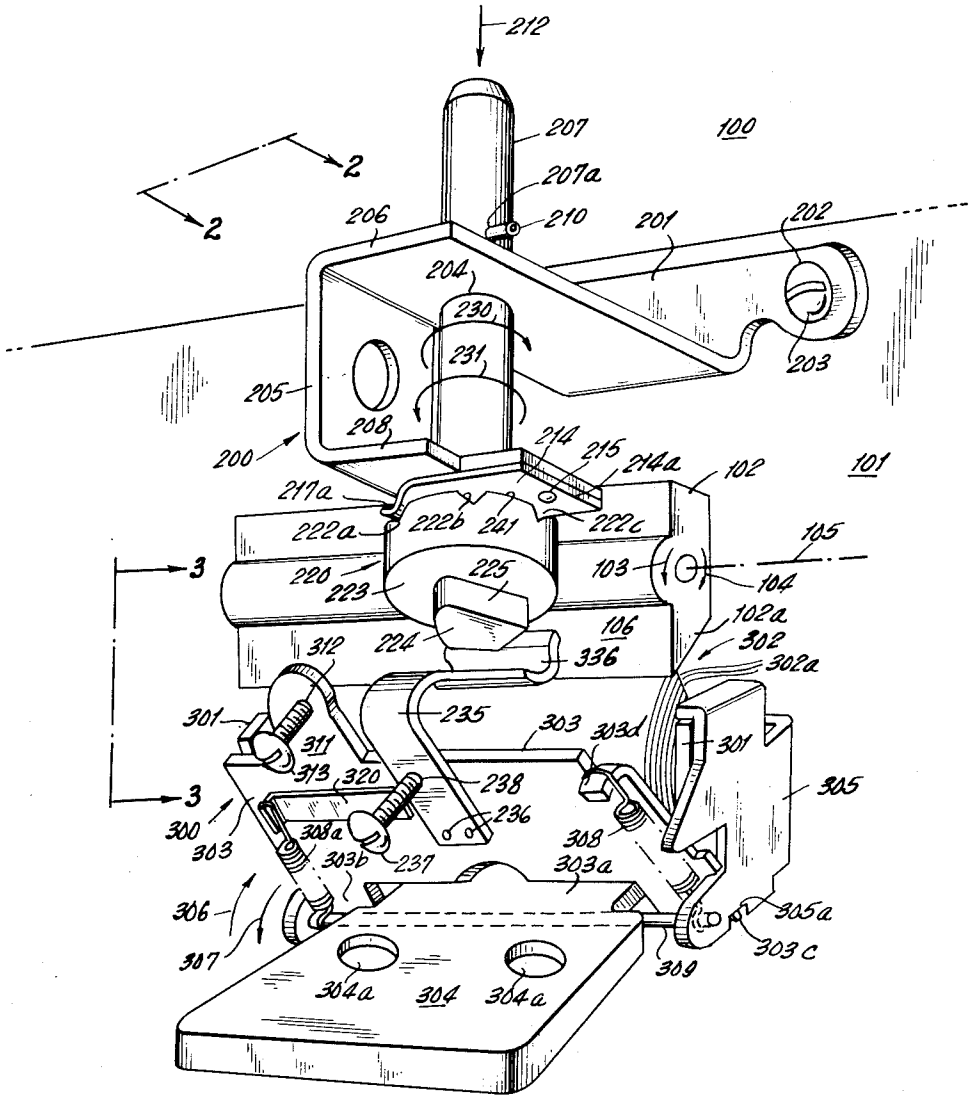
Aug. 17, 1965 W. W. POULTON, JR., ETAL 3,201,659

ARMATURE ADJUSTING STRUCTURE

Filed Nov. 20, 1962 2 Sheets-Sheet 1

FIG. 1.



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FIG. 3.

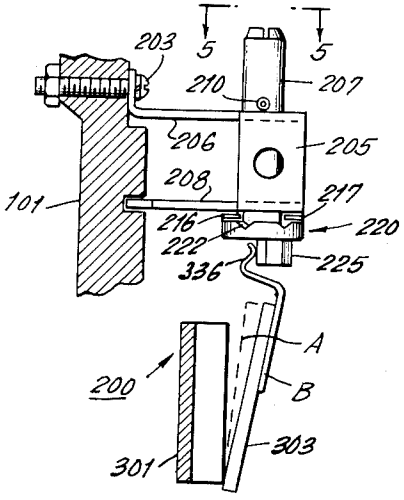


FIG. 2.

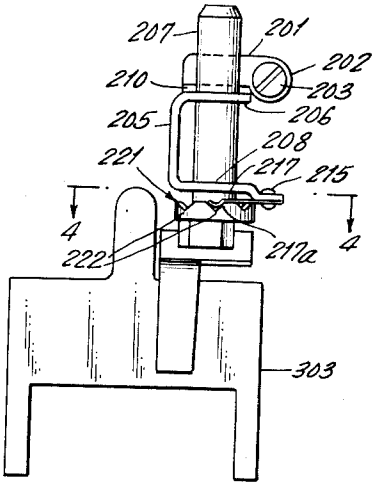


FIG. 4.

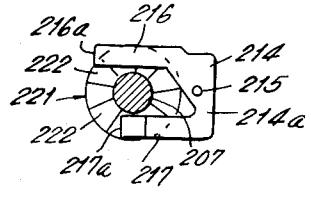
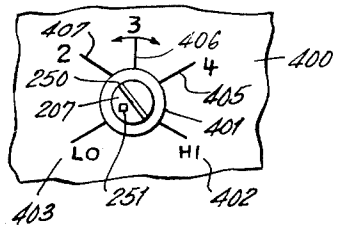


FIG. 5.



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United States Patent Office 3,201,659 Patented Aug. 17, 1965

3,201,659

ARMATURE ADJUSTING STRUCTURE

Wilson W. Poulton, Jr., deceased, late of Broomall, Pa., by Mary K. Poulton, executrix, Broomall, Pa., and Albert Strobel, Cherry Hill, N.J., assignors to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Filed Nov. 20, 1962, Ser. No. 239,096
5 Claims. (Cl. 317—176)

This invention relates to circuit breakers and more particularly to a novel armature adjustment structure for magnetic instantaneous trip means enabling the magnetic air gap to be easily, rapidly and reliably adjusted.

Automatic circuit breakers are usually provided with instantaneous trip means comprising a magnetic structure which, when subjected to overload currents of any 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 de-energized state thereby rapidly separating the circuit breaker cooperating contacts. This operation occurs at speeds sufficient to interrupt the current so as to prevent any harm to befall the elements of the circuit being protected by the circuit breaker.

The adjustment of the magnetic trip means is chosen so as to initiate an instantaneous tripping action during the occurence of a fault condition having a 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 current 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 or a tedious adjusting operation, whether the adjustment be required for purposes of compensation for wearing of parts, or for adjusting a circuit breaker to react according to a predetermined fault current condition.

The assembly of the instant invention acts to provide all of the above features, while at the same time being constructed so as to be easily operated without the necessity for any complex tools or manual manipulations and is further constructed so as to be comprised of a minimum of parts which elements are arranged so that movement of the adjusting structure operating button directly imparts movement to the instantaneous trip means armature member without the necessity of providing additional linkages or connections therebetween.

The assembly of the instant invention is comprised of

an adjusting button mounted for rotational movement within the confines of a bracket member and having a retaining pin and a biasing means for positioning and securing the adjusting member relative to the supporting bracket. A first end of the adjusting member is adapted to receive an adjusting tool for imparting rotation thereto. The opposite end of the adjusting button has a cammed surface which is so constructed as to cooperate with a projecting ear mounted to the magnetic trip means armature which when moving the ear, directly imparts movement to the armature member. The lower end of the adjusting button is further provided with a plurality of grooves in close proximity to the cam member, which cooperate with the biasing spring in order to lock the adjusting button in a plurality of discreet positions, which positions may be selected in any arbitrary manner in order to properly position the armature member of the magnetic trip assembly.

The holding bracket and ear members are so designed as to be easily installable in circuit breakers which are presently in use, as well as in new circuit breaker structures, thereby readily adapting themselves for employment in a wide variety of circuit breaker applications and structures. The biasing means, in addition to maintaining the vertical alignment of the adjusting member is further constructed to cooperate with the plurality of grooves provided in the adjusting member in order to properly position the magnetic means armature member in a variety of arbitrary angular orientations. The plurality of functions which each element of the adjusting structure provides thereby substantially optimizes the number of elements which comprise the armature structure to a minimum, while at the same time providing a safe, accurate and reliable adjusting structure. The arrangement is further so constructed as to provide direct movement of the armature member in response to movement of the adjusting button member without the necessity of any linkages therebetween. Also, the adjusting button member need only be rotated, either clockwise or counterclockwise for positioning the armature member and need not undergo any other movement in order to provide for the adjusting operation.

It is therefore one object of this invention to provide an armature adjustment assembly for circuit breaker magnetic trip means having a novel construction for directly imparting movement of the structure adjustment button directly to the magnetic means armature member.

Another object of this invention is to provide a novel armature adjustment structure for circuit breaker magnetic trip means which is so constructed as to undergo only rotational movement for adjusting the magnetic trip means armature member.

Still another object of this invention is to provide an armature adjustment assembly for a circuit magnetic trip means having a cam surface for smoothly and uniformly operating the magnetic means armature member.

Another object of this invention is to provide an armature adjustment for circuit breaker magnetic trip means which is provided with biasing means, for performing the dual function of positioning and securing the adjustment button and for aligning the armature member in a plurality of predetermined discreet positions.

Still another object of this invention is to provide an armature adjustment assembly for circuit breaker magnetic trip means which is constructed as to be readily adaptable to any present day magnetic trip structures.

These and other objects will become apparent when reading the accompanying description and drawings in which:

FIGURE 1 is a perspective view showing the novel armature adjustment assembly of the instant invention

and some of the cooperating elements of a typical circuit breaker in which the adjustment assembly may be employed.

FIGURE 2 is an elevational view in the direction of arrows 2—2 shown in FIGURE 1.

FIGURE 3 is an elevational view of the structure of FIGURE 1 looking in the directions of the arrows 3—3 shown in FIGURE 1.

FIGURE 4 is a top view of a portion of the adjustment assembly of FIGURE 2 taken in the direction of arrows 4—4.

FIGURE 5 is a top view of the adjustment button shown in FIGURES 1–3 looking in the direction of arrows 5—5.

Referring now to the drawings and more particularly to FIGURES 1–3, the magnetic adjustment assembly which is generally designated by numeral **200** is mounted within a circuit breaker assembly **100** having a wall **101** for receiving the armature adjustment assembly mounting bracket **201**. Only a very limited portion of the circuit breaker **100** has been portrayed in FIGURE 1 for the purposes of clarity, but it should be assumed that the circuit breaker **100** is comprised of a pair of cooperating contacts which may be operated to their open position by both a manual means and at least a magnetic trip means and the manual means may be operable for any purpose, while the magnetic trip means is designed to provide a tripping operation upon the occurrence of high magnitude current faults in the circuit being protected by the circuit breaker. A circuit breaker of this general type is set forth in U.S. application No. 132,046 entitled Assembly of Circuit Breaker Mechanism, filed August 17, 1961, by Wilson W. Poulton, Jr. and assigned to the assignee of the instant invention . A detailed description of such a circuit breaker is unnecessary for purposes of the instant invention and the aforementioned U.S. application is thereby incorporated herein by reference thereto.

For purposes of understanding the device of the instant invention it is sufficient to say that the circuit breaker **100** is provided with a tripper bar **102** mounted in close proximity to the wall **101** of circuit breaker **100** wherein said tripper bar **102** is mounted to rotate in both the clockwise and counterclockwise directions, as shown by arrows **104** and **103**, such that the tripper bar **102** rotates about its central axis represented by phantom line **105**. The tripper bar **102** is biased, by means not shown, in the clockwise direction, shown by arrow **104**, so that the surface **106** of its lower end **102***a* is in close proximity with the projection of the magnetic armature means **303**, for a purpose to be more fully described. Counterclockwise rotation of tripper bar **102** causes release of the circuit breaker latching mechanism (not shown), which releases the circuit breaker operating spring (not shown) for movement of the circuit breaker cooperating contacts (not shown) to their fully disengaged position thus cutting off current flow of the circuit being protected.

The tripper bar **102** shown in FIGURE 1 may be of a length greater than that shown by magnetic means **200** in FIGURE 1 in order to protect multi-phase electrical distribution systems, such as for example, the widely used three-phase electrical systems, which systems are provided with three magnetic structures of the type shown by structure **200** in FIGURE 1 wherein each magnetic assembly protects its individual associated phase of the three-phase system.

The magnetic structure **300** is comprised of a magnetic core member **301** supported in a substantially U-shaped metallic frame **305**. The magnetic core member **301** is a substantially U-shaped core member having an energizing winding **302** surrounding the yoke (not shown) of the U-shaped member **301**, in order to generate a strong magnetic flux pattern in the magnetic core member **301**. Although it is not shown in any of the figures, it should be understood that the winding **302** is connected in series with the circuit being protected in order to generate a flux pattern of sufficient magnitude so as to attract the magnetic structure armature member **303** for imparting rotation to the tripper bar **102**, in a manner to be more fully described.

The energizing winding **302** is formed of a plurality of substantially thin flat copper sheet members **302***a* which surround the core member **301**. The sheet members then extend through an opening **303***a* in the armature member **303** and are joined with a terminal bar **304**, having suitable apertures **304***a* for mounting in the cooperating contact current path and in series therewith.

The magnetic means armature member **303** is a substantially flat member, the lower projections **303***b* and **303***c* being positioned in suitable openings **305***a* in the U-shaped holding structure **305**, enabling the armature to be pivoted about its lower ends in the directions shown by arrows **306** and **307**. It should be understood that movement in the direction **306** is in response to an instantaneous magnetic tripping operation, in a manner to be more fully described.

The armature member **303** is biased in the direction shown by arrow **307** by spring means **308** and **308***a*. The upper end of spring means **308** engages turned out tabs **303***d* at the upper right-hand corner of armature member **303**, while the lower end of spring member **308** engages an elongated pin **309** which is mounted in suitable openings provided at the extreme front edges of the U-shaped holding, or supporting structure **305**. Spring means **308***a* has its lower end engaged by pin **309** and its upper end engaged by L-shaped member **320**. A projection **311** is provided at the upper end of armature member **303** and substantially intermediate its left and right hand edges for the purpose of engaging the surface **106** of the lower portion **102***a* of tripper bar **102**. A tapped aperture **312** is provided in projection **311** for receiving a screw member **313** employed for the purpose of adjusting the armature member **303** relative to the tripper bar **102**.

The operation of the magnetic assembly is as follows:

When fault current of a predetermined magnitude flows through the circuit being protected, the energizing winding **302**, being in series connection with the circuit being protected, generates a magnetic flux pattern in the core member **301**. When this magnetic pattern reaches a predetermined magnitude the faces of the magnetic core member **301** act to attract the armature member **303** causing the armature member to rotate in a direction shown by arrow **306** towards the pole faces of the core member **301**. It should be understood that the magnetic field will be of a sufficient strength to overcome the biasing force imposed upon armature member **303** by the spring means **308** and **308***a*. The projection **311**, likewise moves in the direction shown by arrow **306**, thereby coming into engagement with the surface **106** of tripper bar **102**. As the armature member **303** moves still further in a direction shown by arrow **306**, this movement, through projection **311** and adjusting screw member **313**, is imparted to the tripper bar **102** causing it to rotate in the direction shown by arrow **103**, about its longitudinal axis **105**. After a predetermined amount of rotation is experienced by tripper bar **102**, a latch (not shown) is caused to move to its unlatched position under control of the tripper bar's rotation, thereby enabling the circuit breaker cooperating contacts (not shown) to move to their fully disengaged position.

It can readily be seen that the positioning of the armature member **303** relative to the pole faces of the core member **301** is directly determinative of the magnetic field pattern which must be generated by the energizing winding **302** for the purpose of providing an instantaneous tripping action. Since the circuit breaker **100** may be so designed as to be useful in a variety of different circuit applications it becomes advantageous to provide an adjusting means for accommodating the various applications for which the circuit breaker **100** may be em-

ployed, all of which applications may require different magnetic trip means adjustments.

In order to provide these necessary adjustments the adjustment structure **200** is provided, which structure **200** is comprised of a supporting bracket **201**, having a suitable aperture **202** for receiving fastening means **203** enabling the support member **201** to be secured to the wall **101** of circuit breaker **100**. The support member **201** has a substantially U-shaped portion **205**, having an upper arm portion **206** with a suitable aperture **204** for receiving the adjusting rod **207** therethrough. The lower arm **208** also has a suitable aperture (not shown) for receiving the adjusting rod **207**. The adjusting rod **207** is provided with a suitable aperture **207***a* for receiving a pin **210**. The dimensions of the pin **210** are such that its length is substantially greater than the diameter of the rod **207** and substantially greater than the diameter of the aperture **204** thereby preventing any movement of the adjusting rod **207** in the downward, vertical direction, as shown by arrow **212**, when the pin member **210** engages the upper surface of the supporting bracket **201**.

The lower arm **208** of the substantially U-shaped portion **205** has a spring member **214** of substantially U-shaped configuration (see FIGURE 4) secured to the arm **208** at its front end **214***a* by suitable fastening means **215**. The arm **217** of U-shaped spring member **214** is provided with an ear portion **217***a* which ear portion has a substantially U-shaped profile, as can best be seen in FIGURES 2 and 1. Arm **216** has no U-shaped ear portion and is provided to equalize the biasing force imposed upon adjusting rod **207**.

The adjusting rod **207** is provided with a flanged portion **220** having a diameter substantially greater than that of its body portion **207** and is so arranged that the upper surface **221** makes contact with the ear portion **217***a* and arm **216** of spring member **214**. Spring member **214** is biased in such a manner as to urge adjusting rod **207** in the downward, vertical direction, as shown by arrow **212**. Thus, it can be seen that the holding pin **210** and the biasing spring **214** act to hold the adjusting rod **207** substantially motionless, relative to the vertical direction, while enabling the rod **207** to rotate in the opposing directions **230** and **231** for the purpose of adjusting the air gap between armature and core **303** and **301**, respectively, in a manner to be more fully described. The upper surface **221** of flange **220** is provided with a plurality of radially aligned grooves **222** for receiving the ear portion **217***a* so as to enable positioning of the adjusting rod **207** in a plurality of predetermined, discrete, angular positions, for purposes to be more fully described.

The lower surface **223** of the flanged portion **220** is provided with a projection **224**, having a cammed surface **225** which is employed for moving the magnetic means armature member **303**. The surface of the projection **224** is eccentric, as can most clearly be seen in FIGURE 1, so that the rotational motion of adjusting rod **207** may be converted into substantially linear motion of the upper end of magnetic means armature member **303**, as will become more evident.

The armature member **303** is further provided with a substantially L-shaped bracket **235** suitably secured to armature member **303** at its lower end by fastening means **236**. Adjusting screw **237** is provided in a tapped aperture **238** in member **235** for a purpose to be more fully described. The member **235** has a forwardly extending contact surface **336** which is positioned so as to make sliding engagement with the eccentric surface **225** of projection **224** provided on adjusting rod **207**.

The arrangement is such that upon rotation of the adjusting rod **207**, the eccentric surface **225** bears against the contact surface **336** of L-shaped member **235**. The member **235** is urged in a direction shown by arrow **307** due to spring means **308** and further due to the fact that L-shaped member **235** is rigidly secured to armature member **303**. As the adjusting rod **207** is rotated, either clockwise or counterclockwise, through a full cycle of rotation, the eccentric surface **225** of the lower projection **224** causes the L-shaped member **235** to move substantially linearly in a substantially reciprocating manner, thereby running the armature member **303** through its full cycle of adjustable air gap positions. It should be understood that the adjusting rod **207** may be locked in any one of a plurality of discrete positions so as to select a predetermined air gap dimension. This is provided for in the following manner:

As the adjusting rod **207** is rotated in either of the two directions shown by arrows **230** and **231**, the flanged portion **220** of rod **207** has the same rotation imparted to it, thereby causing the ear **217***a* to be moved out of the grooves **222** provided on the top surface of flange **220**. For example, in the position shown in FIGURE 1 of the drawings, if the adjusting rod **207** is rotated in the direction shown by arrow **231** the ear **217***a* is urged out of engagement with the groove **222***a*. As the rod **207** is rotated still further in the direction shown by arrow **231**, the groove **222***b* will move to a position immediately beneath ear **217***a* thereby causing biasing member **214** to urge the ear **217***a* downward into the groove **222***b*. This locking motion can easily be felt by the operator making the magnetic air gap adjustment and in addition thereto further requires that the party making the adjustment impart slightly more rotational force to the adjusting rod **207** in order to lift ear **217***a* out of groove **222***b*.

It should be understood that the radially aligned grooves **222** may be positioned in any angular orientation desired, depending strictly upon the magnetic air gap dimensions desired by the individual circuit breaker applications.

The adjusting screw **313** is provided on armature projection **311** in order to regulate the desired moment at which the tripper bar unlatching operation should be initiated relative to the movement of the magnetic means armature member **303**. The adjusting screw **237** provided on substantially U-shaped member **235** permits movement of the L-shaped member **235** relative to the armature member **303** in order to provide a secondary adjustment between the armature member **303** and the eccentric cam surface **225** of the adjusting rod **207**.

FIGURE 3 shows the two extreme magnetic air gap positions A and B (wherein the position A of the armature member **303** is shown in dotted fashion). The air gap position B shows the maximum air gap adjustment provided by the adjustment assembly **200** while the position A shows the minimum air gap position provided by the assembly **200**. It should be understood that any plurality of positions between the extreme positions A and B is obtainable with the adjustment assembly **200** of the instant invention. The discreet positions, which may be arbitrarily selected depending upon the individual circuit breaker application may be further facilitated in the manner shown in FIGURE 5. In this example, the entire magnetic trip assembly **300** and adjustment assembly **200** may be completely enclosed by a housing **400**, only a portion of which has been shown for purposes of clarity. The housing **400** is provided with a suitable aperture **401** for receipt of the upper end of adjusting rod **207**. A groove **250** is provided on the upper surface of rod **207** for receiving an adjusting tool, such as for example, a screw driver. The upper surface of the housing **400** is then provided with suitable letter and numeral designations **402–407** which cooperate with an arrow, or pointer, **251**, provided on the top surface of adjusting button **207**. In this manner, simply by lining up the pointer **251** with the discreet position lines **402–407**, a plurality of air gap adjustments are readily obtainable.

It should be noted that the substantially linearly motion experienced by the armature member **303** and substantially L-shaped member **235** is imparted directly thereto by means of the adjusting rod **207** without providing any connecting linkages or translational members therebetween. Thus, any rotary motion of the adjusting rod **207**

is directly imparted (in the form of linear motion) to the armature member 303. In addition thereto, the adjusting rod 207 undergoes substantially no linear motion, either up or down, in the vertical direction, thereby substantially simplifying the adjusting operation for the operator, making it a simple rotational motion and further, enabling the adjustment to be made by moving the adjusting rod 207 in either clockwise or counterclockwise direction since no locking means is provided which prevents a full 360 degree cycle of rotation. In order to eliminate the guess work of accurately positioning the adjusting rod 207, the ear 217*a* of spring means 214, together with the radially aligned grooves 222 in upper surface 221 of flange 220 facilitate and completely control the adjustment of the air gap means.

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

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. Manually operable armature positioning means for adjusting the air gap of a circuit breaker magnetic trip assembly comprising bracket means for mounting said adjusting means to a circuit breaker; an adjusting rod, said bracket means receiving therein said adjusting rod to enable rotation of said rod about its central axis; first means secured to said rod for abutting said bracket means; second means secured to said bracket means for abutting said adjusting rod; said first and second means preventing said adjusting rod from any linear movement along its central axis; one end of said adjusting rod having a cam surface; a first member having an extending arm; said member positioned for securement to the magnetic trip armature; said extending arm positioned to slidably engage said cam surface; said adjusting rod constructed to move said first member substantially in a linear direction due to the rotation of said adjusting rod for positioning the magnetic trip assembly armature.

2. Manually operable armature positioning means for adjusting the air gap of a circuit breaker magnetic trip assembly comprising bracket means for mounting said adjusting means to a circuit breaker; an adjusting rod, said bracket means receiving therein said adjusting rod to enable rotation of said rod about its central axis; first means secured to said rod for abutting said bracket means; second means secured to said bracket means for abutting said adjusting rod; said first and second means preventing said adjusting rod from any linear movement along its central axis; one end of said adjusting rod having a cam surface; a first member having an extending arm; said member positioned for securement to the magnetic trip armature; said extending arm positioned to slidably engage said cam surface; said adjusting rod constructed to move said first member substantially in a linear direction due to the rotation of said adjusting rod for positioning the magnetic trip assembly armature; said adjusting rod having a second surface slidably engaged by said bias means; said surface having at least one groove cooperating with said bias means for maintaining said adjusting rod in a predetermined angular position.

3. Manually operable armature positioning means for adjusting the air gap of a circuit breaker magnetic trip assembly comprising bracket means for mounting said adjusting means to a circuit breaker; an adjusting rod, said bracket means receiving therein said adjusting rod to enable rotation of said rod about its central axis; first means secured to said rod for abutting said bracket means; second means secured to said bracket means for abutting said adjusting rod; said first and second means preventing said adjusting rod from any linear movement

along its central axis; one end of said adjusting rod having a cam surface; a first member having an extending arm; said member positioned for securement to the magnetic trip armature; said extending arm positioned to slidably engage said cam surface; said adjusting rod constructed to move said first member substantially in a linear direction due to the rotation of said adjusting rod for positioning the magnetic trip assembly armature; said adjusting rod having a second surface slidably engaged by said bias means; said surface having at least one groove cooperating with said bias means for maintaining said adjusting rod in a predetermined angular position; said bias means having at least one resilient arm; the free end of said arm being formed to be received by said groove for maintaining said adjusting rod in a predetermined angular position.

4. Manually operable armature positioning means for adjusting the air gap of a circuit breaker magnetic trip assembly comprising bracket means for mounting said adjusting means to a circuit breaker; an adjusting rod, said bracket means receiving therein said adjusting rod to enable rotation of said rod about its central axis; first means secured to said rod for abutting said bracket means; second means secured to said bracket means for abutting said adjusting rod; said first and second means preventing said adjusting rod from any linear movement along its central axis; one end of said adjusting rod having a cam surface; a first member having an extending arm; said member positioned for securement to the magnetic trip armature; said extending arm positioned to slidably engage said cam surface; said adjusting rod constructed to move said first member substantially in a linear direction due to the rotation of said adjusting rod for positioning the magnetic trip assembly armature; said adjusting rod having a second surface substantially perpendicular to said cam surface slidably engaging said bias means; said second surface having a plurality of radially aligned grooves; each of said grooves being adapted to cooperate with said bias means to retain said adjusting rod in a plurality of predetermined angular positions.

5. Manually operable armature positioning means for adjusting the air gap of a circuit breaker magnetic trip assembly comprising bracket means for mounting said adjusting means to a circuit breaker; an adjusting rod, said bracket means receiving therein said adjusting rod to enable rotation of said rod about its central axis; first means secured to said rod for abutting said bracket means, second means secured to said bracket means for abutting said adjusting rod; said first and second means preventing said adjusting rod from any linear movement along its central axis; one end of said adjusting rod having a cam surface; a first member having an extending arm; said member positioned for securement to the magnetic trip armature; said extending arm positioned to slidably engage said cam surface; said adjusting rod constructed to move said first member substantially in a linear direction due to the rotation of said adjusting rod for positioning the magnetic trip assembly armature; said adjusting rod having a second surface substantially perpendicular to said cam surface slidably engaging said bias means; said second surface having a plurality of radially aligned grooves; each of said grooves being adapted to cooperate with said bias means to retain said adjusting rod in a plurality of predetermined angular positions; said bias means having at least one resilient arm; the free end of said arm being formed to be received by each of said grooves for maintaining said adjusting rod in any of said predetermined angular positions.

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897,309 5/62 Great Britain.

JOHN F. BURNS, *Primary Examiner.*