Oct. 25, 1949. T. LINDSTROM ET AL 2,486,300

ELECTROMAGNETIC TRIP CIRCUIT BREAKER

Filed June 29, 1944

Fig. 1.

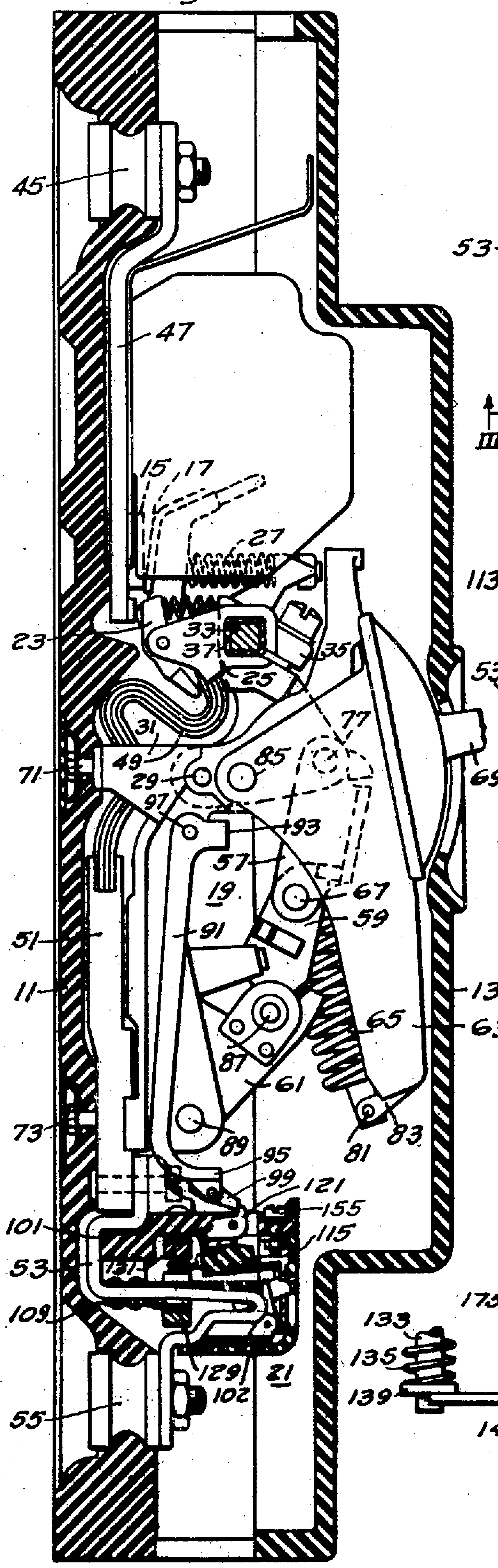


Fig. 2.

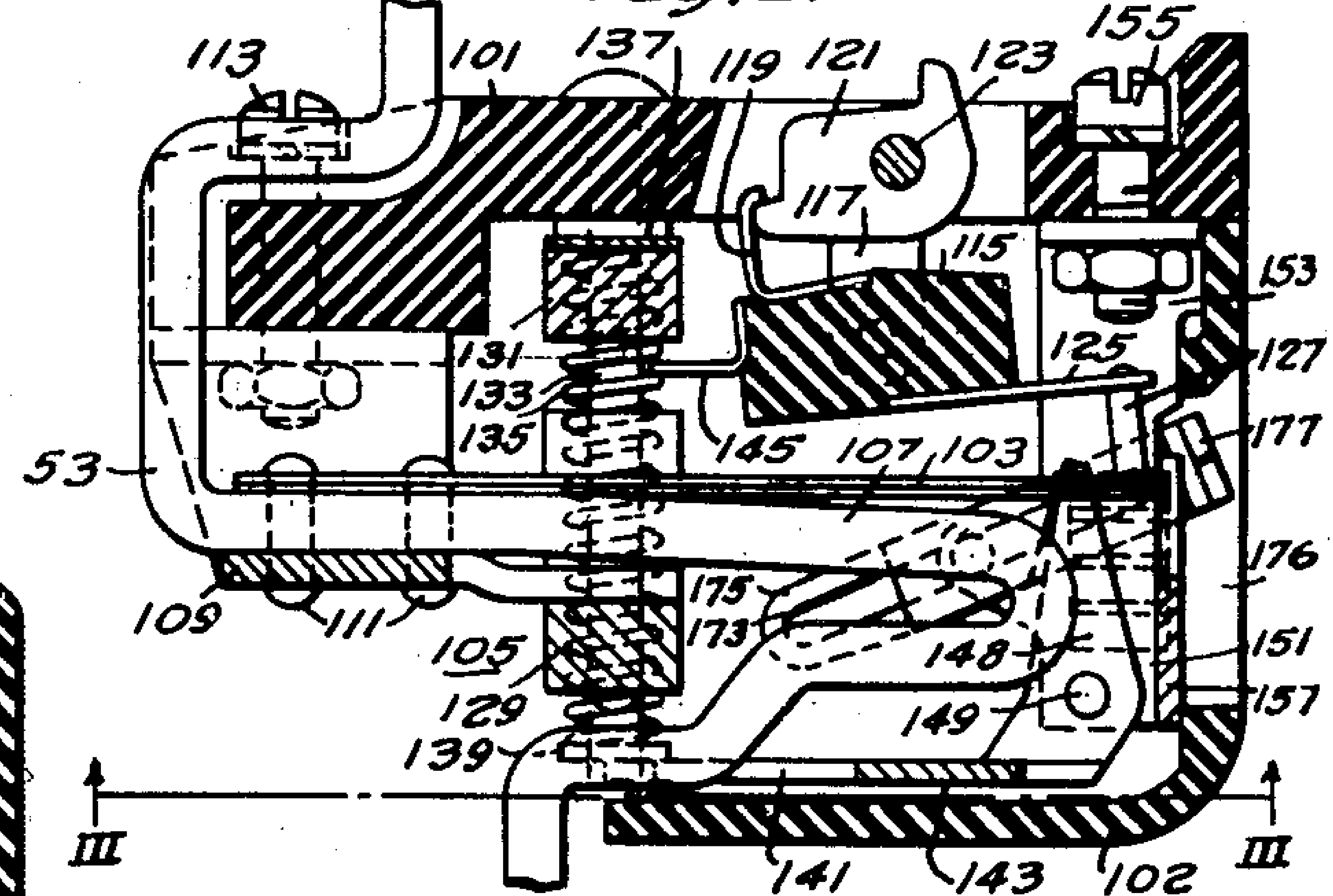


Fig. 3.

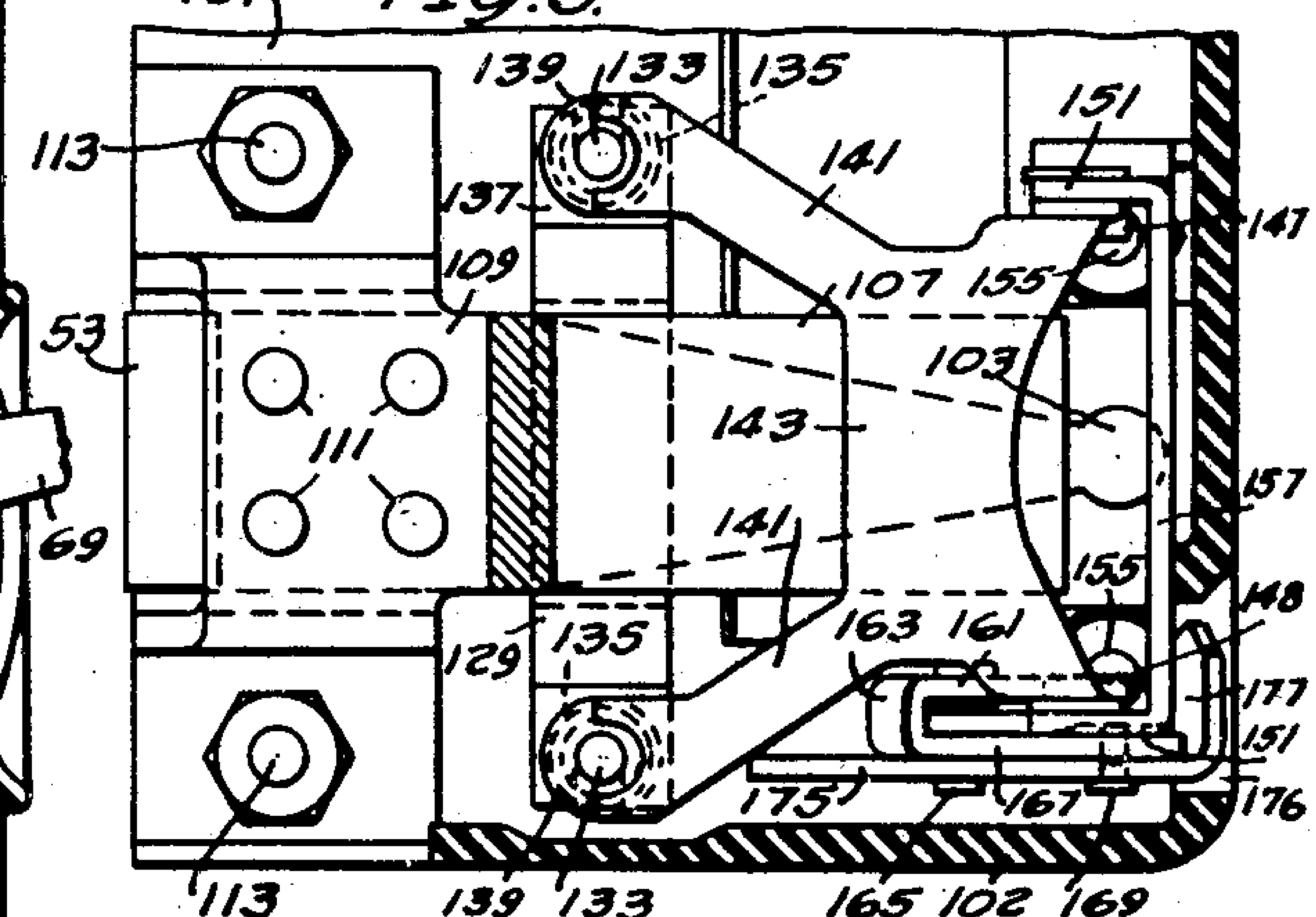


Fig. 4.

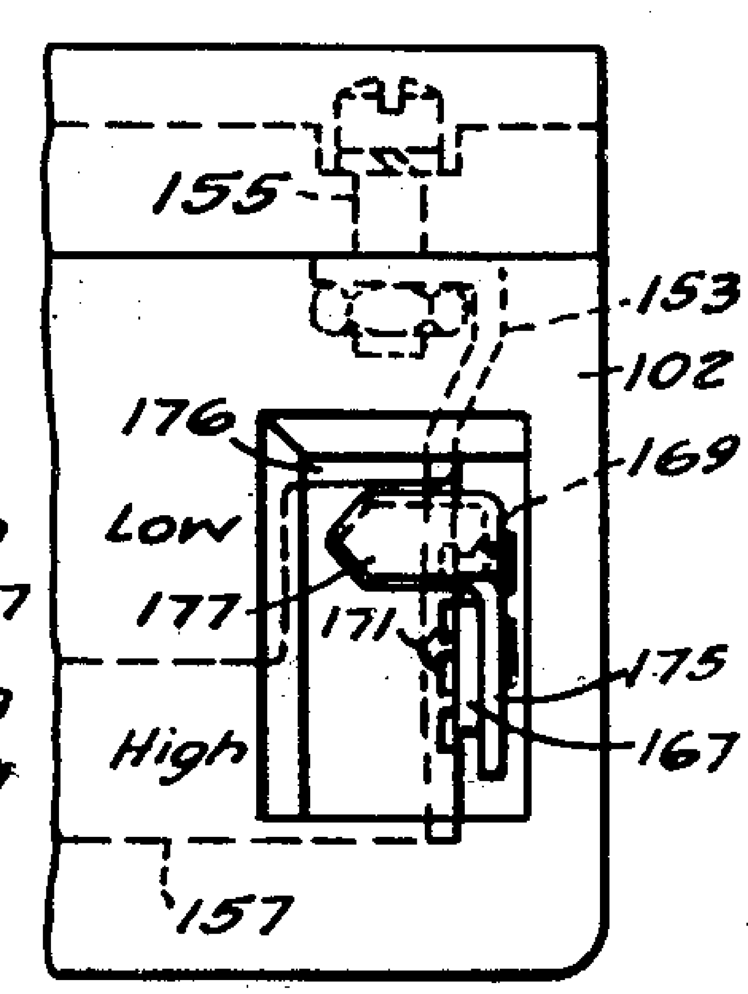
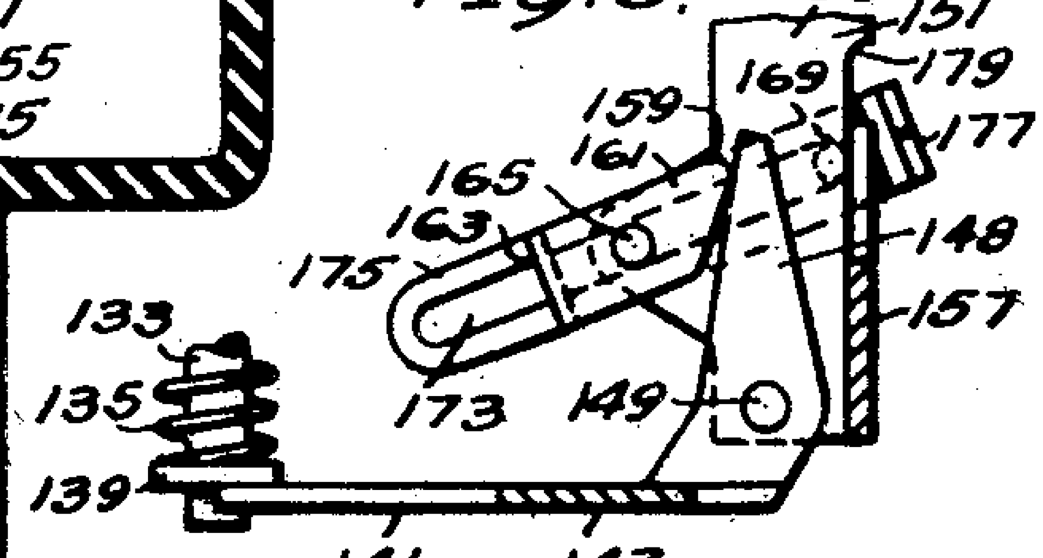


Fig. 5.



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ELECTROMAGNETIC TRIP CIRCUIT BREAKER

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10 Claims. (Cl. 200—109)

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This invention relates to circuit breakers, and more particularly to trip devices for circuit breakers which are operable to instantaneously trip the breaker on overloads above a predetermined value and after a time delay on lesser overloads.

An object of the invention is to provide a circuit breaker having a current responsive trip device with improved means for adjustably determining the minimum current at which the trip device will operate to instantaneously trip the breaker.

Another object of the invention is to provide a circuit breaker having an electromagnetic trip device including an armature operable to trip the breaker with improved means for adjusting the armature biasing means to thereby vary the minimum current required to instantaneously trip the breaker.

Another object of the invention is to provide a circuit breaker wherein an electromagnetic trip device having a movable armature biased against attraction and operable by said electromagnet to trip the breaker with improved means for manually adjusting the tension of the biasing means to thereby vary the minimum overload current required to trip the breaker.

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

Figure 1 is a vertical sectional view of a three-pole circuit breaker showing the operating mechanism and the trip device embodying the principles of the invention.

Fig. 2 is an enlarged sectional view of the trip device showing the improved adjusting device.

Fig. 3 is a sectional view of the trip device taken on line III—III of Fig. 2 and showing the adjusting device,

Fig. 4 is a front elevational view showing the portion of the adjusting lever which projects outside the breaker casing, and

Fig. 5 is a fragmentary sectional view of the adjusting device.

Referring to Fig. 1 of the drawing, the circuit breaker illustrated is of the three-pole type and is of the same general construction as the circuit breaker fully described in United States Patent No. 2,083,304, issued June 8, 1937, to Ture Lindstrom and assigned to the assignee of the present invention. For a more detailed description of the construction and operation of the main circuit breaker, reference may be had to the above-mentioned patent.

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The circuit breaker comprises, in general, a casing 11 of molded insulating material having a removable cover 13 secured thereon, stationary contact means 15, cooperating movable contact means 17, an operating mechanism 19 and a unitary trip device 21.

Three sets of stationary and movable contact means 15—17 are provided forming the three poles of the breaker. The movable contact means 17 for the several poles are mounted on contact members 23 and the movable contact members 23 for the center pole are pivotally mounted on a movable switch member 25, and are biased toward the stationary contact means 15 relative to the switch member 25 by means of springs 27 carried by the switch member.

The switch member 25 is pivotally mounted by means of a pivot pin 29 on a U-shaped main frame 31 which also supports the circuit breaker operating mechanism 19. The switch members for the outer poles are connected to the center pole switch member 25 for simultaneous movement therewith by means of a rigid tie bar 33 which extends transversely across the three poles of the breaker. Each switch member is securely clamped to the tie bar 33 by a clamp 35, and the switch members are insulated from the tie bar and from each other by means of an insulating sleeve 37 surrounding the tie bar 33.

The electrical circuits for the several poles of the breaker are the same for which reason only the circuit for the center pole will be described. This circuit extends from an upper terminal 45 through a conductor 47, the stationary and movable contact means 15—17, a flexible shunt conductor 49, a conductor 51 and an energizing conductor 53 for the trip device 21 to the lower terminal 55.

The operating mechanism 19 (Fig. 1) is mounted in the main frame 31 and includes a toggle comprising a pair of toggle links 57 and 59 having one end pivotally connected to the center pole switch member 25, a carrier lever 61 for releasably restraining the other end of the toggle 57—59 in operative position, a channel-shaped operating member 63, an overcenter spring 65 for connecting the operating member 63 to the knee 67 of the toggle 57—59, and an operating handle 69.

The main frame 31 is disposed below the contact means and is rigidly secured to the base of the casing 11 by means of screws 71 and 73. The screw 73 extends through the conductor 51 and serves to secure the conductor 51 as well as the frame 31 to the casing. One end of the toggle link 57 is pivotally connected to the center pole switch member 25 by a pivot pin 77 and the other end of the toggle link 57 is pivotally connected to one end of the toggle link 59 by the knee pivot pin 67.

The lower end of the overcenter spring unit is pivotally connected to the lower end of the operating member 63 by means of a pivot pin 81 and a pair of supporting ears 83 projecting from the operating member 63. The operating member 63 is pivotally supported on the main frame 31 by means of a pivot pin 85. The lower end of the toggle link 59 is pivotally connected to the carrier lever 61 by means of pivots 87 only one of which is shown.

The carrier 61 is pivotally in the main frame by means of a pivot pin 89 at the apex of the bell crank levers. Clockwise movement of the carrier lever is normally prevented by a latching lever 91 comprising a pair of spaced parallel levers which are joined by integral yokes 93 and 95 and pivotally mounted on a pivot pin 97 supported in the main frame 31. The yoke 93 of the latching lever 91 normally engages the upper end of the carrier lever 61 and restrains the carrier lever in operative position. The free lower end of the latching lever 91 carries a pivoted latch engaging pawl 99 supported on the yoke 95 of the latching lever, the pawl 99 and the latching lever 91 being normally restrained by the trip device 21.

When the trip device is operated the pawl 99 and the latching lever 91 are released thereby permitting counterclockwise movement of the latching lever under the biasing influence of the overcenter spring unit 65. This movement of the latching lever causes the yoke 93 to release the carrier lever 61 which is then moved clockwise about the pivot 89 by the overcenter spring unit 65 and the force exerted by the contact springs 27. This causes bodily movement and eventually collapse of the toggle 57—59 toward the base of the casing 11 in simultaneous opening of the contacts for all of the poles of the breaker.

In order to reset the breaker following an automatic tripping operation, the operating handle 69 is moved in a clockwise direction to the "off" position. This operation of the handle causes the operating member 63 to engage and reset the carrier lever 61 and the latching lever 91 to their latched positions. The contacts may then be closed by moving the operating handle 69 in a counterclockwise direction to the "on" position.

The circuit breaker may be opened manually by moving the operating handle 69 in a clockwise direction from its Figure 1 position to its extreme clockwise position. When the handle has been moved a short distance, a projection (not shown) on the operating member 63 engages the yoke 75 of the toggle link 57 and starts the knee 67 of the toggle 57—59 toward the base of the breaker at the same time the spring 65 moves across the center line of the toggle link 59 and now exerts a force in a direction to move the knee of the toggle toward the base. The movement of the several parts of the operating mechanism is now automatic and the contacts for all of the poles are opened simultaneously with a snap action.

The contacts are closed after they have been opened manually by moving the operating handle in a counterclockwise direction which carries the line of action of the spring unit 65 over the center line of the toggle link 59. The springs 65 then exert a force biasing the knee of the toggle outwardly from the base, causing straightening of the toggle and closing of the contacts of all of the poles with a snap action.

The trip device comprises a unitary structure the several elements of which are mounted on a panel 101 (Figs. 1 and 2) of insulating material removably mounted on the base of the casing 11. The trip device is enclosed in a casing 102 and comprises generally a bimetal element 103 and an electromagnet 105 for each pole of the breaker. The conductor 53 forms a loop 107 which, near its left-hand end, is secured to a bracket 109 by means of rivets 111. The rivets 111 also serve to rigidly secure one end of the bimetal element 103 to the conductor 53. The bimetal element 103 extends to the right substantially parallel to the upper leg of the loop 107 of the conductor 53 which serves as a heater element for the bimetal element. The bracket 109 is firmly secured to the panel 101 by means of bolts 113 which pass through openings in the panel and in the bracket 109 thereby rigidly securing the conductor 53 and the bimetal element 103 to the panel. A trip bar 115 of insulating material is pivotally supported by means of brackets 117 (only one being shown) which are suitably secured to the panel 101. The trip bar extends across all of the poles of the breaker and is adapted to be operated by the thermal trip device or the electromagnetic trip device of any pole to effect release of the operating mechanism and opening of the contacts. Secured to the trip bar 115 is a latch member 119 which engages and restrains an intermediate latch 121. The latch 121 is pivotally mounted on a pin 123 in the bracket 117 and is provided with a latching portion which engages the pawl 99 and restrains the latching lever 91 and the operating mechanism in the closed position. Also secured to the trip bar 115 is an extension 125 having secured thereto near its free outer end a pin 127 which is adapted to cooperate with the bimetal 103 to operate the trip bar.

Upon the occurrence of an overload current below, for instance 1000% of normal rated current in the circuit of any pole of the breaker, the bimetal element 103 associated with the affected pole is heated by the flow of excessive current through the loop 107 of the conductor 53 and when heated a predetermined amount deflects upwardly rotating the trip bar 115 counterclockwise about its pivot point. This movement of the trip bar releases the latch 121 whereupon the force of the operating springs 65 (Fig. 1) causes opening of the contacts in the previously described manner.

The breaker is tripped instantaneously upon the occurrence of overloads of 1000% or more of normal rated current, or on short circuits by means of the electromagnetic trip means 105. The electromagnet 105 comprises a fixed U-shaped core member 129 (Figs. 1 and 2) rigidly supported on the bracket 109, and a movable armature 131 slidably mounted on a pair of spaced rods 133 (see also Fig. 3) secured to and projecting downwardly from the panel 101. The armature 131 is biased to unattracted position by means of springs 135 surrounding the rods 133 and compressed between the ends of a bar 137 to which the armature is secured, and washers 139 on the lower ends of the rods 133. The washers 139 are supported by the legs 141 of a bifurcated adjusting lever 143 (Figs. 2, 3 and 4). The end of each of the legs 141 is formed to straddle the corresponding rod 133 to adjustably support the washers 139 and maintains the springs 135 in compression. The upper leg of the conductor loop 107 passes between the pole pieces of the U-shaped magnet core 129 and serves as an energizing means for the electromagnet.

Normal current flowing in the circuit of the breaker including the conductor 53, energizes the electromagnet 105 but not sufficient to attract and operate the armature 131 against the force of the biasing springs 135. Upon the occurrence of an overload current of 1000% or more of normal, or a short circuit, the electromagnet is energized sufficiently to instantaneously attract and move the armature to the pole pieces of the core member 129. During this movement the armature 131 engages a projecting member 145 secured to the trip bar 115 and thereby actuates the trip bar to release the intermediate latch 121 and cause opening operation of the breaker mechanism in the manner previously described.

The minimum overload current required to instantaneously trip the breaker may be selectively varied by adjusting the tension of the springs 135. This is accomplished by operating the adjusting lever 143. The lever 143 is provided with formed over portions 147 and 148 which are pivotally mounted on pivot pins 149 supported in the spaced sides 151 of a bracket 153. The bracket 153 is U-shaped and the sides 151 thereof are rigidly secured to the panel 101 by means of bolts 155. The sides 151 of the bracket 153 are rigidly connected by an integral cross member 157. The formed over portion 148 (Figs. 2 and 5) comprises an arm extending substantially at right angles to the main body of the adjusting lever 143 and is engaged by the rounded end 159 of an arm 161 of a U-shaped lever 163. The lever 163 is pivotally mounted on a pivot pin 165 mounted in the adjacent side 151 of the bracket 153. The other arm 167 of the lever 163 carries a headed pin 169, the head of which is adapted to engage in one of a plurality of retaining slots 171 in the side 151 of the bracket 153 adjacent the arms 167. The pin 169 also extends through an elongated solt 173 in an operating lever 175 disposed adjacent the arm 167, the slot 173 also engaging the pivot pin 165 of the lever 163. The lever 175 is slidable on the pins 165 and 169 and is supported by the heads of these pins. The outer end of the lever 175 projects through an opening 176 in the cover 102 and is bent at right angles to form a handle and pointer 177.

In order to adjust the tension of the springs 135, the lever 175 is first drawn out until the end of the slot 173 engages the pin 165. The outer or handle end of the lever 175 is then moved outwardly away from the bracket 153 in order to disengage the pin 169 from the slot 171 after which the lever 175 is rotated clockwise (Figs. 2 and 5) about the pivot 165 to the desired position. The lever 175 is then released and the head of the pin 169 enters the appropriate slot 171 which retains the adjusting device in the position to which it is set. The force of the springs 135 pressing the arm 148 (Fig. 5) against the rounded end of the arm 161 of the U-shaped lever 163 produces a force which tends to turn the lever 163 counterclockwise in the plane of the axis 165 of the lever. This presses the arm 167 of the lever 163 against the side of the bracket 153 adjacent the lever, thus retaining the pin 169 in the selected slot 171. The lever 175 is then slid inwardly over the pins 165—169 to the position shown in the drawing. The clockwise rotation of the lever 175, due to the pin and slot connection 169—173, rotates the lever 163 therewith and, due to the engagement of the end 159 of the arm 161 with the arm 148 of the adjusting lever 143, rotates the adjusting lever also in a clockwise direction. Since the arms 141 of the lever 143 engage the washers 139, the clockwise movement of the lever 143 moves the washers 139 along their respective rods 133 thus increasing the biasing force of the springs 135. Increasing the force of the springs biasing the armature 129 against operation increases the minimum current required to instantaneously trip the breaker.

Assuming that the breaker is rated to carry a normal current load indefinitely without actuating the trip device, the bimetal 103 may be calibrated to trip the breaker with an inverse time delay in response to overloads of, for example, between 100% and 300% of the normal rated current. The electromagnetic trip device may be calibrated and adjusted to instantaneously trip the breaker on overloads of, for instance, between 300% and 1100% of rated current depending on the setting of the lever 143 and the corresponding tension placed on the springs 135. Assuming that the trip device is calibrated to the arbitrary values set forth above, with the lever 175 set to the "low" position, as shown in Figs. 2 and 4, the electromagnet will operate in response to an overload current of 300% or more of normal current to instantaneously trip the breaker. If the adjusting lever 175 is moved to the "high" position to correspondingly increase the force of the springs 135 biasing the armature against operation, the armature will not be attracted until the occurrence of an overload current of 1100% or more of normal. By adjusting the lever 175 to a point between the "high" and "low" positions, the magnet will function to instantaneously trip the breaker in response to an overload current of a minimum value corresponding to the particular setting of the lever 175. It will be apparent that the device may be set to cause instantaneous tripping of the breaker in response to minimum overloads of, for instance, 300%, 500%, 700%, 900% or 1100% of normal rated current. It will be understood that if the device is set to instantaneously trip out at a minimum overload of, for example, 700% of normal, the bimetal element 103 will function to trip the breaker after a time delay upon the occurrence of overload currents of any value between 100% and 700% of rated current, or between 100% of normal current and the particular minimum current value between 300% and 1100% at which the device is set.

The "low" or minimum current value at which the magnet will operate to instantaneously trip the breaker may be further adjusted by adding or removing washers 139 (Fig. 5) thus increasing or reducing the initial tension of the springs 135 and the "low" setting of the device. In order to remove or add washers 139, the cover 102 is removed and the operating lever 175—177 is moved counterclockwise beyond the "low" position until it strikes a stop 179 (Fig. 5) in which position the lever 143 has been moved a sufficient distance in a counterclockwise direction to clear the ends of the rods 133 and permit the removal of or the insertion of additional washers 139. The device is then adjusted to the "low" setting. The cover 102 is replaced and sealed so that the adjustment cannot be tampered with.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes and modifications in the structural details and arrangement of parts thereof may be made without departing from some of the essential features of the invention. It is desired, therefore, that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

We claim as our invention:

1. In a circuit breaker, the combination of an armature operable to cause opening of said circuit breaker, spring means arranged to bias said armature against operation, an electromagnet operable in response to predetermined overload current conditions to operate said armature, a lever supporting said spring means, said lever being movable to vary the tension of said spring means to thereby determine the minimum overload current value required to operate said armature, and manual means comprising an adjustable lever engaging said supporting lever and operable when adjusted to move said supporting lever.

2. In a circuit breaker, the combination of an armature operable to cause opening of said breaker, means supporting said armature for sliding movement, means comprising a pair of compression springs arranged to bias said armature against operation, an electromagnet operable in response to overload currents above a predetermined value to operate said armature, a lever having spaced projections engaging and supporting said compression springs, and a lever manually operable to move said supporting lever to vary the compression of said springs to thereby selectively determine the minimum overload current required to operate said electromagnet.

3. In a circuit breaker, the combination of an armature operable to cause opening of said breaker, spaced supports slidably supporting said armature, spring means surrounding said supports and disposed to bias said armature against operation, a pivoted lever having portions thereof engaging and supporting said spring means, said lever being adjustable to vary the tension of said springs, an electromagnet operable in response to overload currents of a predetermined value to operate said armature, and a manually adjustable lever movable to adjust said pivoted lever to selectively determine the operating characteristic of said electromagnet.

4. In a circuit breaker, the combination of a trip member operable to effect opening of said circuit breaker, an armature movable to operate said trip member, a plurality of springs disposed to bias said armature against attraction, a support member common to all of said springs adjustably supporting said springs, a manual lever having a cam portion engaging a portion of said support member, said manual lever being operable to adjust said support member to simultaneously vary the tension of all of said springs, and an electromagnet operable in response to overload currents to operate said armature to effect opening of said circuit breaker.

5. In a circuit breaker, the combination of an armature operable to effect opening of said circuit breaker, spaced supports slidably supporting said armature, spring means disposed to bias said armature against operation, a pivoted lever having spaced portions thereof engaging and supporting said spring means, said lever being adjustable to vary the tension of said spring means, electromagnetic means operable in response to overload currents to operate said armature, a

manually adjustable lever movable to adjust said pivoted lever to thereby selectively determine the minimum overload current required to operate said electromagnetic means, and a projection on said manually adjustable lever engaging a fixed member to restrain said manually adjustable lever and said pivoted lever in the adjusted position, said spring means acting through said pivoted lever to maintain said restraining means in engagement with said fixed member.

6. In a circuit breaker, the combination of an electromagnet including a U-shaped magnet core, an armature operable in response to overload currents to effect opening of said circuit breaker and an energizing conductor extending between the legs of said core member for energizing said electromagnet, spring means disposed to bias said armature against operation, a pivoted lever having spaced legs straddling said conductor and supporting said spring means, and a manually adjustable member movable to adjust said lever and vary the tension of said spring means to thereby vary the minimum overload current required to operate said armature.

7. In a circuit breaker, a trip device operable in response to overload currents to effect opening of said circuit breaker comprising a sealed casing enclosing said trip device, a conductor having an energizing loop disposed in said casing, an electromagnet energized by said conductor, an armature operable by said electromagnet to release said operating mechanism, a pair of springs disposed to bias said armature against operation, a forked lever straddling said loop and supporting said springs, a manually operable lever having a portion extending through an opening in said casing, and said manually operable lever engaging said forked lever and being operable to adjust said forked lever to vary the tension of said springs thereby varying the minimum overload required to operate the armature.

8. In a circuit breaker, the combination of trip device operable to effect opening of said circuit breaker comprising a sealed casing enclosing said trip device, a conductor having an energizing loop disposed in said casing, an electromagnet disposed in said casing between the legs of said loop to be energized thereby, an armature operable by said electromagnet, a pair of springs disposed one on each side of said loop biasing said armature against operation, a support lever mounted in said casing and having legs straddling said loop supporting said springs, a manual lever mounted in said casing and having a portion engaging said support lever, and an extensible arm slidably mounted on said manual lever and extending through an opening in said casing and operable to adjust said support lever to thereby vary the tension of said springs.

9. In a circuit breaker, the combination of a tripping electromagnet including an armature operable in response to overload currents to effect automatic opening of said breaker, a pivoted lever, spring means compressed between one end of said pivoted lever and said armature biasing said armature against operation, said pivoted lever being positionable to selectively vary the compression of said spring means while said armature remains stationary to thereby vary the minimum overload current required to operate said armature, and a settable lever cooperating with said pivoted lever to selectively position said pivoted lever.

10. In a circuit breaker, the combination of a tripping electromagnet, a slidable armature op-

erable to cause opening of said circuit breaker, said electromagnet being operable in response to overload currents to operate said armature, a pivoted member, a plurality of springs compressed between said pivoted member and said armature biasing said armature against operation, and a manual operator cooperating with said pivoted member and operable to adjustably position said pivoted member to thereby simultaneously vary the compression of all of said springs while the armature remains stationary to thereby vary the tripping point of the breaker.

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