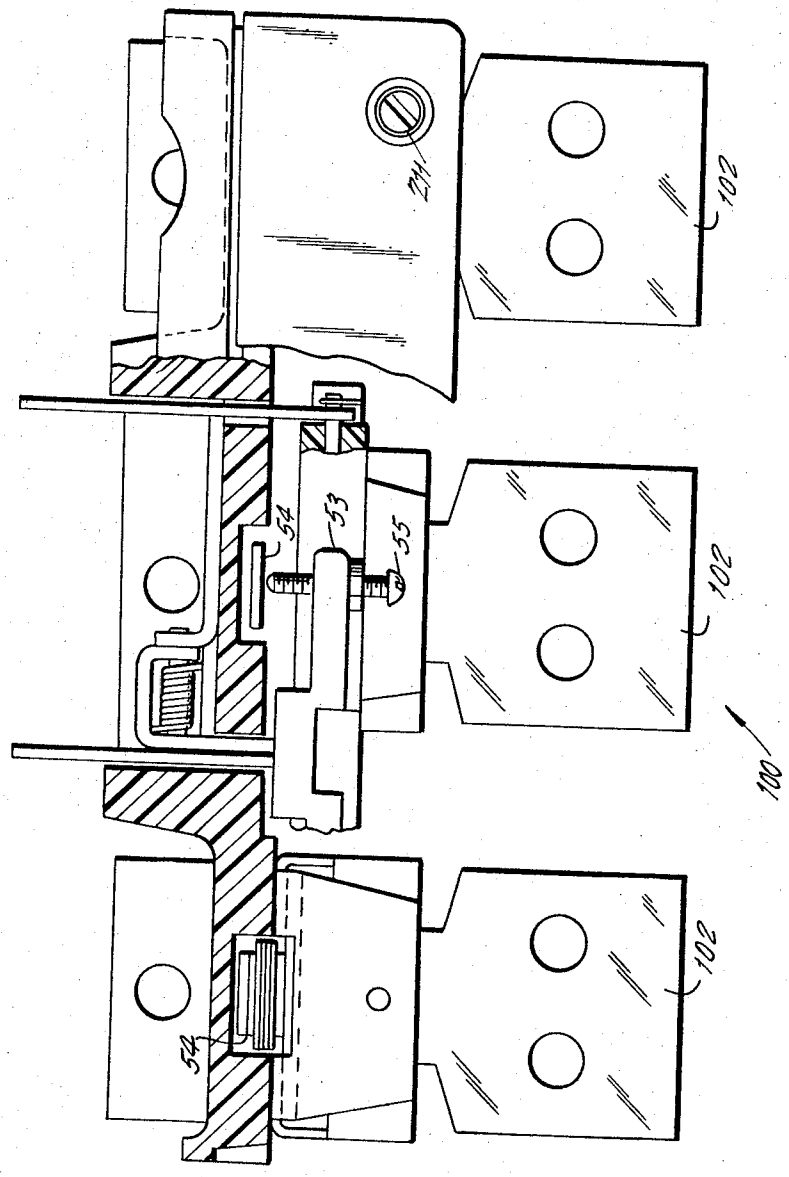
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CIRCUIT BREAKER INSTANTANEOUS TRIP ADJUSTMENT

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FIG. 5.



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CIRCUIT BREAKER INSTANTANEOUS TRIP ADJUSTMENT

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FIG. 6.

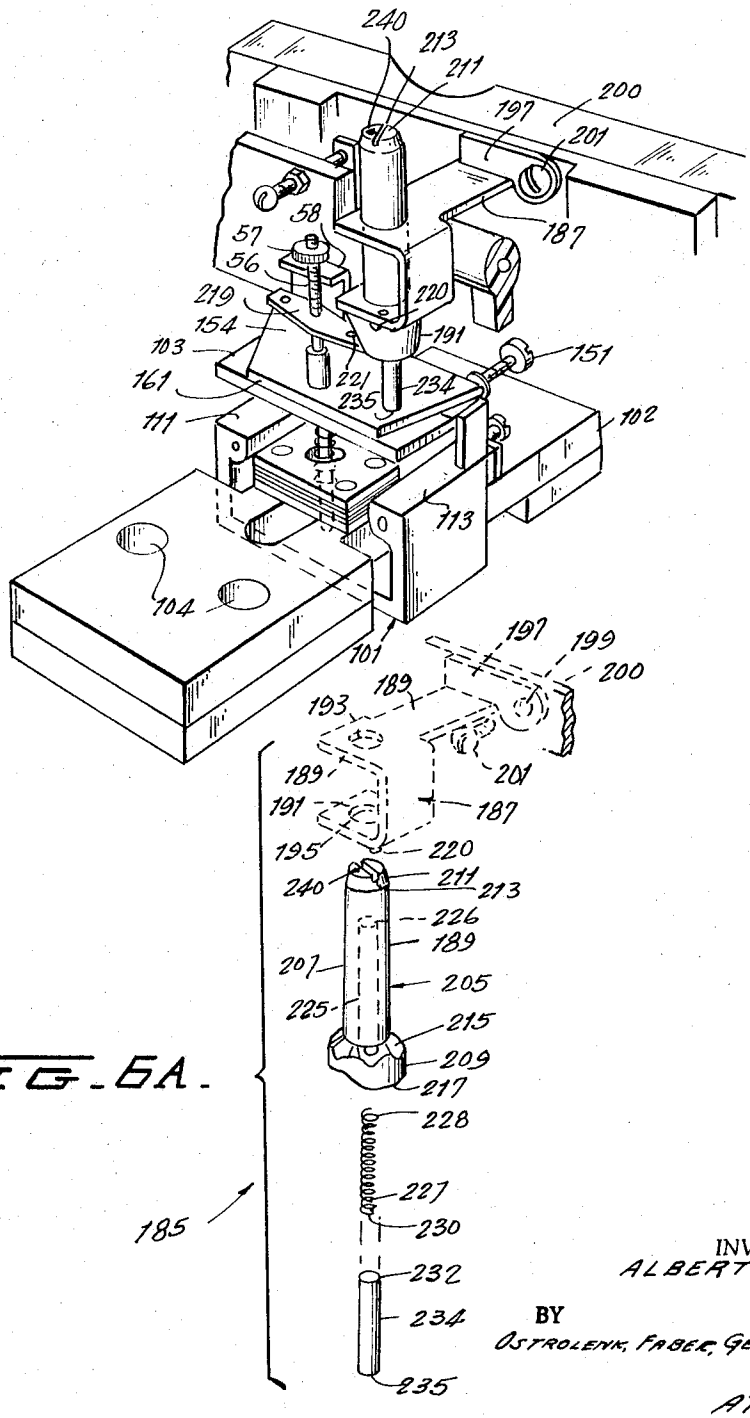


FIG. 6A.

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CIRCUIT BREAKER INSTANTANEOUS TRIP ADJUSTMENT

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FIG. 7.

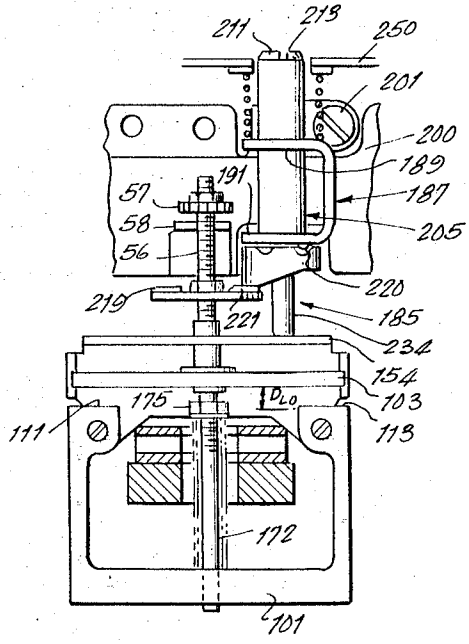


FIG. 8.

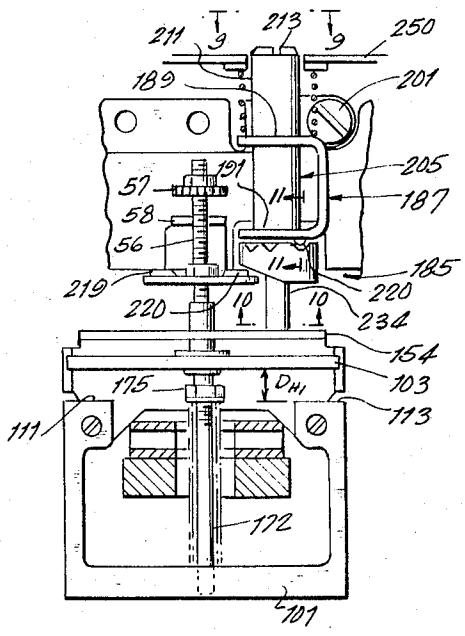


FIG. 11.

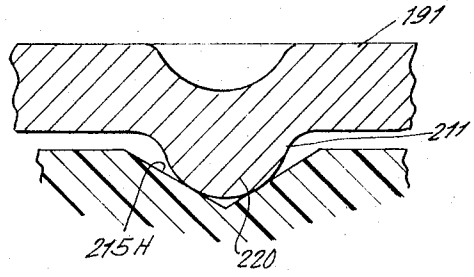


FIG. 12.

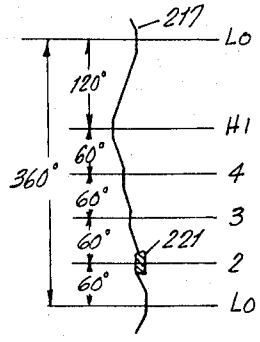


FIG. 10.

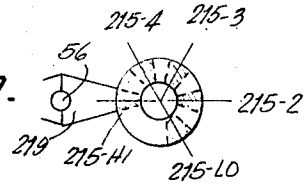
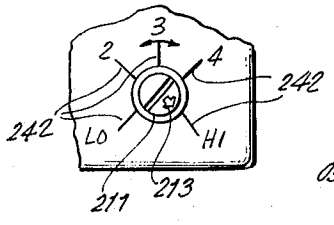


FIG. 9.



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United States Patent Office 3,302,140 Patented Jan. 31, 1967

3,302,140

CIRCUIT BREAKER INSTANTANEOUS TRIP ADJUSTMENT

Albert Strobel, Cherry Hill, N.J., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Filed June 21, 1965, Ser. No. 465,305
9 Claims. (Cl. 335—35)

My invention relates to molded case circuit breakers in general and more particularly to an improved calibration adjustment mechanism for enabling the instantaneous trip means thereof to be easily, rapidly and reliably adjusted. More specifically, the instant structure constitutes an improvement which permits increased ease of manufacture and is less costly than the armature adjusting structure shown in copending U.S. Patent application Serial No. 239,096, filed November 20, 1962, in the name of myself and Wilson W. Poulton, Jr., entitled "Armature Adjusting Structure" and assigned to the assignee of the instant invention, now U.S. Patent Number 3,201,659.

Automatic circuit breakers are usually provided with instantaneous trip means comprising a magnetic structure which, when subjected to overload currents of predetermined magnitudes, actuates a mechanism which in turn causes a tripper bar to be urged into rotational movement. The tripper bar in turn releases a latch mechanism which is held in a position to restrain an energized opening spring from moving to its de-energized state. In this condition the circuit breaker contacts are kept in the closed, or engaged position. Upon release of the latch mechanism the operating spring is thereby enabled to move to its denergized state thereby rapidly separating the circuit breaker cooperating contacts.

The instantaneous magnetic trip means conventionally includes a stationary magnet member and a cooperating armature member which is drawn towards the magnet to actuate the tripping mechanism. The adjustment of the magnetic trip means is chosen so as to initiate an instantaneous tripping action during the occurence of a fault condition above a predetermined high current magnitude. Since the magnetic trip means does operate during extremely high current faults, it is necessary that the operation be both rapid and reliable. It is therefore necessary to adjust the magnetic trip means to operate immediately upon the occurrence of high faults of a predetermined magnitude. Since the circuit breaker may undergo a number of closing and tripping operations during its useful operating life, the mechanical parts undergo a significant amount of wear. The wearing of these parts may so effect the critical adjustment of the elements of the circuit breaker as to severely effect the timing of the instantaneous trip means so that the trip means fails to operate at the predetermined fault current magnitudes for which it was originally adjusted. In addition to such operation, the adjustment of the instantaneous trip means may be necessary, due to the use of the circuit breaker in a variety of different applications wherein each individual application has a different fault current condition to which the instantaneous magnetic trip means must be responsive. It is thereby quite advantageous to provide an armature adjustment structure enabling safe, rapid and reliable adjustment of the magnetic trip means without the necessity for complex tools for a tedious adjusting operation, whether the adjustment be required for purposes of compensating for wearing of parts, or for adjusting a circuit breaker to react according to a predetermined fault current condition.

The adjustment of the instantaneous trip pick-up point is obtained by varying the air gap separation between the armature and its cooperating magnetic pole face during

the non-energized condition. In the past, the instantaneous magnetic trip calibration adjustment structures have oftentimes required an intricate assembly of coupling linkages between the manually operated, and usually externally accessible, calibration button and the armature member. Such complex linkage arrangements have necessitated intricate and time-consuming fabrication techniques, as well as adding to the cost of the trip unit assembly and adversely affecting its ultimate reliability of operation.

Significant improvements in substantially simplifying the calibration adjustment mechanism have been effected by the above-mentioned copending U.S. patent application, now U.S. Patent No. 3,201,659, which avoids the complex linkage arrangements previously required, and permits the necessary adjustments to be made without the necessity for complex tools or a tedious adjusting operation. However, the instantaneous trip adjusting means shown in that patent requires the sub-assembly of the calibration button to a mounting bracket, with the addition of a roll pin axially passing transverse to the axis of the calibration button. Such a roll pin increases the assembly time and has been found to structurally weaken the calibration button. Also, a specially fabricated U-shaped spring member must be secured to the mounting bracket, for engagement with indexing recesses of the calibration button. Such an additional spring member has further increased the manufacturing cost, and has been found to cause excessive frictional engagement during adjustment between positions.

The assembly of the instant invention acts to provide all the desired features of the prior art calibration structures, while at the same time being constructed to effect substantial cost savings, simplicity of manufacture and increase reliability of operation. The assembly of the instant invention includes an adjusting rod or button mounted for rotational movement within the spaced arms of a U-shaped mounting bracket. One end of the adjusting rod passes freely through the openings of the bracket and projects toward an externally accessible region of the circuit breaker trip assembly. The opposite end of the adjusting rod includes an enlarged portion, appreciably greater than the adjacent bracket arm opening, in abutting engagement with the region of the bracket arm thereabout. A hollow interior cavity of the adjusting rod contains a biasing means, such as a conventional expansion spring. An extension rod is provided having one end extending into the interior cavity against the biasing means, and a second end extending outward of the interior cavity beyond the dimensional extremes of the adjusting rod. The opposite end of the extension rod abuts a stationary member of the trip assembly, which stationary member serves as a stop means to prevent the full outward travel of the extension rod under the influence of the biasing means. Hence the extension rod is urged backward, against the biasing means, which in turn is urged against the inwardly located end of the interior cavity for forcibly urging the enlarged portion of the adjusting rod against the surface surrounding the adjacent bracket arm opening.

The enlarged portion of the adjustment rod includes a circumferentially varying cam surface which is in engagement with an adjustment member connected to the magnetic trip armature, such that rotation of the adjustment rod presents different portions of the cam surface in engagement with the adjustment member. This in turn preselectably varies the air gap separation between the armature and cooperating magnetic pole faces. The surface of the enlarged portion, which is in abutting engagement with the bracket arm, includes a plurality of angularly spaced, radially extending indexing recesses corresponding to the various pre-selectable adjustment positions. An integrally formed protrusion of the bracket arm, such as a small, spherical dimple, extends into the selected index-

ing recess to serve as a detent mechanism for maintaining the desired instantaneous trip adjustment.

It is therefore seen that the structure of my invention replaces the previous separate sub-assembly of a specially formed spring member secured to the bracket arm (as well as the increased frictional engagement contributed thereby) by the extreme simplicity of a conventional spring member located within an integral cavity of the calibration button in cooperation with a cylindrical rod member extending outward from such internal cavity and abutting a stationary portion of the magnetic trip unit. Further the previous adjusting structure required a means for preventing axial movement of the adjusting rod, out of the U-shaped bracket member, under the influence of the biasing spring. This required an additional transverse pin member, which has been found to weaken the adjusting rod as well as adding to complexity and cost of the assembly technique.

As an advantageous aspect of my invention, the extension rod member enters the internal cavity of the calibration rod a sufficient length so as to be firmly retained therein. This avoids the need for a definite seating recess within the stop means for receiving the opposite end of the extension rod. Inasmuch as the stop means is mounted to the circuit breaker independent of the instantaneous trip adjustment mounting bracket, the elimination of the need for a definite seat within the stop will permit a substantial degree of misalignment between the adjustment mechanism mounting bracket and other portions of the instantaneous trip without affecting the operation thereof.

The mounting brackets and other members of the instantaneous trip adjustments are so constructed that they may be easily installed in circuit breakers which are presently in use (as, for example, the trip unit which is the subject of copending U.S. patent application filed June 21, 1965, Serial No. 465,313, entitled "Circuit Breaker Trip Unit Assembly" in the name of myself and John C. Brumfield and assigned to the assignee of the instant invention) as well as readily adapting themselves for employment in a wide variety of other circuit breaker structures. The plurality of functions which the calibrating button and mounting bracket serves substantially optimizes the number of elements which comprise the armature structure to an absolute minimum, while at the same time simplifying such elements over those required in the past, and providing a safe, accurate and reliable adjusting structure.

It is therefore a principal object of the instant invention to provide an armature adjusting structure of increased ease of manufacture and simplicity of parts.

Another object of this invention is to provide a novel armature adjusting structure for a circuit breaker magnetic trip means which is assembled and mounted to the trip unit structure in an extremely simplified manner, requiring only a single screw member.

A further object of the instant invention is to provide an instantaneous trip adjustment for a circuit breaker unit, having a calibration button integrally providing a plurality of functions, including a cam surface for varying the armature air-gap position; indexing recesses for maintaining a pre-selectable armature position; an internal cavity for receiving a biasing means in the form of a simple expansion spring member; and enlarged cross-sectional area for maintaining the assembled unit in the bracket mounting means.

Still an additional object of the instant invention is to provide an improved instantaneous trip unit adjustment, wherein calibration maintaining indexing recesses are in spring biased engagement with an integrally formed protrusion of the mounting bracket.

These, as well as other objects of my invention, shall become readily apparent after reading the following description and the accompanying drawings, in which:

FIGURE 1 is a perspective view of a three-phase molded case circuit breaker construction, which may be used in the practice of the instant invention, and wherein the cover is removed to reveal the internal mechanism thereof;

FIGURE 2 is a plan view of the circuit breaker unit shown in FIGURE 1, with the cover replaced and partially cut away;

FIGURE 3 is a longitudinal cross-sectional view taken through the center phase and along the arrows 3—3, as shown in FIGURE 2;

FIGURE 4 is a cross-sectional view taken along the line 4—4 of FIGURE 1, showing the calibration adjustment of the instant invention in conjunction with one of the forms of the trip unit assembly shown in above mentioned copending U.S. patent application Serial No. 465,313.

FIGURE 5 is a top view of FIGURE 4 showing the trip unit assembly, partially broken away in cross-section.

FIGURE 6 is a perspective view of the trip assembly of one of the phases shown in the circuit breaker of FIGURES 1–5.

FIGURE 6A is an exploded perspective view of the instantaneous trip calibration adjustment mechanism of my invention.

FIGURE 7 is a cross-sectional view of the instantaneous trip portion of one of the phases, as shown in FIGURE 4, showing the instantaneous trip calibration adjustment at the minimum air-gap, or low pickup point of adjustment.

FIGURE 8 corresponds to FIGURE 7 but shows the instantaneous trip adjustment at the opposite extreme of maximum armature air-gap, or high pickup adjustment.

FIGURE 9 is a plan view along the line 9—9 of FIGURE 8 and showing the manner in which angularly separated indications on the trip unit casing cooperate with an indicating arrow on the head of the calibrating button to designate the particular calibration adjustments.

FIGURE 10 is a view along line 10—10 of FIGURE 8, showing the various cam positions.

FIGURE 11 is a substantially enlarged cross-sectional view along the line 11—11 of FIGURE 8 and showing the manner in which the integral dimple protrusion of the mounting bracket cooperatively enters the indexing recess of the calibration rod to maintain the desired calibration.

FIGURE 12 is a development view of a typical cam surface configuration that may be used in conjunction with the instant invention.

Now referring to the figures: circuit breaker **10** wherein my invention is incorporated is typically shown as a commercially available three-phase molded case unit. It should be naturally understood that the novel concepts of our invention may be incorporated in numerous other frame sizes and types, with this embodiment being merely for illustrative purposes. The unit is assembled within a housing comprising molded base **11**, separated into compartments **12**, **13** and **14**, respectively, for locating the operating members of each of the phases. The adjacent compartments are separated by housing walls **15** and **16**. Main cover assembly **17** and end covers **18** similarly include barriers for maintaining the longitudinally extending compartments of the housing, with end shields **19** being located at the line and load ends of the circuit breaker **10**.

The current carrying members of all three phases are identical so that for the sake of brevity only one of the sets of elements, such as the center phase as shown in FIGURE 3, will be described. The current path between the line terminal strap **20** and load terminal strap **21** proceeds from stationary contacts **22** and **23** to movable contacts **24** and **25** carried by contact arms **26** and **27** through flexible braids **28**, contact carrier strap **29** and trip unit strap **102**.

The magnetic trip assembly shown in conjunction with the subject invention is of the general type which is the subject of above mentioned copending U.S. patent application Serial No. 465,313. Such magnetic trip assembly includes an actuating rod **56** having a trip unit actuating extension **57** which moves down into engagement with tripper bar extension member **58**. The trip unit actuating extension **57** secured to the upper extreme of actuating rod **56** is preferably of an external knurled configuration to facilitate adjustment thereof, during the initial calibration procedure. However, subsequent use of the trip unit, with its attendant wearing away of parts, as well as the utilization of the circuit breaker trip unit in a variety of different applications, requires an additional externally accessible calibration adjustment such as is the subject of the instant invention.

Magnet member **101** has a generally U-shaped configuration having horizontally disposed pole faces **111**, **113** at the uppermost extremes of its spaced arm members. Armature member **103** is horizontally positioned intermediate the plane or pole faces **111**, **113** and the bottom surface **161** of a forwardly projecting extension **154** of the trip unit mounting bracket **150**. In its non-engaged condition, as shown in FIGURES 7 and 8, the armature member **103** is separated from the pole faces **111**, **113** by an air-gap of a predetermined calibrated extent: as, for example, D_{LO} shown in FIGURE 7 corresponding to low pickup; or D_{HI} of FIGURE 8 corresponding to the other calibrated extreme of high pickup. Upon sufficient magnetizing flux the armature member **103** is downwardly drawn towards cooperating pole faces **111**, **113** in the conventional manner, with such downward movement bringing about the engagement of the trip unit actuating extension **57** and tripper bar extension **58**. Such downward movement of armature member **103** to the tripped condition is opposed by the biasing of spring member **172** about the lower extent of actuating rod **56** and located intermediate the body portion of the magnet **101** and bias force calibration adjustment nut member **175**.

It can be readily seen that the positioning of the armature member **103** relative to cooperating pole faces **111**, **113** is directly determinative of the magnetic force required to actuate the instantaneous trip. Further, since the circuit breaker assembly **100** may be designed so as to be useful in a variety of different circuit applications having different tripping characteristics, it becomes advantageous to provide an adjusting means for accommodating the various applications for which the circuit breaker trip unit **100** may be employed as well as permitting compensation for wear. In order to provide these necessary adjustments, an armature gap calibration means of the instant invention, generally shown as **185**, is provided.

The instantaneous trip calibration adjustment means includes a mounting bracket **187** of a generally U-shape configuration and including spaced arms **189**, **191** having aligned aperture means **193**, **195**, respectively. Rearward extension **197** of the bracket includes aperture **199** which receives screw member **201** for securably mounting the bracket **187** to the trip unit assembly support **200**.

An adjusting rod, or button, **205** is provided having a longitudinally extending cylindrical portion **207** joined to an enlarged cross-sectional portion **209**. The diameter of cylindrical section **207** is such that it can freely pass through the aligned openings **193**, **195** of the support bracket **187**, and can freely turn within these openings about its longitudinal axis. Cylindrical portion **207** is of an appreciable length with the forward end **211** thereof projecting outward to an externally accessible region of the circuit breaker, as, for example, shown in FIGURES 1 and 2. A groove **213** is provided in the upper end **211** of the adjusting rod for receiving an appropriate tool, such as, for example, a screw driver to facilitate the rotation thereof.

Enlarged portion **209** of the adjusting rod includes axially separated surfaces **215**, **217**, respectively. Surface **215** includes a plurality of angularly separated, radially directed indexing recesses designated as **215–LO**, **215–2**, **215–3**, **215–4**, and **215–HI**, respectively. It should be understood that the radially aligned grooves **215** may be of any desired number intermediate the low and high positions depending upon the degree of calibration refinement. These radial indexes receive a cooperating protrusion **220** integrally formed from the arm **191** of the mounting bracket, as by a stamping process, and preferably in the shape of a spherical dimple. As will be subsequently discussed in further detail, the location of the protrusion **220** into a pre-selectable one of the indexing recesses **215** serves as a detent mechanism to fixedly maintain the desired instantaneous trip air-gap adjustment. As the adjusting rod **205** is rotated in either of two directions, indexing protrusion **220** sequentially enters the radially spaced indexing recesses **215** to provide the desired calibration adjustment between the extremes shown in FIGURES 7 and 8. A locking motion can easily be felt by the operator as the operator as the protrusion **220** seats in the indexing recess **215**.

Surface **217** of the enlarged section **209** includes a cam surface, shown developed in FIGURE 12. Cam surface **217** is in engagement with extension member **219** secured to the armature drive rod member **56**, with such engagement being preferably provided by smooth surface **221** for minimum frictional operation. It is to be noted that the cam surface vertically varies about its circumference such that as the adjusting rod **205** is rotated about its axis, the presentment of different portions of the cam surface **217** to extension member **219** will cause that extension member to vertically translate as a cam follower, with such vertical translation being transmitted to the armature member **103** for adjustment of the air-gap between the "LO" and "HI" pickup extremes shown in FIGURES 7 and 8, respectively.

The cam surface development, as shown in FIGURE 12, indicates the "LO" and "HI" positions, as well as the intermediate positions **2**, **3** and **4**, which positions correspond to the similarly designated recesses **215** which cooperatively receive the integral bracket protrusion **220** for maintaining the desired calibration adjustment. The selection of the desired calibration is facilitated by the utilization of an indicating marker, such as arrow **240** at the upper end **211** of the adjusting rod, in conjunction with suitable letter and number designations, **242–H**, **242–L**, **242–2**, **242–3**, **242–4**, formed in trip unit cover **250**. In this manner simply by lining up the pointer **240** with the discrete additional designations **242** a plurality of air-gap adjustments are readily discernible.

The required bias force for maintaining the seating of protrusion **220** within its cooperating indexing recess **215** is provided by a novel arrangement in association with longitudinally extending internal cavity **225** of adjusting rod **205**. Bias means **227**, which may be in the form of a simple expansion spring member, is located within this cavity, such that its upper end **228** abuts upper end **226** of the internal cavity. The opposed end **230** of the bias spring member abuts the upper end **232** of a cylindrical rod extension member **234**. The opposed end **235** of this cylindrical rod extension member abuts forwardly projecting surface **154** of the trip unit mounting bracket **150**, which serves as a positive stop to prevent the full outward movement of extension rod **234** under the force of biasing spring **227**. Hence, the upper end **232** of the rod extension **234** will be upwardly urged against end **230** of spring member **227**, with the upper end **228** of said spring member being upwardly urged against terminus **226** of the interior cavity. This in turn will forcibly urge adjusting rod **205** upward, and particularly the indexing radial recess **215** thereof into co-

operating dimple-like protrusion **220**. This is to be contrasted to the extremely more cumbersome assembly technique and fabrication requirements of the calibration trip adjustment shown in aforementioned U.S. Patent No. 3,201,659, which requires a special U-shape spring member having a notched stop at the end of one leg in the form of a "U," as well as the utilization of a transverse pin abutting the uppermost bracket arm to prevent the downward axial movement of the calibration rod out of the mounting bracket under the influence of such U-shaped spring member.

It is to be further noted that the upper end of the rod extension **234** is sufficiently captivated within adjusting rod opening **225** as not to require a definite seating indentation along planar surface **154** for its end **235**. Thus, anticipated manufacturing tolerances, which may result in some misalignment between the location of the instantaneous trip mounting structure and the cooperating calibration adjustment **185** of the instant invention will not serve to adversely affect the calibration accuracy. This is particularly important since the mounting of bracket **187** of the calibration adjustment is completely independent of the mounting of bracket **150** of the instantaneous trip unit.

The calibration adjustment of the instant invention is assembled in an extremely simplified manner. After the instantaneous and time delayed trip assembly is first mounted to trip unit support **200** by the mounting of screw members **151**, **153** into cooperating apertures of its mounting bracket **150**, the instantaneous trip calibration mechanism is then added as follows:

Cylindrical portion **207** of the adjusting rod is passed through aligned apertures **193**, **195** of the U-shaped bracket such that upper end **211** thereof extends outwardly therefrom. Spring bias member **227** is then inserted within internal cavity **225** and the extension rod member **234** placed therein. End **235** of the adjusting rod is then placed against the upper planar surface **154** of the trip unit mounting bracket **150**, with aperture **199** of the calibration adjustment mounting bracket placed into alignment with its cooperating aperture of support **200**. Single screw member **201** is then inserted. After such mounting it is initially calibrated by positioning cam follower **219** along the length of armature actuating extension rod **56**, to provide the predetermined air-gap separations in accordance with the circuit breaker trip unit performance characteristics.

Although there has been described a preferred embodiment of my novel invention, many variations and modifications will now become apparent to those skilled in the art. Therefore, this invention is to be limited not by the specific disclosure herein but only by the appended claims.

I claim:

1. A manually operable armature positioning means for adjusting the air gap of a circuit breaker trip assembly, said armature positioning means comprising bracket means for mounting to a circuit breaker support member, an adjusting rod, said bracket means including aperture means for receiving said adjusting rod, such that said adjusting rod is rotatable about its central axis, a first end of said adjusting rod freely passing through said aperture means and outwardly projecting towards an externally accessible region of the circuit breaker trip assembly, the second end of said adjusting rod carrying an enlarged portion, appreciably greater than said aperture means and abutting an adjacent region of said bracket means, said enlarged portion including first and second surfaces, said first surface including a plurality of angularly spaced, radially extending, indexing recesses, said adjacent bracket region including an integrally formed protrusion cooperatively entering a preselectable one of said recesses, said second surface including a cam surface in engagement with an adjustment member connected to a magnetic trip armature, the rotation of said adjusting rod presenting different portions of said cam surface in engagement with said adjustment member, with the entering of said bracket protrusion within a preselectable one of said indexing recesses maintaining the engagement of a preselectable portion of said cam surface and said armature adjustment member, said adjusting rod having an axially extending internal cavity, a biasing means located within said internal opening, a rod extension member having a first end freely entering said internal opening and positioned against said biasing means, and a second end extending outward of said internal cavity, beyond the second end of said adjusting rod, with said biasing means urging said second end outward of said internal cavity, a member of said trip assembly abutting said second end of said rod extension and defining a stop means for limiting the outward movement of said rod extension second end such that said adjusting rod is biased in a direction forcibly urging said enlarged portion first surface against said region of said mounting bracket thereabout, with the preselectable one of said indexing recess being retained in firm engagement with said bracket protrusion.

2. A manually operable armature positioning means, as set forth in claim **1**, wherein a substantial length of said rod extension member extends into said internal cavity, such that said rod extension member is firmly retained intermediate said adjusting rod and said stop means, said stop means mounted to said circuit breaker independent of said mounting bracket, said stop means being a substantially planar surface with said second end of said rod extension member abutting said planar surface, the substantial entry of said rod extension member into said internal cavity permitting a substantial degree of misalignment between said mounting bracket means and the positioning of said stop means.

3. A manually operable armture positioning means as set forth in claim **1**, said bracket protrusion being a spherical dimple formed from said bracket.

4. A circuit breaker comprising at least one pair of cooperating contacts, contact operating means for moving said contacts between an engaged and disengaged position; latch means cooperating with said operating means for maintaining said contacts in their engaged position under normal load conditions, a trip unit including current sensing means operatively responsive to the current flow through the circuit, and including means for releasing said latch means responsive to predetermined overload conditions, said current sensing means including a magnetic trip assembly having cooperating magnet and armature members, said armature and magnet members having a preselectable air-gap separation corresponding to their non-actuated condition, manually operable armature positioning means for adjusting said air-gap separation, said armature positioning means including an adjustment member connected to said armature, and an adjusting member for engaging said adjustment member and moving said adjustment member in a desired direction to vary said air-gap separation, a mounting bracket for mounting said adjusting member in cooperative relationship with respect to said adjustment member, an adjusting rod carrying said adjusting member, said mounting bracket including aperture means for rotatively receiving said adjusting rod to enable rotation of said adjusting rod about its central axis, a first end of said adjusting rod freely passing through said aperture means and projecting outward of the circuit breaker, a second end of said adjusting rod carrying an enlarged portion, appreciably greater than said aperture means and abutting the mounting bracket surface surrounding said aperture means, means biasing said enlarged portion against said mounting bracket surface for maintaining said adjusting rod within said aperture means, said adjusting rod having an internal cavity, said biasing means including first and second members, said first member located within said internal cavity, said second member including a first portion extending into said internal cavity, in engagement with

said first member, and a second portion extending outward of said internal cavity.

5. A circuit breaker comprising at least one pair of cooperating contacts, contact operating means for moving said contacts between an engaged and disengaged position; latch means cooperating with said operating means for maintaining said contacts in their engaged position under normal load conditions, a trip unit including current sensing means operatively responsive to the current flow through the circuit, and including means for releasing said latch means responsive to predetermined overload conditions, said current sensing means including a magnetic trip assembly having cooperating magnet and armature members, said armature and magnet members having a preselectable air-gap separation corresponding to their non-actuated condition, manually operable armature positioning means for adjusting said air-gap separation, said armature positioning means including an adjustment member connected to said armature, and an adjusting member for engaging said adjustment member and moving said adjustment member in a desired direction to vary said air-gap separation, a mounting bracket for mounting said adjusting member in cooperative relationship with respect to such adjustment member, an adjusting rod carrying said adjusting member, said mounting bracket including aperture means for rotatively receiving said adjusting rod, to enable rotation of said adjusting rod about its central axis, a first end of said adjusting rod freely passing through said aperture means and projecting outward of the circuit breaker, a second end of said adjusting rod carrying an enlarged portion, appreciably greater than said aperture means, and abutting the mounting bracket surface surrounding said aperture means, means biasing said enlarged portion against said mounting bracket surface for maintaining said adjusting rod within said aperture means, said adjusting member having a cam surface circumferentially about a first region of said enlarged portion, rotation of said adjusting rod about its central axis presenting different portions of said cam surface to said adjustment member for movement thereof in said desired direction, said adjusting rod having a hollow region defining an internal cavity, a biasing means located within said internal cavity, a rod extension member having a first end extending into said internal cavity against said biasing means, and a second end extending outward of said internal cavity, beyond the second end of said adjusting rod, with said biasing means urging said second end outward of said internal cavity, a stop means abutting said second end of said rod extension and limiting such outward movement, such that said biasing means forcibly urges said adjusting rod enlarged portion against said surrounding mounting bracket surface.

6. A circuit breaker as set forth in claim 5, a substantial length of said rod extension member extending into said internal cavity, such that said rod extension member is firmly retained intermediate said adjusting rod and said stop means, said stop means mounted to said circuit breaker independent of said mounting bracket, said stop means being a substantially planar surface with said second end of said rod extension member abutting said planar surface, the substantial entry of said extension member into said internal cavity permitting a substantial degree of misalignment between said mounting bracket and the positioning of said stop means.

7. A circuit breaker comprising at least one pair of cooperating contacts, contact operating means for moving said contacts between an engaged and disengaged position; latch means cooperating with said operating means for maintaining said contacts in their engaged position under normal load conditions, a trip unit including current sensing means operatively responsive to the current flow through the circuit, and including means for releasing said latch means responsive to predetermined overload conditions, said current sensing means including a magnetic trip assembly having cooperating magnet and armature members, said armature and magnet members having a preselectable air-gap separation corresponding to their non-actuated condition, manually operable armature positioning means for adjusting said air-gap separation, said armature positioning means including an adjustment member connected to said armature, and an adjusting member for engaging said adjustment member and moving said adjustment member in a desired direction to vary said air-gap separation, mounting bracket for mounting said adjusting member in cooperative relationship with respect to said adjustment member, an adjusting rod carrying said adjusting member, said mounting bracket including aperture means for rotatively receiving said adjusting rod, to enable rotation of said adjusting rod about its central axis, a first end of said adjusting rod freely passing through said aperture means and projecting outward of the circuit breaker, a second end of said adjusting rod carrying an enlarged portion, appreciably greater than said aperture means, and abutting the mounting bracket surface surrounding said aperture means, means biasing said enlarged portion against said mounting bracket surface for maintaining said adjusting rod within said aperture means, said adjusting member having a cam surface circumferentially about a first region of said enlarged portion, rotation of said adjusting rod about its central axis presenting different portions of said cam surface to said adjustment member for movement thereof in said desired direction, said adjusting rod having a hollow region defining an internal cavity, a biasing means located within said internal cavity, a rod extension member having a first end extending into said internal cavity against said biasing means, and a second end extending outward of said internal cavity beyond the second end of said adjusting rod, with said biasing means urging said second end outward of said internal cavity, a stop means abutting said second end of said rod extension and limiting such outward movement, such that said biasing means forcibly urges said adjusting rod against said mounting bracket, with said first end projecting external of the circuit breaker, said enlarged portion also including indexing recesses circumferentially positioned thereabout in alignment with preselectable portions of said cam surface, said indexing surface abutting a surface of said mounting bracket including an integrally formed bracket protrusion, said biasing means urging the indexing recess corresponding to the preselectable air-gap adjustment against said integrally formed bracket protrusion, for maintaining the preselectable air-gap adjustment.

8. A circuit breaker as set forth in claim 7, said bracket protrusion being a spherical dimple formed from said bracket.

9. A manually operable armature positioning means for adjusting the air gap of a circuit breaker trip assembly, said armature positioning means comprising bracket means for mounting a circuit breaker support member, an adjusting rod, said bracket means including a generally U-shaped section having aligned openings in the space-separated arms thereof for receiving said adjusting rod, such that said adjusting rod is rotatable about its central axis, a first end of said adjusting rod freely passing through said openings, and projecting towards an externally accessible region of the circuit breaker trip assembly, the second end of said adjusting rod carrying an enlarged portion, appreciably greater than an adjacent one of said openings and abutting the region of one of said bracket arm about said opening, said enlarged portion including first and second axially spaced circumferential surfaces at the opposed ends thereof, said first surface including a plurality of angularly spaced, radially extending, indexing recesses, said one bracket arm including an integrally formed protrusion cooperatively entering a preselectable one of said recesses, said second surface including a cam surface in engagement with an adjustment member connected to the magnetic trip armature, the rotation of said

adjusting rod presenting different portions of said cam surface in engagement with said adjustment member, with the entering of said bracket protrusion within a preselectable one of said recesses maintaining the engagement of a preselectable portion of said cam surface and said armature adjustment member, said adjusting rod having a hollow region defining an internal cavity, a biasing means located within said internal cavity, a rod extension member having a first end extending into said internal cavity against said biasing means and a second end extending outward of said internal cavity, beyond the second end of said adjusting rod, with said biasing means urging said second end outward of said internal cavity, a stop means abutting said second end of said rod extension and defining a stop means for limiting the outward movement

of said rod extension second end, such that said adjusting rod is biased in a direction forcibly urging said enlarged portion indexing surface about said region of said mounting bracket thereabout, with said preselectable indexing recess being biased into firm engagement with said bracket protrusion to maintain the desired adjustment.

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