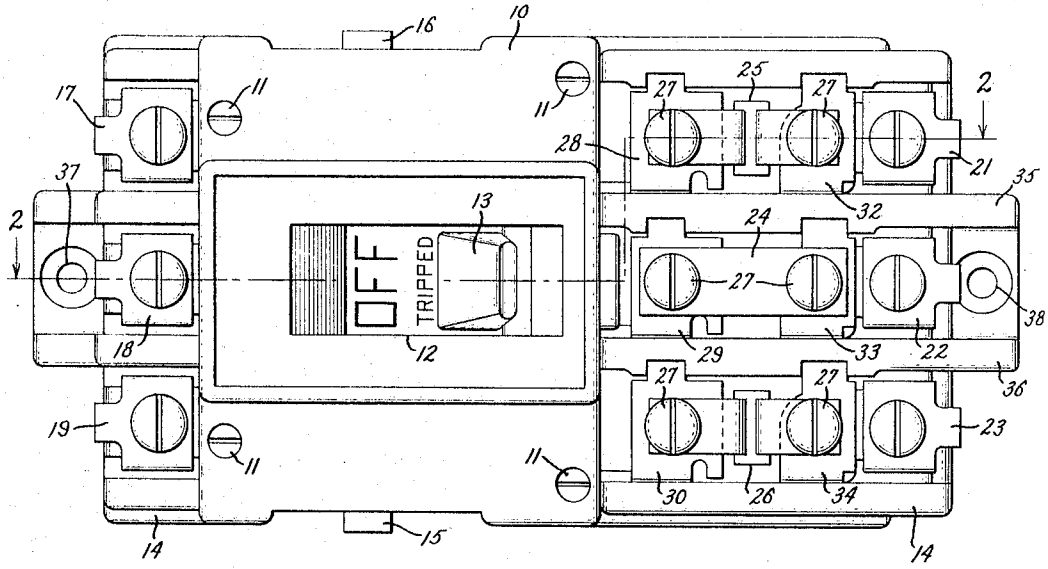
Jan. 3, 1967 W. F. DOWDLE ETAL 3,296,398

THERMAL OVERLOAD ASSEMBLY FOR CIRCUIT BREAKER

Original Filed Aug. 12, 1963 2 Sheets-Sheet 1

FIG. 1.



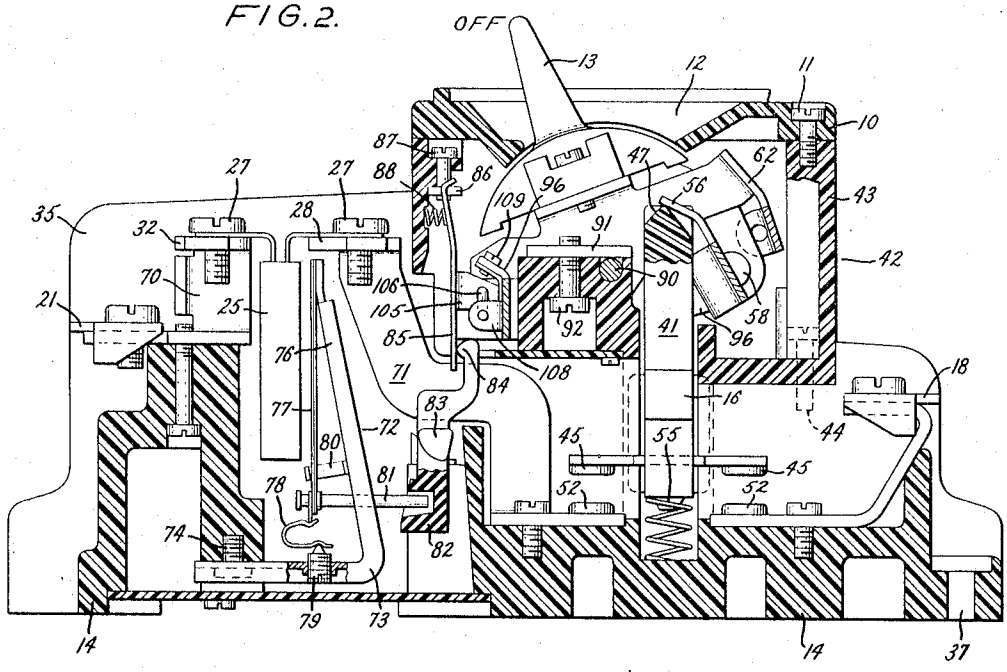
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FIG. 2.



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3,296,398

THERMAL OVERLOAD ASSEMBLY FOR CIRCUIT BREAKER

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Original application Aug. 12, 1963, Ser. No. 301,361, now Patent No. 3,240,904. Divided and this application Oct. 22, 1965, Ser. No. 511,014
7 Claims. (Cl. 200—116)

This invention relates to electrical switching devices, and more particularly, to controllable circuit breakers having means to trip the circuit breaker in response to electrical overloads.

The present application is a division of application Serial No. 301,361, filed August 12, 1963.

Circuit breakers have found wide application in assemblies of industrial control devices known as control panels, wherein the circuit breakers control the application of electrical power to a wide variety of loads including motors of many types. Among the prime considerations in the selection of control components for use in such panels is their size. Accordingly one of the general objects of this invention is to provide a circuit breaker having an unusually small size for a given electrical rating.

Other important features in the design and selection of circuit breakers are reliability of operation and ruggedness of construction. Still further important factors are the ease of assembly and disassembly for inspection and replacement, if necessary, of certain components. Especially important is versatility of application so that certain basic mechanisms are capable of controlling power to a wide variety of electrical loads.

An object of the invention is the provision in a circuit breaker assembly of a sturdy, easily removable and readily adjustable overload assembly which responds accurately to an electrical overload condition to trip the circuit breaker and thereby open its contacts.

In accordance with a preferred embodiment of the invention, there is provided a circuit breaker housing having stationary contacts arranged along the base thereof and a bridging contact-carrying arm disposed to reciprocate slideably toward and away from the stationary contacts, thereby to open and close electrical continuity through the stationary contacts. The contact-carrying arm carries an actuating extension which projects outside the housing. A separate toggle mechanism contained within its own casing is fastened removably atop the housing, where it surrounds and encloses the extending end of the contact-carrying arm. The toggle mechanism is wholly mechanical, carrying no electrical contacts of its own, but is arranged to actuate the underlying switch contacts by controlling movements of the arm extension which it surrounds.

In normal manual operation of the circuit breaker, movements of an operating handle transverse to an upper surface of the toggle casing are translated through a spring-biased overcenter mechanism into vertical movements of a pivotal drive yoke which strikes the end of the arm extension and drives it downward to close the switch contacts. The toggle may also be operated in response to an overload condition and for this purpose an additional spring-biased overcenter link mechanism is provided to trip a normally stationary yoke of the toggle assembly. When this is done the pivotal axis of the drive yoke is forced overcenter, causing the drive yoke to spring away from the contact-carrying arm. The operating handle then assumes a neutral disabled position indicative of the fact that the toggle mechanism has been tripped.

The overload condition which causes the toggle mechanism to be tripped is sensed by one or more unusually

compact unitary bimetallic overload assemblies which are inserted cartridge-like into the bottom or base of the housing and which are each removable simply by the loosening of one screw. Movements of the bimetal portion of the overload assembly are converted by still another overcenter arrangement into a rapid thrust of an operating rod. The operating rod, affixed to one end of the bimetal, extends through an aperture in the rigid cantilever support arm which carries the bimetal to engage a cupped recess in a rocker-like trip arm. Another portion of the trip arm engages a trip lever of the overcenter link mechanism previously referred to for tripping the toggle mechanism.

These and other novel features believed characteristic of the invention are set forth in the appended claims. The construction of a preferred embodiment of the invention, together with further objects and advantages thereof, may be more readily understood, however, from the following description taken in connection with the accompanying drawing in which,

FIGURE 1 is a top view of a threee-pole circuit breaker assembly constructed in accordance with the principles of this invention;

FIGURE 2 is a cross-section view taken on line 4—4 of FIGURE 1;

In FIGURE 1 can be seen from the top cover **10** of a toggle assembly fastened to a toggle casing beneath by screws **11**. Through window **12** of the cover **10** there projects an operating handle **13** of a toggle mechanism. This toggle mechanisms is more fully shown and described in a copending patent application Serial No. 301,361, filed by Walter F. Dowdle and Lyle J. Wenzel on August 12, 1963, now Patent Number 3,240,904, which is assigned to the same assignee as the instant application. The operating handle carries at its base certain signals visible through window **12** indicative of the "on" or "off" condition of the circuit breaker, the handle being shown in its "off" position. The toggle mechanism within the casing beneath is mounted removably atop the circuit breaker housing **14**, which is constructed of an insulating material such as bakelite. Mounted within the housing **14** but concealed from view in FIGURE 1 is a switching mechanism containing fixed and movable electrical contacts. The movable contacts are carried by a slideable contact-carrying arm, the ends **15** and **16** of which project through and beyond the sides of housing **14**. The contact-carrying arm is mounted for reciprocating switching action in a direction perpendicular to the plane of FIGURE 1. The switching action of the contact-carrying arm controls the application of electrical power from source terminals **17**, **18** and **19** to load terminals **21**, **22** and **23**.

Intermediate the source and load terminals there may be and there preferably are installed certain additional load controlling elements such as shunt **24** and overload resistance heaters **25** and **26**. The latter resistance heaters and the shunt **24** are interchangeably connected by screws **27** between intermediate terminals **28**, **29** and **30** on the one hand and intermediate terminals **32**, **33** and **34** on the other. These separate intermediate terminals are otherwise electrically independent of each other except through the aforesaid shunt and resistance heaters. Electrical isolation between the separate sets of terminals is assured by the upstanding projections **35** and **36** on housing **14**. The entire assembly may be fastened to a panel or switch box through apertures **37** and **38** provided for that purpose at opposite ends of the base of the housing **14**.

Referring now to FIGURE 2, a toggle assembly **42** which includes a toggle casing **43** is fastened to and removable from housing **14** by screws such as the one indicated at **44** passing through casing **43** and into the

housing 14. The toggle assembly 42 contains no electrical contacts, being a wholly mechanical assembly. Instead of operating upon its own contacts, the enclosed removable toggle assembly 42 operates upon the sliding contact arm 41 which carries at its lower end movable bridging contacts 45.

The contact-carrying arm 41 resiliently carries three sets of movable bridging contacts 45. The movable contacts 45 cooperate with stationary contacts 52 fastened in the base or bottom of the housing 14. A return spring 55 in the base of the housing urges the contact carrying arm upward toward the "off" position in which the bridging contacts 45 are separated from stationary contacts 52.

Manual operation of operating handle 13 between the "on" and "off" condition causes the toggle assembly 42 to act upon contact-carrying arm 41 to engage and disengage respectively bridging contacts 45 and stationary contacts 52. In addition to this manually operably means, which is more fully shown and described in aforementioned Patent Number 3,240,904, means are also provided to trip the circuit breaker automatically from an "on" condition to an "off" condition in response to an electrical overload through the switch contacts. In FIGURE 2 the means to accomplish this purpose are shown. In this figure electrical continuity can be traced from terminal 21 through connecting support member 70 and, thence, through overload resistance heater 25 which is connected between intermediate terminals 32 and 28 by screws 27. Electrical continuity then continues through conducting support member 71 and through stationary contacts 52 and movable bridging contacts 45 to a terminal at the opposite end of the circuit breaker assembly. The purpose of the overload resistance heater 25 is to generate substantial quantities of heat in response to excessive electrical currents through the switching circuit.

An overload protective assembly 72 positioned immediately adjacent the resistance heater 25 responds to the high temperatures produced to initiate a protective tripping operation of the toggle mechanism to open the circuit breaker contacts. The overload protective assembly 72 consists of a small number of parts held together in a unitary assembly which can be inserted cartridge-like into the base of the circuit breaker mechanism. A rigid bracket 73 having the general configuration of an L is fastened to the circuit breaker base 14 by a single screw 74 which fastens the base portion of the bracket within a groove left for this purpose in the base. To provide rigidity for an upwardly extending cantilever support arm 76 the bracket 73 is constructed with a channel-shaped cross section. The rigidity provided contributes to the precision of operation of the mechanism attached to the bracket. This mechanism includes elongated bimetallic element 77 welded at one end to the extreme terminal portion of the cantilever support arm 76 and extending generally along but spaced from the support arm toward the base portion of the bracket immediately adjacent the overload resistance heater 25 in heat absorbing relationship thereto.

The high expansion side of the bimetal faces the overload resistance heater 25 so that elevated temperatures tend to flex the lower end of the bimetal as seen in FIGURE 2 toward the right. Resisting such flexing movements is a C-shaped overcenter spring 78 connected between the lower end of the bimetal and adjusting screw 79 threaded through the base of the rigid bracket 73. The C-shaped overcenter spring 78 is trapped between the linear lower edge of the bimetal 77 and a single point at the apex of the adjusting screw 79. The C-shaped overcenter spring 78 normally biases the linear lower edge of the bimetal 77 to the left, as shown in FIGURE 2, such that the lower edge is to the left of the pivot point of the spring 78 on the adjusting screw 79. As the bimetal is heated the increasing force on the overcenter spring 78 causes the tip of the bimetal suddenly to snap to the right with a rapid thrust. The tip of the bimetal passes to the right of the pivot point of the spring 78 on the adjusting screw 79, thus moving away from the resistance heater 25 and closer to the support arm 76. Similarly, upon cooling the bimetal does not return gradually to the position shown in FIGURE 2 but snaps back again. To prevent the bimetal from curling too far to the left where it might contact the surface of resistance heater 25, a restraining element 80 having a C-shaped configuration is fastened to the cantilever support arm 76 extending around to the high expansion side of the bimetal. Thus, the most remote position of the lower edge of the bimetal with respect to the support arm 76 is determined by the restraining element 80.

At the lower movable end of the bimetal an aperture is provided through which extends actuating means shown in the form of a push rod 81 having flanges on opposite sides of the aperture to trap the push rod within the aperture and prevent its loss. The push rod 81 extends through another aperture provided in the L-shaped bracket 73 adjacent the end of the bimetal and into a cupped recess within a trip arm 82. The purpose of this arrangement of parts is to transmit the snap acting movements of the lower end of bimetal 77 to a position beyond the protective overload assembly to initiate a protective opening of the circuit breaker contacts and also to permit the easy removal and insertion of the protective overload assembly. Because of the disposition of parts and the rigidity of the bracket 73, and also because the separate elements of the overload protective assembly constitute a basic unitary removable structure, such assemblies can be calibrated with accuracy completely apart from the circuit breaker and then inserted therein with assurance that the overload protective assembly will function accurately when called upon to do so in response to an overload condition. The other resistance heater 26 shown in FIGURE 1 also has associated with it an overload protective assembly of the nature described with its thrust rod extending into another cupped recess in trip arm 82 so that either one of the overload protective assemblies can trip the circuit breaker mechanism. In a typical three-phase circuit connection no more than two such overload protective assemblies are necessary to detect excessive currents in the circuit. Hence, in the top view of FIGURE 1, there is shown a simple shunt 24 in the central conducting path instead of a resistance heater with an associated overload protective assembly.

The thrust of rod 81 within the cupped portion of trip arm 82 causes the trip arm to rotate about its pivot 83 in a counterclockwise direction as seen in FIGURE 2. This movement of the trip arm forces its upper extremity 84 against the lower end of a latch arm 85 mounted within the casing of toggle assembly 42. The upper end of latch arm 85 is mounted for slight pivotal movement on a lug 86 attached to the base of mounting screw 87. A bias spring 88 urges the latch arm 85 to the right as seen in FIGURE 2.

The construction features of the toggle mechanism which permit it to be tripped "off" and which account for the unique compactness and reliability of the toggle mechanism are more fully shown and described in aforementioned Patent Number 3,240,904, and will be only briefly described herein by making reference to FIGURE 2. An operating yoke 62 is mounted for limited pivotal movement on shaft 90 which, in turn, is mounted in a fixed position in a groove in the base of casing 43 and is fastened therein by a plate 91 clamped over the groove by screw 92. A drive yoke 56 which is operated in response to pivotal movements of the operating yoke 62 and its handle 13, is mounted on pivots, only one of which, 58, is shown defining a separate pivotal axis laterally displaced from and parallel to shaft 90.

It is to be particularly noted that drive yoke 56 is mounted to pivot on a normally stationary trip yoke 96. The trip yoke is also mounted for pivotal movement

about stationary shaft **90**, the same shaft about which the operating yoke pivots. This feature contributes further to the compactness of the toggle assembly. The trip yoke **96** is normally latched in the position shown in FIGURE 2, but when released from this latched position as a result of an electrical overload condition, it springs to a tripped position, being urged toward that position by a pair of stiff trip springs (not shown).

Attention is now directed to the latching trip link assembly by which the trip yoke is held in its normal operating position and released or tripped to an overload position. The basic elements of the latching trip link assembly are shown in FIGURE 2. On the central portion of latch arm **85** a perpendicular projection **105** having an aperture therethrough engages the center of trip link **106**. Trip link **106** resembles a crankshaft, being generally in the shape of a C with divergently extended ends. The outer ends of the trip link are retained in apertures **107** of link bracket **108** bolted to the trip yoke **96** by screws **109** which pass through apertures in the trip yoke and into threaded recesses in the link bracket.

In its latched condition the trip link **106** occupies the position shown in FIGURE 2 with its ends below its central portion. The force exerted by the trip springs (not shown) upon trip yoke **96** tends to rotate the outer ends of the link **106** in a clockwise direction to the left of the pivotal connection between the center of the link and the aperture within projection **105** of latch arm **85**. The link, however, is restrained against movement in this direction by the engagement between the extreme end of projection **105** and the center of link bracket **108**. When in response to an overload condition the protective overload assembly causes the upper extremity **84** of trip arm **82** to thrust the latch arm **85** to the left, the central portion of link **106** is moved toward the left, passing over the line of force exerted on the link by the trip springs (not shown). The thrust of trip springs (not shown) then forces the link to rotate in a counterclockwise direction about its central portion to a raised position, and also rotates the trip yoke **96**.

After the condition responsible for the electrical overload has been corrected and the protective overload assembly has cooled and relaxed to its original position, the toggle mechanism can be reset by moving the operating handle to the "off" position shown in FIGURE 2. When this is done portions of the operating yoke engage the trip yoke and force it against the bias of trip springs (not shown) until the trip link mechanism is reset to its normal latched condition. The circuit breaker can then be switched "on" again.

It will thus be seen that a circuit breaker assembly has been provided which meets the objectives of compactness, simplicity and reliability. The circuit breaker described is also characterized by ease of disassembly for inspection, repair and adjustment purposes and for interchangeability of parts. The toggle mechanism can be removed and, if desired, replaced by another form of actuator such as a pushbutton assembly or even an electromagnet-type actuator. It is thus not necessary to reconstruct the entire circuit breaker for it to serve a variety of purposes.

Although there has been described a particular embodiment of this invention, many modifications may be made in the combination described and it is to be understood that the appended claims are intended to cover all such modifications that fall within the true spirit and scope of the invention.

What is claimed as new and is desired to be secured by Letters Patent of the United States is:

1. A thermal overload assembly comprising:

a rigid bracket having a base and a cantilever support arm extended therefrom;

means on said base for affixing said bracket to a support structure;

an elongated bimetallic element fastened at one of its ends to the free end of said cantilever support arm, said bimetallic element extending alongside and spaced from said support arm toward the base portion of said bracket, the high expansion side of said element facing away from said support arm;

an overcenter spring extending between a pivot point on the other end of said bimetallic element and a pivot point at the base of said bracket, said spring normally biasing the other end of said bimetallic element away from said support arm to a first position, heating of said bimetallic element to an elevated temperature causing the other end of said bimetallic element to snap quickly toward said support arm to a second position the opposite side of the pivot point at said base portion the other end of said bimetallic element returning to the first position when the temperature of said bimetallic element is reduced;

said support arm of said bracket having an aperture therethrough adjacent said other end of said bimetallic element; and

an actuating rod affixed to said other end of said bimetallic element and extending through the aperture in said bracket whereby movement of the other end of said bimetallic element between the first and second positions is transmitted as actuating movements by said actuating rod to a location on the other side of said bracket.

2. The combination with a circuit breaker having electrical contacts, releasable trip means for opening said electrical contacts, and at least one resistance heater connected to generate substantial quantities of heat in response to excessive electrical currents through said contacts, of a protective overload assembly insertable within said circuit breaker comprising:

a rigid bracket having a base portion and a cantilever support arm extended therefrom;

means on said base portion for affixing said bracket to said circuit breaker adjacent said resistance heater;

an elongated bimetallic element fastened at one of its ends to the free end of said cantilever support arm, said bimetallic element extending alongside and spaced from said support arm toward the base portion of said bracket, the high expansion side of said element facing away from said support arm and toward said resistance heater;

an overcenter spring extending between a pivot point on the other end of said bimetallic element and a pivot point at the base portion of said bracket, said spring normally biasing said other end of said bimetallic element away from said support arm to a first position, heating of said bimetallic element by the substantial quantities of heat generated by said resistance heater to an elevated temperature causing said other end of said bimetallic element to snap quickly toward said support arm to a second position the opposite side of the pivot point at said base portion the other end of said bimetallic element returning to the first position when the temperature of said bimetallic element is reduced;

said support arm of said bracket having an aperture therethrough adjacent said other end of said bimetallic element;

an actuatig rod affixed to said other end of said bimetallic element and extending through the aperture in said bracket whereby when said bimetallic element is heated to the elevated temperature by the substantial quantities of heat generated by said resistance heater when excessive electrical currents are flowing through said contacts, said bimetallic element snaps quickly to the second position, and said actuating rod moves through the aperture to release said trip means and open the electrical contacts of said circuit breaker.

3. The combination of a circuit breaker and a protective overload assembly as defined in claim **2**, wherein a C-shaped restraining element is fastened to said cantilever

support arm and extends around said high expansion side of said bimetallic element to determine the first position of said other end of said bimetallic element, whereby it is prevented from contacting said resistance heater.

4. An overload protective assembly for use with a circuit breaker, which circuit breaker includes a toggle mechanism for actuating the circuit breaker contacts between open and closed positions, the toggle mechanism being manually operable, and also operable by an overload trip means, the circuit breaker further including a resistance heater which is connected to generate substantial quantities of heat in response to excessive electrical currents through the circuit breaker contacts, said overload protective assembly comprising:

a rigid bracket having a base portion and a cantilever support arm extended therefrom;

means on said base portion for affixing said bracket to the circuit breaker adjacent the resistance heater;

an elongated bimetallic element fastened at one of its ends to said free end of said cantilever support arm, said bimetallic element extending alongside and spaced from said support arm toward said base portion of said bracket;

an overcenter spring extending between a pivot point on said other end of said bimetallic element and a pivot point at said base portion of said bracket, said spring normally biasing said other end of said bimetallic element to a first position on one side of said pivot point at said base portion, heating of said bimetallic element by the substantial quantities of heat generated by the resistance heater to an elevated temperature causing said other end of said bimetallic element to snap quickly to a second position on the opposite side of said pivot point at said base portion, said other end of said bimetallic element returning to the first position when the temperature of said bimetallic element is reduced; and

actuating means affixed to said other end of said bimetallic element and extending to the opposite side of said bracket, whereby when said bimetallic element is heated to the elevated temperature by the substantial quantities of heat generated by the resistance heater when excessive electrical currents are flowing through the contacts, said bimetallic element snaps quickly to the second position, and said actuating means is moved thereby to release the trip means and open the electrical contacts of the circuit breaker.

5. An overload protective assembly as defined in claim 4 wherein said rigid bracket is L-shaped with a channel-shaped cross section.

6. An overload protective assembly as defined in claim 4 wherein said overcenter spring is C-shaped and said pivot point at the base portion of the bracket is the apex of an adjusting screw, said base portion of said bracket being provided with a threaded hole for receiving said adjusting screw.

7. An overload protective assembly as defined in claim 4 wherein said support arm of said bracket has an aperture adjacent said other end of said bimetallic element, said actuating means comprising a rod extending through said aperture, said rigid bracket, said elongated bimetallic element, said overcenter spring, and said actuating rod being formed as a unitary assembly which is inserted cartridge-like into the circuit breaker, and said means on said base portion for affixing said bracket to the circuit breaker is a screw, the threads of which are received by a threaded hole in the circuit breaker housing, whereby said screw affixes said unitary assembly to the circuit breaker.

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