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Belttary

[11] **3,930,211**

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[54] **CIRCUIT BREAKER**

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[52] **U.S. Cl.** **335/6;** 200/246; 335/133; 335/196

[51] **Int. Cl.²** **H01H 73/04**

[58] **Field of Search** 335/196, 133, 43, 145, 335/6; 200/246

[56] **References Cited**

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Attorney, Agent, or Firm—David M. Keay; Elmer J. Nealon; Norman J. O'Malley

[57] **ABSTRACT**

Circuit breaker having a movable contact mounted on a contact carrier. The movable contact is rivet-shaped having a large section which includes a surface for making contact with a stationary contact and having a shank. The shank extends through an opening in the contact carrier so that the large section of the contact is on one side of the contact carrier and a portion of the shank extends to the other side of the contact carrier. A flexible copper conductor is welded directly to the portion of the shank on the other side of the contact carrier and is also connected to a thermostat element. Thus, the contact carrier is not an essential element in the conductive path between the movable contact and the thermostat element and, therefore, may be of a material which is non-conductive or of relatively low conductivity.

5 Claims, 5 Drawing Figures

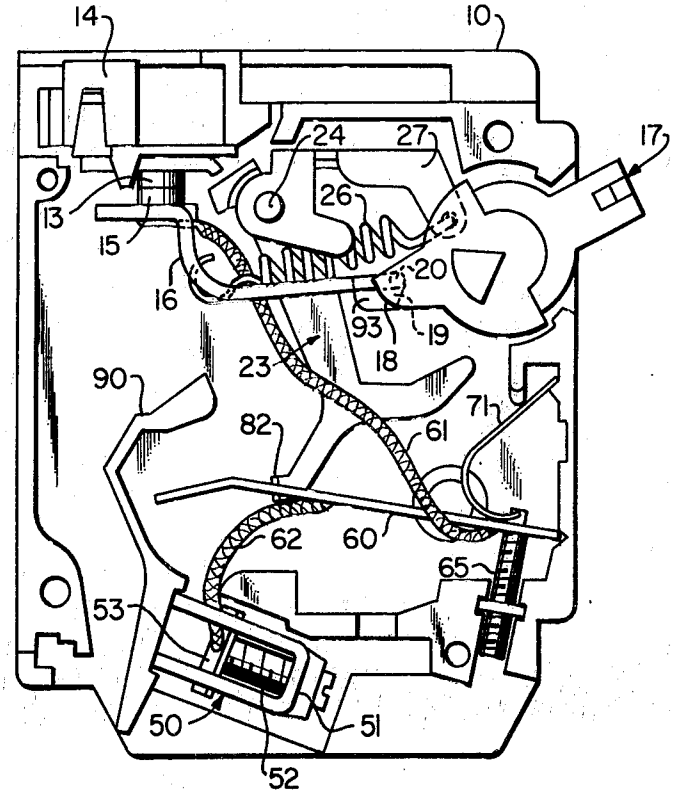


FIG. 1

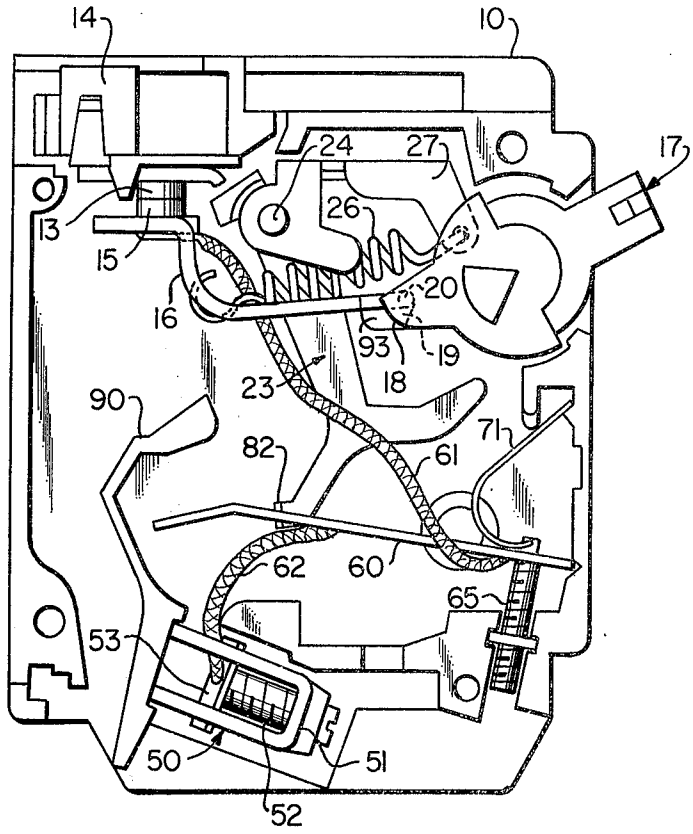
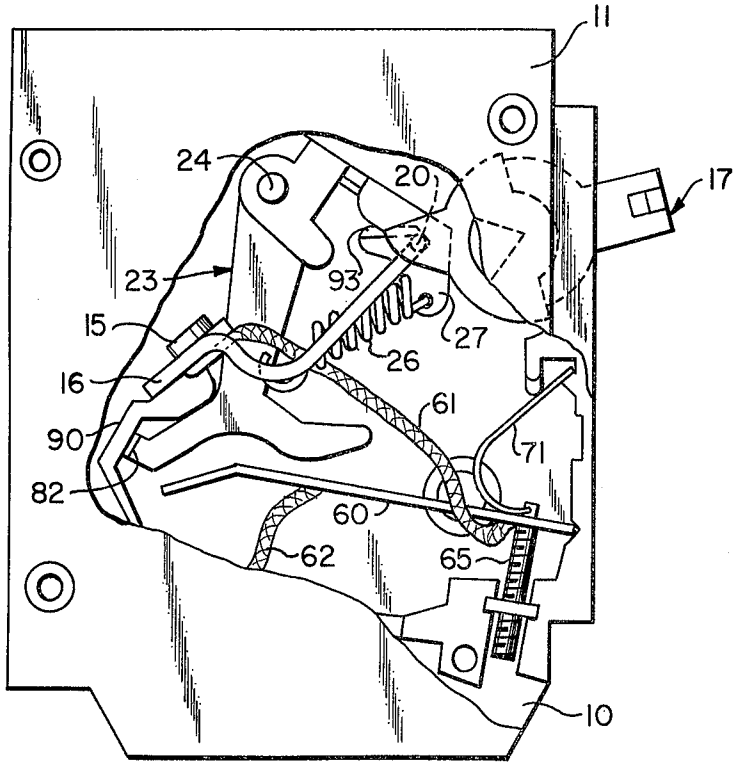

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FIG. 2


11
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65
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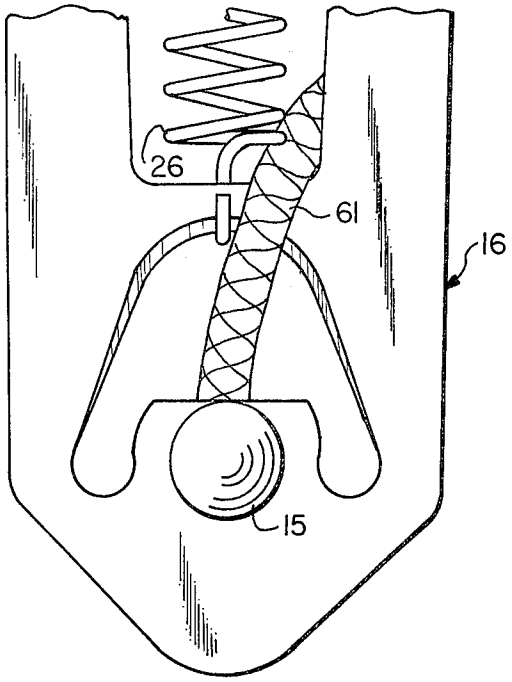


FIG. 3

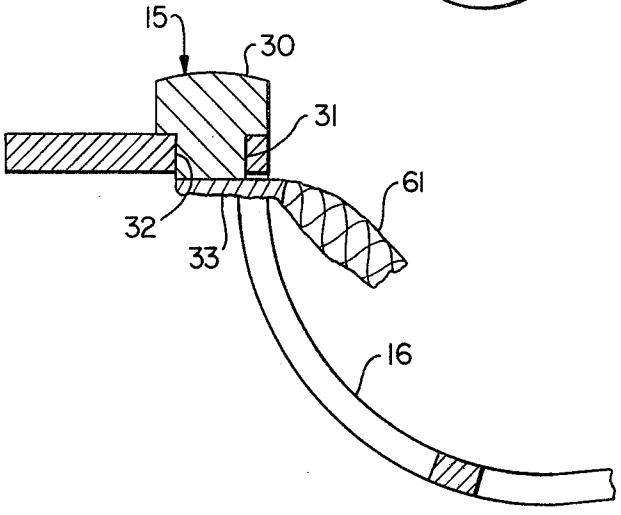


FIG. 4

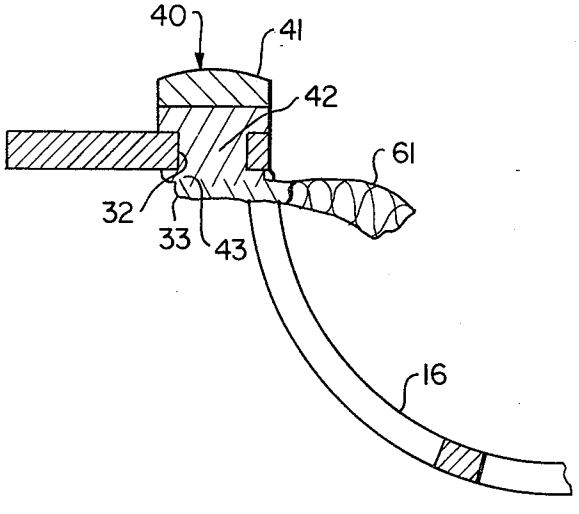


FIG. 5

CIRCUIT BREAKER

CROSS-REFERENCES TO RELATED APPLICATIONS

This application discloses and claims subject matter disclosed but not claimed in application Ser. No. 476,701 filed June 5, 1974 by Harold E. Belttary entitled "Circuit Breaker" and application Ser. No. 476,661 filed June 5, 1974 by Harold E. Belttary entitled "Electric Circuit Breaker."

BACKGROUND OF THE INVENTION

This invention relates to circuit breakers. More particularly, it is concerned with low voltage circuit breakers for controlling low and moderate power electrical circuits.

A circuit breaker for use in controlling electrical circuits typically has a set of contacts, one fixed and one movable, and a toggle, or overcenter mechanism, which is manually operated to close and open the contacts. A circuit breaker also includes an overload mechanism for tripping the circuit breaker and opening the contacts when the electrical current through the circuit breaker exceeds certain predetermined conditions. The overload mechanism includes a current responsive member such as a thermostat element and may also include a magnet and armature arrangement. In response to certain predetermined current conditions through the current responsive member, the current responsive member causes the overload mechanism to trip the breaker and open the contacts.

The stationary contact of the set of contacts typically is connected to a line terminal in the circuit breaker and the current responsive member is connected to a load terminal in the circuit breaker. The path of current flow through the circuit breaker from the line terminal to the load terminal is across the set of contacts, when they are in engagement, and also through the current responsive member. Other conductive members within the circuit breaker for carrying current between these elements must be of sufficient size and conductivity.

One member in the conductivity path is a contact carrier or switch arm on which the movable contact is mounted. The contact carrier is moved by the toggle and by the overload mechanism to move the movable contact into and out of engagement with the fixed contact. A flexible conductor of copper wire is connected between the contact carrier and the current carrying members, including the current responsive member, of the overload mechanism. Thus, the contact carrier is an essential element in the current path and must be of a satisfactory current carrying material and of sufficient cross section.

Materials which are satisfactory for current carrying members such as the contact carrier are relatively expensive and constitute a significant factor in the cost of circuit breakers. In addition, the availability of these materials presents a problem at times. Furthermore, the size and configuration of the contact carrier is at least partially determined by electrical considerations in addition to the mechanical considerations imposed on the contact carrier as an integral part of a switching mechanism.

SUMMARY OF THE INVENTION

Circuit breakers in accordance with the present invention avoid the requirement that the contact carrier be of a highly conductive material and instead it may be of a low or nonconductive material. A circuit breaker in accordance with the invention includes stationary contact and a movable contact. The movable contact is mounted on a contact carrier. The contacts are opened and closed manually in normal operation by an operating mechanism. A tripping mechanism which includes a current responsive member is disposed in a conductive path between the movable contact and a load terminal. The tripping mechanism moves the contact carrier to open the contacts in response to a current overload condition through the current responsive member. A flexible conductor is connected in the current path between the movable contact and the current responsive member. The flexible conductor is directly connected to the movable contact so that the movable contact and the flexible conductor are in the conductive path but the contact carrier is not an element in the direct conductive path.

BRIEF DESCRIPTION OF THE DRAWINGS

Additional objects, features, and advantages of circuit breakers in accordance with the present invention will be apparent from the following detailed discussion together with the accompanying drawings wherein:

FIG. **1** is a side elevational view of a circuit breaker in accordance with the invention with the cover of the housing removed and with the contacts in a closed position;

FIG. **2** is a view of the circuit breaker similar to the view of FIG. **1** with the cover in place but with portions broken away to show the elements in the tripped position;

FIG. **3** is a detailed plan view of a portion of the contact carrier for supporting the movable contact in accordance with the present invention;

FIG. **4** is an elevational view in cross section of a portion of the contact carrier and movable contact of FIG. **3**; and

FIG. **5** is an elevational view similar to FIG. **4** illustrating a modification of the mounting of the movable contact in the contact carrier.

DETAILED DESCRIPTION OF THE INVENTION

A circuit breaker in accordance with the present invention as illustrated in the figures includes a housing comprising a case **10** of suitable insulating material and a cover **11** of similar material. The case and cover are typically of molded plastic. The various elements of the circuit breaker mechanism are mounted within the case **10** and held in place by the cover **11** which is riveted to the case.

A fixed contact **13** is mounted on a line terminal clip **14** which is designed to engage a line bus when the breaker is inserted into a distribution panel box. A movable contact **15** is mounted on a contact carrier **16** which will be described in greater detail hereinbelow. A handle **17** of insulating material is pivotally mounted within the case **10** in a conventional manner for manual operation.

The end of the contact carrier **16** is positioned in slots **18** and **19** in two arms extending from the handle **17** so as to provide a pivot point of connection **20** between the contact carrier **16** and the handle **17.** A

trip arm is mounted on a boss **24** in the case **10** for pivoting between the set position as shown in FIG. **1** and the tripped position as shown in FIG. **2.** An overcenter tension spring **26** has one end connected to the contact carrier **16** and the other end connected to an arm **27** of the trip arm **23.** The handle **17,** contact carrier **16,** and spring **26** form an overcenter arrangement, or toggle, which serves as an operating mechanism and urges the movable contact **15** towards the fixed contact **13** when the spring **26** is on one side of the pivot point **20** as shown in FIG. **1** and urges the movable contact **15** to the open position when the spring **26** is on the other side of the pivot point **20.**

A load terminal **50** for connecting the circuit breaker to a load circuit is also positioned in the molded case **10.** The load terminal includes a lug **51,** a load bar **53,** and a screw **52** for clamping a wire against the load bar **53.**

The current responsive member of the overload tripping mechanism is a thermally responsive latching member **60** which is electrically connected between the movable contact **15** and the load terminal **50** by flexible conductors **61** and **62** of stranded wire, typically copper wire. The thermally responsive latching member **60** is a generally flat elongated thermostat element of at least two layers of metal having different coefficients of thermal expansion so that the element bends as its temperature increases. One end of the flexible conductor **61** is attached directly to the thermostat element adjacent to one end, and the other end of the flexible conductor **61** is attached to the movable contact **15** as will be described in detail hereinbelow. One end of the flexible conductor **62** is connected directly to the thermostat element **60** at the opposite end from the conductor **61.** The other end of the flexible conductor **62** is attached to the load bar **53** of the load terminal **50.**

The thermostat element **60** is mounted at one end within the case **10** in an appropriate manner by the combination of a J-shaped spring **71,** a threaded rod **65,** and the case itself as described in detail in the aforementioned application Ser. No. 476,701. A notch (not visible in the drawings) in the thermostat element **60** provides a latching surface against which a flange **82** of the trip arm **23** bears. The trip arm **23** tends to pivot about the boss **24** by virtue of the urging of the overcenter spring **26.** The trip arm is held in its set position as shown in FIG. **1** by the flange **82** abutting the latch surface formed by the notch in the thermostat element and preventing further movement.

The circuit breaker operates in the customary manner for closing and opening the contacts. The contacts are closed by rotating the handle **17** upward to the fully counterclockwise position as shown in FIG. **1.** The contacts are opened manually by rotating the handle **17** in a clockwise direction to the fullest possible downward position. This action moves the pivot point **20** of the contact carrier **16** and the handle **17** in a clockwise direction to the opposite side of the overcenter spring **26.** With the pivot point **20** on the opposite side of the overcenter spring **26,** the force of the spring **26** moves the contact carrier **16** to the open position with the carrier against a stop member **90.**

The closed contacts are opened automatically by the overload tripping mechanism under conditions of predetermined current flow. With the contacts closed, the electrical current flowing through the thermostat element **60** produces heating and causes the end of the element to bend away from the flange **82** of the trip arm **23** with the increasing temperature. If the current flow is sufficient to produce enough heat, the thermostat element bends sufficiently so that the flange **82** of the trip arm **23** is released from the notch in the thermostat element. The overcenter spring **26** acting on the arm **23** causes the trip arm to rotate about the boss **24** in a clockwise direction. The trip arm **23** moves to the tripped position abutting the stop member **90** as shown in FIG. **2.**

As the trip arm **23** rotates in a clockwise direction, the end of the spring **26** carried by the arm **27** also moves in a clockwise direction and carries the spring **26** to the other side of the pivot point **20.** With the center line of the spring **26** on the opposite side of the pivot point **20,** the spring rapidly forces the contact carrier **16** to the tripped position against the stop member **90** as shown in FIG. **2** separating the contacts **13** and **15.** The handle **17** assumes as intermediate position as shown in FIG. **2.**

The tripped circuit breaker is manually reset by rotating the handle **17** to the manual open or extreme clockwise position. During this movement an arm **93** on the handle **17** engages an area of the trip arm **23** rotating the trip arm in the counterclockwise direction about the boss **24.** The trip arm **23** rotates sufficiently so as to permit the flange **82** to reengage the notch in the thermostat element **60.** During the resetting operation, the contact carrier **16** is also restored to the position it assumes when the contacts are opened manually. The contacts may then be closed by rotating the handle **17** in the counterclockwise direction to restore the circuit breaker to the latched condition shown in FIG. **1.**

The contact carrier **16** and the movable contact **15** which is mounted thereon are illustrated in detail in FIGS. **3** and **4.** The contact **15** is of a material including silver, for example, a sintered mixture of silver and tungsten. The contact **15** is rivet-shaped having a large portion **30** including the contact surface which engages the fixed contact. A shank **31** extends from the large portion **30.** The large portion **30** lies on one side of the contact carrier and the shank **31** fits in an opening **32** in the contact carrier and extends to the other side of the contact carrier as best seen in FIG. **4.**

The contact carrier **16** is of steel and is protectively coated as by tin plating. The silver-tungsten contact **15** is attached to the contact carrier **16** by resistance brazing. In order to provide sufficient silver to obtain a proper braze, extra silver is made available at the brazing surfaces. In one technique the contact is subjected to a high temperature causing silver to "bleed out" from the tungsten. Alternatively, the contact **15** may be treated in a selected etching material prior to brazing to etch away exposed particles of tungsten leaving a silver-rich material at the brazing surfaces.

The flexible conductor **61** consists of several strands of copper wire. Before being attached to the contact, the end of the conductor is subjected to resistance welding to from the strands into a solid copper mass **33.** The end **33** of the copper conductor **61** is fixed to the underside of the contact **15** by resistance welding. The welding of the silver-tungsten contact and the copper conductor takes place at a lower temperature than the previous brazing step; therefore, the mechanical connection of the contact to the contact carrier is not disturbed. As can be seen in FIG. **4** the path of current flow from the movable contact **15** is directly to the

flexible copper conductor **61**, and the contact carrier **16** is not an essential element in the conductive path.

A modification of the movable contact, its manner of being mounted in the contact carrier, and its connection to the flexible conductor is illustrated in FIG. **5**. The contact **40** includes a first section **41** of silver having the contact surface for engaging the fixed contact. The silver section **41** is mounted on a rivet-shaped section **42** of copper or a copper alloy. The shank of the rivet-shaped section **42** extends through the opening **32** in the contact carrier **16** to the underside of the contact carrier. The portion of the shank extending beyond the underside of the contact carrier is deformed as by a standard riveting operation to produce an enlarged region **43** which is larger than the opening **32**. The copper conductor **61** with strands welded at the end **33** is then resistance welded to the enlarged region **43** of the deformed shank. Thus, in the modification shown in FIG. **5** the conductive path from the contact surface of the contact **40** is through the silver section **41**, the rivet-shaped section **42**, and the enlarged region **43** directly to the flexible copper conductor **61**. The contact carrier **16** is not in the direct conductive path.

Since the contact carrier on which the movable contact is mounted is not part of the direct conductive path in circuit breakers in accordance with the present invention as described herein, its electrical characteristics do not need to be considered. Thus, the contact carrier may be of any suitable material, conductive or nonconductive, rather than materials typically used previously such as copper and copper alloys. Its configuration and size may be determined independently of any current carrying functions and solely by the requirements of other function which it performs. For example, in the circuit breaker described hereinabove the contact carrier may be a relatively simple steel stamping with an appropriate protective coating.

While there has been shown and described what are considered preferred embodiments of the present invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined in the appended claims.

What is claimed is:

1. A circuit breaker including

a stationary contact;

a movable contact;

a contact carrier having the movable contact mounted thereon;

an operating mechanism for manually moving said contact carrier to selectively open and close said contacts;

a load terminal;

a tripping mechanism including a current responsive member in a conductive path between said movable contact and said load terminal for moving said contact carrier to open said contacts in response to a current overload condition through said current responsive member;

a flexible conductor connected in the current path between said movable contact and said current responsive member;

said flexible conductor being directly connected to said movable contact whereby said conductive path includes the movable contact and the flexible conductor, and said contact carrier is not an element directly in said conductive path;

a region of the contact carrier having an opening therethrough between opposite sides of the contact carrier;

said movable contact extending from one side of said contact carrier through said opening to the other side of said contact carrier;

said movable contact being fixed to said contact carrier and having a contact surface on the one side of said contact carrier for engaging the stationary contact; and

said movable contact having a surface in the direct fixed connection with said flexible conductor on the other side of said contact carrier.

2. A circuit breaker in accordance with claim **1** wherein

said movable contact is brazed to said contact carrier in the regin of said opening; and

said flexible conductor is welded to said movable contact at said surface in direct fixed connection therewith.

3. A circuit breaker in accordance with claim **2** wherein

said contact carrier is of steel;

said movable contact includes silver and is brazed to the contact carrier with a brazing material including silver; and

said flexible conductor is of copper.

4. A circuit breaker in accordance with claim **1** wherein

said movable contact includes a portion disposed on the one side of said contact carrier and having said contact surface for engaging the stationary contact, and a shank fitting with said opening and extending therethrough to the other side of the contact carrier, the portion of the shank on the other side of the contact carrier being deformed to be larger than said opening thereby holding said movable contact fixed in said contact carrier; and

said flexible conductor is welded to the deformed portion of said shank in direct fixed connection therewith.

5. A circuit breaker in accordance with claim **4** wherein

said contact carrier is of steel;

a region of said portion of the movable contact including said contact surface is of silver;

said shank including the deformed portion is of copper or a copper alloy; and

said flexible conductor is of copper.

* * * * *