

Oct. 28, 1969

K. J. STOKES

3,475,711

ELECTRIC CIRCUIT BREAKER OPERATING MECHANISM AND ASSEMBLY THEREOF

Filed May 17, 1967

2 Sheets-Sheet 1

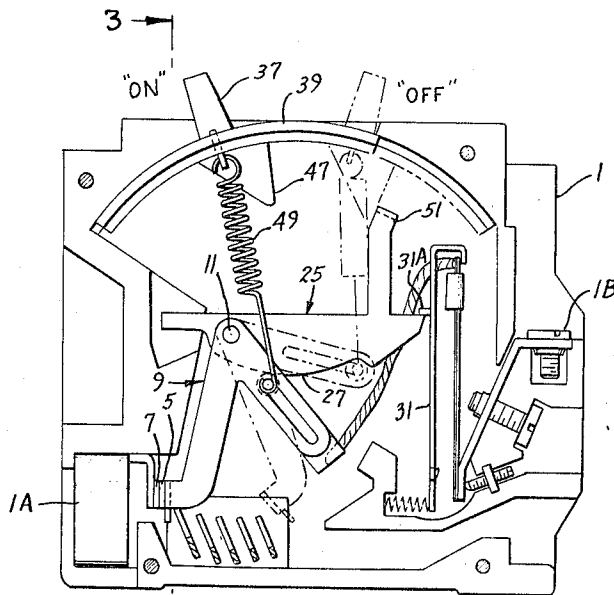


FIG. 1

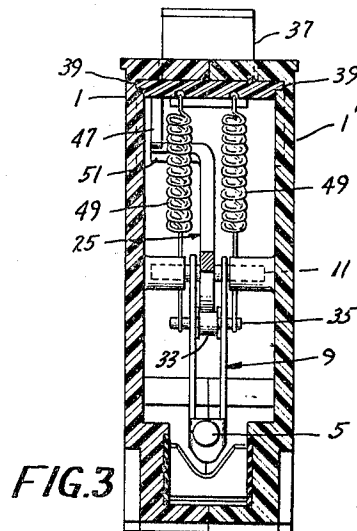


FIG.3

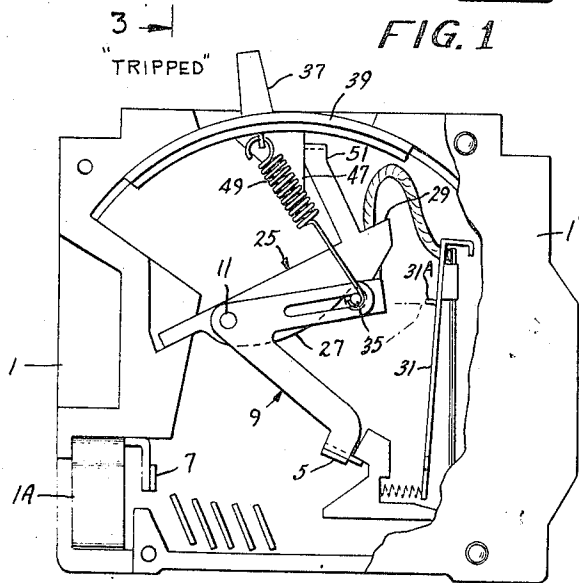


FIG. 2

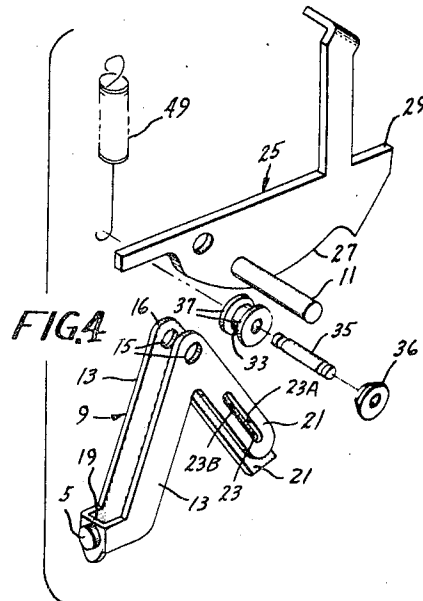


FIG. 4

INVENTOR.
KENNETH J. STOKES

BY Robert T. Casey
ATTORNEY

Oct. 28, 1969

K. J. STOKES

3,475,711

ELECTRIC CIRCUIT BREAKER OPERATING MECHANISM AND ASSEMBLY THEREOF

Filed May 17, 1967

2 Sheets-Sheet 2

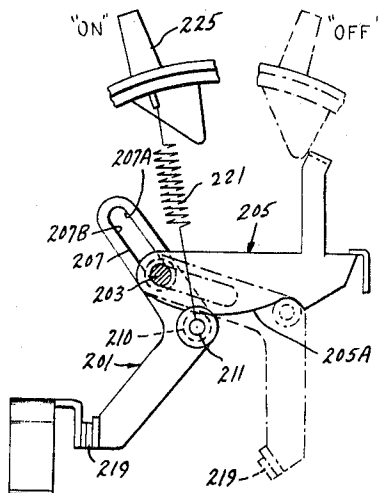


FIG. 5

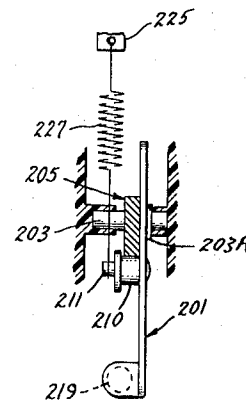


FIG. 6

INVENTOR
KENNETH J. STOKES
BY *Robert H. Casey*
ATTORNEY

1

2

3,475,711

ELECTRIC CIRCUIT BREAKER OPERATING MECHANISM AND ASSEMBLY THEREOF
Kenneth J. Stokes, Wethersfield, Conn., assignor to General Electric Company, a corporation of New York

Filed May 17, 1967, Ser. No. 639,114

Int. Cl. H01h 71/16

U.S. Cl. 337—55

8 Claims

ABSTRACT OF THE DISCLOSURE

An electric circuit breaker operating mechanism including a generally V-shaped contact arm pivotally supported on a pivot pin which also supports a releasable cam member; the contact arm has an elongated slot in which a cam roller is supported; the cam roller is moved along the cam surface of the releasable member by a manually operated overcenter spring; current responsive means retains the releasable member in a normal position.

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 there-through.

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. Patent No. 3,171,922, Stokes, 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 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 thereby changing the line of action of the spring until it passes over center and thereby operates the movable contact arm between open and closed circuit positions.

Because the parts of the ordinary operating mechanisms of prior art circuit breakers including the breaker of the aforementioned patent are individually assembled in the circuit breaker casing as part of the assembly operation of an individual circuit breaker, a substantial portion of the labor and expense necessary to construct the circuit breaker can be attributed to the operating mechanism and the assembly thereof. Thus, there is a need to produce a further simplified operating mechanism which may be assembled in a circuit breaker at a reduced cost while still providing high normal current capacity, and particularly, high speed opening upon tripping.

It is, therefore, an object of the invention to provide an electric circuit breaker operating mechanism which may be partially preassembled before insertion into its insulating casing 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 which exhibits high contact pressure and which is extremely fast acting during automatic opening.

It is a further object of the present invention to provide a circuit breaker mechanism which is simple and less expensive than comparable prior art devices.

In carrying out the objects of my invention in one form thereof, I provide an electric circuit breaker including therein a movably mounted elongated arm, one end of

which is operatively connected to one of a pair of separable contacts. A releasable member is provided which is pivotally mounted for movement to a released position from a normally latched position upon occurrence of predetermined current conditions. The movable arm and the releasable member share a single pivotal support and are thereby interconnected so that they may be preassembled before being positioned in the circuit breaker casing. The releasable member includes an arcuate cam surface. One or more tension springs are provided connected between a manually operable member and a cam follower including a roller which is disposed and arranged to travel along the cam surface of the releasable member. The cam follower is further disposed to ride in an elongated slot including a pair of cam surfaces at the other end of the movable arm. Motion of the cam follower roller along the cam surface of the releasable member is transmitted to the movable arm through the action of the cam roller on one of the cam surfaces, depending on the condition desired, to move it and its associated contact between open and closed circuit positions.

The objects and advantages of my invention may better be understood by reference to the following detailed description taken in connection with the accompanying drawings, in which:

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 closed circuit or "on" position;

FIGURE 2 is a side elevation view similar to FIGURE 1, the parts being shown in the automatically opened or "tripped" position;

FIGURE 3 is a sectional view of the circuit breaker, taken substantially on the line 3—3 of FIGURE 1;

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

FIGURE 5 is a side elevation view of another embodiment of the invention; and

FIGURE 6 is an end elevation view of the operating mechanism of FIGURE 5.

FIGURES 1-4 depict the invention as incorporated in an electric circuit breaker comprising a generally rectangular insulating casing including a base 1 having recesses and supporting formations to carry the parts. A cover 1' is also provided to close the open side of the casing (see FIGURE 3). The casing includes at least one pair of line and load terminals 1A and 1B respectively, the electric continuity of which 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 on a fixed pivot member or supporting shaft 11 carried in bearings or holes in the casing and cover. The movable arm 9 comprises an integral member including two elongated side portions or legs 13, of L-shaped configuration in a preferred form, each pivotally supported by the fixed pivot member 11 disposed in an aperture 15 at the central portion 16 thereof. Legs 13 of the L-shaped member are joined by a bridging portion 19 which, in a preferred form, carries the movable contact 5. Each L-shaped portion 13 also includes an elongated slot 23 providing an upper cam surface 23A and lower cam surface 23B.

In order to manually operate the movable arm 9 and the associated 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 circuit breaker, a releasable member 25 is provided, which is pivotally supported on the supporting shaft 11. Because the releasable member 25 and the movable arm 13 are both supported on shaft 11, these

portions of the circuit breaker may be preassembled. The releasable member 25 includes an elongated convex arcuate cam surface 27 and a latch portion 29. Latch portion 29 is normally engaged and releasably held by a latching or restraining member 31 which is controlled by suitable current responsive means to be described. A cam follower comprising a roller 33 carried by pin 35 is provided which roller 33 is adapted to ride on the cam surface 27 of the releasable member 25. The roller 33 includes a pair of flanged portions 37 (see FIGURE 4) disposed and arranged to maintain the roller in proper relation to the cam surface 27. The pin 35 is adapted to ride in each of the elongated slots 23 in legs 21 of L-shaped portions 13, and acts upon either the upper cam surface 23A or the lower cam surface 23B, depending upon the direction of movement. If desired a shouldered roller 36 may be provided to ride in the elongated slot 23.

A manually operable member or handle 37 is provided to move the contacts 5, 7 between "on" and "off" positions. The member 37 has arcuate portions 39 adapted to be received in corresponding recesses in the case and cover. This engagement supports the handle 37 with respect to the casing and also provides an arcuate track for guiding the movement of the handle. The handle 37 includes a cam projection 47 which may be utilized to aid in resetting the releasable member 25 after it has been moved to its released position under a "tripped" condition, to be described.

A pair of tension type operating springs 49, are also provided, one on each side of the releasable member 25. Each spring 49 is connected at one end to the manually operable member 37, and is connected at the other end to the pin 35 on opposite sides of the movable arm 9. The operating springs 49 bias the cam follower roller 33 toward the handle 37, thereby causing the cam follower to bias the pivotally supported releasable member 25 in a counterclockwise or releasing direction.

The cam surface 27 of the releasable member 25 is designed so that in the "off" position of the operating handle 37 and while the releasable member 25 is in a latched position, as shown in phantom lines in FIGURE 1, the tension springs 49 so act on the cam follower roller 33 as to urge it to the right, as viewed in FIGURE 1, thereby retaining the movable arm 13 and the associated movable contact 5 in an "off" or open-circuit position.

Conversely, when the operating handle 37 is in the "on" position and the releasable member 25 is in a latched position, as is shown in FIGURE 1, the tension springs 49 so act on the roller 33 as to urge it to the left, as viewed in FIGURE 2, thereby retaining the movable arm 9 and the associated contact 5 in an "on" position.

The movement of the handle portion 39 from "on" to "off" positions does not result in instantaneous movement of the roller 33 along the cam surface 27. Instead, the roller 33 moves only when the line of action of the springs 49 with respect to the cam surface 27 is such as to cause such movement. When the line of action reaches a certain point which may be thought of as a point lying on the radius of cam surface 27 at the point where cam follower roller 33 rests, the roller 33 moves quickly along the cam surface 27, with what can be characterized as a snap-action, until the roller 33 reaches the desired "off" position on the cam surface. The movable arm 9 moves in response to such movement of the roller 33 and, therefore, the movement of the arm 9 and its associated movable contact 5 is also characterized by this snap-action. The latching member 31A is carried by an elongated latch member 31.

When the circuit breaker and the operating mechanism thereof is in an "on" position, as shown in FIGURE 1, the occurrence of a predetermined current condition through the circuit breaker may occur. Upon the occurrence of such a current condition, the current responsive means causes the latching or restraining member 31 to move in a clockwise direction, thereby freeing the releas-

able member 25 from the latch 31A. Since the member 25 is biased in counterclockwise direction by the cam follower roller 33, it rotates in this direction. The shift in position of the releasable member 25 and its cam surface 27 as it rotates results in a change of the line of action of the operating spring relative to the cam surface 27 such that the cam follower roller 33 is caused to move to the right, as viewed in FIGURE 2, along the cam surface 27. The movable arm 9 and associated movable contact 5 are also caused to move in response to such movement by the urging of the cam follower pin 35 as it rides in the slots 23 of the legs 21 of side portions 13 and acts on the upper cam surface thereof so that the movable arm 9 is moved to open-circuit position. Surface 47 of the handle 37 then engages a portion 51 of the releasable member 25. Thus, the manually operable member 37 and the handle portion 39 thereof do not move completely to the "off" position, but remain in an intermediate or "trip indicating" position following automatic opening, as shown in FIGURE 2.

In order to reset and reclose the circuit breaker, the handle 37 must be moved to the full "off" position, that is, to the extreme clockwise position as shown in FIGURE 1. This movement serves to move the releasable member 25 in a clockwise direction by reason of the engagement of surface 47 of the handle 37 with surface 51 of the releasable member 25, until the latch portion 29 of the releasable member 25 is once again engaged under and held by the retaining member 31. The handle 37 may then be moved to the "on" position to close the circuit.

The operating mechanism of the present invention not only retains the advantages of having increased normal current capacity and increased short circuit interrupting capacity, and of being particularly fast acting, but, also, that the operating mechanism is simpler and much easier to assemble than prior devices. This is because the releasable member and the movable arm are interconnected in that they are both supported by means of a single fixed pivot member so that they may be preassembled before the entire circuit breaker is assembled. This result is accomplished without causing any increased difficulty or undue burden in assembling the roller and other components in the operating mechanism and serves to produce a mechanism which is quite simple and inexpensive to manufacture.

A second embodiment of the operating mechanism of the invention is shown in FIGURE 5. In this embodiment the elongated movable contact arm is also in the form of a generally L-shaped member 201. A fixed member or supporting shaft 203 which pivotally supports the releasable member 205 is disposed in an elongated slot 207 including upper cam surface 207A and lower cam surface 207B in the upper portion of the L-shaped arm 201. The shaft 203 includes an integral flange portion 203A (see FIGURE 6) which provides lateral support for the contact operating arm 201. The lower portion of the L-shaped member 201 carries the movable contact 219. A cam follower roller 210 is provided which is carried by means of a pin 211 mounted on the central portion of the L-shaped member 201. The roller 210 is adapted to travel along the arcuate cam surface 205A of the releasable member 205.

As best seen in FIGURE 6, a tension type operating spring 221 is provided and is connected at one end to the handle 225 and connected at the other end to the pin 211 carrying the cam follower roller 210.

It has been found that, because of the particular construction of applicant's operating mechanism, the provision of only one spring connected on only one side of the releasable member does not detract from the operation of the circuit breaker and that there is smooth motion when the handle member is moved from "on" to "off" positions or when the breaker is tripped automatically. Movement of the handle 225 between open and

closed circuit positions causes the cam follower roller 210 to travel along cam surface 205A with a snap action, as previously described. The movable arm 201 moves in response to this movement of the roller 210, the shaft 203 riding in slot 207. The cooperation of the cam roller 210 urging the movable arm 201 along cam surface 205A and the action of shaft 203 on cam surfaces 207A and 207B serves to move the arm 201 between open and closed circuit positions, thereby operating movable contact 219 between open and closed circuit positions.

While the invention has been described with two specific examples, it is intended by the appended claims to cover all such modifications thereof which 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 comprising a casing wherein are included:

- (a) at least one pair of separable contacts;
- (b) a member releasable to cause automatic separation of said contacts, said member having an arcuate cam surface and a latch portion thereon;
- (c) pivotal support means supporting said releasable member in said casing for rotation about a predetermined fixed axis of rotation;
- (d) said releasable member being movable from a normally latched position to a released position by rotation about said axis of rotation;
- (e) a movable contact arm supported in said casing by said pivotal support means and movable between open and closed circuit position;
- (f) means operatively connecting said contact arm to one of said separable contacts for movement of said separable contacts between open and closed circuit positions in response to movement of said contact arm between said open and closed circuit positions;
- (g) a cam follower movable along said cam surface of said releasable member in an arcuate path between open and closed circuit positions;
- (h) means connecting said cam follower to said contact arm for movement of said contact arm between open and closed circuit positions in response to movement of said cam follower between open and closed circuit positions;
- (i) a manually operable member supported in said casing and movable between open and closed circuit positions;
- (j) operating spring means connected at one end to said manually operable member and at the other end to said cam follower and moving said cam follower between open and closed positions along said arcuate path with a snap action in response to movement of said manually operable member between open and closed circuit positions while said releasable member is in a latched position;
- (k) said cam follower, when moving between open and closed circuit positions upon said cam surface of said releasable member, acting on said contact arm to move said contact arm between open and closed circuit positions with a snap action;
- (l) said operating spring means acting on said releasable member through said cam follower member when said releasable member is released to rotate said releasable member so as to shift said cam surface of said releasable member with respect to said cam follower and with respect to the line of action of said operating spring means to cause said spring means to move said cam follower along said cam surface to cause opening of said separable contacts; and
- (m) current responsive means supported in said casing and releasably restraining said releasable member

and releasing said releasable member upon the occurrence of predetermined current conditions through said contacts.

2. The electric circuit breaker as recited in claim 1 wherein said contact arm comprises an elongated member pivotally supported on the fixed pivot member at a central portion thereof and including an elongated slot at one end thereof, the upper and lower edge portions of said slot comprising upper and lower cam surfaces, the other end of said elongated member engaging said contact connecting means, and said cam follower riding in said elongated slot and acting on said upper and lower cam surfaces so as to move said elongated member between open and closed circuit positions in response to the movement of said cam follower along said cam surface of said releasable member between said open and closed circuit positions.

3. The electric circuit breaker as recited in claim 1 wherein said contact arm comprises an elongated member connected to the cam follower at a central portion thereof, one end of said elongated member engaging said contact connecting means, said cam follower riding along the cam surface of said releasable member in an arcuate path between open and closed circuit positions and moving said elongated member between said open and closed circuit positions, the other end of said elongated member including an elongated slot wherein is disposed the fixed pivot member, said fixed pivot member riding in said slot when said movable arm moves between said open and closed circuit positions.

4. The electric circuit breaker as recited in claim 1 wherein said contact arm includes two elongated side portions, each pivotally supported at a central portion thereof on the fixed pivot member on opposite sides of the releasable member, each of said side portions engaging said contact connecting means at one end thereof and including an elongated slot at the other end thereof, the upper and lower edge portions of each slot comprising upper and lower cam surfaces, said cam follower riding in each of said slots and acting on said upper and lower cam surfaces so as to move said movable arm between open and closed circuit positions when said cam follower rides along the cam surface of said releasable member between said open and closed circuit positions.

5. The electric circuit breaker as recited in claim 1 wherein said contact arm is directly connected to one of said separable contacts.

6. The electric circuit breaker as recited in claim 1 wherein said operating spring means comprises at least one tension type spring and wherein said manually operable member moving between open and closed circuit positions moves the line of action of said operating spring across the center of curvature of said arcuate path of movement of said cam follower.

7. The electric circuit breaker as recited in claim 1 wherein said cam follower directly engages said contact arm for movement therewith.

8. The electric circuit breaker as recited in claim 1 wherein the manually operable member includes a cam surface which is so engaged by the releasable member when the releasable member is released that the manually operable member is retained in a trip-indicating position.

References Cited

UNITED STATES PATENTS

3,171,929 3/1965 Jencks et al. ----- 335—43

BERNARD A. GILHEANY, Primary Examiner

R. L. COHRS, Assistant Examiner

U.S. Cl. X.R.

335—43; 337—45