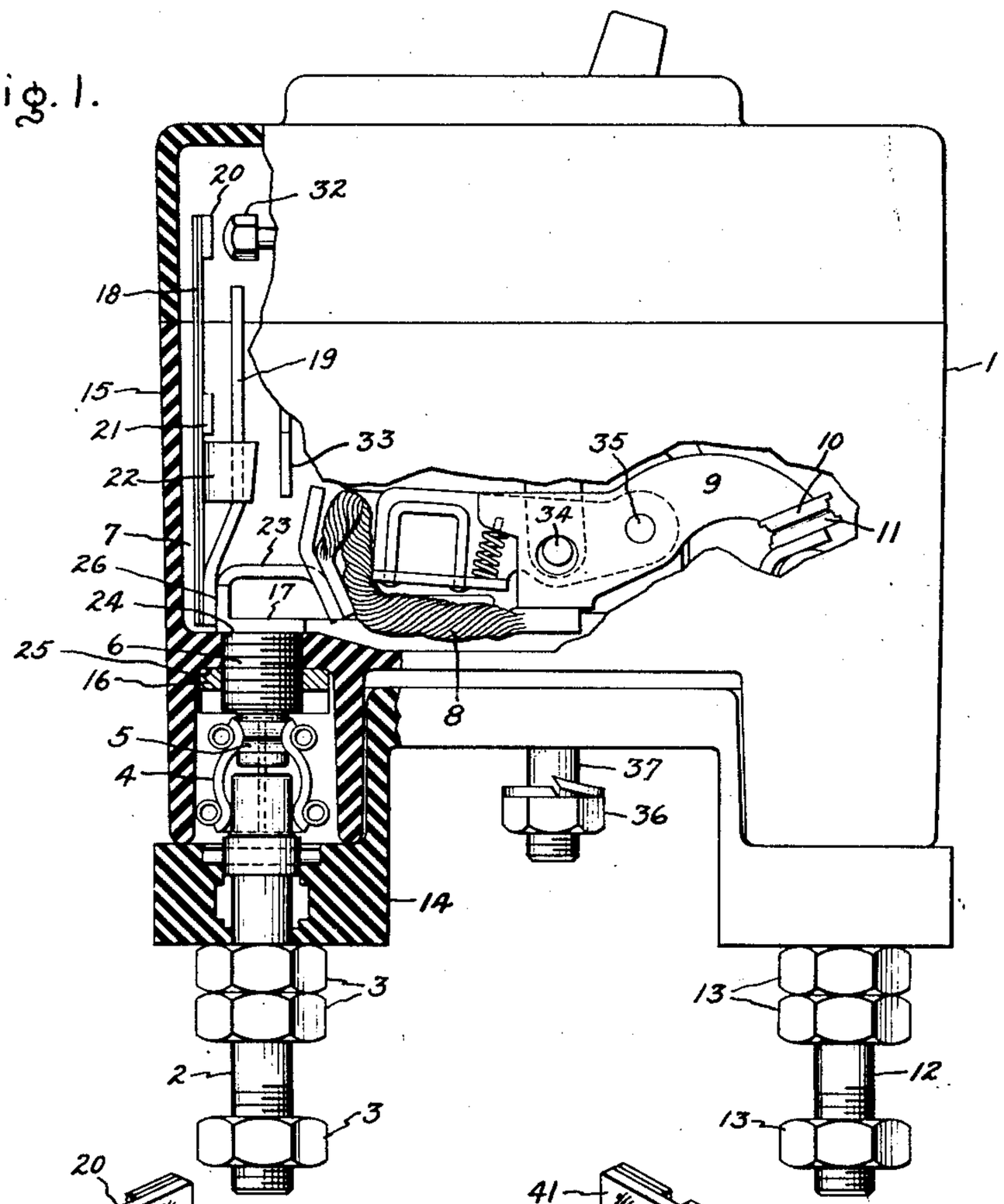
Feb. 24, 1953 R. KERN 2,629,796

THERMAL TRIP MECHANISM FOR CIRCUIT BREAKERS

Filed June 18, 1949

Fig. 1.



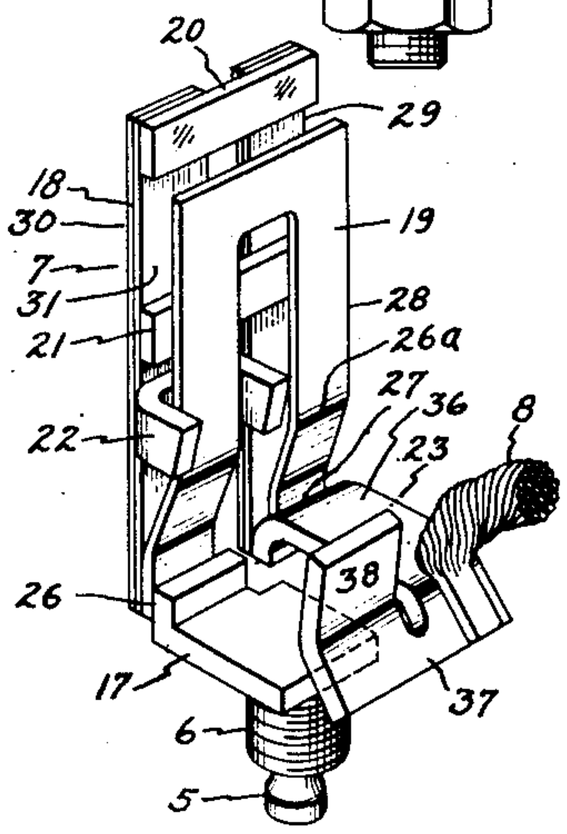


Fig. 2.

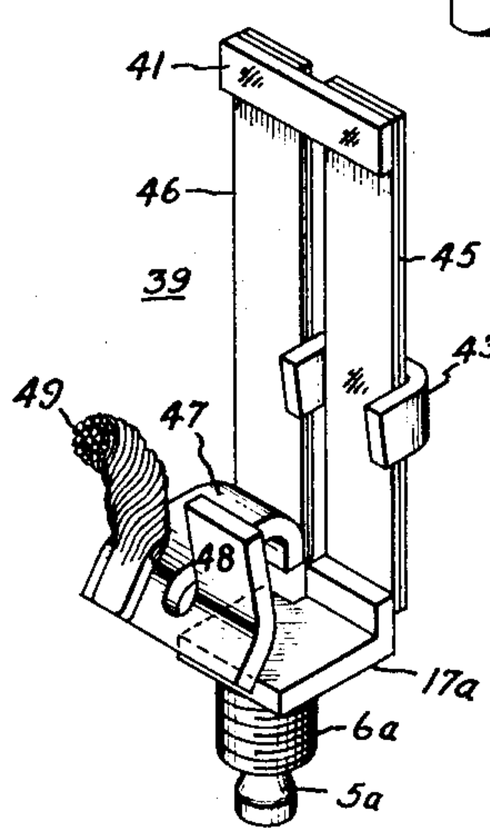


Fig. 3.

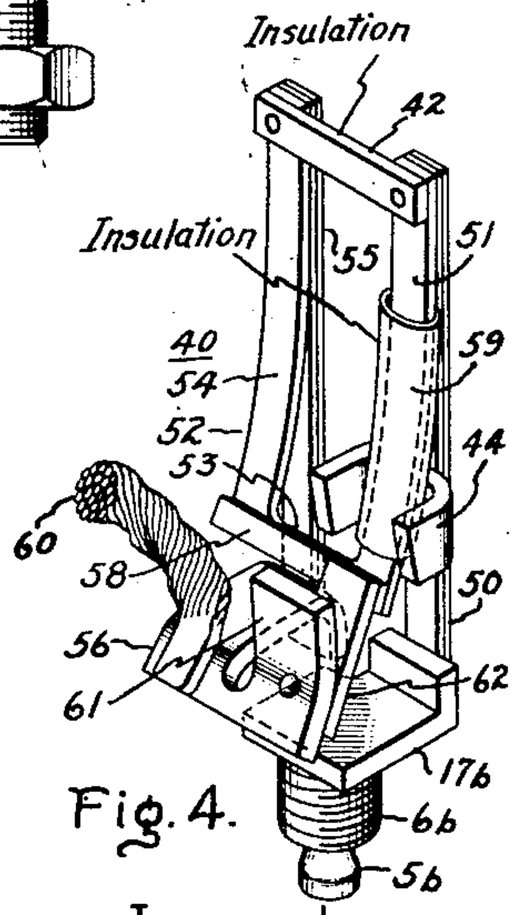


Fig. 4.

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THERMAL TRIP MECHANISM FOR CIRCUIT BREAKERS

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3 Claims. (Cl. 200—116)

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This invention relates to trip units for circuit breakers and in particular to devices that automatically trip to the open position the contacts of a circuit breaker at predetermined overload currents.

Circuit breakers of the subject class are placed directly in electrical lines and serve the function of interrupting the passage of current through the lines when, due to some variation or imperfection in the load circuit, a current equal to or greater than that at which the circuit breaker trip unit is calibrated passes through the lines.

Circuit breakers of the subject type have various operating principles, but one of the more simple types is to have a bimetallic unit operate a tripping mechanism with an inverse time delay when the bimetallic element is heated by load current greater than that at which the circuit breaker trip unit is calibrated to trip with maximum time delay.

Thus the present invention deals primarily with a bimetallic inverse time delay tripping unit that is used to trip to the open position the contacts of a circuit breaker.

An object of this invention is to provide an improved removable single plug contact mounted juxtaposed bimetal trip unit structure capable of calibration at different current ratings to enable interchanging bimetallic units in a circuit breaker so that the circuit breaker may have a rated current ranging from 10 to 200 amperes.

A further object of this invention is to facilitate the production of circuit breakers with the resultant benefits in the art by providing a means whereby one construction of circuit breaker operates on a wide range of rated currents.

A still further object of this invention is to provide a simple method of interchanging bimetallic units within a circuit breaker.

A still further object is to provide a bimetallic unit for circuit breakers which requires minimum operative space.

In its broadest form, this invention comprises a bimetallic means for tripping a circuit breaker at overload current. The said bimetallic means is readily interchangeable allowing the same circuit breaker to be used for various currents up to 200 amperes.

Further objects and advantages of this invention will become apparent and the invention will be better understood from the following description referring to the accompanying drawing, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

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In the drawing, Fig. 1 is a front elevation, partially in section, of a circuit breaker embodying my invention.

Figs. 2, 3 and 4 are perspective views of modifications of the bimetallic unit used in the circuit breaker of Fig. 1.

In the circuit breaker 1 of Fig. 1, an electrical path is provided that comprises a mounting stud 2 which serves to removably mount and electrically connect both the circuit breaker and the trip unit and is located at the point where line current enters the circuit breaker, suitable securing nuts 3, a clip terminal 4, a matching prong or plug contact 5, stud 6, bimetallic unit 7, pigtail 3, movable arm 9, movable contact 10, fixed contact 11, mounting stud 12 which is connected to an electric load, and corresponding nut 13.

Line current is brought into the circuit breaker through stud 2 by means of a lead (not shown) which is held in contact with stud 2 by means of nuts 3. The current passes through stud 2, which is embedded in a plastic base 14, to clip terminal 4 connected to stud 2. The current passes from clip terminal 4 to matching prong 5 and through stud 6, which is an integral part of the bimetallic unit 7, to pigtail 8 welded to bimetallic unit 7, through movable arm 9 to contact 10 which is rigidly recured to the movable arm 9. The current passes from contact 10 to fixed contact 11, to stud 12 and from stud 12 to an electric load (not shown) which is attached to stud 12 by means of a lead (not shown) held in place by nut 13.

The plastic base 14 is removably secured to the body portion 15 of the circuit breaker allowing the body portion to be removed from the base and prong 5 to be removed from clip terminal 4. When the body portion 15 has been removed from the base plate 14, and the cover 15' from body portion 15, the bimetallic unit 7 is readily accessible.

The bimetallic unit comprises prong 5, stud 6, which is held in contact with the body portion 15 of circuit breaker 1 by means of nut 16, a mounting plate 17, a bimetallic element 18, resistor 19, series resistor 20, shunt resistor 21, magnet 22, terminal plate 23 for pigtail 8 which is electrically connected with the movable contact arm 9 carrying contact 10.

Prong 5, an integral part of stud 6, is arranged operatively to engage the spring terminal 4. The contour of prong 5 is such that it may be removably secured within spring contact 4 giving secure electrical contact that allows passage of current from stud 2 to stud 6. Stud 6 is rigidly fastened to mounting plate 17, and is the secur-

ing means for fastening the bimetallic unit 7 to the body portion 15 of the circuit breaker. Stud 6 is inserted through an opening 24 in the body portion of the circuit breaker and held in place by nut 16 which engages a shoulder 25 in the body portion 15.

At point 26, one end of the bimetallic element 18 and one leg of resistor 19 are welded to the mounting plate 17 as indicated in Fig. 2 of the drawing. Current flows from stud 6 through mounting plate 17 to point 26 where it divides, part going through bimetallic element 18 and part going through resistor 19. The current paths are joined again at point 27 where leg 28 of resistor 19 and bimetallic element 29 join the support plate 23 as shown in Fig. 2.

The bimetallic elements 18 and 29 each comprise two strips of metal having different coefficients of expansion. Thus, the outer strip 30 of element 18 has a higher coefficient of expansion than the inner strip 31. The two strips are duplicates and rigidly secured together, in parallel juxtaposition and when heated the top of the bimetallic element bends toward a pin 32 (shown in Fig. 1) which operates a tripping mechanism (not shown). The two bimetallic elements 18 and 29 are joined by a series resistor 20 and a shunt resistor 21. In this construction, shunt resistor 21 functions as a calibrating bar. That is, the current carrying capacity or rating of the bimetallic unit can be changed by varying the position of the shunt resistor 21 along the length of the bimetallic elements 18 and 29. The further shunt resistor 21 is positioned from series resistor 20, the greater is the current rating of the particular bimetallic unit.

Resistor 19 is of substantially uniform cross section and U-shaped, and by changing the size of its cross section, the rating of the bimetallic unit can be varied. From points 26, 27 the resistor is bent away from bimetallic elements 18 and 29, and then at points 26a it is bent again to run parallel to them. Heat generated in the resistor 19 by current passing therethrough is radiated to the bimetallic elements uniformly since both legs of the resistor are of equal size and the heat aids in the bending of the bimetallic elements.

An electromagnet 22 in the form of a U-shaped ferromagnetic member functions as an emergency trip and is securely mounted on bimetallic element 18. When very high current passes through the circuit, such as that caused by a short circuit, a magnetic force is set up in the magnet by the passage of current through bimetallic element 18, to attract an armature 33 which is operatively associated with the pin 32 to cause a tripping mechanism (not shown) to function and open contact 10 away from fixed contact 11. By employing the magnet 22, the contacts of the circuit breaker can be caused to open by the pull of the magnet on arm 33 before the high current has an opportunity to fuse the elements of the bimetallic unit. The magnet 22 is so designed that it does not function at rated or slightly above rated current, but does function only at current levels of the order of short circuit.

Support member 23 preferably comprises a U-shaped portion 36 that forms a mounting seat in offset alignment with the axis of the terminal plug 6 for removably anchoring the bimetal element 29 of unit 7 in position on the body portion 15 of the circuit breaker 1, a flat portion 37 and an upbended portion 38. Current after leaving

bimetallic element 29 and leg 28 of resistor 19 passes through the U-shaped portion 36 of support member 23 to pigtail 8 and from pigtail 8 to movable arm 9 that supports contact 10. The flat portion 37 with its offset upbent arm 38 serves the function of protecting the support plate 17 from the pigtail. That is, it is arranged to prevent electrical contact between support plate 17 and pigtail 8, and the upbent arm 36 acts as a shield between the free portion of the pigtail and the mounting plate 17.

Movable contact arm 9 is electrically connected to pigtail 8 by brazing, and is an integral part of the bimetallic unit; consequently, when a bimetallic unit is installed, a corresponding movable contact arm 9 is also installed. The contact arm 9 is mounted on suitable studs 34 and 35 which in turn are associated with the tripping mechanism (not shown) and which cause the outer end of contact arm 9 which carries contact 10 either to be brought in touch with or away from fixed contact 11.

In operation, current enters from a supply line to stud 2 through clip terminal 4 to matching prong 5, through stud 6 to mounting plate 17 into bimetallic unit 7 through support member 23, pigtail 8 and movable arm 9 to contact 10. When contact 10 is closed on contact 11, current passes through contact 11 to stud 12 to the electrical load.

Load current passing through resistor 19 and bimetallic unit 7 heats the elements 18 and 29, causing them to deflect, and resistor 20 approaches pin 32. The unit is constructed so that, when current at a certain percentage greater than rated passes through the bimetallic unit, enough heat is generated to cause resistor 20 to push against pin 32 and thereby operate a tripping mechanism that causes movable contact arm 9 and its associated contact 10 to move away from fixed contact 11. It is to be understood that suitable arc quenching means are also employed to destroy the arc that extends from contact 10 to contact 11 upon opening.

If a very high current, such as that caused by short circuit, passes through bimetallic unit 7, magnet 22 is energized attracting arm 33 which is operatively associated with pin 32 and causes the tripping mechanism to function and open the contacts 10 and 11. By use of magnet 22, the high short circuit current is interrupted before it has opportunity to fuse the component parts of the bimetallic unit.

When it is desired to change the rating of one of the subject type circuit breakers, the body portion 15 of the circuit breaker is removed from the base portion 14 simply by pulling contact plug 5 out of socket 4. When the cover portion 15' has been removed from body portion 15, the bimetallic unit is then readily accessible and nut 16 may be removed from stud 6 allowing the bimetallic unit to be withdrawn from the body portion 15 after movable contact arm 9 has been removed from pins 34 and 35. A new bimetallic unit of a different rating is then installed in the same manner. That is, movable contact arm 9 is replaced on pins 34 and 35 and stud 6 is inserted through opening 24 and fastened in place by nut 16. The body portion 15 of the circuit breaker is then replaced on the base portion 14 of the circuit breaker with prong 5 coming into operative engagement with spring clip 4. Nuts 36 are then fastened to stud 37 and the circuit breaker is again ready for operation at a different current rating.

Two other types of bimetallic units which are interchangeable with that shown in Fig. 1 and Fig. 2 are illustrated in Figs. 3 and 4 of the drawing. Bimetallic unit **39** shown in Fig. 3 is of the type that has a rating of **50** amperes, while bimetallic unit **40** shown in Fig. 4 is the type that has a rating of 15 amperes. Both bimetallic units **39** and **40** operate the tripping mechanism exactly as the bimetallic unit shown in Figs. 1 and 2. Specifically, the uppermost bars **41** and **42** of bimetallic units **39** and **40**, respectively, press against button **32** to trip the circuit breaker. In addition, each of the bimetallic units **39** and **40** has a magnet **43** and **44**, respectively, that automatically trips the circuit in case of short circuit current.

In bimetallic unit **39**, prong **5***a*, a stud **6***a* and a mounting plate **17***a* are provided which are the duplicates of prongs **5**, **6** and **17** comprising part of bimetallic unit **7**. Bimetallic element **45** is rigidly secured to mounting plate **17***a* and is joined by a series resistor in the form of bar **41** to bimetallic element **46** which is the duplicate of and which is located in spaced alignment with bimetallic element **45**. A supporting plate **47** is rigidly secured to the bottom of bimetallic element **46**. This support plate **47** is similar to plate **23** used for bimetallic unit **7**. Pigtail **48** connects the support plate **47** with a movable arm (not shown) similar to arm **9** shown in Fig. 1. The upturned lip **48** of support plate **47** serves the function of protecting plate **17***a* and bimetallic element **45** from electrical contact with pigtail **49**.

When bimetallic unit **39** is used to replace bimetallic unit **7**, current passes from spring clip **4** into prong **5***a* through stud **6***a* to mounting plate **17***a* and from there into bimetallic element **45** across series resistor **41** and down bimetallic element **46** to support plate **47** through pigtail **49** and the movable contact arm to the contact **10** of the breaker.

The bimetallic elements **45** and **46** comprise a high expansion metal on the outer side and a low expansion metal on the inner side rigidly fastened together, causing bimetallic elements **45** and **46** to bend so that series resistor **41** approaches pin **32** when the bimetallic elements are heated by load current passing therethrough. If the current passing through the bimetallic element is greater than rated current, the element deflects to the extent that series resistor **41** pushes against button **32** causing the mechanism to trip open contacts **10***a* and **11**. If, on the other hand, current of the short circuit magnitude passes through the bimetallic element **45**, a magnetic attractive force is induced in magnet **43** that attracts arm **33** of the tripping mechanism, causing contacts **10***a* and **11** to be opened. By changing the cross section and material of the component parts of bimetallic unit **39**, it can be designed to have a rated current of from 50 to 100 amperes.

Bimetallic unit **40**, illustrated in Fig. 4 of the drawing, comprises prong **5***b*, stud **6***b*, mounting plate **17***b*, bimetallic element **50**, series resistor **52**, bimetallic element **55**, support plate **56**, pigtail **60**, a movable arm and a movable contact. The latter two elements are not shown.

Prong **5***b*, stud **6***b* and mounting plate **17***b* are duplicates of the corresponding parts shown in Figs. 2 and 3. A bimetallic element **50** comprising a high expansion metal and low expansion metal is welded to mounting plate **17***b*. The high expansion metal at the outer side causes an insulating strip **42** to deflect toward button **32** when the bimetallic element is heated.

A U-shaped resistor **52** joins bimetallic element **50** with bimetallic element **55**. The U-shaped resistor **52** comprises two legs **51** and **54** bent away from the two bimetallic elements **50** and **55**. The two legs **51** and **54** of the series resistor are joined by a cross member **53**, and in addition an extra piece of metal **58** is welded to the cross member **53** and serves the function of increasing the area of the cross member **53** so that it will not burn out during interruption tests. The U-shaped resistor **52** that joins the upper ends of bimetallic elements **50** and **55** is fastened to the upper legs of the bimetallic element and is positioned in spaced alignment so that the heat generated in the resistor is uniformly dissipated to the bimetallic elements **50** and **55**, causing them to evenly bend toward pin **32**. A shield **59** is placed on leg **51** of the series resistor **52** in order to protect it from electrical contact with magnet **44** and trip arm **33** which is located near the U-shaped resistor.

A U-shaped magnet **44** is rigidly secured to bimetallic element **50** and serves the same function as magnets **22** and **43** shown in Figs. 2 and 3. Specifically, it attracts tripping arm **33** when current of short circuit magnitude passes through bimetallic element **50** causing movable contact arm **9***b* to separate contacts **10***b* and **11**.

A support plate **56** is rigidly secured to the lowermost portion of bimetallic element **55**, and a pigtail **60** conducts current from support plate **56** to a movable contact arm similar to arm **9** shown in Fig. 1. Support plate **56** has an upturned portion **61** which shields the series resistor **52** from contact with pigtail **60**. An insulating block **62** is employed to prevent the upturned portion **61** of mounting plate **56** from contacting crossbar **53** of series resistor **51** and possibly interfering with operation of tripping arm **33**.

When a bimetallic unit of the type shown in Fig. 4 is inserted in operative position within the circuit breaker in place of bimetallic unit **7**, current flows through mounting prong **5***b*, stud **6***b* and mounting plate **17***b* to a bimetallic element **50**. From there the current passes through leg **51** of series resistor **52**, through cross member **53** of series resistor **52**, through leg **54** of series resistor **52** to bimetallic element **55**, and from there through support plate **56**, pigtail **60**, to the movable arm and contact, through the movable contact to fixed contact **11**, out stud **12** to the electrical load.

Heat generated in the bimetallic elements **50**, **55** and in the series resistor **52** causes the bimetallic elements **50** and **55** to deflect so that insulating bar **42** approaches pin **32**. If greater than rated current passes through the bimetallic elements, the insulating bar **42** presses against pin **32**, causing the mechanism to trip to the open position. If current of short circuit magnitude passes through the bimetallic unit **40**, magnet **44** is activated and attracts arm **33** of the tripping mechanism, causing the circuit breaker to trip to the open position.

While different modifications of the bimetallic units are shown in Figs. 2, 3 and 4, it is to be understood, however, that by varying the physical size of the component parts of each of these bimetallic units, the current rating of each unit can be changed to handle a wide range of currents. Consequently, by interchanging the three units shown and by changing the physical size of the

component parts, it is possible to use one circuit breaker of the type illustrated in Fig. 1 at any current rating of from 10 to 200 amperes.

Modifications of this invention will occur to those skilled in the art, and it is desired to be understood, therefore, that this invention is not to be limited to the particular arrangement enclosed, but that the appended claims are meant to cover all the modifications which do not depart from the spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A circuit breaker trip unit having in combination a mounting plate provided with a single projecting terminal plug contact having threaded means for removably mounting the plug and plate on the circuit breaker, a pair of duplicate bi-metallic elements carried by the mounting plate in spaced apart parallel juxtaposition and having rigid resistor means for heating the elements and for mechanically interconnecting the elements in conducting relation with only one end of one element mounted upon and electrically connected with the mounting plate, a trip member carried by the free ends of the parallel bi-metallic elements, a flexible pigtail for connection with the circuit breaker and having a conducting terminal forming a mounting seat in offset alignment with the axis of the terminal plug contact and electrically and mechanically connected with the other end of the parallel bimetallic element to effect deflection of the free ends of the bi-metallic elements in response to the heating effect of the current passing from the pigtail through the bimetallic elements and the resistor means to the terminal plug contact and thereby effect operation of the trip member in the tripping direction.

2. A circuit breaker trip unit having in combination a supporting plate provided with a single projecting terminal plug contact having threaded means for removably securing the plug and plate on the circuit breaker, a first bi-metallic element secured at one end to the mounting plate, a second bi-metallic element supported in spaced parallel juxtaposition with the one bi-metallic element and having a rigid series resistor mechanically and electrically interconnecting the other end of the one bi-metallic element with the adjacent end of the second bi-metallic element to form a trip member operated thereby, a U-shaped shunt resistor electrically and mechanically interconnecting the one end of the bimetallic element and extending adjacent the elements, a flexible pigtail for connecting with the circuit breaker and having a terminal member forming a mounting seat in offset alignment with the axis of the terminal plug contact and electrically and mechanically connected with the one

end of the second bi-metallic element to effect deflection of the bi-metallic elements in response to the heating effect of the current flowing from the pigtail through the elements and the resistors to the terminal plug contact and thereby effect operation of the trip member in the tripping direction.

3. A circuit breaker trip unit having in combination a mounting plate provided with a single projecting terminal, a plug contact having threaded means for removably securing the plug and plate on the circuit breaker, a pair of bimetallic elements supported by the mounting plate in spaced apart parallel juxtaposition with only one end of one element mounted upon and electrically connected with the mounting plate, an insulating bar joining the other end of the one bi-metallic element with the adjacent end of the other bi-metallic element to form a trip member, a U-shaped series resistor having one end thereof electrically connected with the other end of one bi-metallic element and the other end thereof with the adjacent end of the other bi-metallic element and extending in spaced apart parallel juxtaposition with the elements, a flexible pigtail having a terminal member forming a mounting seat in offset alignment with the axis of the terminal plug contact and mechanically and electrically connected with the other end of the other bi-metallic element for effecting deflection of the bi-metallic elements in response to the heating effect of the current passing from the pigtail through the elements in series with the U-shaped resistor to the terminals and thereby effect operation of the trip member formed by the insulating bar in the tripping direction.

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