April 1, 1969 K. J. STOKES 3,436,710

ELECTRIC CIRCUIT BREAKER

Filed May 24, 1967 Sheet 1 of 2

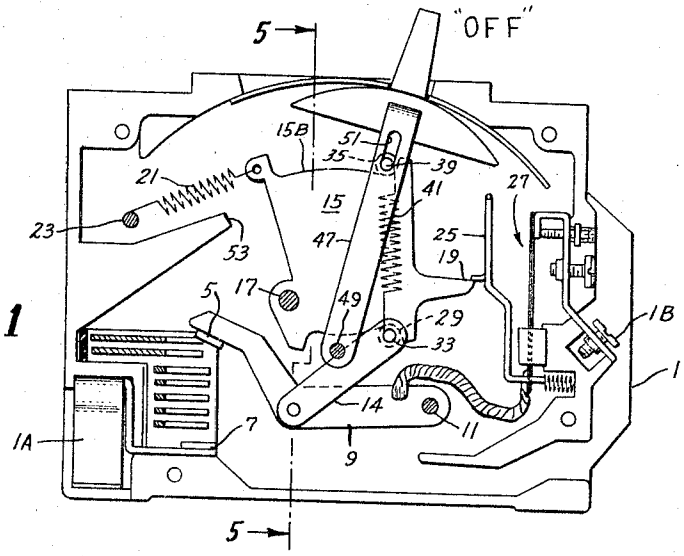

FIG. 1

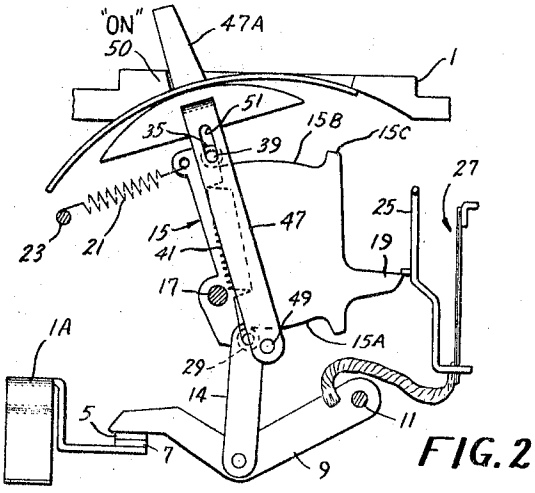

FIG. 2

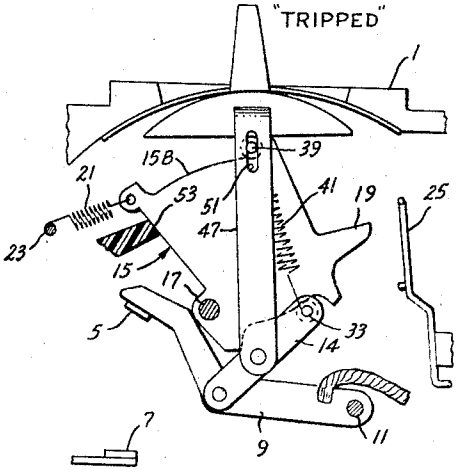

FIG. 3

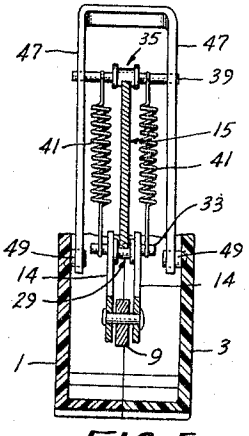

FIG. 5

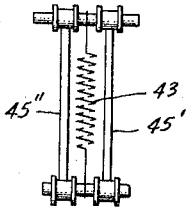

FIG. 6

INVENTOR.
KENNETH J. STOKES
BY Robert T. Carey
ATTORNEY

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ELECTRIC CIRCUIT BREAKER

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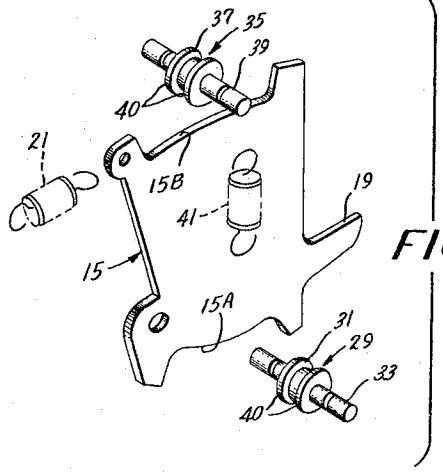

FIG. 4

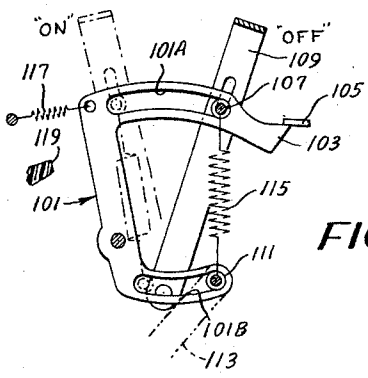

FIG. 7

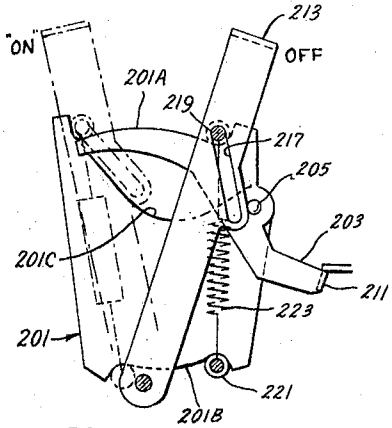

FIG. 8

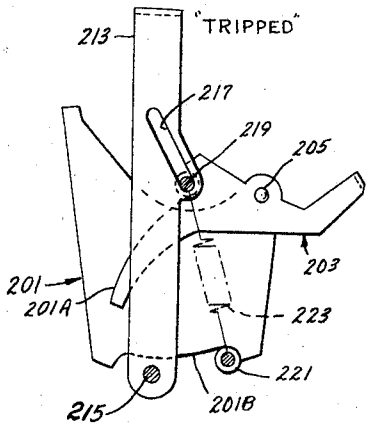

FIG. 9

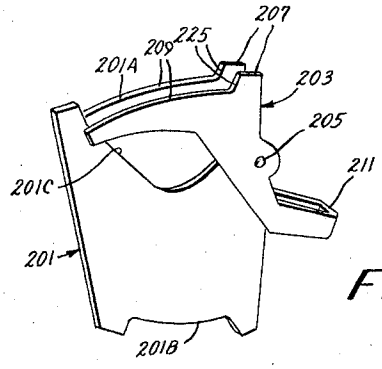

FIG. 10

INVENTOR.
KENNETH J. STOKES
BY Robert T. Casey
ATTORNEY

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3,436,710

ELECTRIC CIRCUIT BREAKER

Kenneth J. Stokes, Wethersfield, Conn., assignor to General Electric Company, a corporation of New York

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Int. Cl. H01h 71/16
U.S. Cl. 337—55 7 Claims

ABSTRACT OF THE DISCLOSURE

An electric circuit breaker includes a normally latched support member having upper and lower outwardly curved cam surfaces. A pair of cam follower rollers ride on the upper and lower cam surfaces and are interconnected by a pair of tension springs. Movement of the upper cam follower roller by manually operated means from one position to another on the cam surface causes corresponding movement of the other cam follower roller with a snap action, which movement is transmitted to a movable contact arm. When released by an overcurrent-operated latch, the support member is rotated by a bias spring while the upper cam roller is prevented by the manual operating member from moving with it, resulting in a change of the line of action of the spring with relation to the lower cam surface and opening of the contacts.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to assemblies of electric circuit breaker operating mechanisms and more particularly to assemblies of mechanisms which control the position of separable contacts within a circuit breaker upon the occurrence of predetermined current conditions therethrough.

Discussion of the prior art

Circuit breakers including overcenter snap-acting operating spring means for use in manually and automatically operating movable contacts between open and closed circuit position in electric circuit breakers of medium and high capacity are known quite generally in the prior art. My prior Patent No. 3,171,922, issued Mar. 2, 1965, and assigned to the same assignee as the present invention, discloses an overcenter operating mechanism of this type wherein a releasable member is provided to not only support the operating mechanism in its operating condition, but which includes an arcuate cam surface to guide a cam follower member which rides thereon. The cam follower member is connected by a pair of links to a movable contact arm, whereby movement of the overcenter spring causes the cam follower to ride along the cam surface with a snap action and thereby operate the movable contact arm between open and closed circuit positions at high speed. This arrangement provides high contact pressure in an overcenter-type releasable mechanism without the use of a pair of toggle links as required by comparable prior art circuit breakers.

The parts of operating mechanisms of prior art circuit breakers, including that of the breaker disclosed in the afore-mentioned patent, are individually assembled in the circuit breaker casing in the course of manufacture. This involves a substantial amount of time and care, especially since the assembly involves a stressed tension spring, and in this type of circuit breaker this is no supporting frame other than the circuit breaker casing itself.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an

electric circuit breaker operating mechanism of the overcenter spring type which does not require a supporting frame for the parts but which may nevertheless be partially preassembled so as to facilitate the manufacture and assembly of the circuit breaker.

It is another object of this invention to provide a partially preassembled circuit breaker operating mechanism of this type which is quick-make and quick-break and exhibits high contact pressure and which does not require a toggle linkage.

In carrying out the objects of my invention in one form thereof, I provide a support member including a pair of opposed arcuate cam surfaces thereon and comprising a releasable member which is biased for movement in releasing direction from a normally latched position. A pair of cam follower members are provided to travel along the respective cam surfaces of the releasable support member and are interconnected by means of an overcenter operating spring. This arrangement may be preassembled apart from the circuit breaker casing. A first one of the cam follower members is operatively connected through a connecting link to a movable contact arm. A manually operable handle member is provided to move the second cam follower member along its associated cam surface between open and closed circuit positions. The movement of the handle member and the second cam follower member is transmitted through the overcenter operating spring to the first cam follower member such that the first cam follower member moves along its associated cam surface with a snap action to operate the movable contact arm between open and closed circuit positions at high speed.

The invention will be better understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a side elevation view of an electric circuit breaker incorporating the invention, a side of the insulating casing being removed and the parts being shown in the normal open circuit or "off" position;

FIGURE 2 is a side elevation view of a portion of the mechanism of FIGURE 1, the parts being shown in the normal closed circuit or "on" position;

FIGURE 3 is a side elevation view of the operating mechanism portion similar to FIGURE 2, the parts being shown in the automatically open or "tripped" position;

FIGURE 4 is an exploded perspective view of a portion of the operating mechanism of FIGURE 1;

FIGURE 5 is an end elevation view partly in section of the operating mechanism of FIGURE 1, taken substantially on the plane indicated by the line 5—5 of FIGURE 1;

FIGURE 6 is an end elevation view of a modification of a portion of the operating mechanism of FIGURE 1;

FIGURE 7 is a side elevation view of a portion of another embodiment of the invention;

FIGURE 8 is a side elevational view of a portion of still another embodiment of the invention, the parts being shown in the normal open circuit or "off" position;

FIGURE 9 is a side elevation view of the operating mechanism of FIGURE 8, the parts being shown in the automatically open or "tripped" position, and

FIGURE 10 is an exploded perspective view of a portion of the operating mechanism of FIGURE 8.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGURES 1–5 show the invention as incorporated in an electric circuit breaker comprising a generally rectangular two-part insulating casing including a case 1 and a cover 3 (see FIG. 5). The circuit breaker includes at least one line terminal 1A and one load terminal 1B. The

electric continuity between the terminals 1A and 1B is controlled by a pair of separable contacts including a relatively movable contact 5 and a relatively stationary contact 7.

The movable contact 5 is carried by an elongated movable arm 9 pivotally supported at one end on a fixed pivot member 11 positioned in bearings or holes in opposing side walls of the case 1 and cover 3. In order to manually operate the movable arm 9 and the contact 5 between open and closed circuit positions, and to automatically open the electrical circuit upon the occurrence of a predetermined current condition through the ciruit breaker, an operating mechanism is provided operatively connected to the movable arm through a connecting link 14. The operating mechanism includes a releasable support member 15 which is pivotally supported on a supporting shaft 17 carried in bearings or holes in the side walls of the case and cover. The releasable support member 15 includes an elongated convex arcuate cam surface 15A at a bottom portion thereof and an opposed elongated convex arcuate cam surface 15B at a top portion thereof, and a latch projection 19. When positioned in the casing, the releasable support member 15 is biased in releasing direction by a spring 21 connected at one end to the releasable support member 15 and at the other end to a pin 23 carried by the casing. The latch projection 19 of the releasable support member 15 is normally engaged and releasably held by a latching or restraining member 25 which is controlled by suitable current responsive bimetallic strip 27.

A cam follower 29 comprising a roller 31 carried by a pin 33 is provided, which roller 31 is adapted to ride on the lower cam surface 15A of the releasable support member 15. A second cam follower 35 comprising a roller 37 carried by pin 39 is provided, which roller 37 is adapted to ride on the upper cam surface 15B of the releasable support member 15. Each roller includes a pair of flanged portions 40 disposed and arranged to maintain the roller in proper relation to the cam surface. Tension springs 41 are provided, one on each side of the releasable support member 15. Each spring 41 is connected at one end to cam follower roller pin 33 and at the other to cam follower roller pin 39, as is shown in FIGURE 5. An alternative arrangement, utilizing only one tension spring 43, is shown in FIGURE 6. In this arrangement, two side portions 45', 45'' comprise the releasable member 45, each of the side portions being identical in configuration to the releasable member 15 shown in FIGURE 1.

A manually operable member or handle 47 having an insulating outer portion 47A is provided to move the contacts 5, 7 between "on" and "off" positions. The handle member 47 is pivotally mounted at one end on a fixed pivot member or shaft 49 carried in bearings on holes in the side walls of the case 1 and cover 3. The handle member 47 includes an elongated slot 51 near the upper end thereof, which slot 51 receives a portion of cam follower pin 39.

The lower cam surface 15A of the releasable member 15 is designed so that when the operating handle 47 and the cam follower 35 are moved to "off" position, and while the releasable member 15 is in a latched position, as is shown in FIGURE 1, the tension springs 41 act on the cam follower 29 so as to urge it to the right on the lower cam surface 15A, as viewed in FIGURE 1, thereby retaining the movable arm 9 and contact 5 in an "off" or open circuit position.

Conversely, when the operating handle 47 and the cam follower 35 are moved to "on" position, and when the releasable member 15 is in a latched position, as is shown in FIGURE 2, the tension springs 41 act on the cam follower 29 so as to urge it to the left, as viewed in FIGURE 2, thereby retaining the movable arm 9 and its associated contact 5 in "on" position.

The movement of the handle member 47 from "on" to the "off" position does not result in instantaneous movement of the cam follower 29. Instead, the cam follower roller 31 moves along cam surface 15A only when the line of action of the springs 41 with respect to the lower cam surface 15A is such as to cause such movement. When the line of action reaches a certain point which may be thought as a point lying on the radius of the lower cam surface 15A at the point where cam follower roller 31 rests, the roller 31 moves quickly along the cam surface 15A, with what can be characterized as a snap action, until it reaches the desired "off" position on the lower cam surface. The connecting link 14 moves in response to such movement of the roller 31 and moves the movable arm 9 and its contact 7. Since the movable arm 9 effectively moves in response to the movement of the roller 31, the movement of the arm and its associated contact is also characterized by this snap action.

When the operating mechanism is in the "on" position as shown in FIGURE 2, the occurrence of a predetermined abnormal current condition through the circuit breaker may result in a "tripped" condition in the circuit breaker. Upon occurrence of such a current condition, the current responsive bimetallic strip 27 causes the latching or restraining member 25 to move in a counterclockwise direction, thereby freeing the latch surface 19 of the releasable support member 15. Since the support member 15 is biased by spring 21, it rotates in this direction until stopped by the projection 53 of the casing. During this counterclockwise rotation of the member 15, the handle 47 is restrained from movement to the left by engagement of the insulating portion 47A with an abutment 50 of the casing 1, 3. Thus the upper cam roller 35 therefore moves with respect to the upper cam surface 15B. The line of action of the spring 41 therefore crosses the center of curvature of the cam surfaces. This shift in position of the releasable member 15 and upper and lower cam surfaces 15A and 15B therefore results in a change of the line of action of the operating springs 41 with respect to the cam surface 15A such that the lower cam follower 29 is caused to move to the right, as shown in FIGURE 3. This in turn causes the springs 41 to move and to change their line of action with respect to the handle pivot 49, causing the handle 47 to move clockwise until it engages the stop projection 15C of the support member 15.

The connecting link 14 is also moved by the cam follower pin 33, thereby moving the movable contact arm 9 and contact 5 to open circuit position as shown in FIGURE 3. It should be noted that, as shown in FIGURE 3, the handle 47 is stopped in a mid-position upon tripping, thereby affording a visible indication of the tripped condition by the position of the handle portion 47A.

In order to reset and reclose the circuit breaker, the handle 47 is moved to the full "off" position, that is, to the extreme clockwise position as shown in FIGURE 1. This movement moves the releasable member 15 in a clockwise direction against the bias of spring 21 until the latch surface 19 of the releasable member 15 is once again engaged under and held by the retaining member 25. The handle 47 may then be moved to the "on" position to close the circuit.

Another embodiment of the invention is shown in FIGURE 7, in which the upper and lower cam surfaces of the releasable member are replaced by a pair of elongated arcuate slots, one slot 101A in the upper portion of the releasable member 101 and the other slot 101B in the lower portion of the releasable member 101. An extension of the upper portion of the releasable member forms a latch surface 103 to be engaged by restraining member 105. A cam follower member 107 comprising a roller and a pin, such as that shown in FIGURE 4, rides in slot 101A. The pin of the cam follower 107 is engaged by the pivotally supported manually operable handle member 109 which can be moved from "on" to "off" positions. A second cam follower member 111 comprising a roller and pin rides in the lower slot 101B of the releasable member 101. The cam follower 111 is operatively connected through a connecting link 113 to a movable

contact arm pivotally supported at one end, such as that shown in FIGURE 1. A pair of tension type operating springs **115** are provided, each connected at one end to the pin of cam follower **107** and connected at the other end to the pin of cam follower **111** on opposite sides of releasable member **101**. Movement of the handle member **109** between open and closed circuit positions causes movement of the upper cam follower **107** in slot **101A** between open and closed circuit positions. This change in position of the cam follower changes the line of action of the operating spring **115** so that the cam follower **111** in the lower slot **101B** travels in the lower slot between open and closed circuit positions with a snap action.

The releasable member **101** is biased in a releasing direction by spring **117**. Upon release of the releasable member **101**, the releasable member rotates until a portion thereof engages stop portion **119** in the casing. Operation of this form of the invention is otherwise similar to that previously described.

A further embodiment of the operating mechanism of the invention is shown in FIGURES 8–10. In this embodiment, the spring **21** of the FIGURE 1 embodiment is omitted and a support frame **201** is provided which is mounted stationary within the casing. A releasable member **203** is pivotally supported on the support frame **201** at **205**, and includes a pair of identical side portions **207**, as best seen in FIGURE 10, each having an arcuate convex cam surface **209** along a portion thereof, which forms an "upper cam surface" **201A** of the support frame **201**. The support frame includes a second arcuate convex cam surface **201B** opposed to the cam surface formed by the releasable member **203**. The releasable member **203** also includes a latch surface **211** along a portion thereof. A manually operable handle member **213** is provided and is pivotally supported at an end thereof by means of a pin **215** carried in bearings holes in the side plate of the casing. The handle member **213** includes an annular elongated slot **217** in a central portion thereof.

A cam follower **219** comprising a roller and a pin, such as that shown in FIGURE 4, rides along the upper cam surface **201A** of the support frame **201**, as defined by the releasable member **201**, and also rides in slot **217** of handle **213**. A second cam follower **221** comprising a roller and pin rides along the lower cam surface **201B** of the support frame **201**. A pair of tension type operating springs **223** are provided, each connected at one end to cam follower **217** and connected at the other end to cam follower **219** on opposite sides of the support frame **201**. The sub-assembly comprising the support frame, the releasable member, the cam followers and the operating springs may be preassembled before assembly in the circuit breaker casing, thereby facilitating manufacture of the circuit breaker.

The operating mechanism is so designed that when the operating handle **213** is in the "off" position and while the releasable member **201** is in a latched position, as shown in FIGURE 8, the cam follower **219** on upper cam surface **201A** is positioned at the top of the slot **217** in the handle member **213** and is urged to the extreme right of cam surface **201A**. This positioning of the upper cam follower **219** causes the tension springs **223** to so act on the lower cam follower **221** as to urge it to the right as viewed in FIGURE 8, thereby retaining the movable arm and contact, through a suitable connecting link, as previously described, in an "off" or open circuit position.

The dotted lines in FIGURE 8 show the handle member **213** in an "on" position. As can be seen, the upper cam follower **219** is caused to move to the extreme leftmost position on upper cam surface **201A**, thereby causing the tension springs **223** to act on lower cam follower **221** so as to urge it to the left.

Upon the occurrence of a predetermined abormal current condition through the circuit breaker, the releasable member **203** is released. Due to the bias of operating springs **223** which act on cam follower **219**, the releasable member **203** rotates in counterclockwise direction to the position shown in FIGURE 9. This shift in position of of the releasable member **203** and its cam surface allows the cam follower **219** to ride down the elongated slot **217** of the manually operable member **213** and along surface **201C** of the stationary frame **201**, until it is restrained by surface **225** of the releasable member **203**. This shift in position of the upper cam follower **219** results in a change of the line of action of the operating springs **223** with respect to the cam surface **201B** such that the lower cam follower **221** is moved to the right with a snap action. The movable contact arm and associated contact are also caused to move in response to such movement by the urging of the connecting link engaging the cam follower pin as it rides along the lower cam surface so that the movable arm is placed in an open circuit position, as previously described. As can be seen in FIGURE 9, the handle member **213** does not move back to the "off" position, but is retained in an intermediate or "trip" indicating" position following automatic opening.

While the invention has been described in specific embodiments, it will be readily apparent that many modifications thereof may be made and it is therefore intended by the appended claims to cover all such modifications as come within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric circuit breaker having a casing wherein are included:

(a) at least one pair of separable contacts;

(b) a support member including a pivotally supported member releasable to cause automatic opening of said circuit breaker, said support member including a pair of opposed arcuate cam surfaces and a latch surface thereon and being movable to a released position from a normally latched position;

(c) first spring means biasing said releasable member in releasing direction;

(d) a first cam follower member movable along one of said opposed cam surfaces on said support member in an arcuate path between open and closed circuit positions;

(e) a second cam follower member movable along the other of said opposed cam surfaces of said support member in an arcuate path between said open an closed circuit positions;

(f) at least one overcenter operating spring inter-connecting said cam follower members;

(g) a manually operable member supported in said casing and movable between open and closed circuit positions, said manually operable member engaging said first cam follower member to move said first cam follower member along said one of said opposed cam surfaces between said open and closed circuit positions;

(h) said operating spring moving said second cam follower along said other of said opposed cam surfaces between open and closed circuit positions with a snap action in response to movement of said first cam follower along said one of said opposed cam surface between said open and closed circuit positions;

(i) means connecting said second cam follower and said separable contacts for movement of said contacts between open and closed circuit positions;

(j) said first spring means acting on said releasable member when said releasable member is released to shift said releasable member with respect to the line of action of said operating spring means to cause said operating spring means to move said first and second cam followers along said opposed cam surfaces to cause opening of said separable contacts, and

(k) current responsive means supported in said casing and releasably restraining said releasable member and releasing said releasable member upon the occur-

rence of predetermined current conditions through said contacts.

2. The electric circuit breaker as recited in claim 1 wherein said support member and said releasable member comprise an integral member releasable to cause automatic opening of the circuit breaker, said integral member including a pair of opposed arcuate cam surfaces and a latch surface thereon.

3. The electric circuit breaker as recited in claim 2 wherein said manually operable member includes an elongated slot therein establishing a pair of cam surfaces, said first cam follower member being disposed in said elongated slot and, when the integral member is in a latched position, being acted upon by the cam surfaces of said manually operable member for movement with said manually operable member between open and closed circuit positions.

4. The electric circuit breaker as recited in claim 3 wherein, upon release of the integral member, said first cam follower member rides in the elongated slot of said manually operable member and acts on the cam surfaces thereof to move the manually operable member to a trip-indicating position.

5. The electric circuit breaker as recited in claim 1 wherein the support member and the releasable member comprise an integral member releasable to cause automatic opening of the circuit breaker and including a pair of opposed arcuate slots and a latch surface thereon, each of said opposed slots establishing a pair of cam surfaces,

said first and second cam follower members riding in said slots between open and closed circuit positions.

6. The electric circuit breaker as recited in claim 1 wherein the releasable member includes one of said opposed arcuate cam surfaces thereon, and wherein the manually operable member includes an elongated slot therein establishing a pair of cam surfaces, said first cam follower member being disposed in said elongated slot and, when the releasable member is in a latched position, being acted upon by the cam surfaces of said manually operable member for movement with said manually operable member between open and closed circuit positions.

7. The electric circuit breaker as recited in claim 6 wherein, upon release of the integral member, said first cam follower member rides in the elongated slot of said manually operable member and acts on the cam surfaces thereof to move the manually operable member to a trip-indicating position.

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BERNARD A. GILHEANY, *Primary Examiner.*

D. M. MORGAN, *Assistant Examiner.*

U.S. Cl. X.R.

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