Dec. 29, 1970 R. C. INGWERSEN 3,551,867

CIRCUIT BREAKER

Filed March 12, 1969 2 Sheets-Sheet 1

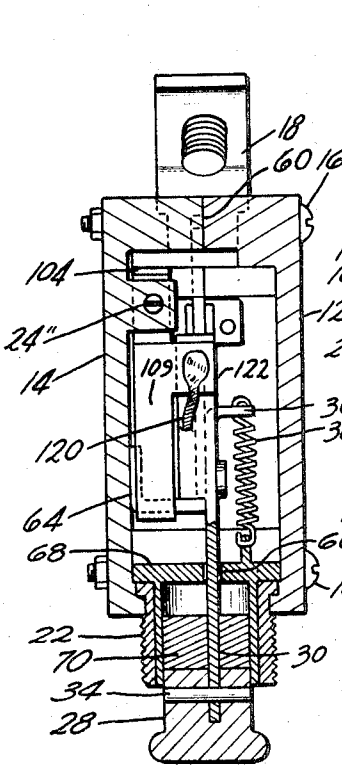


FIG. 2

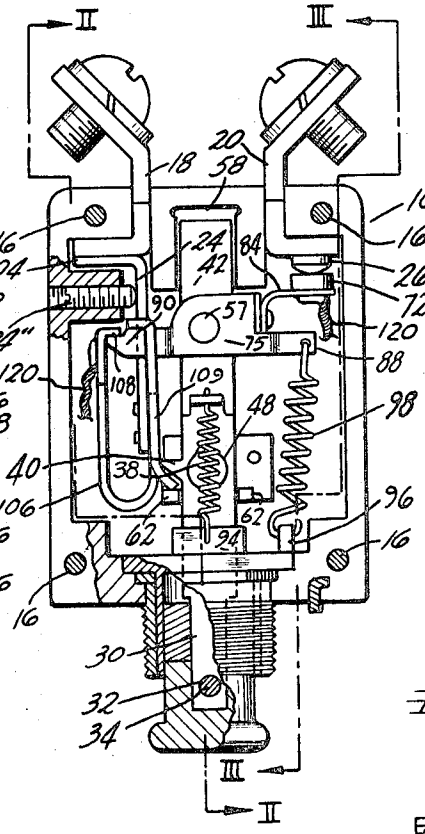


FIG. 1

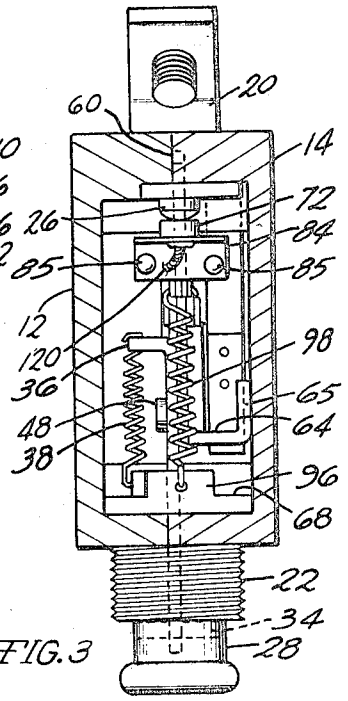


FIG. 3

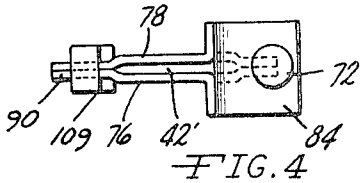


FIG. 4

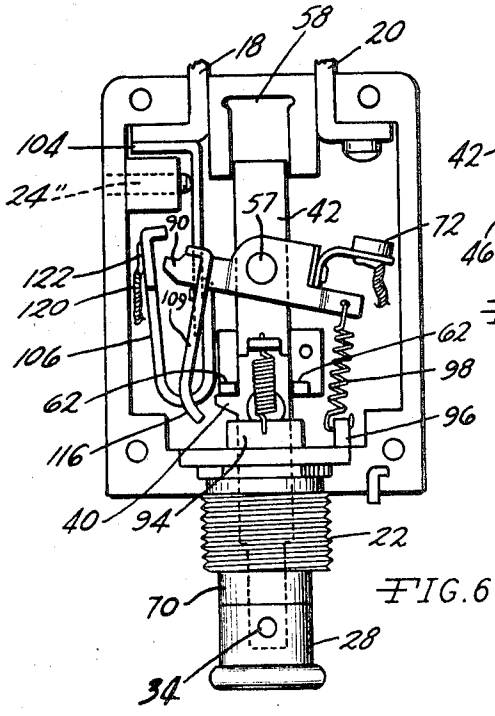


FIG. 6

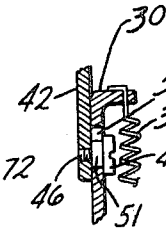


FIG. 5

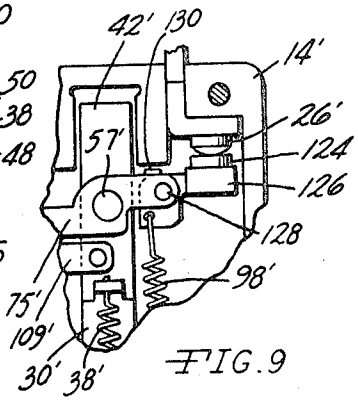


FIG. 9

INVENTOR

RICHARD C. INGWERSEN

BY Beaman & Beaman

ATTORNEYS

Dec. 29, 1970 R. C. INGWERSEN 3,551,867

CIRCUIT BREAKER

Filed March 12, 1969 2 Sheets-Sheet 2

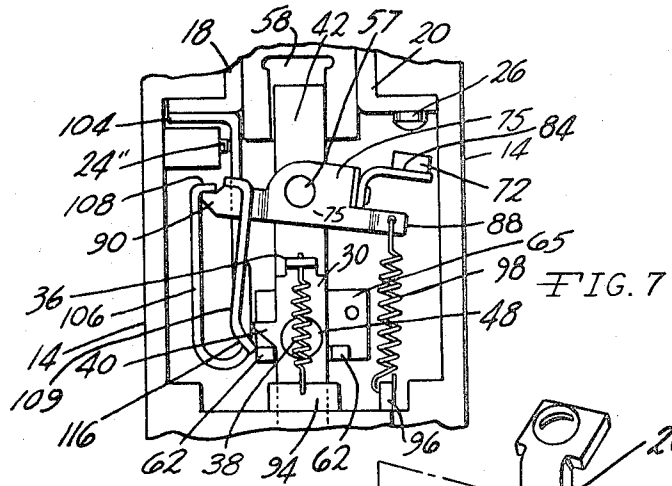


FIG. 7

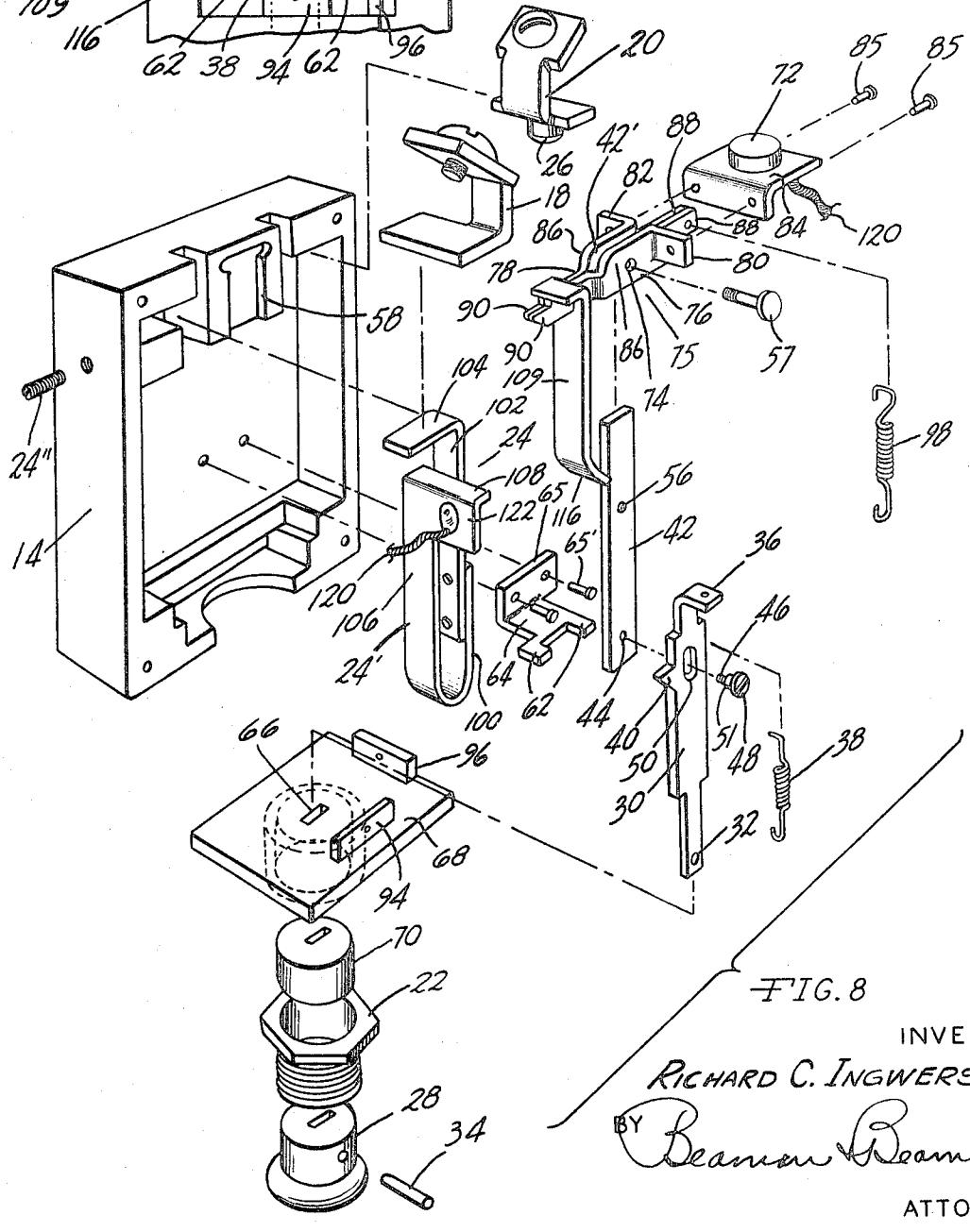


FIG. 8

INVENTOR
RICHARD C. INGWERSEN
BY Beaman & Beaman
ATTORNEYS

United States Patent Office

3,551,867
Patented Dec. 29, 1970

3,551,867

CIRCUIT BREAKER

Richard C. Ingwersen, Treasure Island, Fla., assignor to Allied Control Company, Inc., New York, N.Y.

Filed Mar. 12, 1969, Ser. No. 806,664
Int. Cl. H01h 71/16
U.S. Cl. 337—63 7 Claims

ABSTRACT OF THE DISCLOSURE

A trip-free circuit breaker of the "push-pull" type having a rocker lever carried on the "push-pull" actuator, the rocker lever having a fulcrum point at one end and a contact at the other end, and a mechanical latch carried on the rocker lever and having unitary pivotal movement therewith for supporting the rocker lever in circuit closing position.

BACKGROUND OF THE INVENTION

The present invention relates to circuit breakers of the same general type disclosed in United States Pat. 2,625,625 and 2,668,886 in which a manual "push-pull" actuator is provided for opening the circuit, when desired, for closing the circuit following manual operation or overload, yet the actuator is incapable of being manipulated to hold the circuit closed against a short or overload.

Circuit breakers of the aforesaid type have heretofore embodied a relatively large number of components parts including molded parts with metal inserts. In production such devices have been difficult to calibrate and have had a tendency to lose their calibrations under service conditions, especially under conditions involving vibration and repetitive manual actuation. Surface wear in such prior circuit breakers has been the cause of most of the problems experienced.

SUMMARY OF THE INVENTION

According to the present invention, an all metallic actuator has been provided with the elimination of all molded parts with metallic inserts. By redesigning the functional structure of the circuit breaker, in the order of 35% fewer parts are employed over previously accepted commercial designs. The resulting simplicity makes the circuit breaker easier to assemble and materially reduces calibration problems. At the same time a substantial reduction in manufacturing cost is realized as the parts are fewer and simpler, there is less scrap of plastic parts and finish requirements have been minimized. Moreover, it has been possible to effect a substantial saving in initial tooling cost as well as reducing the cost of tool maintenance.

Obviously, the aforementioned improvements in cost savings would be of no practical consequence without an accompanying high degree of reliability. To that end all critical wear surfaces of the circuit breaker are either work hardened, as in the case of the thermostatic bimetal, or heat treated as in the case of the beryllium copper components. Also, the stored forces for effecting circuit breaking upon overload are well balanced to avoid cocking and binding of the component parts.

DRAWINGS

In the illustrated forms of the invention,

FIG. 1 is a side elevational view of one form of the circuit breaker with the front half of the case shown removed and the circuit closed,

FIG. 2 is a cross-sectional view taken on line II—II of FIG. 1,

FIG. 3 is a view similar to FIG. 2 taken on line III—III of FIG. 1,

FIG. 4 is a fragmentary plan view of the contact rocker member,

FIG. 5 is a fragmentary sectional view through the shoulder screw of the actuator elements,

FIG. 6 is a view similar to FIG. 1 showing the circuit open,

FIG. 7 is a fragmentary view similar to FIG. 1 showing the circuit about to be closed by manual operation,

FIG. 8 is an exploded view of the component parts shown in FIG 1, and

FIG. 9 is a fragmentary side elevational view of a modified form of contact.

DETAILED DESCRIPTION

In the form of the invention shown in FIGS. 1 through 8, the circuit breaker **10** comprises a molded case having a front part **12** and a back part **14** held together by four suitable fasteners **16**. Terminals **18** and **20** are received in opposed slots provided in the parts **12** and **14** in a well known manner. A suitable panel attachment bushing **22** is received in opposed semi-circular depressions in the parts **12** and **14** in an equally well known manner. Attached to the terminal **18** by welding, or otherwise, is the thermal element **24**. A fixed contact **26** is carried on the terminal **20**.

ACTUATOR MECHANISM

The mechanism for manually opening and closing the circuit breaker **10** through the exposed actuator button **28** of suitable insulating material, comprises two separate, relatively movable linear members preferably stamped from a sheet of half hardened beryllium. One such element is in the form of an actuator slide **30** having a hole **32** in its lower end to receive a pin **34** of insulating material to attach the button **28** to the slide **30**. The upper end of the slide **30** is bent to provide an anchor tab **36** for the extension spring **38**. Between the ends of the slide **30**, a laterally extending latch cam **40** is provided.

The other element of the actuator mechanism takes the form of an actuator bar **42** having a tapped hole **44** to receive the threaded end **46** of the shoulder screw **48**. An elongated hole **50** is provided in the actuator slide **30** in which the cylindrical shank **51** of the screw **48** is disposed, the head of the screw **48** holding the slide **30** and bar **42** assembled to each other, yet permitting limited lost motion along their longitudinal axes defined by the amount of clearance of the shank **51** of the screw **48** in the elongated hole **50**. Above the hole **44** and centered on the bar **42** is a reamed hole **56** to receive a suitable shoulder rivet **57** for pivotally supporting the contact rocker lever assembly.

To guide the slide **30** and bar **42** of the actuator mechanism for longitudinal movement, the back part **14** of the case is provided with a generally rectangular depression **58** which, with the surface **60** of the front part **12** of the case, provides a four sided guide for the upper end of the bar **42**. The lower end of the bar **42** is supported for longitudinal movement between the projections **62** defined

on the horizontal leg of the L-shaped guide **64**. The vertical leg **65** of the guide **64** is shown attached to an interior wall surface of the back part **14** of the case by drive pin **65'**, or other suitable means.

Actuator slide **30** is supported for longitudinal movement in the rectangular slot **66** provided in the insulating bushing **68** disposed within the panel attachment bushing **22** with a press fit. As the button **28** and the trip indicator **70** are both located within the bushing **68** with a free guiding fit, the relatively snug fit between the lower end of the slide **30** and the slots in the button **28** and trip indicator **70** results in the slide **30** having a relatively long support bearing in the bushing **68** and overcoming any tendency to cock or bind.

In practice, there is relatively little lateral clearance between the diameter of the shank **51** of the shoulder screw **48** and the parallel sides of the elongated hole **50** through which the screw **48** extends. As a result, the upper end of the slide **30** is guided for longitudinal movement relative to the actuator bar **42** upon the shank **51** of the screw **48**. When the limits of relative movement are reached, as defined by the ends of the elongated hole **50**, the slide **30** and bar **42** will have unitary movement and the upper end of the slide **30** will be guided by the bar **42**, the bar **42**, in turn, being guided in its movement by the depression **58** and surface **60** and the projections **62** on the guide **64**.

CONTACT ROCKER LEVER ASSEMBLY

The movable contact **72**, which is engaged and disengaged with the fixed contact **26** to make and break the circuit, is carried upon a contact rocker lever assembly **75** pivotally supported on the actuator bar **42** by the shoulder rivet **57**. Preferably, the rocker lever comprises front and rear parts **76** and **78**, one of which is the mirror image of the other except for the size of the holes **74** to receive the stepped down diameter of the shoulder rivet **57**. Outturned ears **80** and **82** are provided on the parts **76** and **78** to which is secured to the contact blade **84** by rivets or drive pins **85**. The movable contact **72** is carried on the blade **84**.

In practice, the parts **76** and **78** are stamped from quarter hard beryllium copper sheet while the contact blade **84** is formed from half hard beryllium copper sheet. It will be seen from FIG. 4 that the central portion **86** of the parts **76** and **78** are outwardly offset to provide clearance space **42'** for the actuator bar **42**, the clearance space being sufficient to enable the assembly of the parts **76**, **78** and **84** to pivot through a substantial arc on the bar **42** about the axis of the shoulder rivet **57**. The depth of the offset of each central portion **86** is approximately one-half the thickness of the bar **42** whereby the rocker lever assembly, while freely pivotable on the bar **42**, is firmly supported and guided by opposite sides of the bar **42** directly adjacent the hole **56** in the bar **42** through which the shoulder rivet **57** extends. Each of the parts **76** and **78** have a spring tab portion **88** at one end and a ledge portion at the opposite end, which ledge portion of each of the parts **76** and **78** collectively form a two-ply ledge **90**. The insulating bushing **68** is provided with spring anchor tabs **94** and **96**, the spring **38** being attached to the tab **94** and the extension spring **98** being attached to the tab **96**.

THERMAL ELEMENT

The thermal element **24** is formed in part from a strip **24'** of suitable thermostatic bimetal or trimetal material having a resistance to suit the desired ampere rating. In form, it is generally U-shaped with one bimetallic leg **100** welded or riveted to a nonthermostatic L-shaped member having at its upper end a flange **104** which is welded, or otherwise rigidly attached, to the terminal **18**. The other bimetal leg **106** of the strip **24'** has, at its upper end, an offset inturned flange **108** having its active portion substantially disposed on the center line of the case defined by the parts **12** and **14**. As the low expansion side

of the thermostatic strip **24'** is disposed on the outside of the legs **100** and **106**, on overload the leg **106** will be displaced to the left, as viewed in FIGS. 1 and 6. An adjustment screw **24''**, disposed in a threaded aperture on the part **14**, bears against a surface of the nonthermal member **102** to shift the position of the flange **108** relative to the two-ply ledge **90** of the contact rocker lever assembly **75**.

MECHANICAL LATCH

When the actuator bar **42** is in its closed circuit position, which is its "up" position as seen in FIG. 1, the bar **42** is held against the tension of the extension spring **98** by the mechanical latch **109** rigidly attached at one end to the rocker lever assembly **75** adjacent the two-ply ledge **90**. Preferably, the mechanical latch **109** is formed from a sheet of half-hard beryllium copper. As stamped from the sheet, the latch blank is perforated to receive the two-ply ledge **90** and is flanged to rest on top of the parts **76** and **78**. The upper perforated end of the latch **109** is then welded in position on the ledge **90** and, thereafter, heat-treated along with the assembly **75**. The vertical leg of the latch **109** depends from the rocker lever assembly **75** to terminate in an angularly disposed portion **116** adapted to rest on one of the projections **62** on the guide **64**. The latch **109** is of sufficient width as to enable the nose portion **116** while resting on the projection **62** to also extend laterally therefrom a sufficient distance to be engaged by the latch cam **40** on the actuator slide **30**. With the circuit closed, the latch cam **40** is disposed out of actuating contact with the nose portion **116**. When the cam **40** is lowered by manual movement of the slide **30** engages that portion of the nose portion **116** laterally disposed with reference to the projection **62** and urges the nose portion **116** from its position of support on the projection **62** whereupon the component parts collapse into the position similar to that disclosed in FIG. 6 with the exception that the leg **106** of the thermal element will not be thermally displaced, as shown in FIG. 6, but will be disposed in the position shown in FIG. 7.

At the time the actuator slide **30** is lowered by manual force applied to the button **28** to manually open the circuit breaker, as described in the preceding paragraph, the lost motion connection between the slide **30** and the bar **42** enables the latch cam **40** to move into engagement with the nose portion **116** of the latch portion **109** without movement being imparted to the bar **42** upon which the rocker lever assembly **75** is carried. As the assembly **75** is held against clockwise pivotal movement about the axis of the shoulder rivet **57** by engagement of the two-ply ledge **90** with the fulcrum abutment flange **108**, the nose **116** will tend to resist movement along the face of the projection **62** upon which it rests and some deflection of the latch **109** must take place before the nose portion **116** can be displaced by the latch cam **40**. Through this arrangement the resiliency of the latch **109** resists manual movement of the slide **30** along with the tension of the springs **38** and **98**. Also, any tendency for the nose portion **116** of the latch **109** to be vibrated off its position of normal rest upon the projection **62** is avoided.

OPERATION

In FIG. 6, the actuator bar **42** is shown in its "down" position following an overload. The thermal strip **24'**, having been overheated, is shown with the leg portion **106** moved to the left from the position shown in FIG. 1. The actuator slide **30** is, likewise, in its "down" position with the button **28** in its extreme projected position and the trip indicator **70** is disposed to visually indicate that the circuit breaker has been actuated and the circuit is open.

Upon cooling, the thermal strip **24'** will return to the position in FIGS. 1 and 7 to relocate the flange **108** in the path of movement of the two-ply ledge **90** of the contact rocker lever assembly **75**. To restore the circuit breaker to its closed circuit position of FIG. 1, an up-

ward push is exerted on the button **28** to raise the actuator slide **30** into the position shown in FIG. 1. As the shoulder screw **48** on the bar **42** is resting on the lower end of the elongated hole **50** in the slide **30** with the circuit open, the bar **42** will move upwardly as a unit with the slide **30**.

As the bar **42** moves upwardly, the two-ply latch **90** will engage beneath the flange **108** to swing the contact rocker lever assembly **75** into the position shown in FIG. 1 with the movable contact **72** in stressed engagement with the fixed contact **26** to close the circuit.

To support the bar **42** in the position shown in FIG. 1 closing the circuit, the latch **109** must be so located and shaped, as well as calibrated by adjustment of the screw **24''**, so as to dispose the latch nose portion **116** on the projection **62** of the fixed guide **64**. The necessary movement of the latch **109** is assured by the engagement of the two-ply ledge **90** with the underside of the fulcrum flange **108** which causes the contact lever assembly **75** to be rocked counterclockwise as it is being simultaneously lifted on the bar **42**. With this movement taking place the latch cam **40** is disposed in its elevated position clearing the nose **116**, as shown in FIG. 7. The continued forward movement of the bar **42** will cause the nose portion **116** of the latch **109** to be snapped over the edge of the projection **62** and upon the latch supporting surface thereof into its final position of rest, as shown in FIG. 1.

With the component parts in the position shown in FIG. 1 the springs **38** and **98** are fully tensioned. If the manual force holding the button **28** fully elevated is then removed, only the latch **109** with its nose **116** resting on the projection **62** is acting to prevent the tension of the springs **38** and **98** from collapsing the circuit breaker components into the open circuit position of FIG. 6.

It will be understood, with the component parts shown in FIG. 1, that the tension of the spring **38** on the slide **30** is being resisted by the cam **40** resting on the nose portion **116**, the tension of the spring **38** being insufficient to cause the cam **40** to displace the nose **116** from its position of rest on the projection **62** with the circuit closed.

Upon the occurrence of the short or overload, the flange **108** will be moved from its latching position above the two-ply ledge **90** and the tension of the spring **98** will rock the contact lever assembly **75** about the axis of the shoulder rivet **57** to separate the contacts **26** and **72** with snap action. As the latch **109** will have unitary movement with the assembly **75**, the rocking action on the part of the assembly **75** will remove the latch nose **116** from the projection **62** and the component parts will collapse into the state shown in FIG. 6.

Preferably, the combined length of the latch **109** and its nose portion **116** is such that some slight deflection of the thermal element **24** and the resilient contact blade **84** carrying the movable contact **72** is required to raise the bar **42** sufficiently to allow the latch nose **116** to swing counterclockwise into its position of rest above the projection **62**. Thus, when the manual force on the button **28** is released, the latch **109** is supporting the stress of the deflection of the thermal element **24** and the contact blade **84** as well as the tension of the spring **98**. It will be noted that all of these forces are acting in substantially the same vertical plane.

It should be further noted that only with respect to the thermal element **24** is there any provision for calibration. All the components which react against the thermal element **24**, directly or indirectly, are substantially in balance and act only in the plane in which the bar **42** and the active part of the flange **108** are disposed. In this regard the contact lever assembly **75** comprises two similar parts disposed on opposite sides of the bar **42** and presenting a two-ply support defining the ledge portion **90** to the flange **108**. Likewise, the latch **109** is in complete balance on the bar **42**. By supporting the latch nose **116** on that portion of the projection **62** disposed in the plane of the bar **42** substantial balance is maintained with respect to the forces acting on the latch **109** through the shoulder rivet **57**.

As to the forces which are brought to act on the latch nose **116** through the latch cam **40**, it will be observed that the cam **40** is in juxtaposition to the plane of the bar **42**.

For the sake of clarity, the usual flexible conductor **120**, extending between the contact **72** and the thermal element **24**, is shown broken away except for its points of attachment with the contact blade **84** and the tab **122** on the leg **106**.

MODIFICATION

In FIG. 9 is shown a modification of the movable contact structure in which the contact **124** is carried upon an L-shaped arm **126** pivotally supported on the contact lever assembly **75'** on the pivot pin **128**. A stop **130** limits rocking of the arm **126** counterclockwise about the axis of the pin **128** under the stress of the spring **98'**. Clockwise movement of the arm **126** will increase the tension on the spring **98'** with the reaction being taken by the contacts **26'** and **124**.

I claim:

1. In a trip-free circuit breaker of the type described, the combination with an actuator, of a rocker lever pivotally supported on said actuator intermediate the ends of said lever, one end of said lever constituting a fulcrum point and the other end carrying a movable contact, a fixed body portion in which said actuator is disposed for relative movement, a fixed contact carried on said body portion, a thermostatic conductor including a fulcrum displaceable upon overload with which said fulcrum point normally engages to rock said lever about its pivot point upon manual manipulation of said actuator in one direction to impart translatory motion to said lever, during said manipulation and following engagement of said fulcrum point with said fulcrum said lever is caused to rock about said fulcrum point to move said movable contact into engagement with said fixed contact to close the circuit in which said thermostatic conductor is disposed, energy-storing means energized by said manipulation and tending to rock said lever in a direction to separate said contacts to open the circuit said means being operatively connected between said body portion and said lever, a mechanical latch carried on said lever and having a unitary pivotal movement therewith for supporting said lever in circuit-closing position and resisting said energy-storing means with said fulcrum point engaging said fulcrum and restraining pivotal movement of said lever about its pivot in a circuit-opening direction, and means supporting said thermostatic conductor relative to said fulcrum point whereby the heat of an overload will displace said fulcrum from engagement with said fulcrum point to enable said lever to be rocked by said energy-storing means in a direction to open the circuit.

2. In a trip-free circuit breaker of the type described in claim **1** having means on said actuator for operating said latch when said actuator is moved in the opposite direction to enable the pivot of said lever to move relative to said fulcrum to rock said lever in a direction to separate said contacts to open said circuit.

3. In a trip-free circuit breaker of the type described in claim **2** wherein said actuator is manually manipulated in both directions to open and close the circuit.

4. In a trip-free circuit breaker of the type described in claim **1** wherein said actuator is of the push-pull type having two linear parts with a lost motion connection between them, said lever being pivotally carried on one of said parts and means on the other of said parts for engaging said latch to render the same inoperative when said actuator is moved in a direction to open said circuit.

5. In a trip-free circuit breaker of the type described in claim **4** wherein a cam is provided on said other part and disposed adjacent said seat for displacing said latch from said seat upon movement of said other part in a circuit-opening direction.

6. In a trip-free circuit breaker of the type described in claim 1 wherein a fixed seat is provided for said latch, said latch having a portion for engaging said seat to resist rocking movement of said lever about its pivot with said fulcrum point engaging said fulcrum.

7. In a trip-free circuit breaker of the type described in claim 6 wherein said latch, when engaged on said seat, reacts against said lever at a point between one end of said lever and its pivotal connection with said actuator.

References Cited

UNITED STATES PATENTS

2,816,192 12/1957 Ingwersen ..... 337—63

BERNARD A. GILHEANY, Primary Examiner

D. M. MORGAN, Assistant Examiner

U.S. Cl. X.R.

337—66, 74