April 30, 1963 F. L. GELZHEISER 3,088,008

CIRCUIT BREAKER

Filed Nov. 3, 1959 4 Sheets-Sheet 1

Fig. 1.

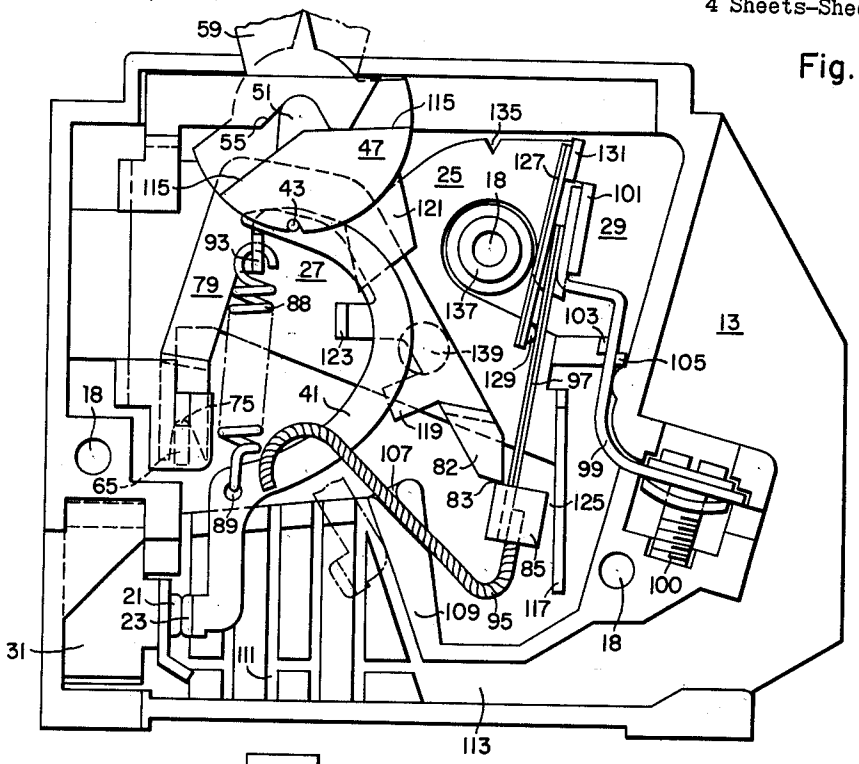
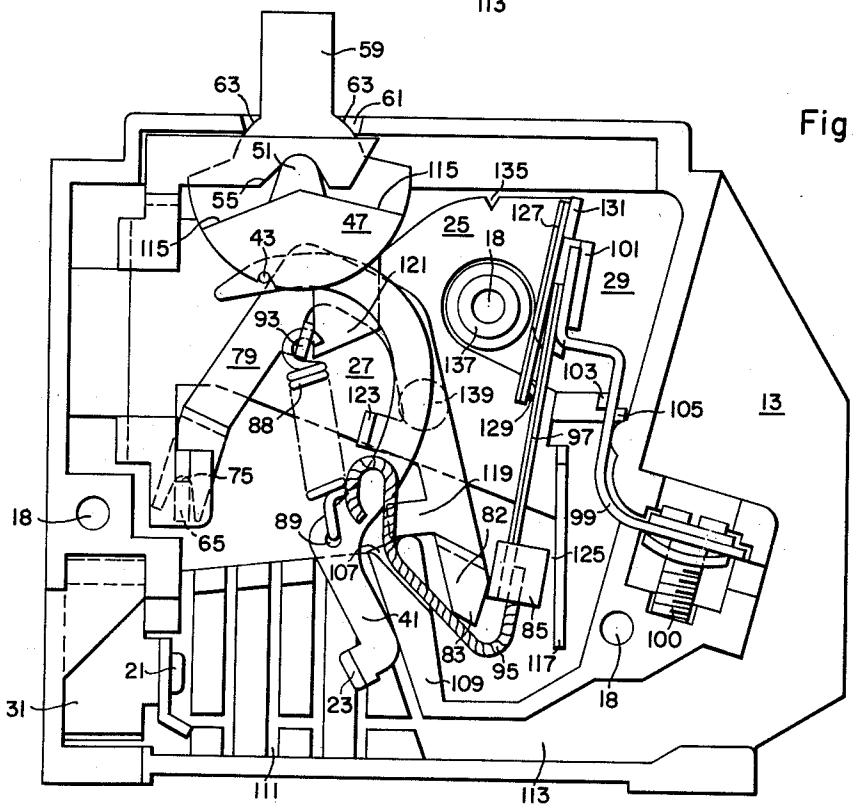


Fig. 2.



April 30, 1963 F. L. GELZHEISER 3,088,008

CIRCUIT BREAKER

Filed Nov. 3, 1959

4 Sheets-Sheet 2

Fig. 3

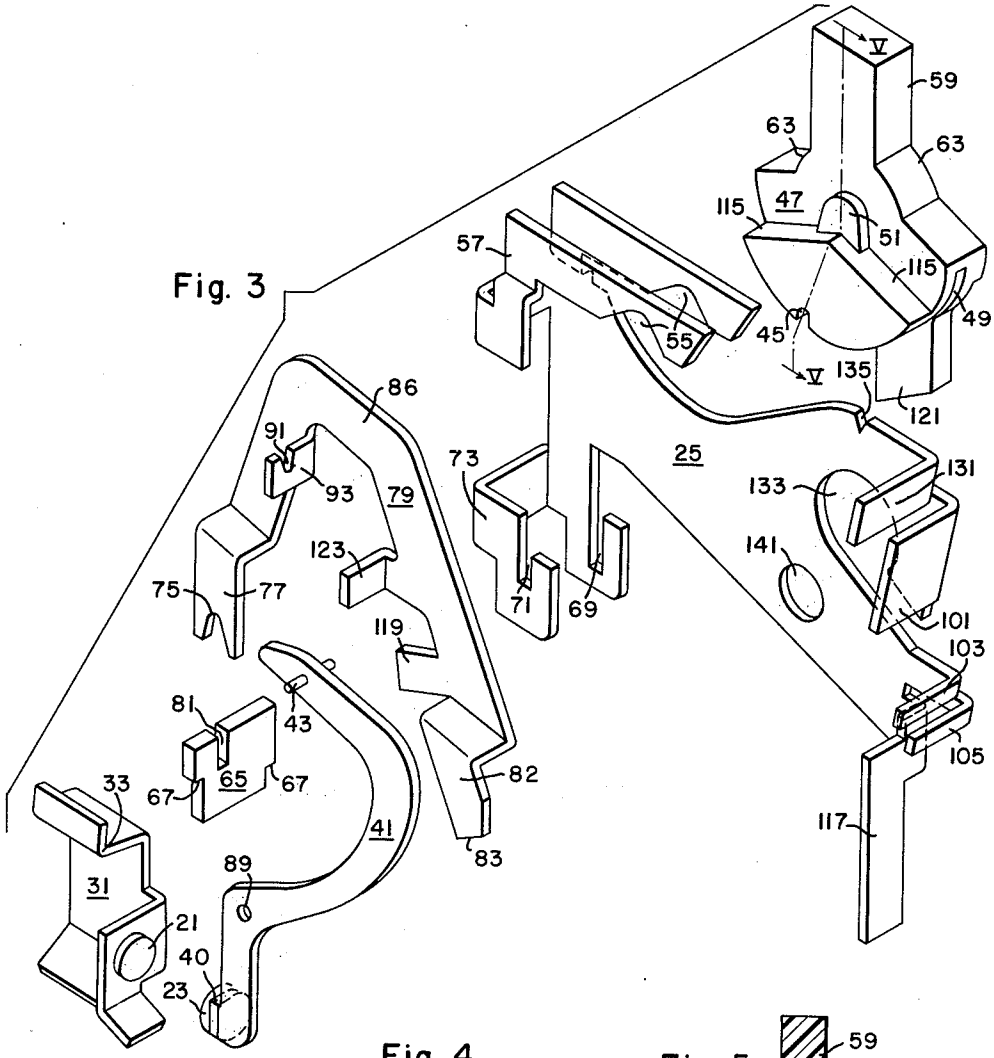


Fig. 4

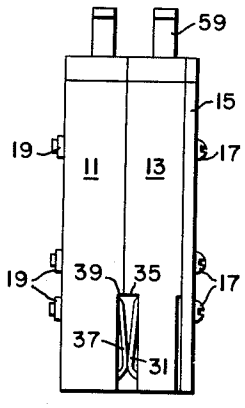


Fig. 5

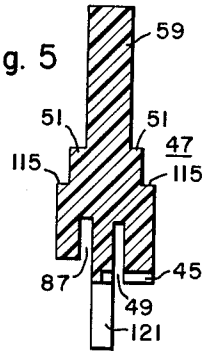
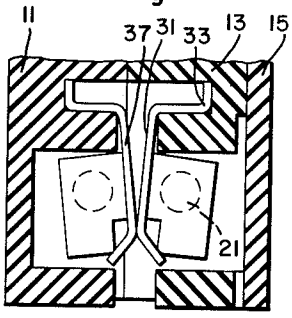


Fig. 6



INVENTOR

Francis L. Gelzheiser

BY

ATTORNEY

April 30, 1963 F. L. GELZHEISER 3,088,008

CIRCUIT BREAKER

Filed Nov. 3, 1959 4 Sheets-Sheet 3

Fig. 7.

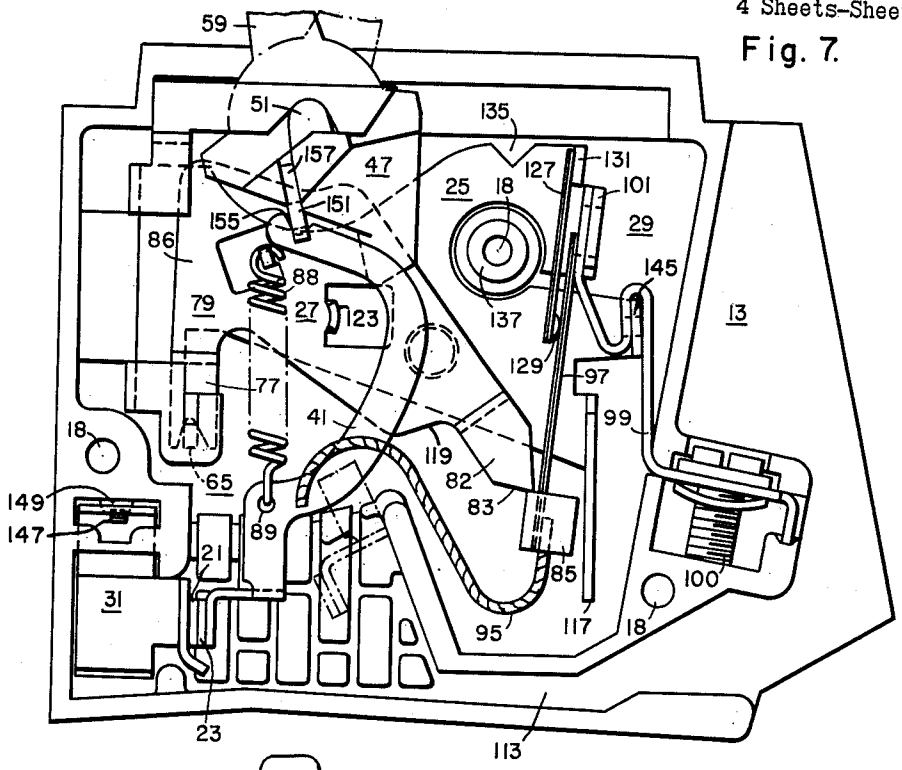
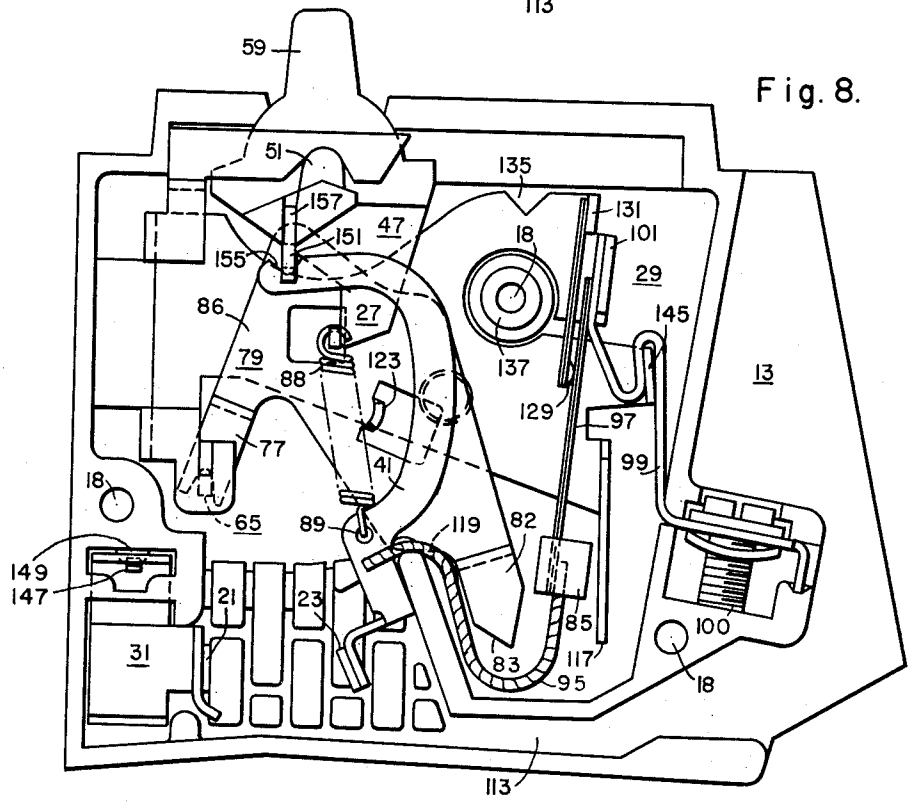


Fig. 8.



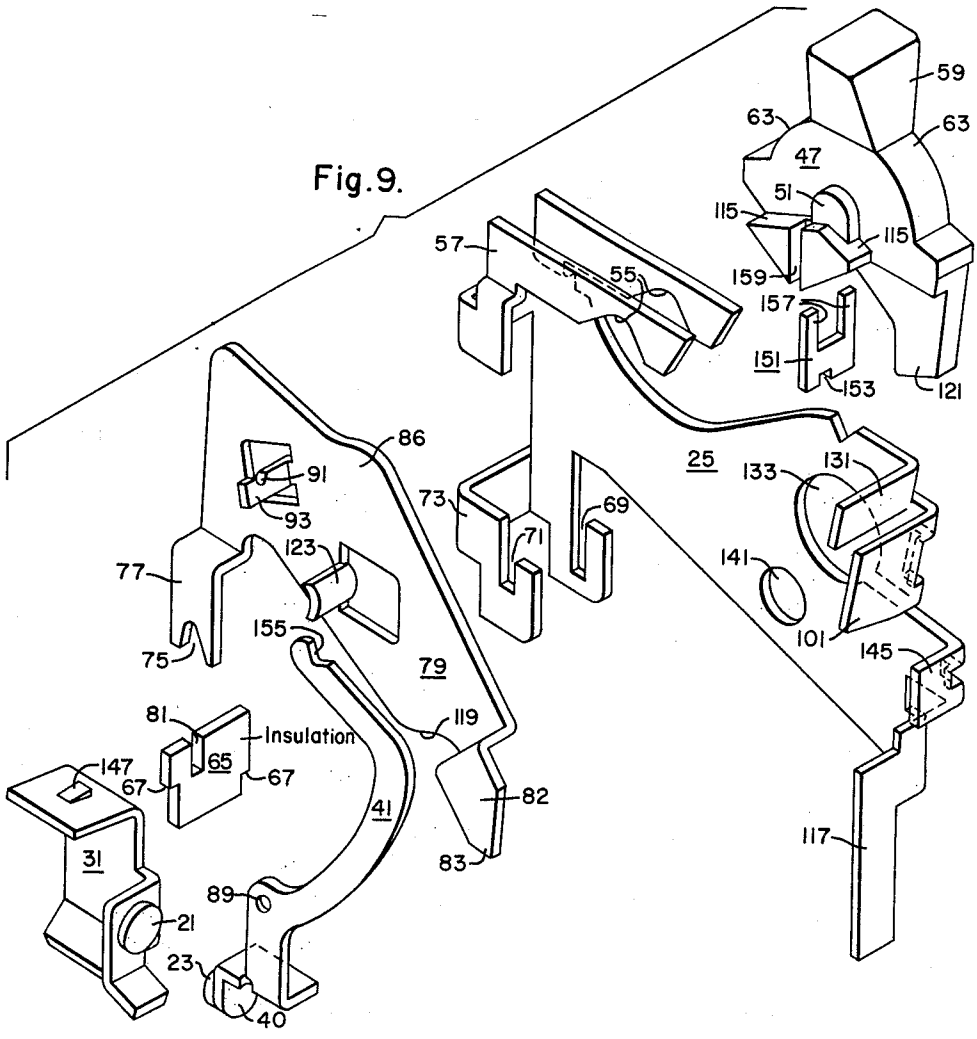
April 30, 1963 F. L. GELZHEISER 3,088,008

CIRCUIT BREAKER

Filed Nov. 3, 1959

4 Sheets-Sheet 4

Fig.9.



United States Patent Office 3,088,008
Patented Apr. 30, 1963

3,088,008

CIRCUIT BREAKER

Francis L. Gelzheiser, Fairfield, Conn., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Filed Nov. 3, 1959, Ser. No. 850,650
20 Claims. (Cl. 200—88)

This invention relates to circuit breakers and more particularly to manually and automatically operable low-voltage circuit breakers for controlling small and moderate power electric circuits.

Certain features that are herein disclosed are disclosed and claimed in my copending patent application Serial No. 850,651, filed November 3, 1959.

An object of the invention is to provide an improved circuit breaker of compact design.

Another object is to provide a circuit breaker with improved means for compactly supporting the mechanism.

Another object is to provide an improved double-type circuit breaker of compact design such that the width of the entire circuit breaker is not more than one inch in dimension.

Another object is to provide a circuit breaker embodying improved automatic tripping means.

Another object is to provide a circuit breaker embodying automatic tripping means with improved means for calibrating the tripping means.

Another object is to provide a circuit breaker embodying a bimetal trip device with improved means for compensating for any bending or unbending of the bimetal in response to changes in ambient temperature.

Another object is to provide a circuit breaker with improved means for positively initiating opening movement of the contacts.

Another object is to provide a circuit breaker with improved means for spacing and insulating the parts from each other.

Another object is to provide a double-type circuit breaker with a novel line terminal structure comprising a separate plug-in terminal member for each breaker mechanism with the terminals engageable with opposite sides of a single stab contact of a load center or panelboard.

Another object is to provide a circuit breaker which is safe and reliable in operation, and which is in inexpensive to manufacture.

The novel features that are considered characteristic of the invention both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of several embodiments thereof when read in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side elevational view of a circuit breaker embodying the principles of the invention. The breaker is shown with the cover removed, and in a closed position with the open position of the movable contact and operating handle being shown in dot-and-dash lines;

FIG. 2 is a view similar to FIG. 1 except that the parts are shown in the tripped position;

FIG. 3 is an exploded perspective view on an enlarged scale of some of the circuit breaker mechanism;

FIG. 4 is an end view on a smaller scale of the assembled duplex breaker.

FIG. 5 is a sectional view of the operating member taken along line V—V of FIG. 3;

FIG. 6 is an end view on an enlarged scale of the lower part of the duplex circuit breaker as viewed in FIG. 4, the outer wall of the insulating housing parts 11 and 13 being broken away for clarity; and

FIGS. 7, 8, and 9 are views similar to FIGS. 1, 2 and 3,

respectively, illustrating another embodiment of the invention.

Referring to FIG. 4 of the drawings, the circuit breaker insulating housing is composed of two parts 11 and 13 forming two compartments. Each of the parts 11 and 13 is composed of a back portion molded integral with four sides forming an open front. The open front of the part 11 is covered by the back portion of the part 13, and the open front of the part 13 is covered by a cover 15. The three portions 11, 13 and 15 of the housing are held rigidly together by three bolts 17 which extend through three openings 18 (FIGS. 1 and 2) in each of the three housing portions, and which have three nuts 19 threadedly engaging the ends thereof. Three flush head rivets may be used in place of the three bolts 17 when manufactured in quantity production.

The housing parts 11 and 13 form two independent compartments housing two circuit breaker mechanisms which, except for a line terminal structure that will be described later, are of identical construction and operation, each operating independently of the other. For this reason, only the mechanism enclosed by the housing part 13 will be specifically described, it being understood that, unless otherwise mentioned, the description applies to both mechanisms of the double-type circuit breaker.

Referring to FIGS. 1 and 3 of the drawings, the circuit breaker mechanism, enclosed by the housing part 13, comprises a stationary contact 21, a cooperating movable contact 23, a supporting metal frame indicated generally at 25, an operating mechanism indicated generally at 27 and a trip device indicated generally at 29.

Referring to FIGS. 3, 4 and 6, the stationary contact 21 is welded, or otherwise attached, to a line terminal 31 which has an L-shaped upper portion 33 that fits and is cemented into a suitable slot in the housing part 13. A portion of the line terminal 31 protrudes through an opening 35 (FIG. 4) in the housing part 13. A similar portion of a symmetrically constructed line terminal 37 protrudes through an opening 39 in the housing part 11. The line terminals 37 and 31 are independent in that each is secured at its upper end in its own housing member 11 or 13 and is a part of a separate independently functioning circuit breaker mechanism. The two terminals are of somewhat resilient material and are independently biased inwardly so as to make good electrical contact with opposite sides of a stab contact in a load center or panelboard when the duplex breaker is mounted in operating position.

Referring to FIGS. 1, 2 and 3, the stationary contact 21 cooperates with a movable contact 23 that is welded or otherwise attached to a small flange 40 of a flat metallic generally C-shaped or concave contact arm or switch member 41. A pin 43, extending through the upper portion of the contact arm 41, fits into a slot 45 in an insulating operating member 47. The upper portion of the flat contact arm 41 rides longitudinally in a slot 49 (FIGS. 3 and 5) in the operating member 47, and is supported by said slot against lateral movement.

The operating member 47 has an arcuate trunnion 51 molded at each side thereof. The trunnions 51 fit and rotatably ride within two arcuate surfaces 55 on the frame 25 one of which is part of an extension 57 (FIG. 3) projecting out from the frame 25. The operating member 47 is rotatably supported between the surfaces 55 of the frame 25 and the pin 43 of the contact arm 41. The operating member has a handle portion 59 molded integral therewith which extends through an opening 61 (FIG. 2) in the housing part 13 whereby the mechanism may be manually operated to open and close the breaker. Arcuate surfaces 63 on opposite sides of the handle 59

substantially close the opening 61 in all positions of the operating member 47.

The frame 25 supports an insulating pivot 65 (FIG. 3) having shoulders 67 at opposite ends thereof, which shoulders rest within a slot 69 in the frame 25 and a slot 71 in a projection 73 of the frame 25. A metal trip member 79 is pivotally supported at one end 77 by a bight portion 75 which is pivotally supported in a slot 81 in the insulating pivot 65. The other end 82 of the trip member 79 has a latch point 83 which rests on top of a magnet 85 (FIG. 1) to support the trip member in latched position. The magnet 85 is part of the trip device 29 which will be described later. As best illustrated in FIG. 3, the ends 77 and 82 of the trip member 79, are offset, and disposed in a plane which is at one side of and parallel to a plane in which a main body portion 86, of the trip member 79, is disposed. The upper part of the main body portion 86 of the trip member 79 is disposed in a slot 87 (FIG. 5) in the operating member 47 which slot supports the trip member 75 against lateral movement. An overcenter spring 88 (FIGS. 1 and 2) is connected, under tension, at one end in an opening 89 in the contact arm 41, and at the other end in a slot 91 (FIG. 3) in a projection 93 extending from the trip member 79.

The movable contact arm 41 is connected by means of a flexible shunt 95 (FIGS. 1 and 2) to the free end of a bimetal 97 which is attached, at its other end, to a load terminal conductor 99 by being welded thereto. A load terminal screw 100 is provided for connection to the load terminal conductor 99. The load terminal conductor 99 is welded or otherwise attached to a projection 101 extending out from the supporting frame 25 (FIG. 3) so that both the bimetal and terminal conductors are fastened to the metal frame without being insulated therefrom. The terminal conductor is given additional support by being welded between two other projections 103 and 105 extending out from the supporting frame 25. Thus, the load terminal conductor 99 cannot move to affect the calibration of the trip device 29. The shunt 95 fits in a slot 107 in an insulating projection 109 which is molded integral with the base 13. The slot 107 fixedly positions the shunt 95 within the breaker and isolates the shunt from the metal frame 25. The electrical circuit through the breaker in its closed position extends from the line terminal 31 through the stationary and movable contacts 21, 23, contact arm 41, flexible shunt connection 95, the bimetal element 97 and the load terminal conductor 99. Since the movable contact arm 41 extends downwardly from its pivot point, the arc is established adjacent the bottom of the housing in an arc chute 111, one end of which is connected by a vent passage 113 to an opening in the end of the housing beneath the load terminal screw 100 (FIGS. 1 and 2).

The circuit breaker may be manually operated to open and close the contacts by operation of the insulating handle 59. Movement of the handle 59 clockwise from the full-line position (FIG. 1) to the position in which it is shown in dot-and-dash lines, carries the upper end of the contact arm 41 and its pivot 43 to the left of the line of action of the spring 88 whereupon the spring acts to move the contact arm 41 with a snap action to the open position shown partially in dot-and-dash lines in FIG. 1. The projection 109, on the housing part 13, acts as a limit stop for the movable contact arm 41 during an opening operation. Movement of the operating handle 59 in a counterclockwise direction from the dot-and-dash position (FIG. 1) to the full line position moves the pivot point 43 at the upper end of the contact arm 41 to the right of the line of action of the spring 88 which thereupon acts to move the contact arm to the closed position with a snap action. Movement of the handle 59 in either direction is limited by the surfaces 115 which strike the frame 25 at either side of the pivot 51.

The trip device 29 includes the bimetal 97, the U-shaped magnet or armature member 85 which is welded or otherwise attached to the free end of the bimetal 97, and a magnetic yoke or pole piece 117 which is preferably an integral projection on the frame 25. The magnetic yoke 117 is positioned adjacent the free ends of the U-shaped magnet 85. As is illustrated in FIG. 1, the latch point 83, of the trip member 79, rests on top of the magnet 85 which acts as a latch to support the trip member in a latched position.

Upon the occurrence of an overload current below a predetermined value, the bimetal element 97 becomes heated, and when heated a predetermined amount, bends, moving the magnet 85 to the right as seen in FIG 1 to release the trip member 79. When the trip member 79 is released, the spring 88 acts to rotate it clockwise about its pivot 65 until it is arrested when a projection 119 extending from the trip member 79, strikes the projection 109 of the housing part 13. During this movement, the line of action of the spring 88 moves to the right of the pivot 43 of the contact arm 41 whereupon the spring biases the contact arm in opening direction and the line of action of the force exerted on the operating member 47 shifts across the pivot 51, whereupon the spring 88 actuates both the contact arm 41 and the operating member 47 to the tripped portion in which these parts appear in FIG. 2. The movements of the trip member 79 and contact arm 41 are arrested by the extension 119 on the trip member engaging the top of the projection 109 and by the lower end of the contact arm engaging the side of the projection 109. In order to provide a visual indication that the breaker has been automatically tripped open, the movement of the operating member 47 is stopped in an intermediate position (FIG. 2) when a projection 121, molded integral with the operating member 47, strikes the projection 93 which extends from the trip member 79.

Positive separation of the contacts is assured during a tripping operation by the provision of a projection 123 extending from the trip member 79. The projection 123, upon release of the trip member, strikes the inner edge of the substantially C-shaped contact arm 41 with a swiping action and starts the contact arm in opening direction if the contacts are slow in opening due to sticking, drag or other reasons. The projection 123 is positioned so that it will not strike the movable contact arm 41 during a normal tripping operation when the contacts separate properly.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the operating handle 59 clockwise, from the tripped position (FIG. 2), slightly beyond the full open position in which it is shown in dot-and-dash lines in FIG. 1. During this movement, due to the engagement of the projection 121 of the operating member 47 with the projection 93 of the trip member 79, the trip member is moved counterclockwise until the latch point 83 is again supported in latched position by the magnet 85. The contacts may now be closed in the previously described manner by movement of the handle 59 counterclockwise to the closed position.

The circuit breaker is tripped automatically and instantaneously by the electromagnets 95, 85, 117 in response to overload currents above the predetermined value. Upon the flow of current through the bimetal 97, the magnetic flux, which is induced around the bimetal, takes the path of least reluctance through the magnet 85, across an air gap 125 and through the magnetic yoke 117. When an overload above the predetermined value occurs, the pull of the magnetic flux, across the air gap 125, is of such strength that the magnet 85 and bimetal 97 are pulled to the right, with a snap action. This movement releases the trip member 79 and the contacts are opened in the same manner previously described in connection with the thermal tripping operation.

Means are provided to compensate for any movement of the bimetal **97** in response to changes in ambient temperature. A compensating bimetal **127**, having an insulating pad **129** attached to the free end thereof, is welded or otherwise attached to a projection **131** extending from the frame **25**. The compensating bimetal **127** is of greater strength than the bimetal **97**. When the parts are in the normal position, the compensating bimetal **127** biases the bimetal **97** to a flexed position in tripping direction, i.e., to the right as viewed in FIG. 1. The high expansion sides of the two bimetals are adjacent. As the bimetal **97** bends to the right in response to a rise in ambient temperature, the compensating bimetal **127** bends to the left diminishing the bias against the bimetal **97** and allowing the bimetal **97** to unflex to the left towards its unbiased unflexed position. If the ambient temperature then drops, the bimetal **97** starts to straighten out to the left as viewed in FIG. 1, but the compensating bimetal **127** straightens out to the right to its normal position (FIG. 1), in which position it again exerts a bias against the bimetal **97** holding it in a flexed position in tripping direction. In this way, the compensating bimetal **127** provides that the latching position of the bimetal **97** is not disturbed by changes in ambient temperature.

Alternate ambient temperature compensating means may be provided in place of the compensating bimetal **127**. In this embodiment, the trip member **79** is made of a high coefficient of expansion material such as stainless steel, and the frame **25**, which supports the bimetal **97**, is made of a material with a low coefficient of expansion such as ordinary steel. The bimetal **97**, not being biased by a compensating bimetal, which is left out of this embodiment, normally rests in a straight position. As the ambient temperature rises and the bimetal **97** bends to the right, the trip member **79** expands moving the latch point **83** to the right thereby providing that there is no loss of latch engagement. When the ambient temperature then drops and the bimetal straightens out to normal position, the trip member **75** contracts to normal position. This alternate compensating means provides that the relative latching positions of the bimetal **97** and trip member **75** are not disturbed by changes in ambient temperature.

Shrinkage or warpage of the molded insulating housing will have no substantial effect on the operating mechanism or trip device because all moving parts are supported by the metallic frame **25**. The operating member **47** is mounted between the surfaces **55** of the frame **25** and the pin **43** of the moving contact arm **41**. The trip member **75** is pivotally supported at one end on the insulating pivot **65** which is supported in the slots **69** and **71** in the frame **25**. The latch end **82** of the trip member **79** is supported in latched position, by the magnet **85** which is attached to the bimetal **97** that is supported by the projection **101** of the frame **25**. The frame projection **131** supports the compensating bimetal **127**, and the load terminal **99** is supported by the projections **101**, **103** and **105** which extend from the frame. The movable contact arm **41** is supported, at its outer end, by the pin **43** which fits in the slot **45** in the operating member **47**, and at its inner end by the spring **88** which is connected between the contact arm **41** and the trip member **79**. The magnetic yoke **117**, which attracts the magnet **85** to trip the breaker, is also a projection of the frame **25**. The frame, which is stamped and formed from sheet steel, is made up of a minimum amount of material. As best viewed in FIG. 3, the main body portion of the frame is disposed in one plane with the supporting projections extending out from the plane a short distance.

The mounting of all movable parts and the current responsive trip means on the supporting frame **25** also enables the utilization of improved calibrating means. To calibrate the mechanism, the frame and the mechanism supported thereby are mounted in a nesting block or fixture, and a circuit, having a predetermined current flowing therein, is established from a stationary contact member that is part of the nesting block, through the breaker to the load terminal thereof. A tapered pin is then driven through an opening **133** (FIG. 3) in the frame **25** enlarging the opening **133** by narrowing a slot **135** in the metal frame **25** and stretching the metal adjacent the slot. As the opening **133** is enlarged, the projection **101** on the frame **25** moves the bimetal **97** and magnet **85** to the right as viewed in FIG. 1 until the breaker trips. The tapered pin is then driven through the opening an additional distance to compensate for spring-back of the frame.

The calibrated mechanism is then removed from the nesting block and assembled in the circuit breaker housing. There is an insulating projection **137** (FIGS. 1 and 2) molded integral with the housing, which passes through the frame opening **133** (FIG. 3) to strengthen the frame and position it within the housing. One of the openings **18** for one of the bolts or rivets **17** extends through the projection **137**. Another insulating projection **139** (shown in broken lines in FIGS. 1 and 2), which is molded integral with the housing part **13**, passes through an opening **141** (FIG. 3) in the frame **25**, and serves also to fixedly position the frame within the housing. The projection **139** also serves to keep the metallic trip member **79** away from the metallic frame **5** and to keep them electrically insulated from each other.

One important feature of the invention lies in the novel manner in which the necessary insulation is provided between the parts of conducting material. As has been pointed out, the bimetal **97** and load terminal conductor **99** are both supported by the metal frame **25** without being insulated therefrom. This makes it possible to weld or braze the upper end of the bimetal and the load terminal conductor directly to the ear **101**. This means that the bimetal is rigidly supported in fixed position to maintain its calibration independently of shrinkage or warping of the housing of insulating material, and the breaker mechanism may be advantageously calibrated before it is mounted in the housing. The fact that the frame and load terminal are both at the same potential also makes possible the additional support of the load terminal by the ears **103—105** on the frame, so that twisting forces applied to the outer end of the load terminal when tightening the terminal screw **100** are not transmitted to the bimetal to affect its calibration.

The trip member **79** is insulated from the frame and load terminal by the pivot support **65** which is of insulating material. With the other end **82** of the trip member in engagement with the latch portion at **83** on the bimetal or magnet, the trip member **75**, flexible conductor **95**, spring **88** and switch arm **41** are all at the same potential as the lower end of the bimetal, and are insulated from the other end of the bimetal through the insulation adjacent the support of the trip member on the metal frame.

The structure and operation of the operating member **47**, trip member **79**, contact arm **41** and spring **88** make possible a thin breaker of compact design. This arrangement can be more clearly understood, by imagining a first plane that could be defined generally by the operating member slot **49** and a second parallel plane that could be defined generally by the operating member slot **87**. The main body portion **86** of the trip member **79** is movable in the second plane, and the bight portion or pivoting point **75**, the latch point **83** and the spring retaining slot **91** are all movable in the first plane. Except for the small flange **40** to which the contact **23** is attached, the contact or switch arm **41** is movable in the first plane. The overcenter spring **88** is also movable in the first plane. This arrangement is such that the flat movable contact or switch arm **41** is movable in the same plane as the overcenter spring **88** making possible a thin breaker of compact design because there are no U-shaped members enclosing the spring. The deep curvature or C-shape of the contact arm **44** in its own plane, gives room for the coil spring **88** within the curve,

and does not require any increase in the width of the breaker.

The structure of the invention is thin and of low cost also because only a single, simple coil spring 88 is required. At the same time, the spring can exert a large force to give good contact pressure and the forces are balanced so that there are no forces from the spring to move the parts laterally since the line of action of the spring 88, its terminal points 89 and 91, the pivot 75 for the trip member 79 and its latch point 83 all lie and move in the same plane as the plane of the switch arm 41. The offset of the main body 86 of the trip member in a spaced parallel plane gives room for movement of the coil spring 88 and the contact arm without changing the fact that all forces act effectively in substantially a single plane.

It should also be noted that the pivoting pin 43, of the contact arm 41, is above the slot 91 in the projection 93 where the spring 88 engages the trip member 79. This makes possible a thinner breaker because the spring 88 does not extend up into the operating member 47 which does not have to be bifurcated to receive the spring. Also, the upper end of the spring moves within the curvature of the contact arm, so that the spring does not have to be made with two parts to straddle the contact arm.

Another embodiment of the invention is illustrated in FIGS. 7, 8 and 9. The circuit breaker shown therein is substantially the same as the circuit breaker illustrated in FIGS. 1–5, and like parts, therefore, are identified with like reference characters. The main body portion 86 of the trip member 79 is larger for additional strength. The load terminal conductor 99 is shaped into a different configuration, and it is looped over and welded to a single supporting projection 145 extending from the metallic supporting frame 25. The line terminal 31 is of a slightly different configuration, and it is held firmly in place at its upper end by a stamped-out resilient clip portion 147 that biases against a projection 149 (shown in broken lines in FIGS. 7 and 8 which is molded integral with the housing part 13. These structural changes do not affect the operation of the circuit breaker which operation is the same as that described in connection with the first embodiment of the invention. Novel means, however, are provided for manually actuating the circuit breaker shown in FIGS. 7, 8 and 9.

A bearing 151 has a slot 153 that is complementary with a V-shaped slot 155 in the upper portion of the movable contact arm 41. Two upper leg portions 157 of the bearing 151 fit into two slots 159 (only one being shown in FIG. 9) in the operating member 47. The bearing 151 transmits motion from the operating member 47 to the movable contact arm 41 when the breaker is manually operated. When the breaker is tripped automatically in response to an overload current, the bearing 151 transmits motion from the movable contact arm 41 to the operating member 47 to centrally position the handle 59 providing the visual indication that the breaker has been tripped (FIG. 8). An advantage of this structure is that there is substantially no friction between the operating member 47 and the bearing 151, and a minimum of friction between the bearing 151 and the movable contact arm 41. This provides for a smooth operation with a minimum of wear on the parts.

The invention has been described specifically in accordance with the provisions of the patent statutes. It is to be understood, however, that various changes and modifications may be made in the structural details and combination of elements disclosed without departing from some of the essential features of the invention.

I claim as my invention:

1. A circuit breaker comprising, in combination, a stationary contact and a movable contact cooperating therewith to open and close a circuit, a one-piece generally flat metallic frame disposed mainly in one plane and having a number of projections formed integral therewith extending out of said plane, an operating member supported by one of said projections and movable to actuate said movable contact member, an insulating pivot supported by one of said projections, a releasable trip member pivotally supported on said insulating pivot, an overcenter spring having one end attached to said trip member and the other end attached to said movable contact member, trip means supported by one of said projections and responding to abnormal conditions to release said trip member, and said trip member when released changing the line of action of said overcenter spring to effect movement of said movable contact member to an open position.

2. A circuit breaker comprising, in combination, a stationary contact and a movable contact member cooperating therewith to open and close the circuit, a one-piece generally flat metallic frame disposed mainly in one plane and having a number of portions thereof bent-over to form projections extending out of said plane, an operating member supported by one of said projections and movable to actuate said movable contact member, an insulating pivot supported by one of said projections, a releasable trip member pivotally supported on said insulating pivot, an overcenter spring having one end attached to said trip member and the other end attached to said movable contact member, trip means supported by one of said projections and responding to abnormal conditions to release said trip member, and said trip member when released changing the line of action of said overcenter spring to move said movable contact member to an open position.

3. A circuit breaker including a stationary contact and a movable contact member cooperating therewith to open and close the circuit, a one-piece metallic frame, an operating member supported by said frame and movable to actuate said movable contact member, a releasable trip member supported by said frame, a projection on said trip member, an overcenter spring having one end connected to said projection and the other end connected to said movable contact member, a current responsive member supported by said frame and movable in response to abnormal current conditions to release said trip member, said trip member when released changing the line of action of said opercenter spring to move said movable contact member to open said circuit breaker, and a compensating member supported by said frame and movable to compensate for movement in response to changes in ambient temperature of said current responsive member.

4. A circuit breaker including a stationary contact and a movable contact member cooperating therewith to open and close the circuit, an operating member having a handle and movable to open and close said circuit breaker, a trip member movable to effect automatic opening of said circuit breaker, current responsive means movable to actuate said trip member, a frame comprising a generally flat plate disposed substantially in one plane and having a number of portions thereof bent-over to form projections extending out of said plane, all of said movable structures being supported by said projections, an insulating housing, said frame being supported within said housing, and said housing enclosing all of said movable structures except said handle.

5. In a circuit breaker, a stationary contact and a movable contact member cooperating therewith to open and close a circuit, a stationary metal frame, mechanism including a trip member mounted on said stationary metal frame and movable to effect automatic opening of said circuit breaker, current responsive means supported on said stationary frame and operating in response to certain abnormal current conditions to actuate said trip member, and said current responsive means being calibrated by deformation of a portion of said stationary frame.

6. A circuit breaker comprising, in combination, a stationary contact and a movable contact member cooperat-

ing therewith to open and close the circuit, a trip member movable to effect automatic opening of said circuit breaker, a stationary metal frame, current responsive means supported on said frame and operating in response to certain overload current conditions to actuate said trip member, said frame having an opening therein, said current responsive means being calibrated by varying the dimension of said opening.

7. A circuit breaker including a stationary contact and a movable contact member cooperating therewith to open and close the circuit, a trip member movable to effect automatic opening of said circuit breaker, a stationary metal frame, current responsive means supported on said stationary frame and operable in response to certain abnormal current conditions to actuate said trip member, said stationary frame having an opening and a slot therein, said slot permitting deformation of a portion of said stationary frame by allowing enlargement and contraction of said opening to effect calibration of said circuit breaker.

8. A circuit breaker comprising, in combination, a stationary contact, a movable contact member cooperable with said stationary contact to open and close the circuit, a stationary metallic frame comprising a first portion and a second portion, a releasable trip member supported by said first portion and releasable to effect automatic opening of said circuit breaker, a latching member supported by said second portion and movable in response to fault currents above a certain value to release said trip member, said first portion and said second portion defining an opening in said frame, a slot adjacent said opening allowing enlargement and contraction of said opening, said enlargement and contraction of said opening causing relative movement between said first portion and said second portion and therefore causing relative movement between said trip member and said latching member, whereby said trip member and said latching member are relatively positioned by said enlargement and contraction of said opening and the automatic opening operation of said circuit breaker is adjusted.

9. A circuit breaker comprising a pair of contacts, a generally flat switch member having a main body portion movable endwise in a plane to open and close said contacts, a releasable trip member mounted on a fixed pivot, an overcenter spring having one end attached to said trip member and the other end attached to said movable switch member, said trip member when released changing the line of action of said overcenter spring to effect movement of said movable switch member to an open position, said spring being movable in the same general plane as said plane of movement of said main body portion, and a trip device operable in response to abnormal circuit conditions to release said releasable trip member.

10. A circuit breaker including, in combination, a stationary contact, a generally flat switch member movable endwise to cooperate with said stationary contact to open and close said circuit breaker, a releasable trip member having a pivoting portion at one end thereof mounted on a fixed pivot, a latch point at the other end of said trip member, an overcenter spring having one end attached to said trip member and the other end attached to said movable switch member, a trip device latching said latch point of said trip member and responding to abnormal conditions to release said trip member, said trip member when released changing the line of action of said overcenter spring to effect movement of said movable switch member to an open position, and said pivoting portion, said latch point, said spring and said movable switch member all being movable in the same general plane.

11. A circuit breaker comprising, a stationary contact, an operating member pivoted intermediate its ends and having a handle portion extending upwardly and an operating portion extending downwardly, a generally flat switch arm having a contact thereon and being movable endwise, said switch arm being pivoted on said operating portion and extending downwardly therefrom to a position where said contact engages said stationary contact, a releasable trip member, a coil type spring attached at its lower end to said switch member and at its upper end to said trip member, said operating member being movable to move said switch arm and spring to effect opening and closing of said contacts, and the point of attachment of the spring to the trip member being lower than the point at which the switch arm is pivoted to the operating portion of the operating member whereby the pivot of the switch arm and operating portion moves over the spring during said opening and closing operations.

12. A circuit breaker comprising, a stationary contact, an operating member pivoted intermediate its ends and having a handle portion extending upwardly and an operating portion extending downwardly, a generally C-shaped switch member having one leg pivoted on said operating portion and the other leg extending downwardly therefrom to engage the stationary contact, a releasable trip member having a spring-receiving portion movable within the confines of the C-shaped switch member, a coil-type spring attached at its lower end to said switch member and at its upper end to said spring-receiving portion of the trip member, the point of attachment of the spring to the trip member being lower than the point at which the switch member is pivoted to the operating portion of the operating member, said point at which the switch member is pivoted to the operating member being movable over the point at which the upper end of the spring is attached to the trip member when the operating member is moved to open the circuit breaker, and said point at which the spring is attached to the trip member moving under the point at which the switch member is pivoted to the operating member when the trip member is released to trip the circuit breaker.

13. A circuit breaker including, in combination, a stationary contact, a movable switch member cooperable with said stationary contact to open and close said circuit breaker, a trip member having a substantially flat main body portion, said trip member having an offset portion at each end thereof and a projection intermediate said ends, a pivoting portion at one of said ends mounted on a fixed pivot, a latch point at the other of said ends, an overcenter spring having one end attached to said projection and the other end attached to said movable switch member, a trip device latching said latch point of said trip member and responding to abnormal conditions to release said trip member, said trip member when released changing the line of action of said overcenter spring to effect movement of said movable switch member to an open position, and said pivoting portion, said latch point, said spring, said projection where said spring is attached and said movable switch member all being movable in one general plane at one side of the plane of the substantially flat main body portion of the trip member.

14. A circuit breaker including, in combination, an operating member having two substantially parallel slots therein, a stationary contact, a movable contact member cooperating with said stationary contact to open and close said circuit breaker, a trip member movable to effect automatic opening of said contacts, a trip device operable in response to abnormal conditions to actuate said trip member, said trip member being supported against lateral movement in one of said slots in said operating member, and said movable contact member being supported against lateral movement in the other of said slots in said operating member.

15. A circuit breaker including, in combination, an operating member, a first slot in said operating member defining generally a first plane, a second slot in said operating member defining generally a second plane, said planes being substantially parallel, a stationary contact, a movable contact member supported against lateral movement

in said first slot and movable in said first plane to cooperate with said stationary contact to open and close said circuit breaker, a releasable trip member having a main body portion supported against lateral movement in said second slot and movable in said second plane to effect automatic opening of said contacts, a projection on said trip member, an overcenter spring having one end attached to said projection and the other end attached to said movable contact member, means for releasing said trip member in response to abnormal conditions, said trip member when released changing the line of action of said overcenter spring to effect movement of said movable contact member to open said circuit breaker.

16. A circuit breaker comprising, in combination, a stationary contact and a movable contact member cooperating therewith to open and close said circuit breaker, a substantially flat one-piece metallic frame having an opening therein, said one-piece frame being disposed in a plane and having a portion thereof bent-over to form a projection extending out of said plane, an operating member movable to actuate said movable contact member, an insulating pivot supported on said projection, a releasable metallic trip member pivotally mounted on said insulating pivot and when released moving to effect automatic opening of said circuit breaker, an insulating housing for said circuit breaker having an insulating projection extending through said opening in said frame to contact said trip member thereby preventing contact between said metallic trip member and said metallic frame.

17. A double type circuit breaker including a housing having two compartments therein, a circuit breaker mechanism mounted in each of said compartments each of said mechanisms including a stationary contact and a movable contact structure cooperable therewith to open and close a circuit, said mechanisms being independently operable, each of said mechanisms having its own load terminal, an independent line terminal connected to each of said stationary contacts, said line terminals cooperating to form a clip-on type terminal structure.

18. A circuit breaker including, in combination, a stationary contact and a movable switch member cooperable therewith to open and close said circuit breaker, an operating member movable to actuate said movable switch member, said movable switch member having a notch therein, and a bearing member movable as a unit with said operating member and pivotally engaging in said notch to transmit motion between said operating member and said movable switch member.

19. A circuit breaker comprising, in combination, a stationary contact, a movable contact member cooperating with said stationary contact to open and close said circuit breaker, an operating member movable to actuate said movable contact member and having two openings therein, said movable contact member having a V-shaped slot therein, a bearing formed with two upper leg portions and having a lower slot therein, said two upper leg portions being disposed in said operating member openings to provide for unitary movement of said operating member and said bearing, said bearing lower slot being complementary with said movable contact member V-shaped slot to pivotally associate said bearing and said movable contact member, and said bearing transmitting motion between said operating member and said movable contact member.

20. A circuit breaker comprising, in combination, a stationary contact, a movable contact cooperable with said stationary contact to open and close an electric circuit, a metallic supporting frame, a latched trip member movably supported by said supporting frame and releasable to effect opening of said contacts, a bimetal member rigidly attached to said supporting frame and latching said trip member, said bimetal member bending in response to certain abnormal current conditions to release said trip member, said trip member comprising a single-metal member having a higher coefficient of expansion than said metallic supporting frame, and said trip member, said supporting frame and said bimetal member being constructed and arranged such that upon the occurrence of a rise in ambient temperature said trip member will expand more than said supporting frame and move in a direction to compensate for the bending of said bimetal member in response to said rise in ambient temperature.

References Cited in the file of this patent

UNITED STATES PATENTS

1,111,789	Freas	Sept. 29, 1914
2,209,351	Sachs	July 30, 1940
2,224,990	Sachs	Dec. 17, 1940
2,290,495	Sandin et al.	July 21, 1942
2,370,206	Taylor	Feb. 27, 1945
2,568,423	Walker	Sept. 18, 1951
2,700,084	Broekhuysen	Jan. 18, 1955
2,703,827	Gelzheiser	Mar. 8, 1955
2,769,049	Edmunds	Oct. 30, 1956
2,779,840	Getchell	Jan. 29, 1957
2,795,670	Cellerini	June 11, 1957
2,810,048	Christensen	Oct. 15, 1957
2,844,689	Middendorf	July 22, 1958
2,846,548	Christensen	Aug. 5, 1958
2,847,533	Christensen	Aug. 12, 1958
2,889,428	Kingdon	June 2, 1959
2,892,054	Walker	June 23, 1959
2,899,524	Smith	Aug. 11, 1959
2,902,560	Stanback	Sept. 1, 1959
2,953,661	Hammerly	Sept. 20, 1960