United States Patent [19]

Leonard

[11] **3,860,898**

[45] **Jan. 14, 1975**

[54] **CIRCUIT BREAKER FOR DISTRIBUTION TRANSFORMER**

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[73] Assignee: **Westinghouse Electric Corporation,** Pittsburgh, Pa.

[22] Filed: **Sept. 11, 1973**

[21] Appl. No.: **396,162**

[52] **U.S. Cl.** **337/59,** 337/54, 337/70, 337/75, 337/79, 337/82, 337/112

[51] **Int. Cl.** **H01h 71/16**

[58] **Field of Search** 337/3, 54, 59, 68, 70, 337/71, 72, 75, 79, 82, 84, 94, 112, 90, 89; 335/145

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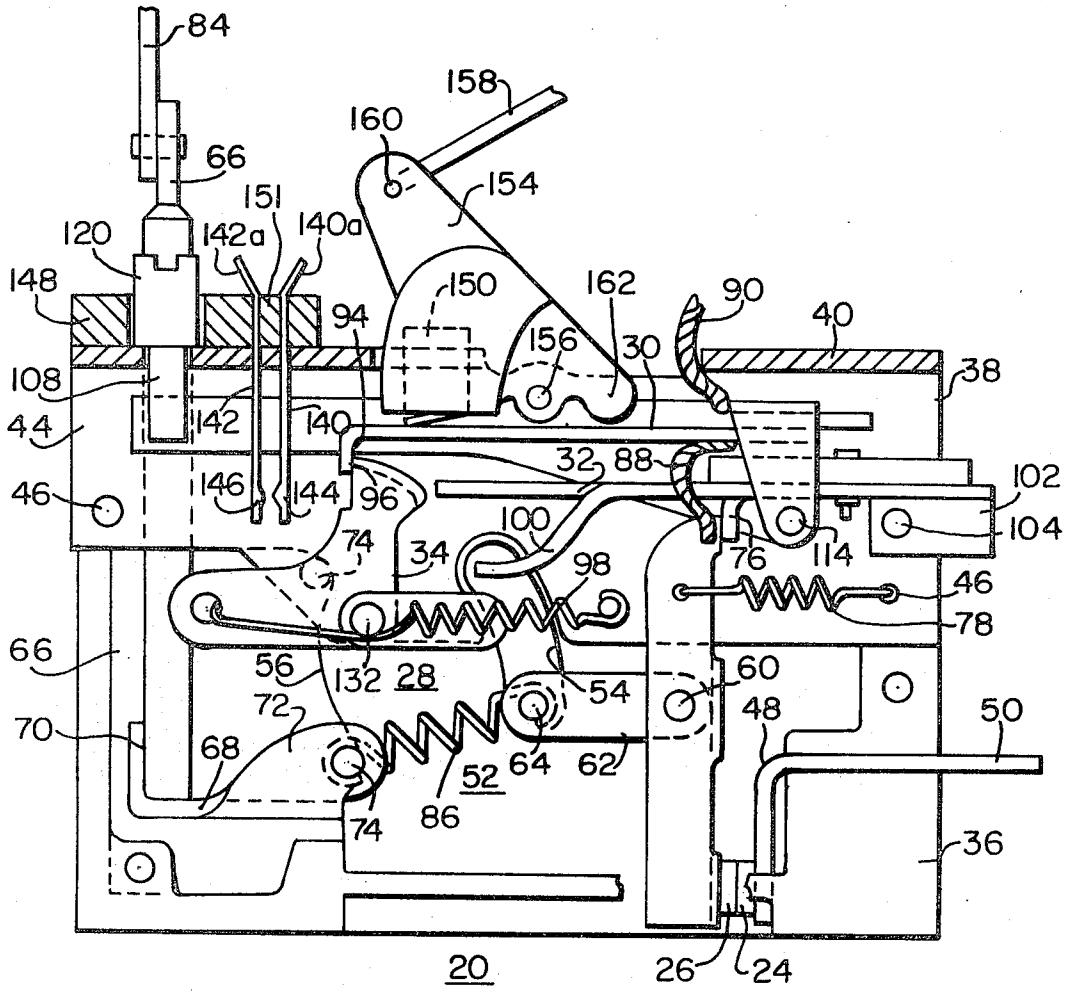
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Primary Examiner—Arthur T. Grimley
Attorney, Agent, or Firm—L. P. Johns

[57] **ABSTRACT**

A circuit breaker for a distribution transformer characterized by a housing including a molded portion of insulating material and another portion of metal, a stationary contact on said molded housing portion, a bimetal element having one end mounted in said other housing portion and having a flanged portion at the other end, a trip arm spaced from the bimetal element and composed of a magnetically permeable material attractable to the bimetal element at a designated current load, the trip arm being pivotally mounted on said other housing portion and having a flange. The circuit breaker also comprises a movable switch arm having at one end a contact for cooperation with the stationary contact and the other end being detachably engageable with the flange, guide means on the molded housing portion, a toggle link operatively connected to the switch arm and movable along said guide means, a latch pivotally mounted in the channel to effect release of the trip arm when the bimetal element is actuated, and manual means connected to said toggle link for moving the contacts to the open position.

11 Claims, 13 Drawing Figures



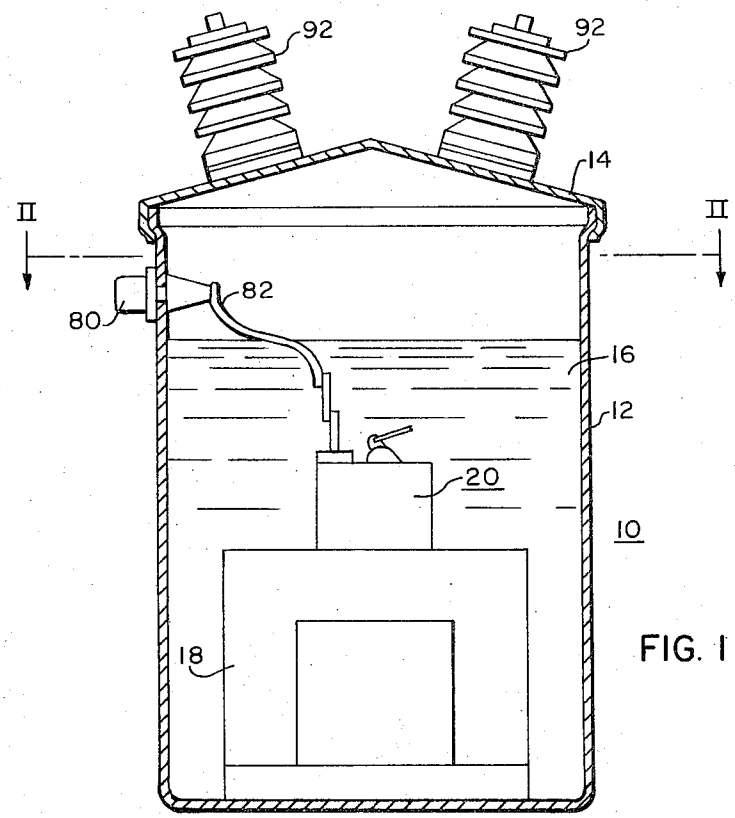


FIG. 1

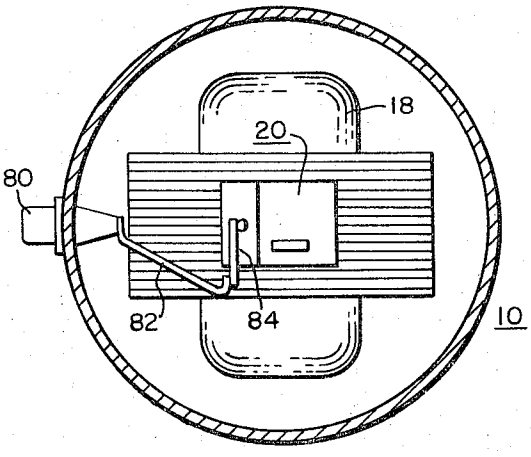


FIG. 2

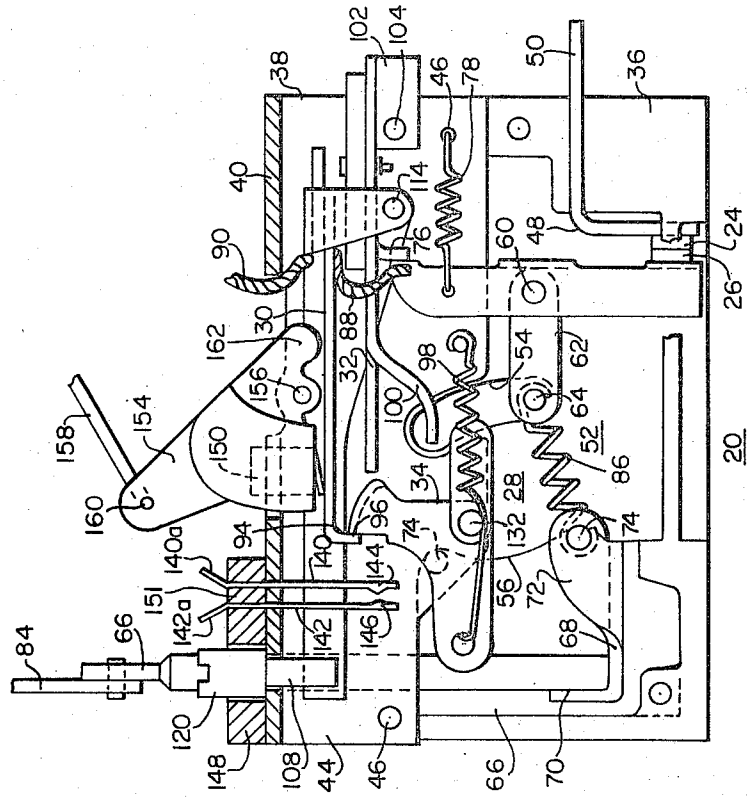

102
104
38
46
78
50
36
40
114
90
76
60
48
24
26
30
88
162
32
98
54
62
156
100
64
158
154
150
52
86
20
34
28
160
96
132
74
74
94
140
144
140a
56
72
151
142a
142
146
68
84
66
120
148
108
44
46
66
70

FIG. 3

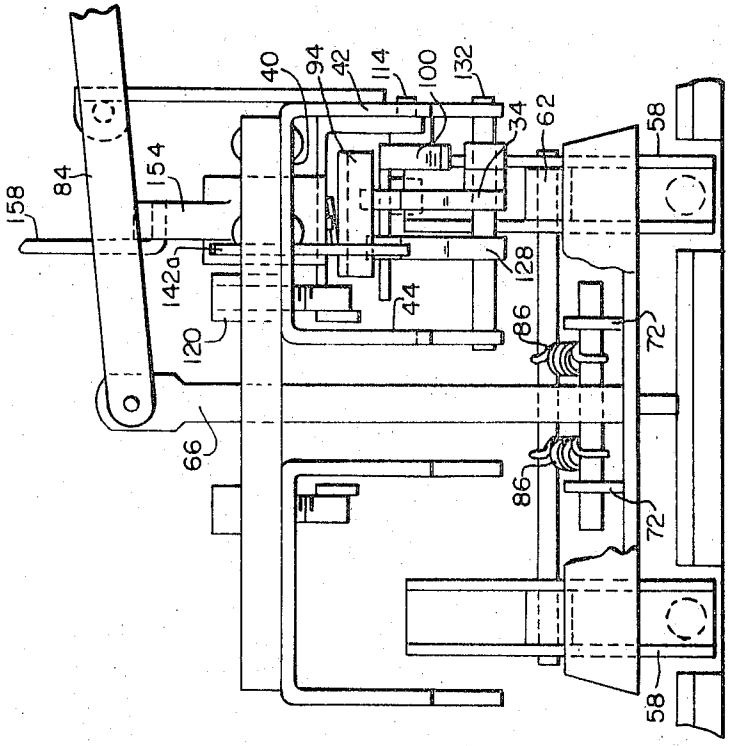

40
94
42
114
100
132
34
62
58
84
154
158
142a
128
44
120
86
72
66
86
72
58

FIG. 5

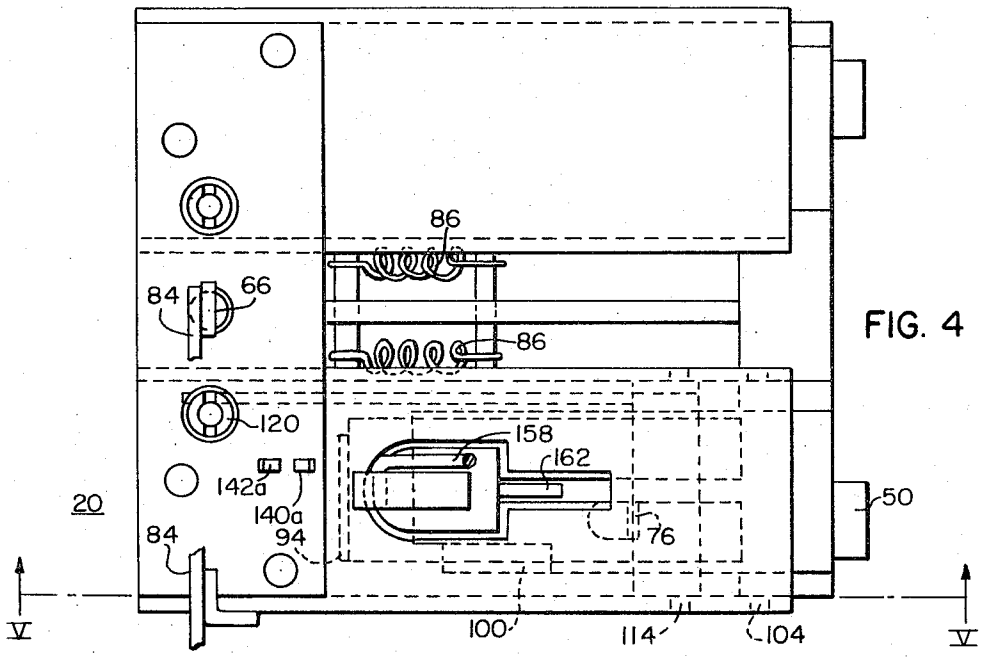


FIG. 4

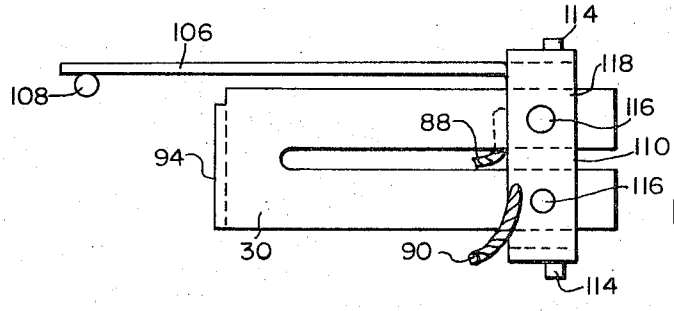


FIG. 6

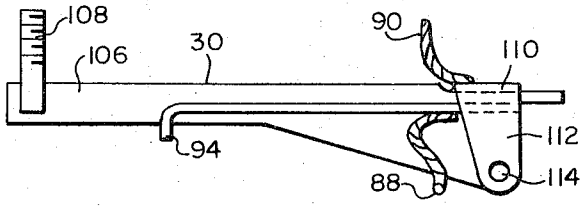


FIG. 7

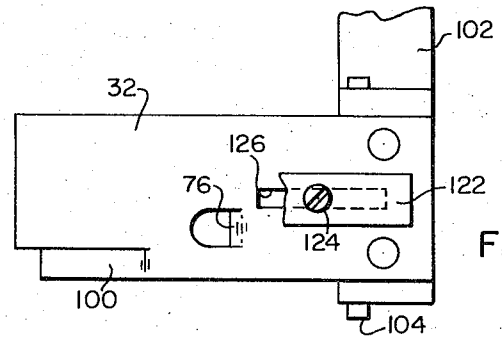


FIG. 8

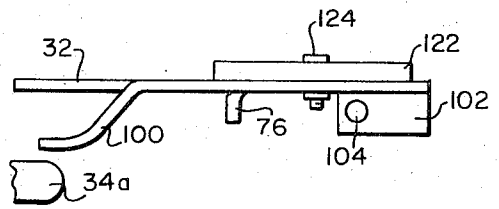


FIG. 9

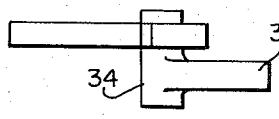


FIG. 10

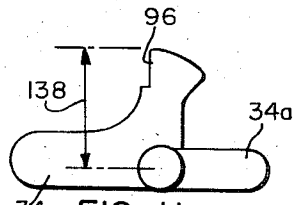


FIG. 11

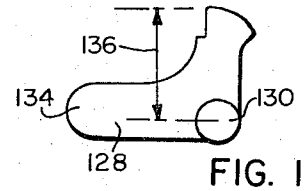


FIG. 12

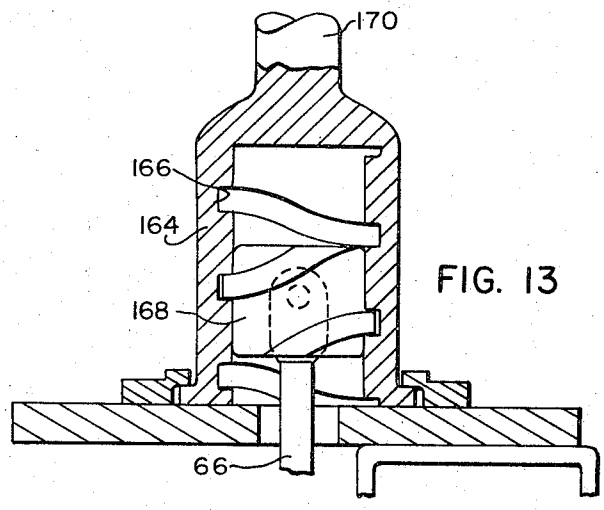


FIG. 13

CIRCUIT BREAKER FOR DISTRIBUTION TRANSFORMER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to circuit breakers, and more particularly, to circuit breakers for distribution transformers to control moderate power distribution on feeder circuits.

2. Description of the Prior Art

Circuit breakers for use in liquid-immersed type of transformers have been provided heretofore. The circuit breakers have performed various functions including manual opening and closing means, automatic trip for given overload conditions, combined thermal and magnetic response to control the trip-time relationship, automatic signal circuit for predetermined warning of breaker trip, manual adjustment for increased overload control, and manual lock for preventing automatic trip. The circuit breaker disclosed in U.S. Pat. No. 2,686,242 involves some of those functions.

SUMMARY OF THE INVENTION

In accordance with this invention, it has been found that an improved circuit breaker may be provided which comprises a first housing of molded insulating material, a second housing of metal on said first housing, a stationary contact on said first housing, a bimetal element having one end mounted in the second housing and having a flanged portion at the other end, a trip arm spaced from the bimetal element and composed of a magnetically permeable material to effect movement toward the bimetal element, said trip arm being pivotally mounted on said second housing and having a flange, a movable switch arm having a contact for cooperation with said first stationary contact, one end of said switch arm being engageable with the flange, guide means on said housing, toggle link means operatively connected to the switch arm and movable along said guide means, second guide means on the first housing, a latch pivotally mounted in the channel to effect release of the trip arm when the bimetal element is actuated, manual means connected to the toggle link for moving the contact to the open position, the manual means also comprising a member movable along the second guide means and comprising toggle spring means between said member and the toggle link, the manual means also comprising a rod movable longitudinally to effect opening and closing of the contacts and a rotatable nut engaging a threaded portion of the rod to effect longitudinal movement of the rod, a control arm pivotally mounted on the second housing and movable into the path of travel of the trip arm to effect locking of the trip arm in the non-trip position, and calibration means including a calibration arm mounted on said one end of the bimetal element and a calibration screw mounted in the second housing and operatively connected to the opposite end of the calibration arm to effect adjustment of the movement of the bimetallic element.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view through a distribution transformer;

FIG. 2 is a horizontal sectional view taken on the line II—II of FIG. 1;

FIG. 3 is an elevation view of the circuit breaker;

FIG. 4 is a plan view of the circuit breaker;

FIG. 5 is an end view taken on the line V—V of FIG. 4;

FIG. 6 is a plan view of the bimetal element;

FIG. 7 is an elevation view of the bimetal element;

FIG. 8 is a plan view of the trip arm;

FIG. 9 is an elevation view of the trip arm;

FIG. 10 is a plan view of the release latch;

FIG. 11 is an elevation view of the release latch;

FIG. 12 is an elevation view of the signal latch; and

FIG. 13 is a sectional view of another embodiment of a device for operating the pull-rod.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. 1 and 2 a distribution transformer is generally indicated at 10 and it includes a tank 12, a cover 14, transformer oil 16, and a transformer assembly 18 including a conventional core and coil. In addition to the foregoing, a circuit breaker 20 is mounted on the upper side of the assembly 18 and is immersed in the oil 16. The circuit breaker 20 is shown more particularly in FIGS. 3, 4 and 5. It comprises a housing 22, a stationary contact 24, a movable contact 26, and an operating mechanism 28. As shown more particularly in FIG. 4, the circuit breaker 20 is a two-pole circuit breaker comprising two compartments disposed in adjacent relationship with a portion of the operating mechanism 28 disposed therebetween as set forth hereinbelow. In addition to the foregoing, each pole of the circuit breaker 20 comprises a bimetal element 30, a trip arm 32, and a latch 34.

The housing 22 is a box-like member comprising lower and upper housings 36 and 38. The lower housing 36 is composed of molded insulating material, such as wood flour phenolic. The upper housing 38 is composed of metal and is an inverted U-shaped member having a top surface 40 and opposite sides 42 and 44. The upper and lower housings 36 and 38 are secured together by case rivets 46. It is one of the features of this invention that the housing 22 comprise an upper housing portion 38 composed of metal to provide the rigidity necessary for maintaining the several parts 30, 32, and 34 in precise positions and spacings with respect to each other. Prior circuit breakers of the type involved comprised housings composed entirely of molded insulation material, and were found to have a tendency to distort slightly over extended periods of time, particularly when exposed to a heated medium such as oil. Any slight distortion of these parts may adversely affect the accuracy of calibration of the circuit breaker.

The lower housing 36, however, is necessarily composed of insulating material to provide the necessary dielectric strength between a conductor 48 on which the stationary contact 24 is mounted and other parts, such as the bimetallic element 30. As shown in FIG. 3, the conductor 48 extends through an opening in the housing 36 and includes an outer terminal portion 50. The lower housing 36 includes a wall or partition 52 in which guide means are provided for aiding in the opening and closing of the contacts 24 and 26. More particularly, the guide means includes an arcuate slot 54. The wall 52 is also provided with another guide means or surface 56 which is likewise arcuate in a direction opposite to the arcuate axis of the slot 54.

As shown in FIG. 3, the operating mechanism 28 comprises a contact arm 58 which is pivotally mounted at 60 on a toggle link 62 which is provided with a guide pin 64 at the end of the link opposite that of the pivot 60. The pin 64 extends through the slot 54 and through a corresponding slot in a wall or partition of the adjacent pole of the circuit breaker. In addition the operating mechanism 28 includes a rod 66, the upper portion of which extends through the top surface 40 of the upper housing 38, and the lower portion of which includes a bracket 68 which is secured to the lower end portion of the rod in a suitable manner such as by a welded joint 70. The bracket includes a pair of upturned flanges 72 for supporting a pin 74.

In operation, in the closed position of the contacts 24 and 26, the contact arm 58 is disposed between the stationary contact 24 and a downturned support flange or projection 76 of the trip arm 32, where it is retained by a spring 78 which extends between the upper portion of the arm and an opening (not shown) in the lower housing 36. As shown in FIG. 3, the contact arm 58 is likewise held in the closed position by the link 62 when it is disposed in the lower end of the slot 54. To manually open the circuit through the contacts 24 and 26, an operating handle 80, which is located on the outer surface of the tank (FIGS. 1 and 2), is maintained to cause a connecting rod 82 to be lowered and thereby move a lever 84 (FIG. 5) in order to pull the rod 66 upwardly. By that motion the pin 74 moves to the upper end of the surface 56, whereby a pair of toggle springs 86 pulls the guide pin 64 to the upper end of the slot 54, thereby pulling the contact arm 58 to a retracted position of the contact 26.

The circuit breaker 20 comprises automatic trip means for opening the contacts 24 and 26 when an electric current overload exists. During operation of the circuit breaker 20, a circuit through each pole follows a path through the contacts 24, 26 and the contact arm 58, a flexible conductor or shunt 88 to one leg of the U-shaped bimetal (FIG. 6) 30. After it flows around the bimetal element 30, the circuit path continues through another flexible conductor or shunt 90 from where it flows through one of the secondary bushing terminals 92 (FIG. 1).

Under predetermined conditions of overload current and oil temperature, the bimetal is heated sufficiently in a certain period of time so that deflection upward (as viewed in FIGS. 1, 6 and 7) moves the catch 94 out of engagement with the latch 34 at location 96 (FIGS. 3 and 11), whereupon the latch 34 rotates counterclockwise under the influence of a spring 98 and causes a portion 34*a* of the latch 34 (FIG. 9) to strike a dependent portion 100 of the trip arm 32. The trip arm 32 then rotates clockwise to lift the projection 76 (FIG. 3) out of engagement with the upper end of the contact arm 58, so that the spring 78 rotates the arm clockwise about the pivot 60 and opens the circuit through the contacts 24, 26.

The foregoing trip action is dependent upon the heating of the bimetal element 30 caused by a combination of current flow and the temperature rise of the liquid (transformer oil) in which it is immersed. The circuit breaker 20 may also be tripped by magnetic action. The bimetal element 30 consisting of a U-shaped member which comprises a loop like a one-turn electromagnet through which the current flows. The trip arm 32, being composed of a highly permeable material, such as mild steel, is substantially the same width and length as the bimetal element 30. The trip arm 32 is mounted on a support member 102 which is composed of an electrically insulating material and which is provided with end pins 104, one of which is shown in FIGS. 3 and 8. The pins 104 are seated in pin-receiving apertures in opposite sides 42 and 44 of the upper housing 38. When a given current overload occurs, the ampere-turns increase sufficiently to produce a magnetic attraction in the bimetal element 30 sufficient to attract and lift the trip arm 32, whereby the projection 76 is removed from engagement with the upper end of the contact arm 58, whereupon the spring 78 rotates the contact arm clockwise about the pivot 60 and separates the contacts 24, 26.

The bimetal element 30 is provided with calibration means comprising an arm 106 and an adjusting screw 108. The right end of the arm as viewed in FIGS. 6 and 7 is rigidly secured to a mounting member 110 and the screw 108 is secured to the left end of the arm. The mounting member 110 includes a pair of downturned supports 112, each of which is provided with a mounting pin 114 which is seated in apertures on opposite sides 42 and 44 of the upper housing 38. Moreover, spaced end portions of the bimetal element 30 are fixedly mounted, such as by rivets 116, on the mounting member 110 and insulation between those end portions is obtained by providing pads 118 of electrically insulating material between each end portion and the mounting member 10. The adjusting screw 108 extends upwardly through an aperture in the top surface 40 of the upper housing 38 and a calibrating nut 120 is mounted on the upper end portion of the screw 108. Rotation of the nut in one direction lifts the end portion 94 of the bimetal element 30, while rotation of the nut 120 in the opposite direction lowers said end portion with respect to the latch 34. Thus, the bimetal element 30 is thermally calibrated. Magnetic calibration is provided by any convenient means such as by the addition of a strip 122 on the upper side of the trip arm 32, where it is secured in a suitable manner such as a screw 124. The strip 122, being composed of highly permeable material such as mild steel in order to increase the magnetic attraction to the bimetal element 30, is preferably adjustably mounted in any given position in aperture means such as a slot 126 in the trip arm 32 in order to move a greater or lesser portion of the strip 122 into the area of the magnetic field between the trip arm 32 and bimetal element 30.

It is noted that the thermal tripping action occurs when the bimetal element deflects in response to a moderate current overload, such as up to 3 or 4 times the normal load over a period of time, for example, 20 minutes. Magnetic tripping occurs only at relatively high overload currents of the order of short-circuit values, and when this tripping occurs, it is much faster than the thermal trip action. For example, if the current is 25 times normal, the trip arm 32 is actuated magnetically in a time of the order of one cycle, and at this time the thermal effect on bimetal element 30 is not deflected enough to release catch 34.

Moreover, the circuit breaker 20 may be provided with the signal means for preliminarily indicating a possible tripping of the circuit breaker due to thermal deflection of the bimetal element 30. For that purpose, the circuit breaker has a second latch 128 (FIG. 12) which latch includes an aperture 130 by which it is

mounted on a mounting pin **132** (FIG. **5**) on which the latch **34** is also mounted. The latch **128** is spring-biased in the counterclockwise direction in a suitable manner such as by the provision of an aperture **134** to which a spring (not shown) is attached, such as the manner of attachment of the spring **98** to the latch **34.** Inasmuch as the latch **128** is a signal latch, it is tripped prior to the latch **34,** and for that purpose, the length of the arm, as indicated by the arrow **136,** is slightly less than that of the arrow **138** for the latch **34.** Accordingly, when the bimetal element **30** deflects a sufficient distance to move the catch or end portion **94** out of engagement with the upper end of the latch **128,** the latch **34** remains in engagement with the catch.

Upon release of the spring-biased latch **128,** it rotates toward a leaf spring **140** (FIG. 3), and moves it towards a leaf spring **142,** thus closing contacts **144** and **146** at the lower ends of the leaf springs **140** and **142,** respectively. The leaf springs **140** and **142** constitute the removable assembly, the upper ends of which are seated within an aperture within a block **148** mounted on the topside of the top surface **40** of the upper housing **38.** The upper end portions **140***a* and **142***a* extend above the block **148** to enable the connection of suitable lead wires to a signal device such as a light. The portions of the leaf springs **140** and **142** within the insulating block **148** are secured in place by a wedge **150** which is inserted in the aperture between the leaf springs. The leaf springs **140** and **142** extend through another aperture (not shown) in alignment with and substantially larger than the aperture in the insulating block **148.**

After one or both latches **34** and **128** are tripped, they can be reset by raising the rod **66** to its extreme upward position. This causes the breacket **68** at the lower end of the rod to pick up the left end portions of the latches and rotate them clockwise back to their latched positions.

Occasionally, load conditions are abnormally severe, for which reason it is necessary to set the calibration higher for a limited period of time. To make this emergency operation possible, the bimetal element **30** is restrained by bringing a spring **150** to bear upon the upper side of the bimetal element. The spring **150** is carried in a socket of an emergency control arm **154,** and when the arm is rotated about a pivot **156** by a suitable rod **158** attached to the aperture **160,** the spring **152** touches the top of the bimetal element **30.** The amount of restraint depends upon several factors, such as the amount of spring deflection, the stiffness of the spring, the preloading of the spring, and the point of bearing on the bimetal element. The rod **158** extends to the location of the operating handle **80** (FIG. **1**) where suitable manipulating means are provided for moving the arm **154.**

Under some operating conditions, it is desirable to provide an emergency lock to prevent tripping of the circuit breaker from any cause. For that purpose, the control arm **154** is rotated clockwise until a projection or finger **162** is brought to bear upon the top of the trip arm **32.** The finger **162** extends either between the legs of the bimetal element **30** or on one side thereof. This prevents the release of the upper end of the contact arm **58** under either thermal or magnetic forces, but it does not impede the release and reset of the latches **34** and **128,** nor the manual operation of opening and closing the circuit breaker.

Another embodiment of the invention comprises alternate means for raising and lowering the rod **66** as shown in FIG. **13.** Where it is necessary to control the circuit breaker **20** by manual means located in the cover **14** (FIG. **1**), the lever **84** (FIG. **5**) may be replaced by a nut or thimble **164.** The inner surface of the nut **164** has a coarse thread **166** which is engaged by a correspondingly threaded member **168** which is secured to the upper end of the rod **66.** A manipulating shaft **170** extends upwardly through the cover **14** of the transformer, where it is accessible for manual rotation in either direction. Thus, rotation of the shaft either clockwise or counterclockwise may open, close, or reset the circuit breaker **20.**

In summary, the device of the present invention satisfies certain disadvantages of circuit breakers of prior art construction, which advantages include (1) a rigid cell-like housing to provide mechanical support for the parts that determine stability of calibration and substantially free from the effects of distortion, warpage, and relaxation in the other parts of the circuit breaker; (2) trip-time adjustment for emergency load obtained by spring-loading to restrain the deflection of the thermal element; (3) trip lock-out to prevent automatic operation of any load level without interfering with manual control; and (4) a choice of operating handle on the side of the tank (preferred for pole-mounted transformers) or on top of the tank (generally preferred for underground mounting of transformers).

What is claimed is:

1. A circuit breaker comprising a first housing of molded insulating material, a second housing of metal on said first housing, a stationary contact on said first housing, a bimetal element having one end mounted in the second housing and having a flanged portion at the other end, a trip arm spaced from the bimetal element and composed of magnetically permeable material to effect movement toward the bimetal element, said trip arm being pivotally mounted on said second housing and having a support flange, a movable switch arm having a first contact for cooperation with said stationary contact, a second contact on said switch arm for cooperation with the flange, guide means on said first housing, a toggle link operatively connected to the switch arm and movable along said guide means, a latch pivotally mounted on the second housing to effect release of the trip arm when the bimetal element is actuated, and manual means connected to said toggle link for moving the first and second contacts to the open position.

2. The circuit breaker of claim **1** in which the second housing has a channel configuration.

3. The circuit breaker of claim **1** in which second guide means is provided on the housing and the manual means comprises a member movable along the second guide means.

4. The circuit breaker of claim **3** in which the manual means comprises toggle spring means between said member and the toggle link.

5. The circuit breaker of claim **1** in which the manual means comprises a rod movable longitudinally to effect opening and closing of the contacts and a rotatable nut engaging a threaded portion of the rod to effect longitudinal movement of the rod.

6. The circuit breaker of claim **1** in which a control arm is pivotally mounted on the second housing and movable into the path of travel of the trip arm to effect locking of the trip arm in the non-trip position.

7. The circuit breaker of claim 1 in which a calibration arm is operatively mounted on said one end of the bimetal element and a calibration screw mounted in the second housing and operatively connected to the opposite end of the calibration arm to effect adjustment of the movement of the bimetallic element.

8. The circuit breaker of claim 1 in which a mild steel member is releasably slidably mounted on the trip arm to effect magnetic adjustment for the amount of current required to trip the circuit breaker.

9. A circuit breaker comprising a housing, a stationary contact on the housing, a movable switch arm having a contact thereon for cooperation with said stationary contact, a switch arm projection on said swtich arm, first guide means on said housing, a toggle link operatively connected to the switch arm and movable along said guide means, second guide means on the housing, manual means connected to the toggle means and movable along said second guide means to effect opening and closing of the contact with the stationary contact, a bimetal element having one end mounted in the housing and having a flanged portion at the other end, a trip arm spaced from the bimetal element and composed of a magnetically permeable material to effect movement toward the bimetal element, said trip arm being pivotally mounted on the housing and having a projection engageable with the switch arm and a latch pivotally mounted on the housing to effect release of the trip arm when the bimetal element is actuated.

10. The circuit breaker of claim 9 in which the manual means comprises a pin in slidable contact with the second guide means and toggle spring means between the pin and the toggle link to effect movement of the trip arm.

11. The circuit breaker of claim 9 in which a control arm is pivotally mounted on the housing and is movable into the path of travel of the trip arm to effect locking of the trip arm in the non-trip position.

* * * * *