March 2, 1965 C. L. JENCKS ETAL 3,171,929

CIRCUIT BREAKER WITH RELEASABLE CAM TYPE MECHANISM

Filed Dec. 31, 1962 3 Sheets-Sheet 1

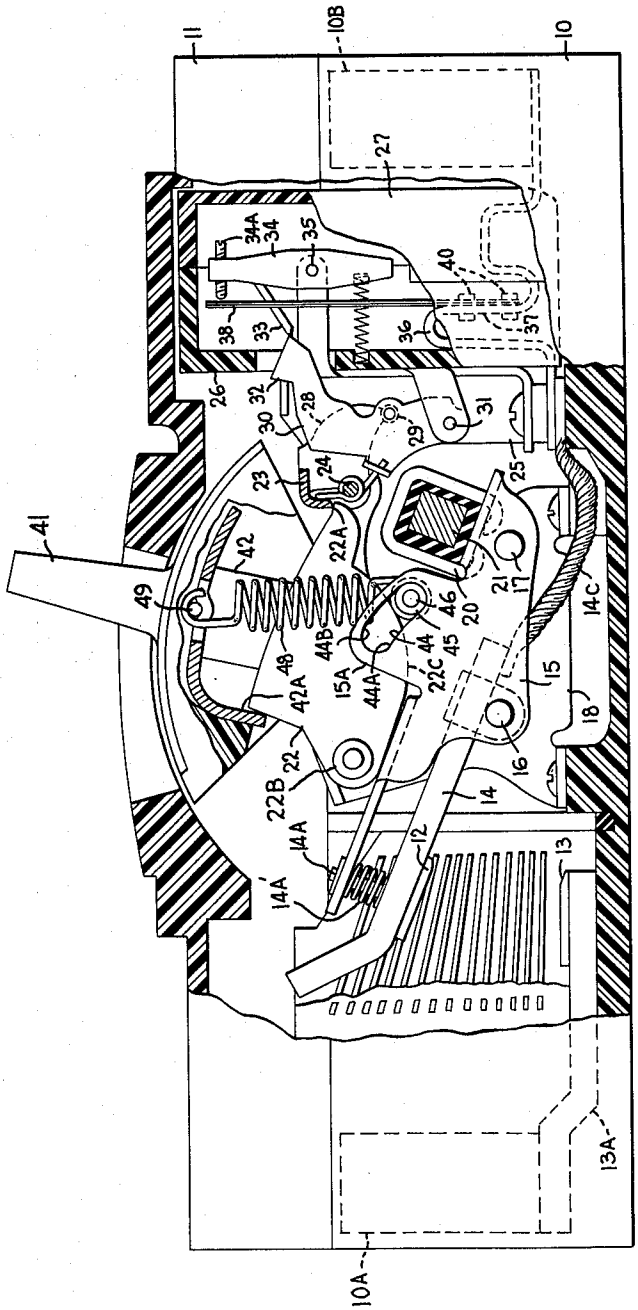


FIG. 1

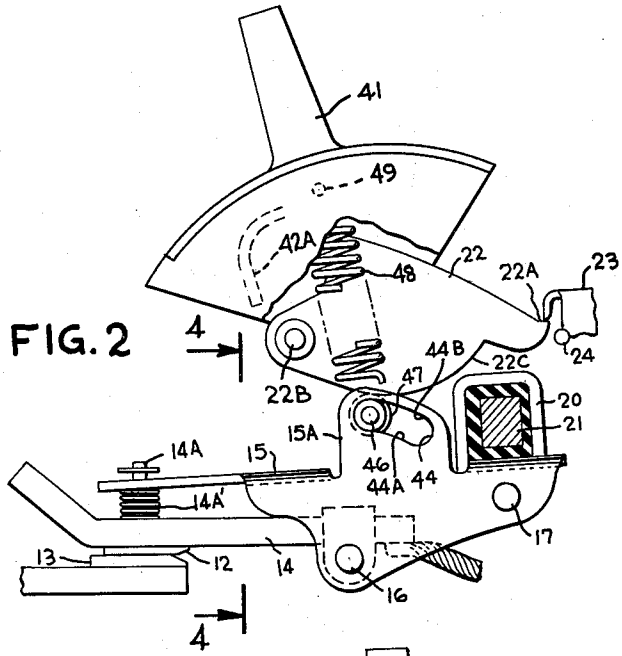
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FIG. 2



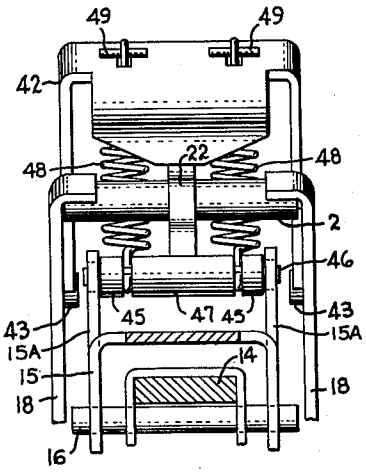


FIG. 4

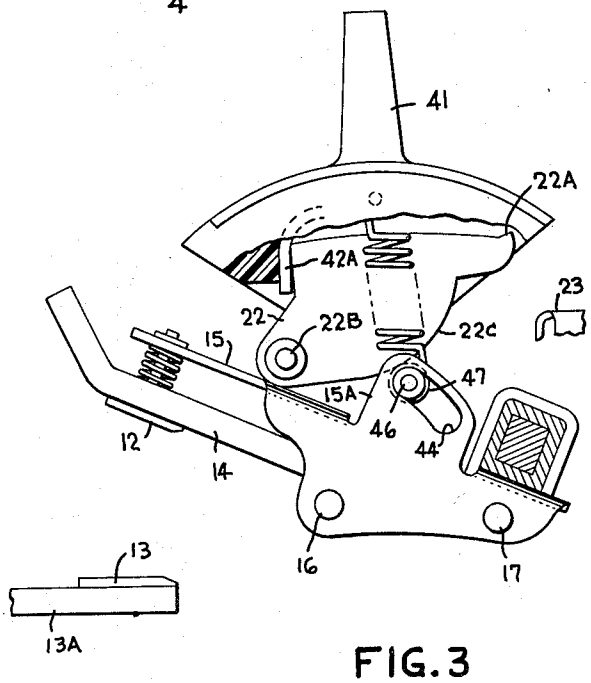


FIG. 3

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CIRCUIT BREAKER WITH RELEASABLE CAM TYPE MECHANISM

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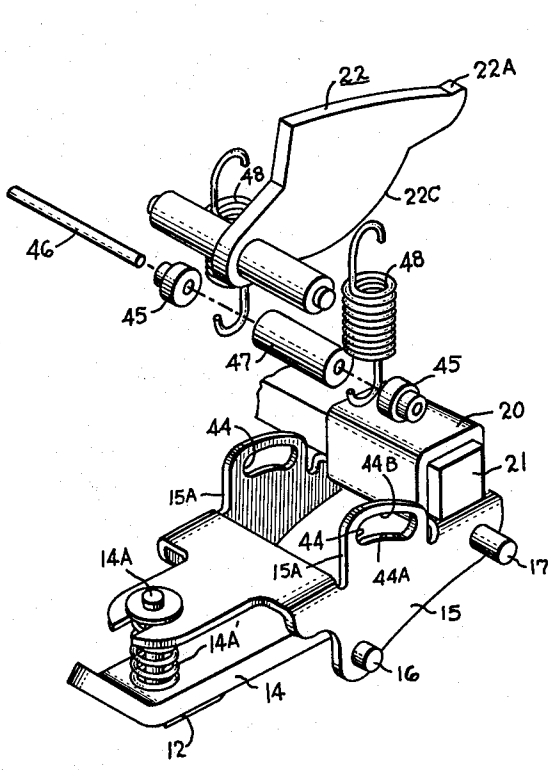


FIG. 5

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CIRCUIT BREAKER WITH RELEASABLE CAM TYPE MECHANISM

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Filed Dec. 31, 1962, Ser. No. 248,692
6 Claims. (Cl. 200—116)

Our invention relates to electric circuit breakers, and more particularly to electric circuit breakers of the type including at least one movable contact and overcenter spring operating means for manually and automatically operating the movable contact between open and closed circuit positions.

Circuit breakers including overcenter snap-acting operating spring means of the type described have been widely used for manually and automatically operating movable contacts between open and closed circuit position in electric circuit breakers of medium and high capacity, such for example as 100 to 1200 amperes. Application Serial No. 241,304, filed Nov. 30, 1962 by Kenneth J. Stokes, and assigned to the same assignee as the present invention discloses a particularly advantageous type of overcenter operating mechanism. In accordance with the aforesaid application, the mechanism is simplified and its speed of operation is enhanced by the provision of a releasable member which not only acts to support the operating mechanism in its operating condition, but which also acts as a cam member to guide a portion of the mechanism during "on," "off" and "trip" operations.

It is an object of the present invention to further simplify and accelerate the speed of operation of electric circuit breakers of the type described. In the Stokes application, a cam follower member is provided which 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 and thereby to operate the movable contact arm between open and closed circuit positions.

In accordance with the present invention in one form, an electric circuit breaker is provided of the type including a pivotally supported movable contact member and a pivotally supported, normally latched, releasable support member. The releasable support member is provided with an arcuate cam surface so arranged and disposed that a cam follower roller member, which is operated by a pair of tension springs, moves from one point to another on the cam surface of the releasable member with an overcenter or "snap" action. The movable contact member is also provided with a cam surface, whereby the action of the cam follower roller and moving along the cam surface of the releasable member is transmitted to the movable contact member to move it from open to closed circuit position. In addition, the movable contact member is provided with a second cam surface which the cam follower member is adapted to engage to operate the movable contact arm from closed position to open position. The mechanism is therefore characterized by the total absence of connecting links, with attendant simplification and increased speed of movement.

The invention will be more fully understood from the following detailed description, and its scope will be pointed out in the appended claims.

In the drawings,

FIGURE 1 is a side elevation view of an electric circuit breaker incorporating the invention, the side wall being broken away, and the parts being shown in the normal "open" circuit position;

FIGURE 2 is a side elevation view, on enlarged scale, of the operating mechanism portion of the circuit breaker

of FIGURE 1, the parts being shown in the normal closed-circuit or "on" position;

FIGURE 3 is a view similar to FIGURE 2, the parts being shown in the automatically opened or "tripped" condition;

FIGURE 4 is a fragmentary sectional view taken substantially on the line 4—4 of FIGURE 2;

FIGURE 5 is an exploded perspective view of portions of the operating mechanism of FIGURE 1.

Referring to the drawings, and particularly to FIGURE 1, the invention is shown as incorporated in an electric circuit breaker comprising a molded insulating casing including a base 10 and a cover 11. The casing is generally rectangular and carries three line terminals 10A, only one shown, at one end, and three load terminals 10B, only one shown, at the other end. Electrical continuity between each pair of corresponding line and load terminals is controlled by a pair of contacts including a relatively movable contact 12 and a relatively stationary contact 13, only one pair shown. The current path provided between each pair of line and load terminals is referred to conventionally as a "pole," and the circuit breaker illustarted is therefore a "three-pole" circuit breaker.

Each of the stationary contacts 13 is supported on a contact supporting strap 13A which supports the line terminals 10A at the other end. Each of the movable contacts 12 is carried by a movable contact support 14 which is pivotally connected to a generally channel-shaped contact arm 15 by a pivot pin 16. The contact support 14 is connected by a flexible conductive braid 14C to one terminal of the "trip unit" to be described, and thence to the terminal 10B.

The forward end of the contact support 14 has a post 14A extending through an opening in the contact arm 15. A compression spring 14A' is positioned on the post 14A between the support 14 and the contact arm 15.

The contact arm 15 for each pair of line and load terminals is anchored by suitable fastening means, such as inverted U-shaped clamp 20, to a contact cross-arm 21. Movement of the center contact arm 15 about its pivot point 17 in the frame 18, therefore carries with it the two outside contact arms, not shown.

The contact arm 15 for the central pole space, illustrated in FIGURE 1, is pivotally supported on a pivot pin 17 which in turn is supported between two spaced-apart side plate portions 18 of a stationary frame assembly. The contact arm 15 is generally channel-shaped through out its major portion, and the pins 16 and 17 pass through depending side portions of the channel-shaped portion.

A releasable support member 22 is provided, which is pivotally supported on a pivot pin 22B between the opposed side plates of the mechanism frame 18. The support member 22 includes a latch portion 22A, which is adapted to be releasably held by a latch member 23, and a convex cam surface 22C.

The latch member 23 is pivotally supported on a pivot pin 24 carried between a pair of side plates 25, only one shown, which in turn is carried by the insulating casing 26 of the trip unit 27. The latch member 23 includes a downwardly extending portion 28 which rests against a roller member 29 carried by an intermediate latch member 30. The intermediate latch member 30 is pivotally supported on a pin 31 at one end and carries and includes a latched portion 32 at the other end which is normally releasably held by a latch member 33. The latch member 33 is carried by a rotatable trip bar 34 which is pivotally supported on a pivot pin 35 in the trip unit casing.

For the purpose of causing release of the latch 23 upon the occurrence of predetermined current conditions, means is provided including a conductor 36 having a generally

U-shaped reduced cross-section heater portion **37** having mounted thereon a bimetallic strip **38** by suitable means such as by rivets **40**.

Upon the occurrence of excess current conditions, the intermediate portion **37** of the conductor **36** becomes heated, transferring heat, by conduction, to the bimetallic strip **38**, and causing the bimetallic strip **38** to deflect so as to move its free end to the right as viewed and into engagement with an adjustable calibrating screw **34A** carried by the trip bar **34**. This causes the trip bar **34** to rotate clockwise as viewed, moving the latch member **33** out of engagement with the intermediate latch member **32**. This permits the intermediate latch member **32** to move clockwise as viewed under the bias exerted thereon by the action of the latch member **28** bearing on the roller member **29**. As the intermediate latch member **32** moves to the right, therefore, the roller **29** no longer blocks rotation of the latch member **23**, and this member therefore rotates, permitting upward movement of the latch portion **22A** of the releasable support member **22**.

Referring particularly to FIGURES 1 and 5, the mechanism for operating the movable contacts manually and automatically also comprises a handle member **41**, of insulating material, which is supported on and carried by a generally U-shaped operating member **42** which is pivotally supported on pivot pins **43** in the side frames **18** of the mechanism frame respectively.

The contact arm **15** has portions **15A** of the side walls thereof projecting upwardly and provided with arcuate slots **44** each establishing a lower cam surface **44A** and an upper arcuate cam surface **44B**. A shouldered roller member **45**, carried by a supporting pin **46** is disposed to move in each of the slots **44**. A cam follower roller **47** is carried by the central portion of the pin **46** and is adapted to roll along the cam surface **22C** of the releasable cam member **22**. A pair of tension type operating springs **48** are connected at one end by means of an anchor pin **49** to the handle support member **42**, and at the other end to the supporting pin **46** at a point between the cam follower roller **47** and the rollers **45**.

The operation of the invention will be understood by reference to FIGURES 1 through 3. In FIGURE 1, the manually operable member **41** is shown in the "off" position, the cam follower roller member **47** being at the right hand end of the arcuate slots **4**. The latch portion **22A** of the releasable support member **22** is engaged by the latch member **23**, and the operating springs **48** are under slight tension. The resultant of the force of the springs **48** acting on the cam roller **47** and the cam surface **22C** is such as to urge the cam roller **47** and the associated rollers **45** upwardly and to the right as viewed in FIGURE 1. This force is transmitted to the movable contact arm **15** by the action of the rollers **45** in the slots **44**, and particularly by their force against the upper arcuate surface **44B**.

In order to close the circuit breaker, the handle member **41** is moved to the left, to the "on" position. As the handle **41** is moved toward the "on" position, the springs **48** are stressed prior to any movement of the cam follower member **47** because, until the line of action of the spring reaches a certain point, the resultant of the spring force on the roller **47** is still to urge the roller **47** to the right and upwardly. When the line of action of the springs **48** reaches a certain point, which may be thought of as a point lying on the radius of the cam surface **22C** at the point where the roller cam follower **47** rests, the cam roller **47** and its associated rollers **45**, move quickly to the left to the position shown in FIGURE 2, moving along the cam surface **22C**. As this occurs, the shouldered rollers **45**, acting on the lower cam surface **44A** in the slots **44**, move the contact arm **15** counterclockwise as viewed to the closed position as shown in FIGURE 2, travel of the roller assembly in the left direction being limited by the ends of the slot **44**.

In moving from "on" to "off" position, this process is repeated, the tension springs **48** being stressed during portion of the movement of the handle **41** toward "off" position, and then the cam follower roller **47** moving suddenly to move the shouldered rollers **45** back to the other end of the slot **44** to move the contact arm to open position again as shown in FIGURE 1.

With the parts in the closed circuit position as shown in FIGURE 2, should there be an overload current condition such as to cause release of the latch member **23** in the manner previously described, the cam member **22** would be free to rotate. By reference to FIGURE 2, it will be seen that the operating springs **48**, in the "on" position, exert a bias on the support member **22** tending to rotate it in the counterclockwise direction. When the latch member **23** is released, the support member **22** is free to rotate and moves to the position generally as shown in FIGURE 3. It will be observed that the action of the tension springs **48** on the parts is such as to move the contact arm to open-circuit position, even though the manually operable handle member **41** be forcibly restrained in the "on" position. The contact arm **15** moves upwardly until its travel is stopped by engagement with the enlarged portion of the pin **22B**. This prevents the roller **47** from moving further, and therefore establishes the position of the lower end of the tension springs **48**. It will be observed, however, that this position of the lower ends of the springs **48** is such as to reverse the bias of the operating springs on the operating handle **41**, and the handle is therefore pulled back toward "off" position a small amount, as indicated in FIGURE 3, thereby giving the handle a mid or "trip indicating" position.

The handle support member **42** includes a downwardly bent portion **42A** which is adapted to engage an abutment portion of the releasable support member **22**, to determine the trip indicating position of the handle member.

In order to reset the breaker following tripping, the handle member **41** is moved to the full off position, thereby causing the extension **42A** of the handle support member **42** to engage the releasable support member **22** and move it clockwise to the relatched position in engagement with latch **23**. At the same time, the cam follower roller **47** is returned to the extreme right end of the slots **44**, and the parts then resume the position as indicated in FIGURE 1.

It will be observed that there is no positive linkage connection between the releasable support member **22** and the contact arm **15**. In other words, when released by the latch member **23**, the releasable member **22** is free to move as fast as possible.

It will also be apparent that while the cam surface **22C** of the releasable support member **22** has been shown as a circular sector having its center somewhere in the piece **22**, the curvature of the cam surface **22C** may be varied as desired to obtain different characteristics in the rate of the application of spring closing force and/or spring opening force. If desired, the curvature of the cam surface **22C** may be such that its center point lies outside of the cam member **22** itself.

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

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

1. An electric circuit breaker comprising:
   (*a*) an insulating casing,
   (*b*) at least one relatively stationary contact supported in said insulating casing,
   (*c*) at least one relatively movable contact supported in said insulating casing,
   (*d*) an elongated contact arm pivotally supported adjacent one end in said insulating casing and movable between open and closed circuit positions to move

said relatively movable contact into and out of engagement with said relatively stationary contact,

(*e*) a first elongated convex cam surface carried by said contact arm,

(*f*) a releasable support member pivotally supported in said insulating casing adjacent the movable end of said contact arm and having a latch portion adjacent the pivotally mounted end of said contact arm,

(*g*) a cam follower member,

(*h*) said releasable support member including a second convex cam surface having its direction of curvature directed away from said movable contact arm,

(*i*) said first and second cam surfaces being in contact with portions of said cam follower member substantially opposite each other,

(*j*) a manually operable handle member supported for oscillating movement between on and off positions in said casing at the side of said releasable support member opposite said contact arm,

(*k*) a tension type operating spring having one end thereof connected to said cam follower member and having the other end thereof connected to said handle member, for moving said cam follower member along said cam surfaces between on and off positions with a snap action,

(*l*) said cam follower member when moving between said on and off positions acting on said cam surface of said contact arm and said cam surface of said support member to move said contact arm between open and closed circuit positions respectively with a snap action, and

(*m*) current responsive means supported on said casing and releasably restraining said releasable support and releasing said releasable support member upon the occurrence of predetermined current conditions through said contacts.

2. An electric circuit breaker comprising:

(*a*) an insulating casing,

(*b*) at least one stationary contact mounted in said insulating casing,

(*c*) at least one movable contact in said insulating casing,

(*d*) an elongated contact arm supported in said insulating casing for movement between open and closed circuit positions for moving said movable contact between open and closed circuit positions, said contact arm having a cam surface thereon,

(*e*) a releasable support member pivotally supported in said insulating casing,

(*f*) a cam follower member,

(*g*) a cam surface carried by said releasable support member,

(*h*) tension type manual operating spring means having one end thereof connected to said cam follower member,

(*i*) a manually operable handle member supported in said insulating casing and oscillatably movable between open and closed cricuit positions respectively,

(*j*) means connecting the other end of said spring means to said handle member, whereby movement of said handle member between said closed and open positions serves to move said cam follower member between said closed and open positions,

(*k*) said cam follower member acting on said cam surface of said contact arm to move said contact arm from said open to said closed circuit positions when said cam follower member moves from said open to said closed position,

(*l*) means separate from said cam surface of said contact arm connecting said cam follower member to said contact arm to move said contact arm from said closed to said open position when said cam follower member moves from said closed to said open position, and

(*m*) current responsive means releasably restraining said releasable support member and releasing said support member upon the occurrence of predetermined current conditions through said circuit breaker to cause opening movement of said contact arm.

3. An electric circuit breaker comprising:

(*a*) an insulating casing,

(*b*) at least one stationary contact mounted in said insulating casing,

(*c*) at least one movable contact in said insulating casing,

(*d*) an elongated contact arm pivotally supported adjacent one end thereof for movement between open and closed circuit positions for moving said movable contact between open and closed circuit positions, said contact arm having upper and lower cam surfaces thereon extending substantially parallel to each other,

(*e*) a releasable support member pivotally supported in said insulating casing,

(*f*) a cam follower member,

(*g*) a convex arcuate cam surface carried by said releasable support member for guiding said cam follower member for movement between open and closed circuit positions along an arcuate path,

(*h*) manually operable spring means having one end thereof connected to said cam follower member,

(*i*) a manually operable handle member supported in said insulating casing and oscillatably movable between open and closed circuit positions respectively,

(*j*) means connecting the other end of said operating spring means to said handle member,

(*k*) said operating handle member moving said other end of said spring means across the center of curvature of said arcuate path, whereby movement of said handle member between said open and closed circuit positions serves to move said cam follower member between said open and closed circuit positions with a snap action,

(*l*) said cam follower member acting on said lower cam surface of said contact arm to move said contact arm from said open to said closed circuit positions when said cam follower member moves from said open to said closed circuit position,

(*m*) said cam follower member acting on said upper cam surface of said contact arm to move said contact arm from said closed to said open circuit position when said cam follower member moves from said closed to said open circuit position, and

(*n*) current responsive means supported in said casing and releasably restraining said releasable support and releasing said releasable support member upon the occurence of predetermined current conditions through said contacts.

4. An electric circuit breaker comprising:

(*a*) an insulating casing,

(*b*) at least one pair of relatively movable contacts in said insulating casing,

(*c*) at least one movable contact arm in said insulating casing movable between open and closed circuit positions for causing corresponding opening and closing movement of said relatively movable contacts,

(*d*) an elongated cam surface carried by said contact arm,

(*e*) a releasable support member,

(*f*) an elongated cam surface carried by said releasable support member for guiding said cam follower member for movement along an arcuate path,

(*g*) a cam follower member having substantially opposite external portions thereof engaging said cam surface of said contact arm and said cam surface of said releasable support member respectively to move said contact arm between open and closed circuit positions,

(*h*) a pair of tension type operating springs each

having one end thereof connected to said cam follower member, and

(*i*) manually operable handle means having the other ends of said springs connected thereto and oscillatably movable between open and closed circuit positions to move the line of action of said operating spring across the center of curvature of said arcuate path of movement of said cam follower member, and

(*j*) current responsive latch means for causing release of said releasable member upon the occurrence of predetermined current conditions through said contacts.

5. An electric circuit breaker comprising:

(*a*) an insulating casing,

(*b*) at least one pair of relatively movable contacts in said insulating casing,

(*c*) an elongated contact arm pivotally supported adjacent one end thereof in said insulating casing and movable to cause movement of said relatively movable contacts between open and closed circuit positions,

(*d*) a releasable support member pivotally supported in said insulating casing and having an elongated convex cam surface thereon,

(*e*) said contact arm having an elongated cam surface thereon,

(*f*) a cam follower member having a first peripheral portion in engagement with said cam surface of said releasable member and having a second peripheral portion in engagement with said cam surface of said contact arm, said peripheral portions being substantially opposite each other,

(*g*) tension type overcenter operating spring means having one end thereof connected to said cam follower member,

(*h*) manually operable means in said casing connected to operate the other end of said overcenter spring means between open and closed circuit positions to move said cam follower member between open and closed circuit positions with a snap action,

(*i*) current responsive means supported in said casing and normally restraining said releasable member in supporting position and causing release of said releasable member upon the occurrence of predetermined current conditions through said contacts, and

(*j*) means connecting said cam follower member to said contact arm to move said contact arm from said closed to said open circuit position in response to movement of said cam follower member from said closed to said open circuit positions.

6. An electric circuit breaker comprising:

(*a*) an insulating casing,

(*b*) at least one pair of relatively movable contacts in said insulating casing,

(*c*) an elongated contact arm pivotally supported adjacent one end thereof in said insulating casing,

(*d*) means connecting the other end of said contact arm to said relatively movable contacts to cause movement of said relatively movable contacts between open and closed circuit positions upon movement of said contact arm between corresponding open and closed circuit positions,

(*e*) a releasable supporting member pivotally supported in said insulating casing,

(*f*) an elongated cam surface carried by said releasable supporting member,

(*g*) said contact arm including a pair of opposed side portions each of said side portions having an elongated slot therein, the upper and lower edge portions of said slots comprising upper and lower cam surfaces, said releasable supporting member including an elongated cam surface portion extending adjacent to and in a plane passing between said opposed side portions of said contact arm, and

(*h*) a cam follower roller member comprising a supporting shaft, a central cam follower roller disposed and arranged to ride along said cam surface of said releasable support member and a pair of outer cam follower roller portions each disposed in one of said elongated slots respectively, and

(*i*) a pair of tension type overcenter operating springs, each of said operating springs having one end portion thereof connected to said supporting shaft between said central roller and one of said outer rollers respectively,

(*j*) whereby said central roller acts on said cam surfaces of said supporting member and said outer rollers act on said upper and lower cam surfaces of said contact arm, and

(*k*) current responsive means normally engaging and restraining said releasable member in said supporting position and operable to cause release of said releasable member upon the occurrence of predetermined current conditions through said contacts.

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