# United States Patent

[11] 3,593,234


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[21] Appl. No. **9,565**
[22] Filed **Feb. 9, 1970**
[45] Patented **July 13, 1971**
[73] Assignee **Cutler-Hammer, Inc.**
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[54] **TRIP ADJUSTMENT MEANS FOR INSTANTANEOUS TRIP CIRCUIT BREAKER**
**7 Claims, 6 Drawing Figs.**


[52] **U.S. Cl.** ..... 335/176, 335/42
[51] **Int. Cl.** ..... **H01h 71/74**
[50] **Field of Search** ..... 335/176, 9, 273, 35, 38, 42



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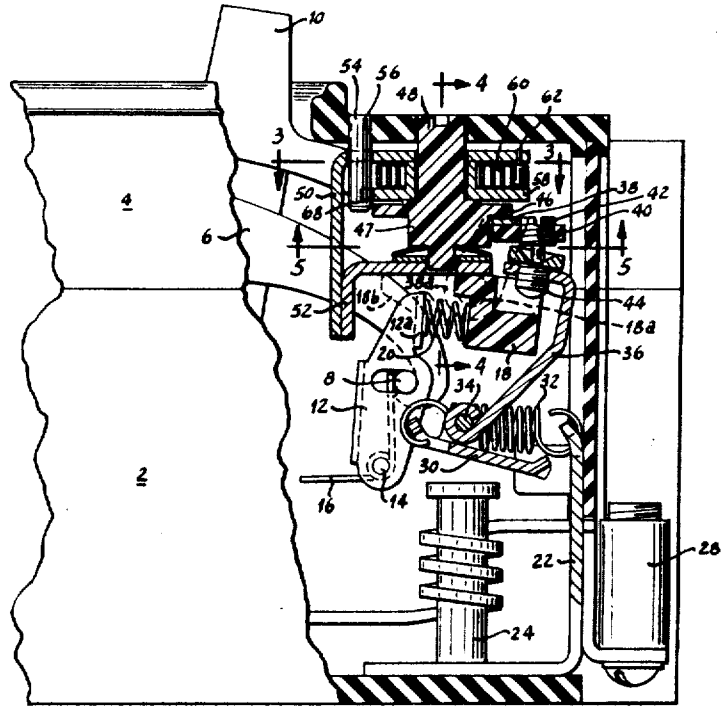
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**ABSTRACT:** An externally accessible adjustment cam for varying the armature gap of a magnetic trip circuit breaker is spring biased to the lowest setting through a lost motion connection with a disc to which a torsion spring is operatively attached. The cam may be rotated to any one of a plurality of higher settings, driving with it the spring biased disc. A pin is inserted through an opening in the circuit breaker case to engage and rotatably fix the disc at the chosen position to set the upper limit for the cam while the latter may be rotated backward through the lost motion connection to a somewhat lower setting if desired.

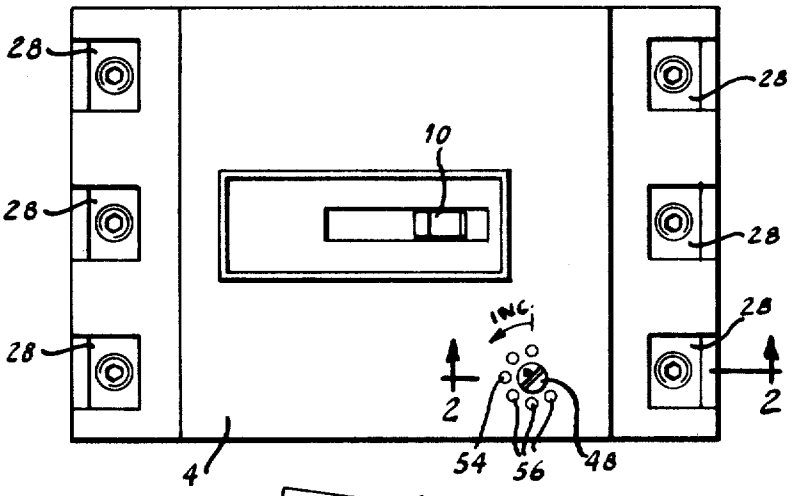

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Fig. 1

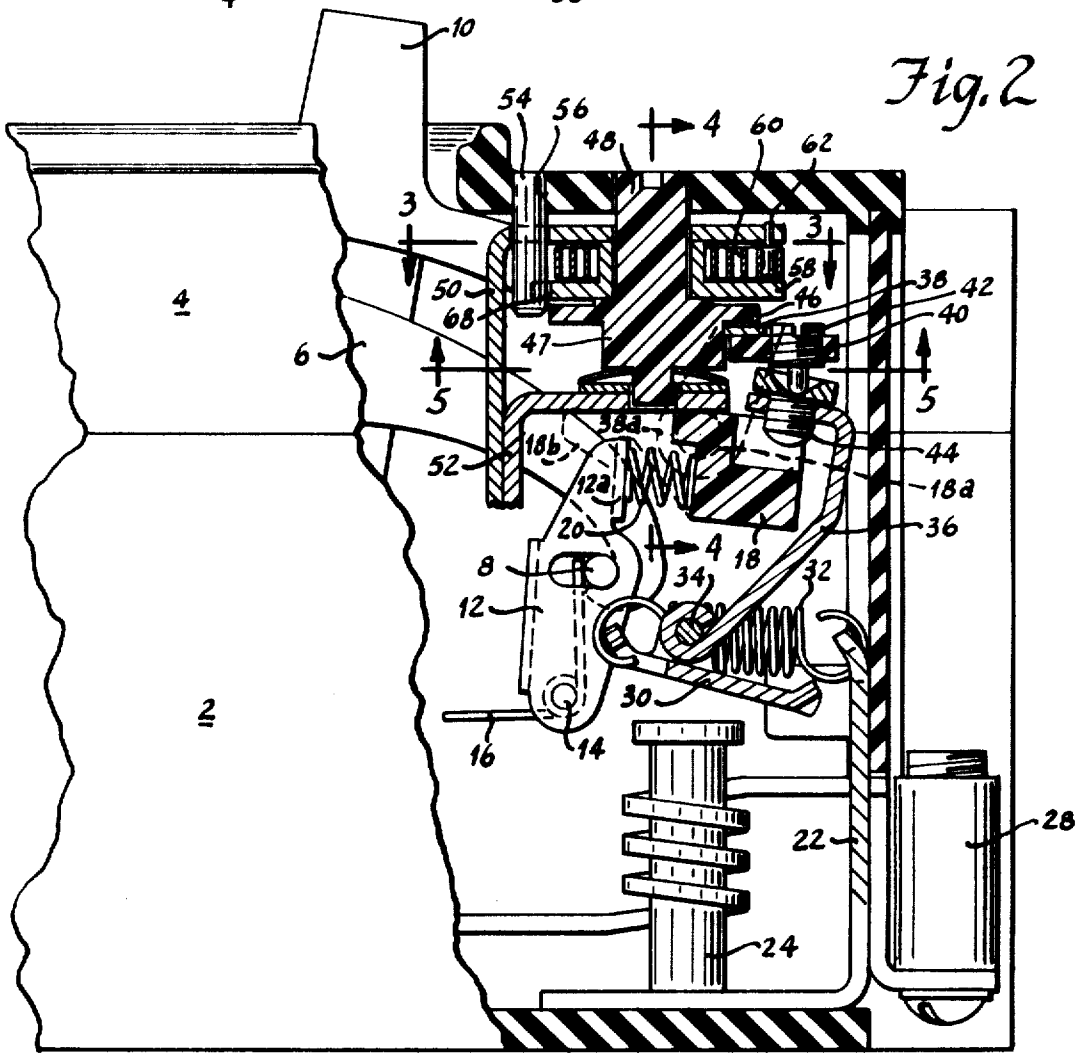

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Fig. 2

Fig. 3

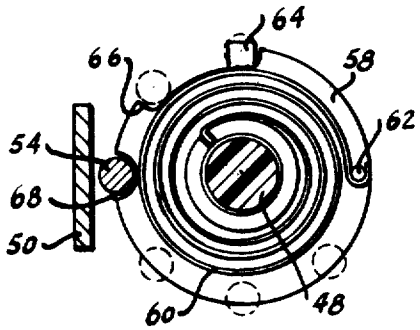



Fig. 4

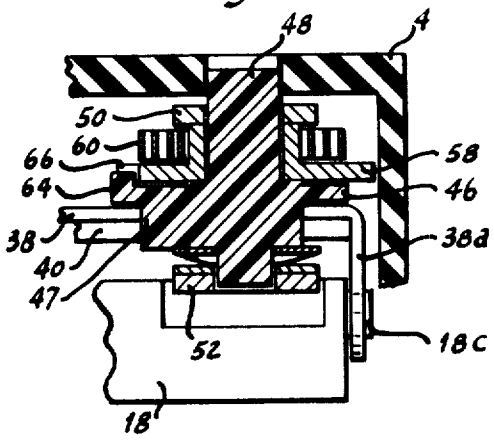



Fig. 5

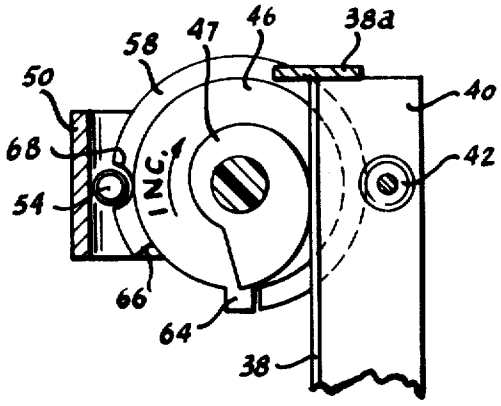
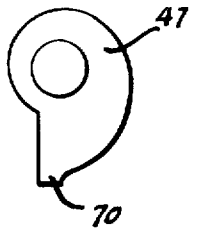



Fig. 6




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# TRIP ADJUSTMENT MEANS FOR INSTANTANEOUS TRIP CIRCUIT BREAKER

## BACKGROUND OF THE INVENTION

This invention relates to trip adjustment means for molded case instantaneous trip circuit breakers and more particularly to a means for rendering the breaker inoperative, either literally or practically, unless a considered choice of adjustment is made.

The National Electric Code has recently been changed to recognize instantaneous trip circuit breakers for the protection of motor circuits when the breaker is used in the same enclosure with the motor controller and if overcurrent protection is provided in all three lines. The code requires that the breaker preferrably be set at seven times the full load current of the motor with which it is being used, and have an upper limit not to exceed 13 times the full load current.

Adjustable instantaneous breakers have long been available and are adjustable over ranges which exceed the limits now prescribed by the code. Since it is not practical to factory calibrate and adjust individual breakers for each separate value of motor current to be encountered, it is proposed to comply with the intent of the requirements by providing adjustable breakers as have been available, except to modify the breakers wherein they will be biased to the lowest setting or held open until an adjustment has been chosen and made. Such adjustment would be performed by a qualified workman in the field and would fix the upper limit to which the breaker could be adjusted, the choice of settings being made in a manner analogous to that in which the workman would choose a proper fuse for a fused protection device.

## SUMMARY OF THE INVENTION

Accordingly this invention provides an improved adjustment means for an externally adjustable instantaneous trip circuit breaker. Means are provided to normally bias the adjustment cam to its lowest setting wherein the breaker may trip at very low values of current or be held open to prevent setting the breaker. The breaker may be adjusted to a predetermined limit by rotating the cam which carries with it the biasing means, then fixing the biasing means at the predetermined setting. A lost motion connection between the cam and the biasing means permits limited adjustment of the cam between the fixed upper limit and a lower setting.

It is a primary object of this invention to provide an externally adjustable instantaneous trip circuit breaker wherein the adjustment means is normally biased to its lowest setting.

It is a further object of this invention to provide an externally adjustable instantaneous trip circuit breaker wherein the trip adjustment means are normally biased to the lowest setting and remain so biased until an upper limit of adjustment is fixed in a prescribed manner.

These and other objects and advantages of the invention will become more apparent in the following specification and claims when read in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of an instantaneous trip molded case circuit breaker having external trip adjustment means, drawn to a reduced scale from that of the remaining figures;

FIG. 2 is a fragmentary sectional view taken generally along the line 2–2 in FIG. 1;

FIG. 3 is a cross sectional view taken generally along the line 3–3 in FIG. 2;

FIG. 4 is a cross sectional view taken generally along the line 4–4 in FIG. 2;

FIG. 5 is a cross sectional view taken generally along the line 5–5 in FIG. 2; and

FIG. 6 is a view of a modified profile of a cam used in the circuit breaker of FIGS. 1—5.



## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2 there is shown therein a three-pole circuit breaker of a type commercially available by the Westinghouse Electric Corporation. The particular breaker is closely similar to the Westinghouse Type EB, EHB or FB circuit breakers, except modified for use specifically in motor circuit protection applications by making the breaker a magnetic trip only device.

The circuit breaker as shown in FIGS. 1 and 2 has a molded insulation case which comprises a base 2 and cover 4. Insulating barriers within the case serve to insulate the separate poles, each of which has a stationary contact and a cooperating movable contact. Each movable contact is supported upon an individual switch arm and all three switch arms are driven through a common tie bar. A collapsable toggle linkage operating mechanism is disposed over the center pole and has connection to the center pole switch arm. The linkage further includes a cradle member 6 which extends to the right in FIG. 2 and engages a latch roller 8 to latch the toggle linkage in an extended position whereby the movement of the switch arms are under the direct control of an operating handle 10. For a more complete disclosure of an operating mechanism of the type employed herein, reference may be had to U.S. Pat. No. 3,462,716 to N. Yorgin et al.

The latch roller 8 is supported at its opposite ends within a pair of horizontal slots formed in the legs of a U-shaped latch lever 12. The latch lever 12 is pivotally supported in the center pole of the breaker upon a pivot pin 14 and is biased in a clockwise direction about the pin 14 and into engagement with the hooked end of cradle 6 by a torsion spring 16 which bears at one end against a fixed portion of the breaker and at its other end upon the latch roller 8. The legs of lever 12 each have a tab 12*a* formed at right angles to the respective leg and extending toward each other at the upper end of the legs.

A molded trip bar 18 is pivotally mounted within the base 2 on a pair of molded projections 18*a*, one of which is shown in dotted lines in FIG. 2. The trip bar 18 extends transversely across all three poles of the breaker. A single hook portion 18*b* extends outwardly of the trip bar within the center pole of the breaker to overlie and engage one of the tabs 12*a* on the latch lever 12. A helical compression spring 20 is disposed between the other tab 12*a* and a substantially vertical surface of the trip bar to bias the hook portion 18*b* against the tab 12*a* and to provide a counterclockwise bias to the latch lever 12. The spring 20 is designed to provide sufficient torque upon the lever 12 to overcome that of spring 16 and therefore move the top of the lever to the left to release the cradle 6 upon clockwise movement of the trip bar 18.

Each pole of the breaker contains an individual electromagnetic trip device, each device being identical. The trip devices individually comprise an L-shaped magnet frame 22 and core 24 secured to the bottom of base 2. A coil winding 26 is attached to a solderless lug terminal 28 at one end and to the respective switch arm through a flexible connector at the other end. An armature member 30 is pivotally mounted between a pair or projections formed from the vertical leg of L-shaped frame 22 near the upper end thereof. Each armature 30 has a pair of tension springs 32 (only one of which is shown) connected between the free end thereof and the upper end of frame 22 to bias the armature 30 away from the core 24.

Armature 30 has a pair of upstanding ears formed on the opposite sides thereof to support a pin 34 therebetween. The lower end of a hook member 36 is pivotally attached to the pin 34 while the upper end of the hook member extends around the trip bar 18 to be disposed over an upper surface of the latter.

A cam follower adjustment bar 38 is pivotally supported upon the trip bar 18 in a common axis with that on which the trip bar is pivotally mounted. The bar 38 has depending leg portions 38*a* formed at right angles to the bar at each end and

the leg portions have openings therein which are disposed over cooperating projections 18c formed on the ends of trip bar 18 as shown in FIG. 4. The cam follower 38 has a fiber board or the like insulating strip 40 secured to the underside thereof. The strip 40 carries three adjustment screws 42, one in line with each pole of the breaker. Each screw 42 has a semispherically tipped finger depending therefrom which extends into a dished upper surface of a cooperating screw 44 carried in the upper end of the respective hook member 36. The upward bias provided by springs 32 on armature 30 serves to urge the hook 36 and screw 44 into constant engagement with the screw 42 and further urges the cam follower bar 38 counterclockwise about its pivotal axis.

Initial adjustment and factory calibration is afforded the breaker by altering the relative positions of the individual screws 42 and 44. Field adjustment of the breaker is afforded by the provision of a rotatable adjustment member 46 which has a cam portion 47 on its inner end and a slotted shank portion 48 at its opposite end extending into an aligned opening in the cover 4. Adjustment member 46 is rotatably supported between upper and lower frame members 50 and 52, respectively, which are rigidly mounted within base 2 in any suitable convenient manner. A cylindrical projection on the bottom of adjustment member 46 is journaled within a cooperating opening in the lower frame member 52 while the shank 48 is similarly received in an opening in the upper frame member 50. As seen in FIGS. 2 and 5 the cam follower bar 38 rests upon the profile of cam portion 47 due to the influence of armature springs 32 and the associated linkage. Turning the adjustment member 46 in the direction of the arrow (FIGS. 1 and 5) presents a cam surface of decreasing radial dimension wherein the follower bar may pivot counterclockwise to permit the armature 30 to pivot upwardly, thereby increasing the airgap of the respective electromagnets and increasing the trip current value at which the breaker will operate. Rotation of the adjustment member 46 in the direction opposite that indicated by the arrows will cause the cam follower 38 and hook member 36 to move the armature 30 closer to the core 24, thereby lowering the trip current value.

Magnetic only circuit breakers having the aforedescribed adjustment feature are will known in the art. It has further been known to provide breakers of this type with a means of limiting this adjustment at the time the apparatus is installed by driving a pin 54 into one of several spaced holes 56 in cover 4 which radially surround the adjustment cam shank 48 as seen in FIG. 1. The pin normally extends into the casing to interfere with a projection on the adjustment member to prevent rotation of the member beyond the pin, thereby permanently fixing the upper limit at which the breaker may be set.

The foregoing method of fixing the upper limit for the adjustment cam provides an instantaneous trip breaker which can be field adjusted and still meet the requirements of the National Electric Code by not permitting unauthorized later adjustments exceeding 13 times the motor full load current rating. However, this method does not insure that such upper limit be selected and fixed in order that the breaker may be used. This invention provides an additional mechanism which may be used in conjunction with a breaker of the aforedescribed type to bias the adjustment cam to its lowest rated setting until an upper limit setting is selected and the pin 54 inserted in the proper hole to fix such limit.

Accordingly there is provided a disc member 58 which has a central hub portion disposed over the shank 48 of adjustment member 46, the disc member 58 resting upon an integral annular shoulder of the adjustment member. A helical torsion spring 60 is disposed around the central hub of disc 58, one end of the spring 60 extending into a vertical slot in the hub as shown in FIG. 3. The other end of the spring is secured around a pin 62 fixed in the upper frame member 50 to depend therefrom. The adjustment member 46 and disc 58 are connected by a lost motion drive arrangement wherein a projection 64 (FIG. 4) on the member 46 extends into a slot 66 on the periphery of the disc 58 to abut against the disc at either end of the slot. The length of slot 66 is determined by the amount of relative movement necessary between the adjustment member 46 and the disc 58 to achieve a decrease in trip current rating from 13 to at most seven times motor full load current. In the device illustrated in the drawings, the slot 66 permits adjustment physically corresponding to the distance between adjacent holes 56 in cover 4. Disc 58 is further provided with a semicircular recess 68 at the edge thereof to receive the pin 54 in a manner to be described hereinafter.

With reference to FIG. 1 it can be seen that the exposed end of shank 48 contains a slot for receiving the blade of a screwdriver or similar tool to facilitate adjustment. Also on the end of shank 48 is an arrow, or other similar indicating mark, which indicates the position of the cam portion 47 relative to the follower 38. At the lowest rated position the arrow will point to the right of the uppermost hole 56 in FIG. 1 and the point of the cam adjacent the tab 64 will be against the follower surface. As indicated earlier, the trip current value may be increased by turning the adjustment member 46 in the direction indicated by the legend on the cover 4, thereby increasing the gaps between the respective armatures and cores in the breaker. The trip current values for the various cam positions increase logarithmically, that is the trip current values approximate a straight line when plotted on a logarithmic scale against the cam settings.

In operation, the spring 60 biases the adjustment member 46 to its lowest setting position through the disc 58, at which position the trip current is at the lowest value for the breaker. The cam profile 47 of member 46 may further be modified as shown in FIG. 6 to provide a bump 70 at the point of the cam, wherein the bump 70 would pivot the follower far 38 an amount sufficient to cause the screws 44 to hold the trip bar 18 off the latch lever 12, preventing the breaker from being operated at all in the lowest cam setting position. A value of 13 times the motor full load current is calculated by the workman and the particular hole 56 having a trip current value corresponding to the calculated value is selected according to an instruction sheet supplied with the breaker. In the breaker depicted in the drawings, a value requiring adjustment to the third hole is disclosed. The workman must rotate the adjustment member 46 in the direction of the legend in FIG. 1 to cause the arrow on the shank 48 to point to the third hole. The disc 58 is biased in a clockwise direction by spring 60 so that the left-hand end of slot 66 (as viewed in FIG. 3) initially abuts the projection 64 of member 46. The rotation of adjustment member 46 counterclockwise therefore drives the disc 58 in the same direction against the bias of spring 60. When the arrow on shank 48 aligns with the selected third hole 56, the semicircular recess 68 in disc 58 is also in line therewith and the pin 54 may be driven into the breaker casing to extend into the recess 68, thereby rotatably locking the disc 58 in this position. It is to be noted that the upper frame member 50 is suitably apertured in the areas directly under the holes 56 to permit the pin 54 to pass through the frame.

With the disc 58 fixed, the adjustment member 46 may be freely rotated within the limits defined by the movement of tab 64 within slot 66. As may be seen in FIG. 3, the slot 66 is of sufficient length to permit the adjustment member to be backed up to the preceding or second, hole 56. Thus the workman has fixed the upper limit at 13 times the full load current of the motor, but is able to adjust the value downward to a lesser value which preferrably includes the recommended value of seven times full load current. Should the recommended value not be sufficient to permit starting of the motor, the workman can adjust the value upward again toward the fixed limit until a workable value is reached.

Thus there is provided herein an externally adjustable instantaneous circuit breaker in which the external adjustment feature is biased to a low trip current value to render the breaker impractical for most application, or totally inoperative, until a workman selects and permanently fixes an upper limit to which the breaker may be adjusted. It is to be understood that the device as described in the foregoing is

susceptible to further modification without departing from the scope of the appended claims.

I claim:

1. In a magnetic trip circuit breaker, means for adjusting the airgap of the magnetic trip means comprising, in combination:

an insulating casing for a circuit breaker, said casing having a primary opening and a plurality of secondary openings extending through an external surface of said circuit breaker casing, said secondary openings surrounding said primary opening and being radially spaced therefrom;

a rotatable adjustment member supported within said circuit breaker casing, said adjustment member having a portion at one end thereof accessible through said primary opening and a cam portion on the inner end thereof;

cam follower means biased into engagement with said cam portion and including means connecting with the armature of said magnetic trip means, said cam follower means moving said armature in a direction to increase the airgap in response to rotation of said adjustment member in one direction and moving said armature in a direction to decrease the airgap in response to rotation of said adjustment member in an opposite direction;

means biasing said adjustment member in said opposite direction wherein said adjustment member normally assumes a position establishing the smallest airgap possible by said adjustment member, and

means inserted into a selected one of said secondary openings and extending into said casing to engage said biasing means to render said biasing means inoperative upon said adjustment member and to limit rotation of said adjustment means in said one direction.

2. The combination according to claim 1, wherein said means inserted into a selected one of said secondary openings engages said biasing means when the latter is displaced by rotation of said adjustment member to the selected one of said secondary openings, the engagement of said means inserted with said biasing means relieving the bias upon said adjustment member.

3. The combination according to claim 1, wherein said means biasing said adjustment member comprises an intermediate member having a lost motion connection with said adjustment member and spring means connected between said intermediate member and a stationary portion of said circuit breaker.

4. The combination according to claim 3, wherein said intermediate member is a disc member disposed about said adjustment member to be coaxially rotatable thereabout.

5. The combination according to claim 4, wherein said lost motion connection between said disc member and said adjustment member comprises an elongated slot in said disc member extending in a circumferential direction and a tab formed on said adjustment member extending into said slot, the relative motion between said disc member and said adjustment member being defined by the amount of travel of said tab within said slot.

6. The combination according to claim 5, together with means provided in said disc member for engagement by said means inserted in said selected one of said secondary openings when said disc member is displaced by rotation of said adjustment member to cause said means provided in said disc member to be in alignment with said selected one of said secondary openings.

7. The combination according to claim 1, wherein said cam means includes a projection engaging said cam follower means in the normal position of said adjustment member to hold said cam follower means in said armature in the tripped position of said circuit breaker.