March 15, 1966 J. N. GROVES ETAL 3,240,903

CIRCUIT INTERRUPTER WITH THERMAL TRIP MEANS

Filed Nov. 15, 1961 2 Sheets-Sheet 1

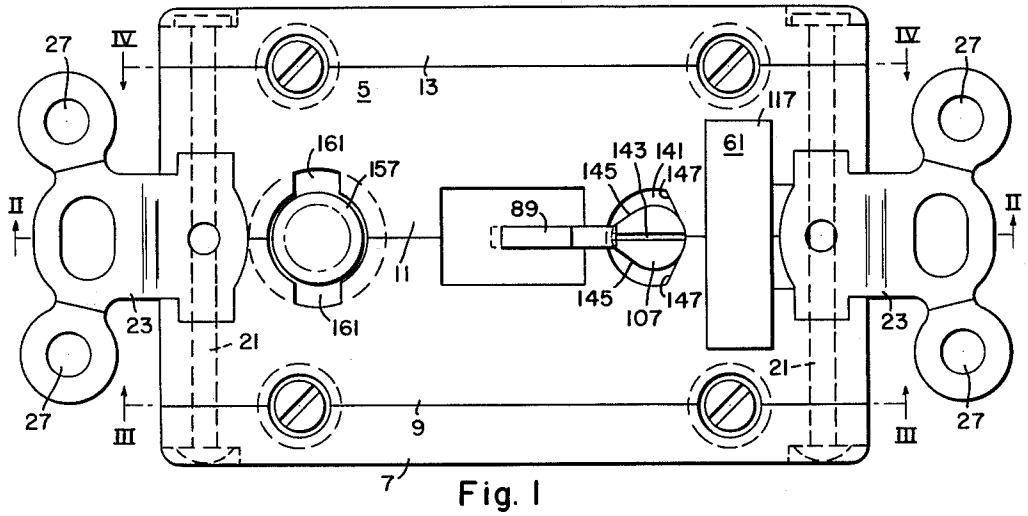


Fig. 1

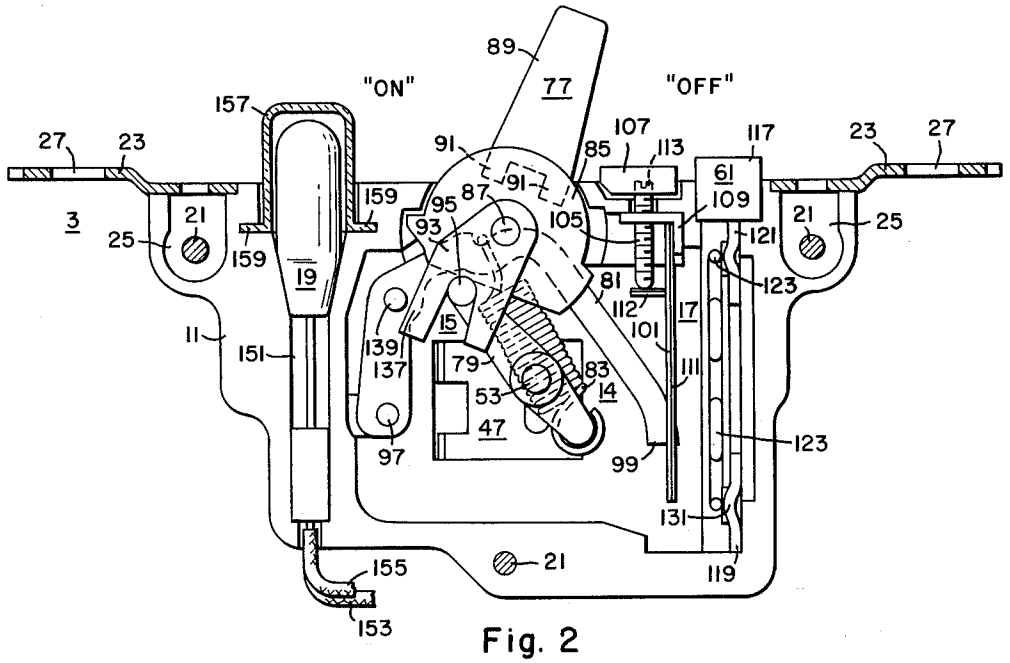


Fig. 2

WITNESSES

John C. Newby, Jr.

James T. Young

INVENTORS
John N. Groves &
Howard E. Reichert
BY William A. Elchik
ATTORNEY

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CIRCUIT INTERRUPTER WITH THERMAL TRIP MEANS

Filed Nov. 15, 1961 2 Sheets-Sheet 2

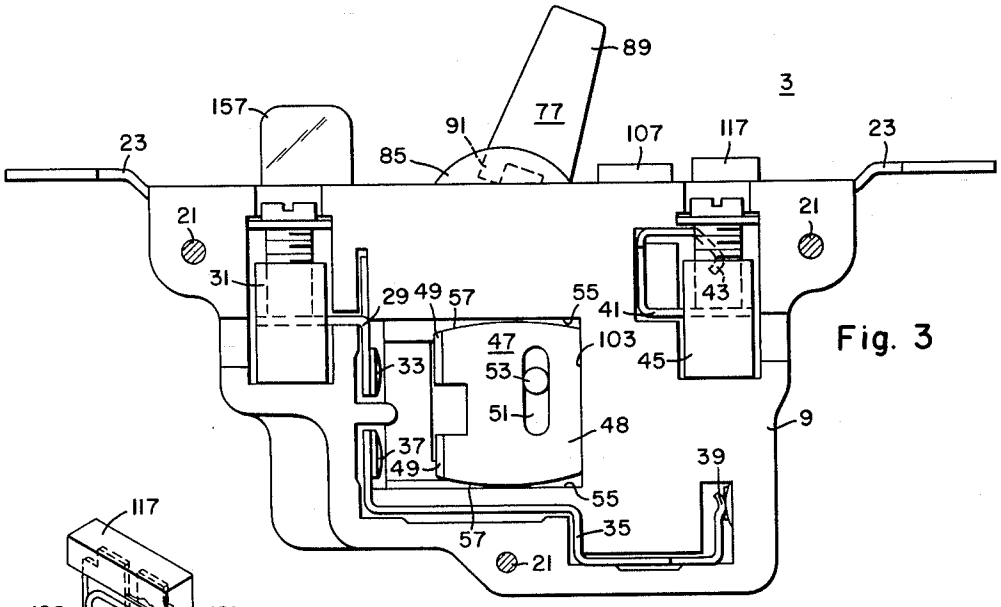


Fig. 3

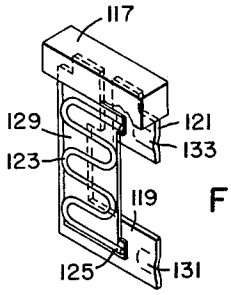


Fig. 5

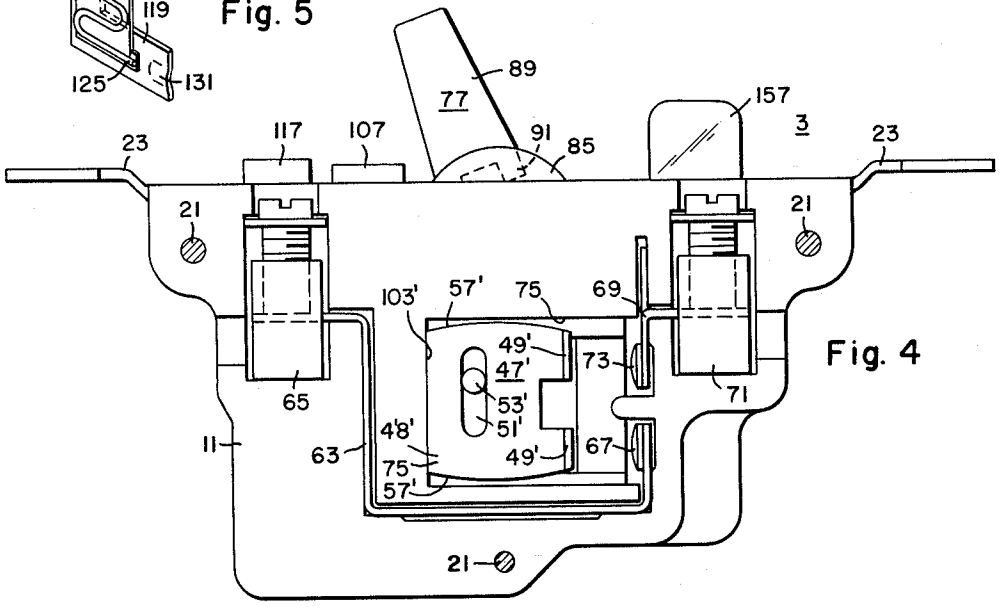


Fig. 4

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3,240,903

CIRCUIT INTERRUPTER WITH THERMAL TRIP MEANS

John N. Groves and Howard E. Reichert, Beaver, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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2 Claims. (Cl. 200—116)

This invention relates to circuit interrupters, and more particularly to manually and automatically operable circuit breakers for controlling motor, lighting and other small and moderate power electric circuits.

Circuit breakers having thermally operated automatic tripping devices are generally calibrated in the factory to trip open upon the occurrence of certain predetermined overload current conditions. It is desirable to provide for an additional adjustment that can be made in the field in order to prevent these breakers from tripping open when a tripping operation is not necessarily required for protection of the circuit.

Accordingly, an object of this invention is to provide an improved circuit breaker having a thermally operated tripping mechanism that can be adjusted in the field to prevent the above-mentioned type of nuisance tripping.

In order to provide that an operator cannot over-adjust the tripping mechanism, which over-adjustment might damage the mechanism or prevent a tripping operation upon the occurrence of a damaging overload, another object of this invention is to provide an improved circuit breaker having a thermally operated tripping mechanism that can be externally adjusted only to a limited extent.

In accordance with another object of this invention, compactness and simplicity are achieved by providing an improved circuit breaker having an improved external adjusting mechanism that operates the same screw that is operated for factory calibration of the tripping mechanism.

In the art of controlling small motor circuits, it is sometimes desirable to have a circuit interrupter that can be used with circuits having different electrical loads so that the same circuit breaker can be used in different motor circuits. Certain prior-art type circuit breakers are provided with removable heater members for heating the thermally responsive element of the tripping device. Thus, these circuit breakers can be adjusted by merely changing the removable heater members. It is desirable, for this type of circuit breaker to provide for a further trip adjustment in addition to the adjustment by means of the heater change in order to provide a breaker having a wide coverage of interrupting ratings without requiring a large number of heater changes.

Thus, another object of this invention is to provide an improved circuit breaker having a trip device that can be adjusted by changing a removable heater member and that is provided with means permitting an additional external adjustment.

A further object is to provide an improved circuit breaker in accordance with the immediately preceding object wherein means are provided to limit the amount of the additional external adjustment.

Another object of this invention is to provide an improved circuit breaker with a handle, adjustable means and indicating means at the front of the circuit breaker, and with removable heater means accessible for removal at the front of the housing.

A general object of this invention is to provide a circuit breaker having increased utility.

Certain features that are herein disclosed are disclosed and claimed in the patent to Gerald J. Freese, Patent No. 3,211,861, issued October 12, 1965.

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

In the drawings:

FIGURE 1 is a top plan view of a circuit breaker constructed in accordance with this invention;

FIG. 2 is a sectional view taken substantially along the line II—II of FIG. 1 looking in the direction of the arrows and showing the operating and tripping mechanisms of the circuit breaker;

FIG. 3 is a sectional view taken along the line III—III of FIG. 1 looking in the direction of the arrows and showing the contact structure of one pole of the breaker;

FIG. 4 is a sectional view taken along the line IV—IV of FIG. 1 looking in the direction of the arrows and showing the other pole of the breaker, and

FIG. 5 is a perspective view on a smaller scale of a heater member seen in FIG. 2.

As shown in the drawings, a circuit breaker **3** comprises a housing **5** (FIG. 1) which is divided into four parts **7, 9, 11** and **13** to facilitate assembly of the breaker. The housing parts are all of molded insulating material.

The two central housing parts **9** and **11** are provided with internal surfaces and recesses for receiving and supporting a circuit-breaker mechanism **14** (FIG. 2) comprising an operating mechanism **15**, a trip device **17** and a lighting device **19**. The two central housing parts **9** and **11** are also provided with recesses and surfaces on the outer sides thereof for cooperating with similar recesses and surfaces on the inner sides of the outer housing parts **7** and **13** (FIG. 1) for receiving and supporting the terminals, conductors and contact structures seen in FIGS. 3 and 4. The housing parts **7, 9, 11** and **13** are held together by means of three rivets **21**.

In order to mount the circuit breaker in an outlet box, there is provided a pair of brackets **23**, one disposed at each end of the breaker housing. Each of the brackets **23** is provided with a pair of downwardly extending ears **25** (FIG. 2) having openings therein for receiving one of the rivets **21**. The brackets **23** have openings **27** therein for receiving means for mounting the breaker on a panel or in an enclosure.

As seen in FIG. 3, the various recesses and surfaces of the housing parts **7** and **9** support a pole unit comprising a conductor **29** having a solderless terminal connector **31** attached to one end thereof and a stationary contact **33** secured to the other end; a conductor **35** having a stationary contact **37** secured to one end thereof and a contact surface **39** at the other end, and a conductor **41** having a contact surface **43** at one end thereof and a solderless terminal connector **45** suitably supported at the other end.

In operation, the stationary contacts **33** and **37** are bridged by an improved movable contact member **47** comprising a generally flat conducting plate **48** having two contact surfaces **49** at one end thereof. The plate **48** may be of a suitable conducting material such as copper and the contact surfaces **49** may be of a better conducting material such as silver. The plate **48** has a slot **51** therein for receiving a pin **53** that drives the contact member **47** to slide it endwise or rectilinearly into and out of engagement with the contacts **33, 37** in a manner to be hereinafter specifically described. As seen in FIG. 3, the housing part **9** has two surfaces **55** thereon that provide a track for guiding the member **47** in its path. Upper and lower surfaces **57** of the contact member **47** are curved as seen in FIG. 3 so that if the contacts **49** or the contacts **33, 37**

are slightly out of alignment the contact member 47 can rock in the plane of its flat surfaces in order to provide adequate contact engagement.

When the movable contact member 47 is in the closed position, the circuit through the pole unit seen in FIG. 3 extends from the terminal 45 through the conductor 41, the contact 43, a plug-in type heater member indicated generally at 61 (FIGS. 2 and 5), the contact 39 (FIG. 3), the conductor 35, the contact 37, the bridging movable contact member 47, the contact 33, the conductor 29, to the terminal member 31. The circuit is opened by movement of the contact member 47 to the open-circuit position seen in FIG. 3.

The various recesses and surfaces of the housing parts 11 and 13 (FIG. 1), support a pole unit (FIG. 4) comprising a conductor 63 having a solderless terminal connector 65 attached to one end thereof and a stationary contact 67 secured to the other end, and a conductor 69 having a solderless terminal connector 71 attached to one end thereof and a stationary contact 73 secured to the other end. Surfaces 75 on the housing part 11 form a track for guiding a contact member 47' that is identical with the contact member 47 seen in FIG. 3 for which reason like reference characters are applied to the contact member seen in FIG. 4, except that the reference characters are primed in FIG. 4. A pin 53' is disposed in the slot 51' of the contact member 47' to move the contact member into and out of bridging contact engagement with the stationary contacts 67, 73 in the same manner as the contact member 47 is moved.

Although, as shown in FIGS. 3 and 4, the contact members 47 and 47' at first glance appear to move in different directions, it will be understood from noticing the section lines and the direction of the arrows in FIG. 1, that actually these movable contact members 47 and 47' move in the same direction upon movement of the pins 53 and 53'.

When the circuit breaker is closed, the circuit through the pole unit seen in FIG. 4 extends from the terminal 65 to the conductor 63, contact 67, movable contact member 47', contact 73, conductor 69, to the solderless terminal connector 71.

The contact members 47 and 47' are manually operated to the open and closed positions by operation of the operating mechanism 15 (FIG. 2) which comprises an improved handle-key operating structure 77, an insulating contact operating arm 79, a releasable member 81 and an overcenter spring 83.

The improved handle-key operating structure 77 is of molded insulating material and comprises a lever part 85 pivotally supported by means of two pins 87 (only one being shown in FIG. 2) that are molded integral with the part 85. The pins 87 are pivotally supported in suitable openings in the molded housing parts 9 and 11. The lever part 85 of the operating structure 77 has an opening therein that is shaped to receive and mate with a handle part 89 having two extended parts 91 that fit snugly into the opening. Thus, when it is desired to operate the operating structure 77, the handle 89 is placed in position providing leverage for operating the lever part 85, and after operation, the operator can remove the handle part 89 to make it difficult for an unauthorized person to manually operate the circuit breaker.

The operating lever 85 is generally U-shaped, only one leg 93 thereof being seen in FIG. 2. Each of the legs 93 is itself generally U-shaped as seen in FIG. 2 and each generally U-shaped leg 93 receives in the opening between its legs a pin 95 that is molded integral with the contact operating arm 79. The contact operating arm 79 is generally U-shaped only one leg being seen in FIG. 2, and each leg thereof carries one of the pins 95 that is disposed in the opening between the legs of one of the U-shaped legs 93. An overcenter spring 83 is connected at one end to the bight part of the U-shaped contact operating arm 79 and at the other end in a suitable depression in the releasable member 81. The releasable member 81 is pivotally supported at 97 by means of a pivot pin that is rotatably seated in suitable openings in the housing parts 9 and 11. The other or free end 99 of the releasable member 81 is latched in an opening in a bimetal structure 101. Each of the pins 53 and 53' (FIGS. 3 and 4, respectively) is molded integral with one of the legs of the U-shaped contact operating arm 79 (FIG. 2) and is disposed in the associated slot 51 or 51' (FIGS. 3 and 4) in the associated movable contact member 47 or 47'.

The circuit breaker is shown in the open circuit position in FIGS. 1–4. When it is desired to close the circuit breaker, the handle portion 89 is inserted into the operating lever 85, and rotated counterclockwise (FIG. 2) from the "off" to the "on" position about the pivot 87. This movement because of the engagement of the U-shaped legs 93 of the operating lever 85 with the pins 95 of the contact operating member 79, and also because of the engagement of the pins 53 and 53' in the slots 51 and 51' of the contact members 47 and 47' moves the contact operating arm 79 down the members 47 and 47' being prevented from moving back by engagement thereof with surfaces 103 and 103' that are formed on the housing members 9 and 11 charging the over-center spring 83. During this motion, the line of action of the over-center spring 83 is moved to the left of a straight line drawn between the centers of the pins 53, 95 and 87, whereupon the overcenter spring 83 discharges snapping the lower part of the movable contact arm 79 to the left (FIG. 2) and moving the pins 53 and 53' to the left to move the movable contacts 47 and 47' (FIGS. 3 and 4) into engagement with their respective stationary contacts 33, 37 and 67, 73.

Thereafter, the handle portion 89 can be removed until it is desired to then open the circuit breaker. In order to manually open the circuit breaker, the handle portion 89 is placed in position in the operating lever 85 and rotated from the "on" to the "off" position (FIG. 2) during which movement the line of action of the overcenter spring 83 is moved to the right of a straight line through the centers of the pins 53, 95 and 87, whereupon the spring 83 discharges snapping the movable contact arm 79 back to the position seen in FIG. 2, which movement, by virtue of the engagement of the pins 53 and 53' in the slots 51 and 51', respectivley, of the contact members 47 and 47' (FIGS. 3 and 4), moves the movable contact members 47 and 47' back to the open-circuit position seen in FIGS. 3 and 4 with a snap-action.

The circuit breaker is automatically tripped open upon the occurrence of an overload current condition above a predetermined amount by means of the trip device 17 (FIG. 2) comprising the plug-in heater member 61 (FIGS. 2 and 5), the bimetal structure 101 (FIG. 2), a calibrating and adjusting screw 105 and an adjusting member 107. The bimetal structure 101 is welded or otherwise secured to an L-shaped bracket 109 that is suitably secured to the housing parts 9 and 11. As was hereinbefore explained, the bimetal structure 101, has an opening in the lower or free end thereof forming a lower edge upon which one end 99 of the releasable member 81 is latched.

The bimetal structure 101 comprises a first part 111 and a second part 112. The second part 112 is lanced out of the part 111 and it extends generally normal to the part 111 (FIG. 2). The calibrating screw 105 is supported in a tapped opening in one leg of the bracket 109 and it engages the lanced-out part 112 of the bimetal structure 101. The upper end of the screw 105 has a notch 113 therein for receiving a screwdriver or other tool.

The plug-in heater member 61 (FIGS. 2 and 5) comprises a supporting frame 117 of molded insulating material having secured thereto two conducting plates 119 and 121. A resistance wire 123 is secured at one end

125 to the conducting plate 119 and at the other end 127 to the conducting plate 121. An insulating sheet 129 is provided between the resistance wire 123 and the conducting plates 119, 121, except where the connections 125, 127 are made. When the heater member 61 is in operating position, a lower contact portion 131 on the conducting plate 119 engages the contact 39 (FIG. 3) of the conductor 35, and an upper contact portion 133 (FIG. 5) on the conducting plate 121, engages the upper contact portion 43 (FIG. 3) of the conductor 41. Thus, when the plug-in heater is in position, the circuit through the pole seen in FIG. 3, extends from the contact 39 through the contact 131 (FIG. 5), the conducting plate 119, the resistance wire 123, the conducting plate 121, the contact 133, to the contact 43 (FIG. 3).

When an over-load current above a predetermined amount occurs in the circuit controlled by the closed circuit breaker, the resistance wire 123 is heated to inductively heat the bimetal structure 101 (FIG. 2). The high expansion side of the bimetal part 111 is on the left as seen in FIG. 2, so that when the bimetal is heated sufficiently, the bimetal part 111 bends and the lower end thereof moves to the right to release or unlatch the releasable member 81. When the releasable member 81 is released, the member 81, under the bias of the over-center spring 83, is pivoted clockwise about its pivot 97 moving the lever 85, the contact operating arm 79, and the over-center spring 83 to positions wherein the line of action of the spring 83 is to the right of a straight line through the centers of the pins 53, 95 and 87, whereupon the spring 83 operates to move the contact operating arm 79 to thereby move the contacts 47, 47' to the open position. During this movement, the lever 85 (and the handle 89 if it is secured thereto) is moved to a center position intermediate the "on" and "off" positions to provide a visual indication that the circuit breaker has tripped open.

After a tripping operation, the breaker is relatched by manual movement of the handle 89 and lever 85 to the extreme "off" position during which movement a part 137 of the lever 85 engages a pin 139 on the releasable member 81 to move the releasable member 81 counterclockwise about the pivot 97 to relatch the end 99 on the bimetal 101. Thereafter, the circuit breaker is manually operated, in the same manner hereinbefore described, by movement of the handle 89.

The circuit breaker is calibrated when it is assembled at the factory. This calibrating operation comprises running a predetermined overload current through the breaker and rotating the screw 105 to vary the amount of latching engagement between the end 99 of the releasable member 81 and the latching surface of the bimetal 101 until the circuit breaker trips with the desired time delay being considered in the calibrating operation. Thereafter, the part 107 is secured to the member 105 and cemented to this member so that it becomes a permanent part of the trip device.

The member 107 is part of improved means for adjusting the trip device to a limited extent in the field. Referring to FIGURE 1, it will be seen that the member 107 is disposed partially in a cup-shaped opening 141 in the housing parts 9 and 11. A slot 143 is provided in the adjusting member 107 to receive a screwdriver. When it is desired to adjust the trip device, the member 107 is rotated either clockwise or counterclockwise (FIG. 1) to move the bimetal 101 to thereby vary the amount of latch engagement between the releasable member 81 and the bimetal 101.

When the bimetal structure 101 is in the normal position shown in FIG. 2, the part 111 thereof is flexed slightly to the right by means of the screw 105. Thus, if it is desired to adjust the trip device 17 so that the breaker will trip upon the occurrence of a greater minimum overload, the member 107 is rotated counterclockwise (FIG. 1) to move the screw 105 up (FIG. 2) to permit the bimetal structure 101 to unflex to the left. This movement of the bimetal structure 101 increases the amount of latch engagement between the releasable member 81 and the bimetal 101 so that the breaker will trip upon the occurrence of a greater minimum overload. If the adjusting member 107 is rotated clockwise (FIG. 1) the screw 105 is moved down (FIG. 2) to move the bimetal structure 101 to the right. This movement decreases the amount of latch engagement between the releasable member 81 and the bimetal structure 101 so that the breaker will trip upon the occurrence of a lesser minimum overload.

The adjusting member 107 is limited to rotation of less than 90° in either direction, from the position in which it is seen in FIG. 1, by means of stop surfaces 145 thereon that engages with stop surfaces 147 on the housing parts 9 and 11. Thus, the trip mechanism cannot be over-adjusted in the field in a manner that would damage the bimetal or prevent interruption of the circuit upon the occurrence of a damaging overload.

The indicating lamp 19 is supported in a suitable opening 151 in the housing parts 9 and 11 and two leads 153 and 155 from the lamp 19 can be connected across-the-line in the terminals 45 (FIG. 3) and 65 (FIG. 4) in order to provide a visual indication of whether the circuit controlled by the breaker 3 is closed or opened. A plastic cap 157 having two ears 159 thereon is provided over the lamp 19 for protection of the lamp. The ears 159 are placed down into depressions 161 (FIG. 1) in the housing parts 9 and 11 when the cap 157 is being mounted and the cap is then rotated slightly whereupon the ears 159 move within a slot in the housing to a position where they are out of alignment with the depressions 161. The cap 157 is thus locked in place.

From the foregoing, it will be understood that there is provided by this invention a circuit breaker having improved means for adjusting the tripping mechanism of the breaker after the breaker is assembled for use. Thus, the breaker can be adjusted in the field. Simplicity and compactness are achieved by having the external adjusting means operate the same screw that is used for calibrating the circuit breaker during the assembly of the breaker. The external adjusting means can be adjusted only a limited amount to prevent over-adjustment of the tripping mechanism.

With the provision of replaceable heater members and externally operable adjusting means, the total ampere range, within the capacity of the breaker, can be covered. For example, in order to protect a certain motor, it is desirable to interrupt the motor circuits when the current reaches 125% of the normal full load current. A customer could have a choice between two heater members one of which might effect tripping at 120% of the full load current in which case nuisance tripping could occur. The other heater member might effect tripping at 130% of the full load current in which case the motor would not be adequately protected. With the provision of the externally operable adjusting means of this invention, either one of the heater members could be used and the member 107 could be rotated either clockwise (FIG. 1) or counterclockwise, depending on which heater member is used, to adjust the tripping mechanism to trip at 125% of the full load current. It can be understood that the heater members can be constructed having ratings of certain increments and that the external adjusting means can be constructed with a plus and a minus adjustment that will cover the range between increments. With the improved combination of the removable heater members and the external limited adjusting means, it is possible to have the circuit breaker trip at any desired overload within the capacity of the breaker. Thus, an improved circuit breaker is provided having a full coverage of interrupting ratings, with the capacity of the breaker, without requiring a large number of heater changes.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details thereof may be made without departing from some of the essential features of the invention.

We claim as our invention:

1. A circuit breaker comprising an insulating housing, said housing comprising a front part having opening means therein, a circuit-breaker mechanism disposed within said housing and comprising relatively movable contacts operable to open and close an electric circuit, an overcenter spring mechanism operable to open and close said contacts, a handle extending from said opening means in said front part and being manually operable to operate said overcenter spring mechanism to open and close said contacts, trip means comprising a latched trip member releasable to effect opening of said contacts, a bimetal member in an initial position latching said trip member, a heater member removably mounted in said housing and operating upon the occurrence of certain overload current conditions to heat said bimetal member to cause said bimetal member to effect release of said trip member, said heater member being removable through said opening means at said front part of said housing, externally operable adjusting means at said opening means at said front part of said housing operable to move said bimetal member to adjust the releasing action of said bimetal member, and an indicating lamp at said opening means operable automatically to provide a visual indication at said opening means of a particular condition of said contacts.

2. A circuit breaker comprising an insulating housing, said housing comprising a front part having opening means therein, a circuit-breaker mechanism disposed within said housing and comprising relatively movable contacts operable to open and close an electric circuit, an overcenter spring mechanism operable to open and close said contacts, a handle extending from said opening means in said front part of said housing and being manually operable to operate said overcenter spring mechanism to open and close said contacts, trip means comprising a latched trip member releasable to effect opening of said contacts, a bimetal member in an initial position latching said trip member, heater terminal means disposed within said housing, a plug-in type heater member in plug-in type engagement with said heater terminal means and being operable upon the occurrence of certain overload current conditions to heat said bimetal member to cause said bimetal member to effect release of said trip member, said plug-in type heater member being removable through said opening means in said front part of said housing, rotatable adjusting means externally accessible at said opening means in said front part of said housing, said adjusting means being rotatable to move said bimetal member to adjust the releasing action of said bimetal member, means limiting rotation of said adjusting means in both directions, and an indicating lamp at said opening means operable automatically to provide a visual indication at said opening means of a particular condition of said contacts.

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BERNARD A. GILHEANY, *Primary Examiner.*