May 22, 1962 L. W. BRACKETT 3,036,178

TOGGLE LEVER CIRCUIT BREAKER

Filed Sept. 21, 1960

2 Sheets-Sheet 1

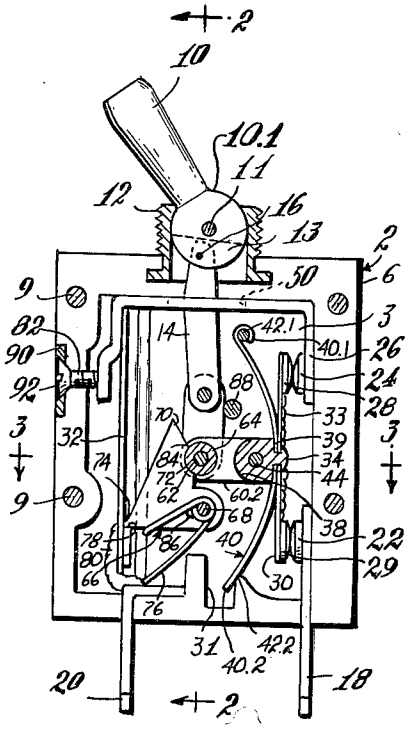


Fig. 1

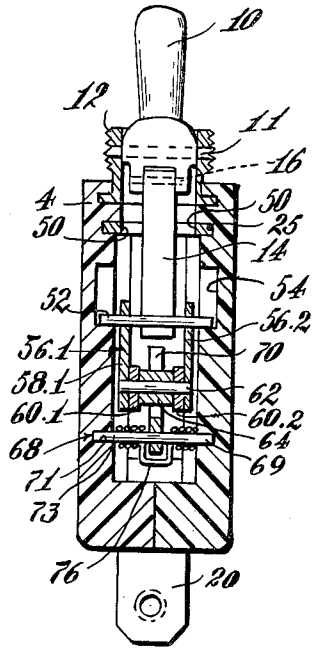


Fig. 2

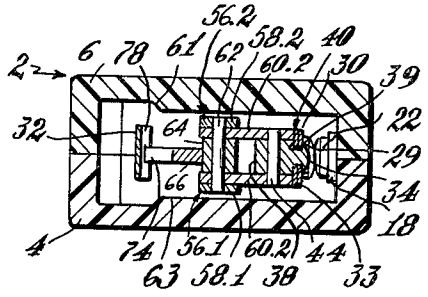


Fig. 3

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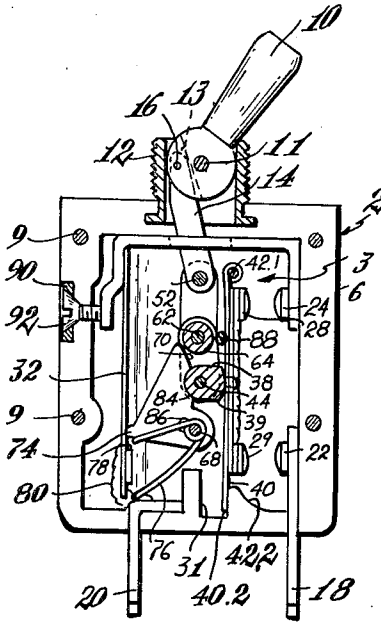


Fig. 4

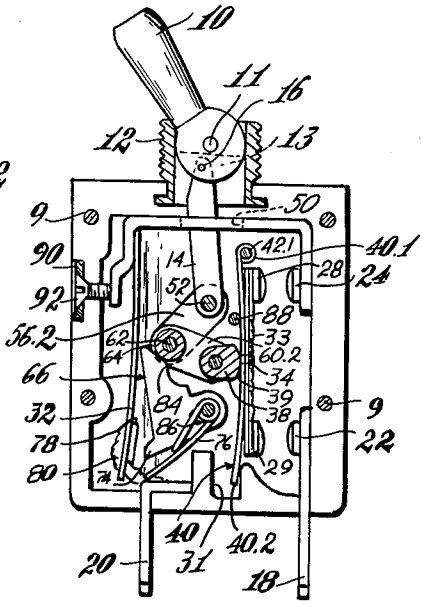


Fig. 5

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TOGGLE LEVER CIRCUIT BREAKER

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The field of this invention is that of manually operable circuit breakers; it is an improvement upon the circuit breaker disclosed in my copending application Serial No. 747,195, now Patent No. 2,955,177.

Objects of this invention are to provide a circuit breaker which is automatically operable to open a circuit at a predetermined current overload; which may be manually operated by a convenient and familiar motion to either open or close a circuit; which may be adjusted to operate to open a circuit with great rapidity under either manual or automatic operation; which suppresses arcing to a considerable degree thereby preventing sparking through casing openings such as that opening for the operating lever; which automatically resets for automatic operation; which will not close the circuit so long as the automatically operable tripping means is conditioned by a current overload, even if the switch operating lever is forcibly held in closing position; which is of simple, compact, sturdy and lightweight construction; which utilizes a minimum number of parts all of which are easily manufactured and assembled without requiring closely toleranced machining or selective assembly; and which compensates for wear and misalignment during extended operation.

The substance of the invention can be briefly summarized in some of its characteristic aspects as follows.

Circuit breakers according to the invention comprise fixed contact means; a movable contact member for closing a circuit through the fixed contact means, the movable contact being biased to an open circuit position; an operating lever including a crank pivot; a connecting rod; a pivotally mounted cam member; actuating means pivotally engaging the connecting rod and movable contact and slidably engaging the cam member to urge the movable contact against said bias to closed circuit position in response to movement of the operating lever and releasable latching means retaining the cam member in slidable engagement with the actuating means.

In the preferred embodiment of the invention, the movable contact member is a bridge adapted to connect two fixed contacts, and the actuating device has toggle-joint means having a knee-pivot pin, with opposite remote ends of the toggle-joint means pivotally engaging the connecting rod and the bridge respectively. A rotatable roller is mounted on the knee-pivot to engage the cam member which has a recess to intercept movement of the roller in response to movement of the operating lever, to urge the bridge against its bias to close the circuit, with the roller snapping into the cam recess to maintain the operating lever and the bridge in closed circuit position after manually applied pressure on the operating lever is released. The latching means can be controlled in various ways, but in the preferred embodiment the releasable latching means comprises, in accordance with the invention, a strip of current responsive conducting material, preferably a straight bimetallic strip which bends upon temperature change, interposed in the circuit, with one end of the strip rigidly fixed in position, and the opposite end tangentially and releasably engaging the cam member to retain the cam in engagement with the knee-pivot without flexure of the strip. An overload current in the strip, causing flexure of the strip, releases the cam permitting the bridge biasing means to rotate the cam and to open the circuit irrespective of the position of the operating lever.

Also in accordance with the invention, the pivotally

mounted cam engages spring means, whereby, when the cam has been pivoted by the biasing means after overload-current tripping of the circuit, the cam will be biased to return to latched engagement with the strip and to maintain slidable engagement with the actuating means returning the operating lever to open circuit position. The cam engages its pivot with a slot so that, when it is returned to latched position in response to the spring bias it can be displaced to ride into engagement over the latching strip.

These and other aspects of the invention will appear from the following description of a practical embodiment illustrating its novel characteristics.

The description refers to a drawing in which:

FIG. 1 is a side elevation partially in section with one half of the housing removed, showing the mechanism in closed circuit position;

FIG. 2 is a section along the line 2—2 of FIG. 1 showing the mechanism in closed circuit position;

FIG. 3 is a section on lines 3—3 of FIG. 1;

FIG. 4 is an elevation similar to FIG. 1 showing the mechanism in open circuit position; and

FIG. 5 is a side elevation similar to FIG. 1 showing the mechanism in automatically tripped position before the spring means has reacted to reset the mechanism for manual operation.

Referring to the drawings, 2 indicates an insulating casing which completely encloses the breaker operating mechanism 3. The casing is formed with a front section 4, a back section 6, and countersink rivets 9 which serve to connect the casing sections 4 and 6. A bushing 12 is locked in engagement with the casing 2 by means of the flange 5 and engages a lock nut 7 which serves for mounting the breaker on an instrument panel as desired.

The circuit breaker can be connected in series in a line to be protected from an overload current by means of the terminals 18 and 20 which extend exteriorly of the casing 2. Within the casing, fixed contacts 22 and 24, one of which is mounted on the terminal 18 and one of which is mounted on a bus bar 26, correspond to contacts 28, 29 mounted on the movable contact bridge 30 to close the line circuit and to allow line current to flow through the breaker by way of terminal 18, bridge 30, bus bar 26, and the latching strip 32 to be described below, to the terminal 20. Recesses 25 and 27 in the casing sections 4 and 6 retain the bus bar 26 in proper location. A casing barrier 31 is positioned between the spring end 40.2 and the terminal 20 assuring effective breaker operation without arcing between the said spring end and the terminal. The preferred embodiment of the circuit closing member 30 is shown here but a single-contact circuit closing member would be satisfactory under certain load conditions. Thus, if contacts 22 and 29 were eliminated and the lower end of the circuit closing member 30 were pivotally connected to the terminal 18, the breaker would operate effectively to open and close a circuit by means of contacts 24 and 28.

The movable contact bridge, composed of stiffly resilient conducting material and having a flexible-braid conductor 33 brazed thereto, is attached by the rivet neck 34 of pivot-boss 38 to the leaf spring 40. The boss has a rounded surface 39 permitting free bending of the spring 40. The leaf spring has a loop 40.1 engaging a pivot pin 42.1 and a straight end 40.2 sliding on a casing projection 42.2. The pivot pin 42.1 is integral with the back casing section 6. This arrangement biases the bridge 30 away from the fixed contacts 22 and 24 to open circuit position. The pivot-boss 38 supports a pivot pin 44.

An operating lever 10 is rotatably mounted in bushing 12 by the bushing pivot pin 11.

The lower portion 10.1 of the lever 10, constituting a crank, is slotted at 13 to provide clearance for the con-

necting rod 14 which engages the lever 10 by means of crank pivot pin 16.

The connecting rod 14 extends into the casing 2 through an aperture 50 in the bus bar 26 and engages a rod pivot pin 52 which is long enough to slidably engage slots 54 in the casing sections 4 and 6.

These slots 54 guide the movement of the lower end 15 of the connecting rod 14 so as to produce a straight line motion of the pin 52 corresponding to a rotational movement of the operating lever 10.

Twin toggle-joint members 56.1, 56.2, comprising links 58.1, 58.2 and 60.1, 60.2 made of an insulating material and the common knee-pivot pin 62, each engage the pivot-pin 44 and the pivot-pin 52 to positively connect the connecting rod 14 and the movable contact bridge. A rotatable roller 64 is mounted on the pivot-pin 62 and rollably engages the cam member 66. Thick walled portions, 61 and 63, narrowly confine the operating mechanism 3 to prevent sidewise displacement of toggle-joint members, 56.1 and 56.2.

The cam member 66, pivotally mounted on the pivot-pin 68 which is mounted in the casing sections 4 and 6, has a cam surface 70 for slidable engagement with the roller 64, a recess 72 for retaining the roller 64 in over-center engagement to hold the bridge 30 and the operating lever 10 in closed circuit position, a slot 86, and a latching lip 74 for releasable engagement with the latching strip 32. Pin 68 is knurled at one end 69 for press fitting in casing section 6, while casing section 4 is provided with a recess 71 for receiving the end 73 of the pin 68. A spring 76 biases the cam for clockwise motion about the pivot-pin 68.

Pivotal motion of the cam 66 in a counterclockwise direction, in response to the pressure in this direction exerted by the contact bridge spring 40, is normally restrained by the bimetallic latching strip 32 which releasably engages the latching lip 74 by means of a latch plate 78 integral with the bimetallic strip. The bimetallic strip is rigidly fixed to bus bar 26 for physical support and for electrical connection in the breaker circuit. The latch plate end of the strip 32 is free to move if the strip is warped by temperature increase of the strip due to an overload current in the circuit. The flexible conductor 80 maintains the electrical connection of the strip 32 with the terminal 20 although the strip may be displaced by action of the screw 82 to adjust the strip engagement with the latching lip 74. The square metal insert 90 provides proper bearing for the screw 82 in the insulating casing 2 but is insulated after adjustment of the screw with an epoxy resin 92 as shown.

The pin 88, integral with the back casing section 6, provides an additional stop preventing the toggle-joints 56.1, 56.2 from passing overcenter on the knee-pivot pin 62 into an inoperative position and also serves as a stop for the spring 40 and the bridge 30.

The operation of the above described device is as follows:

This circuit breaker can be manually operated to close a circuit by pivoting the operating lever 10 about its pivot in a counter-clockwise direction as seen in FIG. 1. This movement, translated by the crank pivot 16 and the connecting rod 14 into a linear motion, forces the roller 64 against the cam surface 70 of the cam member 66. Since the latching lip 74 of the cam member is in engagement with the latch plate 78, the cam member will not rotate but will exert a reactive force on the roller 64 wedging the roller obliquely relative to the movement of the connecting rod 14. This sidewise force on the roller 64 is transmitted to the contact bridge 30 through the links 60.1, 60.2 to urge the bridge against the bias of the spring 40 until contacts 28, 29 bear upon contacts 22 and 24 closing the circuit. The roller 64 then snaps over the edge 84 into the cam recess 72 to retain the mechanism in closed circuit position. This closed circuit position is shown in FIGS. 1, 2 and 3.

Similarly, the circuit breaker may be manually operated just as easily to open as to close a circuit. When the operating lever 10 is rotated clockwise about its pivot 11 to a position as shown in FIG. 4, the roller 64 snaps out of engagement in the recess 72 and rides up the cam surface 70 allowing the spring 40 to urge the bridge 30 away from the fixed contacts 22 and 24 to break the circuit with considerable rapidity and to seat the pivot boss 38 in said cam recess 72.

This operation, which requires a mere brushing of the operating lever 10 with the finger tips is felt to present an appreciable advantage over requiring that an operating member be grasped and pulled in order to open a circuit.

Tests indicate it as probable that this breaker has its excellent arc suppression characteristics because of the arrangement of current conducting members to form a loop within the casing 2 in combination with movement of the contact bridge 30 within the loop. This loop arrangement of current conductors sets up a magnetic field transverse the movement of the contact bridge 30 and thus tends to terminate arcing upon circuit breaking with considerable rapidity.

The automatic circuit breaker operation in response to an overload current in the circuit is illustrated by a comparison of FIG. 1 with FIGS. 4 and 5. When an overload current flows in the closed circuit as shown in FIG. 1, the bimetallic strip 32 will register the resulting increase in temperature by bending, moving the latch plate 78 out of engagement with the latching lip 74 as shown in FIG. 5. The cam member 66 then is free to rotate in a counterclockwise direction in response to the force exerted thereon by the spring 40 allowing the contact bridge 30 to move away from the contacts 22 and 24 to open the circuit. Since the force of the spring 40 can easily overcome the clockwise bias of the cam due to the spring 76, the contacts are easily and rapidly separated. When cam rotation begins, the roller 64 will snap out of the recess 72 and roll along the cam surface 70.

When the counterclockwise motion of the cam 66 is completed, the components will be in the position shown in FIG. 5. The spring 76 will then be under tension and will react to rotate the cam in a clockwise direction, the cam surface 70 forcing the operating lever 10 into open circuit position and the cam latching lip 74 returning into engagement with the latch plate 78. This position is shown in FIG. 4. If the bimetallic strip 32 interferes with this clockwise rotation of the lip 74, the cam will move along the slot 86 until the lip has passed over the latch plate 78. The apparatus is then reset for manual closing of the circuit as described above.

It will be noted that, if the latching strip does not re-engage the cam member, as where the strip 32 has not sufficiently cooled to return to its normal straight disposition, the attempted manual closing of the circuit by the rotation of the operating lever 10 will be ineffective. If the cam 66 is not latched, the cam will exert no reactive force on the roller 64 but will rotate freely in a counterclockwise direction. Thus, the circuit cannot be manually closed when the automatic-overload protection means is not set to operate.

The overload current which will be sufficient to break the circuit automatically may be selectively predetermined by adjustment of the screw 82. Adjustment of the screw inwardly of the casing will decrease the bearing of the strip 32 on the latching lip 74. Therefore, the strip will require a smaller distortive force in order to overcome this bearing pressure. Thus, unlatching will require a lower temperature and so the strip may be subjected to a lower current, and will create sufficient distortive force within the strip to disengage the lip 74.

It will be noted that this circuit breaker serves all the functions of circuit breakers of this general type and that it accomplishes these results with a greatly reduced number and complexity of working parts as compared to existing switching devices used for similar purposes. In addi-

tion, the components of this device are readily and interchangeably assembled and are freely operable without requiring closely toleranced machining. Further, the working members may be subjected to a greater degree of wear and disalignment during operation without detracting from the freely working character of the apparatus. It will be noted that errors in machining or defects due to wear or disalignment which are not compensated for by complementary errors or defects elsewhere in the device, are absorbed by the resilience of the bridge **30**, or by slight folding of the toggle-joints **56**, or will be manifested in poor engagement of the lip **74** and the latch plate **78**. As was noted above, this engagement may be adjusted by means of the screw **82**.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications which fall within the scope of the appended claims.

I claim:

1. A circuit breaker comprising: fixed contact means; a movable contact member cooperable with said fixed contact means to close a circuit; means for biasing said movable contact member to an open circuit position; an operating lever including a crank rotating on a bushing pivot pin and having a crank pivot pin; a connecting rod engaging said crank pivot at one end and having a rod pivot pin at the other end; means for restraining the travel of said other end of the connecting rod to a substantially straight line motion; a pivotally mounted cam member; actuating means pivotally connected to the connecting rod and to the movable contact member and slidably engaging the cam member, for urging the movable contact member against said bias to closed circuit position in response to movement of the operating lever, and for permitting normal opening and closing of the circuit by movement of the operating lever while actuating means and cam member are engaged; and releasable latching means adapted normally to retain said slidable engagement between said actuating means and said cam member and, upon release, disengaging the actuating means from said cam member allowing said biasing means to move said movable contact member to open the circuit and to keep it open regardless of the position of the operating lever.

2. A circuit breaker comprising: fixed contacts; a movable contact bridge cooperable with said fixed contacts to close a ciruit; means for biasing said contact bridge to an open circuit position; an operating lever including a crank rotating on a bushing pivot pin and having a crank pivot pin; a connecting rod engaging said crank pivot at one end and having a rod pivot pin at the other end; means for restraining the travel of said other end of the connecting rod to a substantially straight line motion; a pivotally mounted cam member; a toggle-joint member pivotally connected to the connected rod and to the contact bridge at opposite remote ends of said toggle-joint member, said toggle-joint member slidably engaging the cam member at the common pivot of said toggle linkage for urging the bridge against said bias to closed circuit position in response to movement of the operating lever and for permitting normal opening and closing of the circuit by movement of the operating lever while the common pivot of said toggle-joint member and the cam member are engaged; and releasable latching means adapted normally to retain said slidable engagement between said common pivot and said cam member, and, upon release, disengaging said common pivot from said cam member allowing said biasing means to move said bridge to open the circuit and to keep it open regardless of the position of the operating lever.

3. A circuit breaker comprising: an insulating casing; fixed contacts; a movable contact bridge cooperable with the fixed contacts to close a circuit; means for biasing said contact bridge to open circuit position; an operating lever extending exteriorly of the casing and including a crank pivot; a connecting rod engaging said crank pivot at one end and having at the other end a pin engaging slots in said insulating casing; a pair of toggle-joint members having a common knee-pivot pin, said toggle-joint members being disposed in parallel relation and each pivotally engaging the connecting rod and the bridge at opposite remote ends of said toggle-joint members; a rotatable roller mounted on the knee-pivot pin holding the toggle-joint members in spaced relation; a pivotally mounted cam member, said cam member having a cam surface obliquely engaging the rotatable roller for urging the bridge against said bridge bias in response to movement of the operating lever, said cam surface having a recess for receiving the roller for retaining the bridge in closed circuit position, said engagement between said rotatable roller and said cam surface permitting normal opening and closing of the circuit by movement of the operating lever; a current-responsive strip interposed in said circuit, said strip being adapted to engage the cam member for retaining the cam in engagement with the roller, such that an overload current in the circuit will release the strip engagement with the cam and will allow the bridge biasing means to rotate the cam and to open the circuit irrespective of the position of the operating lever; and spring means engaging the cam whereby, when the cam has been pivoted by the bridge-biasing means after overload-current tripping of the circuit, the cam will be biased to return to latched engagement with the strip and to maintain slidable engagement with the roller forcing the operating lever to open circuit position.

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