March 10, 1970 J. DE TORRE 3,500,266

HIGH-SPEED CIRCUIT BREAKERS

Filed Aug. 1, 1968 2 Sheets-Sheet 1

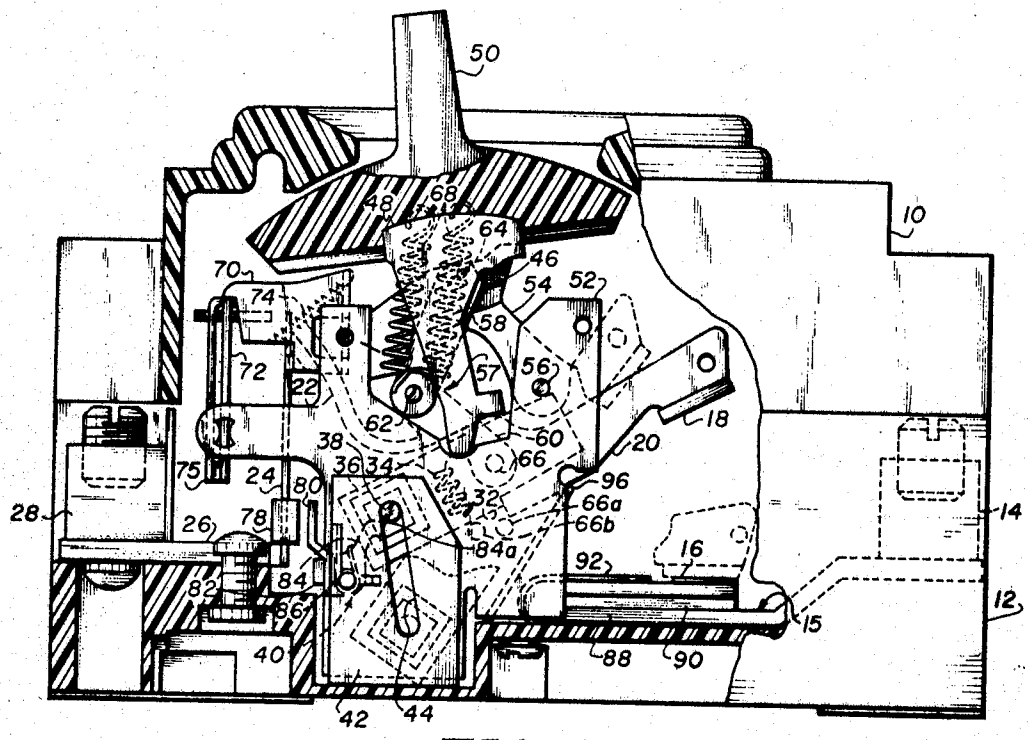


FIG. 1

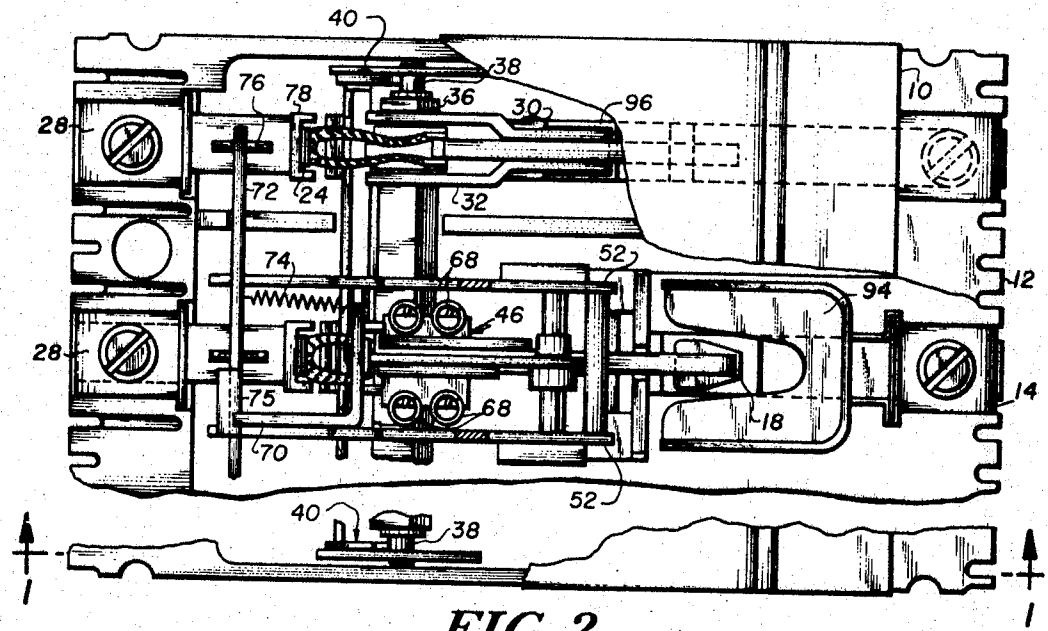


FIG. 2

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HIGH-SPEED CIRCUIT BREAKERS

Filed Aug. 1, 1968 2 Sheets-Sheet 2

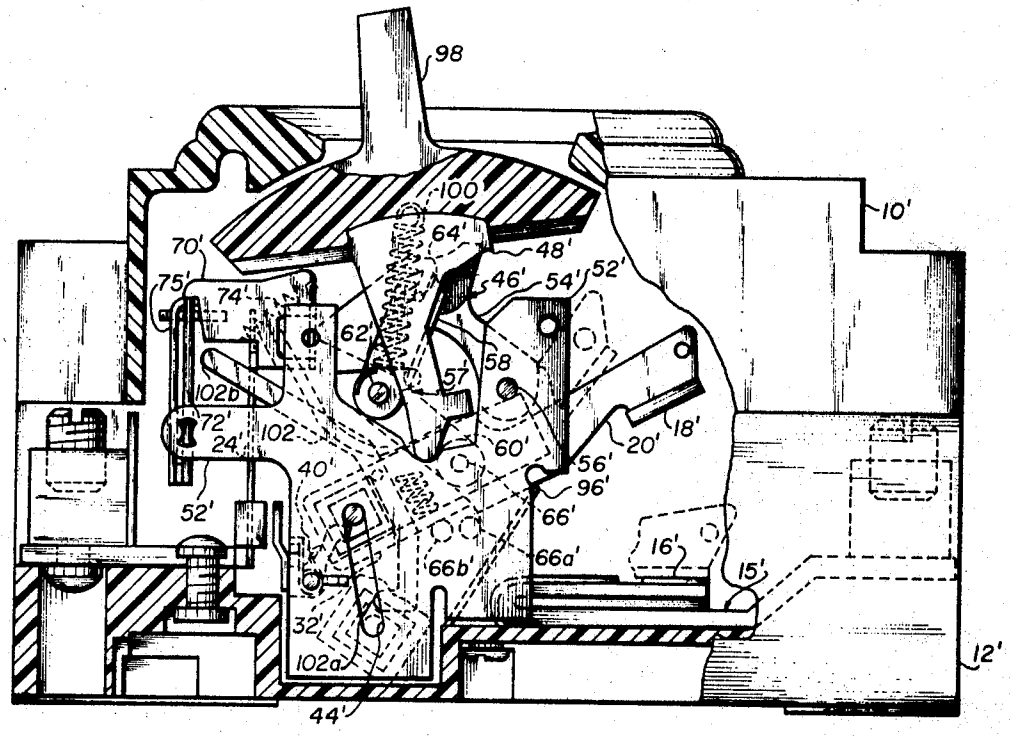


FIG. 3

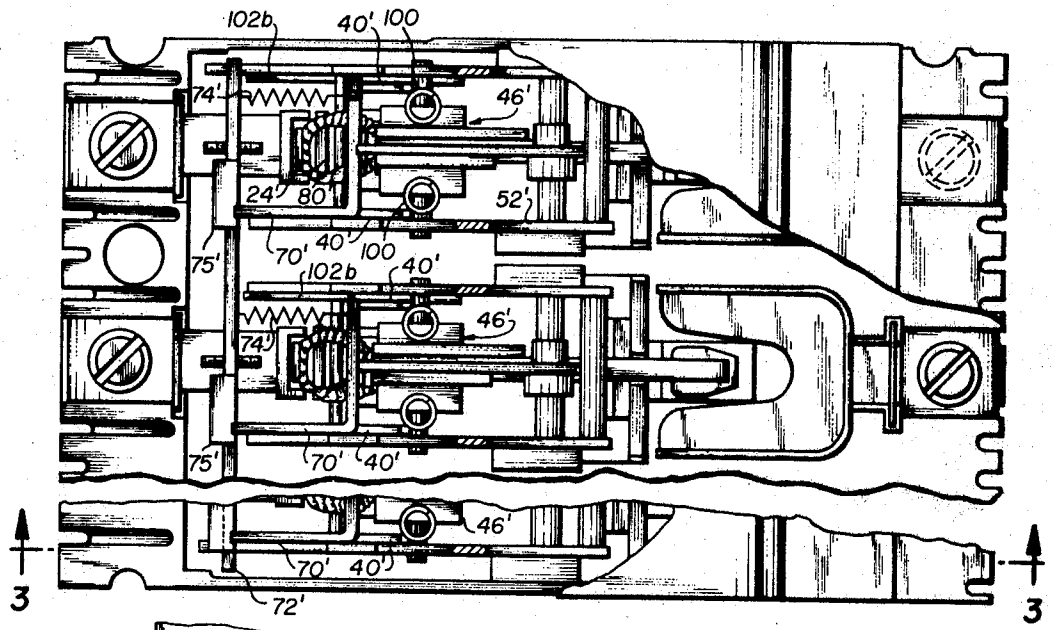


FIG. 4

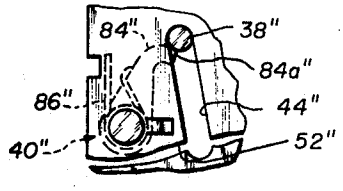


FIG. 5

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HIGH-SPEED CIRCUIT BREAKERS

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Int. Cl. H01h 75/08, 77/04
U.S. Cl. 335—16 24 Claims

ABSTRACT OF THE DISCLOSURE

A circuit breaker wherein a moveable contact arm moves between closed and alternative open circuit positions. A releasable means supports said contact arm at one end for pivotal movement between said closed position and a first open position. A toggle pivotally connects said contact arm intermediate the ends thereof for moving said contact arm between said closed position and said first open position. Means are supplied for biasing said contact arm for pivotal movement about said toggle pivotal connection to a second open circuit position when the releasable means releases the supported end of said contact arm, said contact arm moving to said second open position without collapsing the said toggle.

This invention relates to circuit breakers and more particularly to circuit breakers of the molded case type.

An object of this invention is to provide an improved circuit breaker having reduced opening time under fault conditions.

An object of this invention is the provision of an improved circuit breaker having two opening modes alternatively selected automatically dependent on the circuit condition to be interrupted.

A further object of the invention is the provision of an improved circuit breaker having increased contact separation in one mode of operation as compared to its second, normal mode of operation.

A further object of this invention is the provision of a circuit breaker mechanism having reduced inertial mass for rapid opening yet which has sufficient mass in its normal closing operation for rapidly closing against faults and for normal operation.

Yet another object of this invention is the provision of an improved circuit breaker having a high speed response to high fault currents.

A still further object of the invention is a provision of a circuit breaker having increased interrupting capacity within a given volumetric dimension compared to standard breakers heretofore available.

Still another object of this invention is to provide a circuit breaker having an improved fast-acting high-current release.

The above and other objects and advantages of the invention are accomplished in the illustrative circuit breakers described below and as shown in the accompanying drawings, as embodiments of the invention in its various aspects. In those drawings:

FIG. 1 is a side view of a multipole circuit breaker embodying certain aspects of the invention, partly in section as viewed from the plane 1—1 in FIG. 2;

FIG. 2 is a plan view of the circuit breaker of FIG. 1 with some parts broken away and other parts omitted;

FIG. 3 is a side view of another embodimen of the invention shown as multipole circuit breaker which illustrates certain other aspects of the invention. The view is partly in section as viewed from the plane 3—3 in FIG. 4;

FIG. 4 is a plan view of the circuit breaker of FIG. 3 with some parts broken away and other parts omitted; and

FIG. 5 is a fragmentary side view of yet another embodiment.

Referring to FIG. 1, the circuit breaker mechanism is enclosed in a case of molded insulation including a cover 10 and a base 12. The circuit through an illustrative pole of the circuit breaker (when it is closed) extends from one terminal 14 through a reverse current path conductor 15 to the stationary contact 16, thence to movable contact 18, through the contact arm 20, along conductive flexible braid 22, through bimetal 24 to conductive bar 26, and thence to the opposite terminal 28. Contact arm 20, which carries contact 18, is in turn carried by a pivot 30 in the contact arm carrier 32 and is biased by compression springs 34 in the direction to build up contact pressure when the contacts are closed. When the contacts are open, the swing of the contact arm 20 produced by the spring 34 is limited by the engagement of a portion of the contact arm with the bottom edge of the channel-shaped contact arm carrier 32. The contact arm carrier 32 is affixed to an insulated shaft or tie bar 36 the ends of which are formed as pivot pins 38 that are supported by oppositely disposed latch means 40. The latch means 40 are mounted on guide members 42 that are affixed to the molded base 12 at either end of the tie bar 36. The pivot pins 38 ride in and are guided by slots 44 formed in the guide members 42 for purposes that will be described in greater detail below. Plural contact arm carriers 32, with respective contact arms 20, are mounted on the aforesaid shaft for coordinated cooperation of the contacts in a multipole circuit breaker.

An overcentering spring mechanism indicated generally at 46 is provided for operating the contacts between the closed and the first of two alternative open positions and in certain embodiments for effecting automatic release and opening of contacts in response to overloads. The operating mechanism includes a manual operating lever 48 and handle 50. Lever 48 is pivoted at its lower extremity in a fixed frame 52 secured to the breaker base 12. The frame includes a pair of spaced metal members or plates which extend from a point adjacent the midpoint of the breaker casing toward one end of the case. An overload release member or "cradle" 54 has a pivot 56 fixed in the frame 52. Toggle 57 includes a pair of toggle links 58 and 60 that are pivotally connected to each other at a knee 62. These toggle links have a top pivot 64 and a bottom pivot 66 in members 54 and 32 at the center pole of the illustrative circuit breaker of FIGS. 1 and 2. Two pairs of springs 68 extend between the manual lever 48 and the knee 62 of the toggle although only one pair is visible in FIG. 1. The open circuit position of the contact arm is determined by contact of the carrier 32 with the pivot pin 56. In the embodiment of the invention of FIGS. 1 and 2 there is only a single operating mechanism 46 for all of the contact arm carriers operated by the tie bar 36 while in the embodiment of FIGS. 3 and 4 multiple operating mechanism are used.

The breaker operating mechanism 46 and a cooperating secondary latch 70 are both located at the center pole position of the embodiment of FIGS. 1 and 2. The end of the cradle 54 remote from its pivot 56 is normally restrained against movement in the toggle collapsing direction by the secondary latch 70 which is pivoted on the side frames 52. Details of this secondary latch and the operating mechanism may be found in U.S. Patent No. 3,209,098 entitled, "Circuit Breakers Having Improved Tripping Mechanisms," which is assigned to the same assignee as the present invention. Further details are not believed necessary to the understanding of the present invention and therefore will be omitted from the following discussion.

Referring to FIG. 2, a trip bar 72, of insulation, extends

across all the pole positions and is pivoted on the frame **52**. A spring **74** is tensioned between the trip bar **72** and the latch **70** and urges them into engagement. The secondary latch **70** engages a primary latch **75** carried by the trip bar.

Each of the illustrative circuit breaker poles is provided with two overcurrent sensing means in the embodiment shown in FIGS. 1 and 2. Since each of the poles is identical, only one pole will be described in detail. The two overcurrent sensing means which are provided respond to different overcurrent levels. Where protection against sustained overloads is desired the overcurrent sensing means usually incorporates an inverse time characteristic so that as the overload current increases the time of response is decreased. This mode of operation is obtained by employing the known characteristics of bimetal member **24** through which the current flows when the breaker is closed. Bimetal **24** deflects, due to overload current passing therethrough, and engages an adjustment screw **76** carried by trip bar **72**. Continued deflection of the bimetal drives the trip bar **72** counterclockwise to disengage the secondary latch **70** from the primary latch **75** and open the circuit breaker as will be explained below.

In order to obtain "instantaneous" trip of the circuit breaker upon the occurrence of severe overloads a structure which responds electromagnetically to the current flow through the bimetal **24** is provided. Referring to FIGS. 1 and 2 a channel or U-shaped pole piece **78** is positioned about and mounted closely adjacent the bimetal **24** where the bimetal is secured to the conductive bar **26**. An armature **80**, for magnetic attraction to and cooperation with the yoke **78**, is mounted on a trip bar **82** of insulation which extends across all of the poles. For purposes of clarity and convenience the first-mentioned trip bar **72** will hereinafter be referred to as the time delay trip bar while the trip bar **82** will hereinafter be referred to as the instantaneous trip bar. Instantaneous trip bar **82** is supported at each end, by latch means **40** that are, in turn, pivoted on guide members **42**. Latch means **40** includes a lever arm portion **84** that has a face **84***a* adapted to engage and releasably support the contact arm guide pin **38** in cooperation with the guide slots **44**. A torsion spring **86** reacts between the latch portion **84** and the guide member to provide a restoring force for the latch means **40**.

Referring to FIG. 1, the reverse current path conductor **15** includes a conductive member **88** which is bent back upon itself. A spacer of insulation **90** is interposed between the legs of member **88** which are secured together by appropriate means, not shown. A layer **92** of insulation is applied to that portion of conductor **15** that is outside arc chute **94** to assure arc interruption within the arc chute.

Contact opening bias is provided in part by a hairpin spring **96** that reacts between the base **12** and the contact arm **20**. Spring **96** assists in moving the contact arm to both of the alternative open circuit positions as will be explained in detail below.

The circuit breaker is illustrated in FIGS. 1 and 2 in its "normal" open condition, with the cradle **54** latched so that the operating mechanism is in condition for driving the contacts closed when operated. The guide pins **38** are supported in position for the normal closing operation of the breaker by the latch means **40**. Closing of the breaker is accomplished by moving manual lever **48** to the right in the drawing. The upper end of the tension springs **68** are correspondingly shifted to the right and when the resulting spring tension through knee **62** is shifted so as to act along the line to the right of the upper pivot **64** in the cradle **54** the knee is biased to the right and tends to straighten the toggle. This occurs with a snap-action, and suddenly drives the contact carrier **32** in the closing direction driving movable contact **18** against the stationary contact **16**, the low dotted-line position in FIG. 1. Overtravel of the carriers **32** beyond the point of engagement of the companion contacts stresses the overtravel spring **34** in each of the contact arms thus providing contact pressure.

When the contacts are closed the lower toggle pivot **66** assumes the position indicated at **66***a*. At this time the line of upward thrust through the knee of the toggle passes to the right of the upper toggle pivot **64** in the cradle **54**. In the embodiment shown in FIGS. 1 and 2 there are two possible modes of opening for the circuit breaker to cause separation of the contacts. In the first or standard manner of operation in the event of an overcurrent, cradle **54** is released by the time delay trip bar **72** for clockwise swing about its pivot **56**, and the upper toggle pivot **64** shifts to the right and across the resulting line of action of the springs **68**. When this takes place, the tensioned overcenter springs **68** are free to cause sudden collapse of the toggle and correspondingly, to pivot the various contact carriers **32** about the pivot pins **38**, as a unit, from their closed position. The release of the cradle **54** is accomplished by the deflection of the bimetal **24** under the influence of a sustained overcurrent. As the bimetal deflects toward the left in FIG. 1 it ultimately presses against the adjustment screw **76** causing the time delay trip bar **72** to pivot, shifting the primary latch **75** from its point of engagement with the secondary latch **70** which is then free to pivot and release the cradle **54** as aforesaid. When the breaker opens in this operation, it returns to the full line position shown in FIG. 1 which position may be considered the "normal" open position. The opening of the breaker manually by reversely shifting the operating handle **48** also causes collapse of the toggle causing the breaker to open to the normal open circuit position.

More significantly the illustrative circuit breaker embodies a novel structure whose function will now be explained. Upon the occurrence of a severe overload or short circuit in the monitored circuit a sudden increase in the current through the affected pole or poles will be experienced. This current passing through the bimetal **24** causes yoke **78** to forcefully attract armature **80** secured to the instantaneous trip bar **82** before the bimetal is able to deflect enough to operate the time delay trip bar **72**. The pivotal movement of the instantaneous trip bar **82** causes the latch **40** to swing arm **84** thus shifting surface **84***a* to free the contact arm guide pins **38**, formed at the end of tie bar **36**, for movement along the guide slots **44** under the impetus of spring **96**. The contact arm initially pivots about its pivotal connection **66** to the toggle without waiting for collapse of the toggle. At the start of this movement pivot **66** is at the closed circuit position **66***a*. The toggle remains erect during the instantaneous opening operation of the breaker. Previously, during the normal operation of the breaker the contact arm was constrained to pivotal motion about the pins **38** by the interengagement of the guide pins **38**, the slots **44**, and the latch means **40**. The erecting movement of the toggle as transmitted through the pivot **66** was effective to swing the contact arm in an arc to the closed position. The operation of the latch means **40** by the overcurrent frees the restrained end of the contact arm and allows rotation of the arm about pivot **66**. The pivot shifts to position **66***b* as the contact arm moves to its upper dotted-line position (FIG. 1). The rotation of the contact arm continues until the arm engages the pivot pin **56**. It will be noted that this second open circuit position is a "wide" open position having greater clearance between the moving contact **18** and the stationary contact **16** than in the normal position of the arm. This increased separation is effective in increasing the interrupting capacity of the breaker.

The reverse current path conductor **50** is effective to cause acceleration of the contact arm to the wide open position due to the reaction of the current flowing in the conductor **15** and in contact arm **20**. It will be noted by those who are skilled in the art that the shift of the operative pivot of the contact arm from latched guide pin **38**

to the pivotal connection point **66** has moved the center of rotation of the contact arm from a point adjacent one end thereof to a point which is closer to the center of the mass of the contact arm. This shift in pivotal location results in a very large change in the moment of inertia of the contact arm and therefore allows faster movement to the open circuit position. The change in movement of inertia makes the contact arm more responsive to the relatively light contact opening springs **96** of each of the contact arms and significantly more responsive to the electrodynamic effect of repulsion between the contact arm and the reverse current path in the upper part of conductor **15**.

Restoration of the circuit breaker into condition for reclosing after release by a sustained moderate overload is produced by moving the operating handle **48** slightly beyond the open or off position. The handle drives cradle **54** to re-engage the secondary and primary latches in a manner well known in the art. Restoration of the circuit breaker upon the occurrence of an "instantaneous" overcurrent condition, wherein the contact arms have moved to the second open circuit position without collapsing the toggle, is accomplished by merely moving the circuit breaker to the off position. When the springs **68** are moved to the off position the knee of the toggle is shifted causing the toggle to collapse and the force of springs **68** acting on the knee of the toggle **62** is sufficient to lift the contact arms to their normal open circuit position. Each guide pin **38** cams its latch arm **84** out of the way as it returns to the position shown in FIG. 1 while the latch snaps into position beneath the guide pin under the influence of the latch return spring **86** previously described.

In certain applications where only the short circuit-instantaneous response characteristic is desired, as when the circuit breaker is used with a motor starter having built-in overload protection, the overcurrent sensing means **24** may be omitted. The time delay trip bar **72** and the associated secondary latch **70** are also omitted. In this construction magnet yoke **78** is arranged about an extension of conductor **26** to monitor the current through the pole. The cradle **54** remains fixed in the position of FIG. 1 and the toggle **57** serves to normally open and close the circuit breaker and to reset the circuit breaker after operation of the latch means **40** in response to the instantaneous trip. The contact arms **20** remain in the wide open position until the handle **50** is moved to the off position collapsing the toggle **57**. When the toggle is collapsed the overcentering springs **68** lift contact arms to their reset position.

Referring now to FIGS. 3 and 4 there is illustrated another embodiment of the invention in which parts corresponding to similar parts in FIG. 1 are identified by the same reference numerals primed. For purposes of clarity and simplicity only those parts necessary for an understanding of the embodiment are specifically identified. In the multipole circuit breaker of FIGS. 3 and 4 a plurality of operating mechanisms **46'** are provided, one for each pole of the circuit breaker. The operating levers **48'** of the respective poles are interconnected for common operation by a handle **98** that engages the operating levers for conjoint operation for opening and closing all of the poles simultaneously. Each of the poles has a frame **52'** that includes a pair of spaced metal members or plates which extend from a point adjacent the mid point of the breaker casing toward one end of the case and an overload release member or cradle **54'** that has a pivot **56'** fixed in the frame **52'**. Toggle **57'** includes a pair of toggle links **58'** and **60'** that are pivotally connected to each other at a knee **62'**. These toggle links have a top pivot **64'** and a bottom pivot **66'** in members **54'** and **32'**. A pair of springs **100** extend between the manual lever and the knee **62'** of the toggle. The contact arm **20'** of each pole has guide pins **38'** that are slidable in guide slots **44'** formed in the frame members **52'**.

Each pole has a secondary latch **70'** that cooperates with the end of the respective cradle **54'** and restrains the cardle against movement in the toggle collapsing direction. A common trip bar **72'**, of insulation, extends across all the pole positions and is pivoted on the exterior frame members **52'** of the outer poles (see FIG. 4). A spring **74'** extends between the trip bar **72'** and each of the secondary latches **70'** and urges them into engagement with the trip bar. Secondary latch **70'** engages a respective primary latch **75'** carried by the trip bar **72'** at each pole position.

As in the embodiment of FIGS. 1 and 2 each of the poles is provided with two overcurrent sensing means which respond to different overcurrent levels. As before, bimetal **24'** provides the inverse time characteristic response while the electromagnetic "instantaneous" over current characteristic is provided by yoke **78'** positioned about bimetal **24'** and an armature **80'** carried by an individual instantaneous trip bar **82'** at each pole. The common time delay trip bar **72'** provides for opening of all of the poles in response to an overload in any one pole. Movement of the trip bar **72'**, by the bimetal **24'** of the overloaded pole, releases each of the individual cradles **54'** to collapse the toggle **57'** and opens the circuit through the respective poles.

When one of the poles is tripped by a severe short circuit that causes the latch **40'** of that pole to release the contact arm for high speed-low inertia movement to the "wide" open position, the other poles are likewise caused to open. As the pivot pins **38'** of the released contact arm travel along the slots **44'** after release they encounter one end **102***a* of bell crank **102** that is pivoted on the frame **52'**. The movement of the pin **38'** causes bell crank **102** to pivot counterclockwise driving end **102***b* against the time delay trip bar **72'** to release the cradles **54'** of all of the poles. Release of the cradles **54'** causes collapse of the respective toggles **57'** opening all of the poles. It should be noted that the contact arm of the overloaded pole opens to the "wide" open position first and then, upon collapse of its toggle, returns to the normal open position. The time in which the pole is in the "wide" open position may be determined, in part, by the location of the end **102***a* of the bell crank. Collapse of the toggles **57'** of the overloaded pole automatically conditions the pole for normally closing by allowing the operating springs **100** to lift the pivot pin **38'** above the latch surface **84***a* as in the embodiment of FIGS. 1 and 2. If bell crank **102** is omitted, the "let-through" current that passes through the bimetal **24'** of the overloaded pole during the interruption operation will normally be sufficient to cause the bimetal **24'** to deflect to the tripping point thus collapsing the toggles **57'** and opening all of the poles.

Referring to FIG. 5 there is illustrated a latch construction applicable to the embodiments of FIGS. 1 to 4 which is responsive to the electrodynamic forces generated between the contact arm **20** and the reverse current path conductor **15**. When high overload currents flow through the contact arm-conductor a large force is generated which tends to lift the arm away from the conductor. The arm is pivotally connected to the toggle and through the contact pressure springs to the contact arm carrier. As the arm lifts, it reaches a limiting position in carrier **32**, due to a stop or when the turns of spring **34** touch so that the spring becomes "solid." Thereafter the electrodynamic force developed in arm **20** is converted to downward pressure of pins **38''** against the latch face **84***a''*. This latch face is not tangent to an arc about its pivot **40''** but has a push-off angle. A component of the force of pins **38''** tends to rotate the latch **40''** out of the release path of the pin. When that component of force exceeds the forces due to friction and due to restoring spring **86''**, the pins are released allowing the arm to travel to the "wide" open position. When the latch of FIG. 5 is applied to the embodiment of FIGS. 3 and 4, the latch arms **84** may be suitably connected together for

simultaneous movement or, preferably, common release of all the poles may depend on bell cranks **102**. This latch structure may also be applied to the illustrative embodiment of FIGS. 1 and 2. The magnetic yoke and associated armatures of FIGS. 1 to 4 may be omitted when the latch is formed to include a push-off angle, or latches with a push-off angle may be used together with armatures. The push-off angle adapts the latch to respond to the electrodynamic force of the contact arm developed under severe overcurrent conditions and promotes speedier release under such conditions.

While the embodiments of the invention shown and described in detail are in the form of multipole circuit breakers it will be readily apparent to those skilled in the art that single pole circuit breakers are also within the scope of the invention. Various other changes and modifications may be made therein without departing from the scope or spirit of the invention.

What is claimed is:

1. A molded case circuit breaker including a movable contact and a companion contact, a contact arm, said movable contact being mounted adjacent one end of said contact arm for movement therewith between closed and alternative open circuit positions, releasable means supporting said contact arm at its other end for pivotal movement between said closed circuit position and a first open circuit position, operating means for moving said contact arm between said closed circuit position and said first open circuit position, said operating means including a toggle pivotally connected to said contact arm intermediate the ends thereof for moving said contact arm between said closed circuit position and said first open circuit position, means biasing said contact arm for pivotal movement about said toggle pivotal connection thereto to a second open circuit position, operation of said releasable means being responsive to overcurrent conditions for releasing the supported end of said contact arm to allow pivotal movement thereof to said second open circuit position without collapsing said toggle.

2. A circuit breaker according to claim **1** further including means providing a reverse current path adjacent said contact arm that provides an electrodynamic reaction between current flowing in said contact arm and in said reverse current path for providing a force to operate said contact arm toward said second open position.

3. A circuit breaker according to claim **2** wherein said releasable means has a portion releasably supporting said contact arm, said portion being shiftable to a releasing position solely responsive to the level of the electrodynamic reaction between current flowing in said contact arm and in said reverse current path to release said contact arm for movement to said second open circuit position in response to electrodynamic reaction above a given level and to maintain said contact arm in its supported position at all levels below said given level.

4. A circuit breaker according to claim **1** further including contact arm guide means, said contact arm having portions cooperating with said guide means for guiding the path of movement of said contact arm between said closed circuit position and said second open circuit position.

5. A circuit breaker according to claim **4** wherein said guide means includes a pair of guide members disposed on opposite sides of said contact arm guide slots formed in said members and wherein said contact arm cooperating portions are guide pins fixed thereto which are slidable in said slots, respectively.

6. A circuit breaker according to claim **5** wherein said releasable means engages said contact arm guide pin to releasably support said contact arm for pivotal movement between said closed circuit position and said first open circuit position.

7. A circuit breaker according to claim **6** wherein said releasable means includes latches pivoted on side members, respectively.

8. A circuit breaker according to claim **5** wherein said guide members support said circuit breaker operating means.

9. A circuit breaker according to claim **1** wherein said releasable means includes latch means and overcurrent responsive means controlling latch means.

10. A circuit breaker according to claim **1** wherein said releasable means includes first overcurrent responsive means controlling said releasable means and second overcurrent responsive means operatively connected to said toggle for collapsing said toggle and thereby allowing said contact arm to move to said first open circuit position.

11. A circuit breaker according to claim **10** wherein said first overcurrent responsive means has an instantaneous response characteristic and said second overcurrent responsive means has an inverse time current responsive characteristic.

12. A multipole circuit breaker having a pair of separable contacts per pole, a casing of insulation, each said pair of contacts including a movable contact and a companion contact mounted in said casing, a plurality of contact arms, each of said movable contacts being mounted adjacent one end of a respective one of said contact arms for movement therewith between closed and alternative open circuit positions, releasable means in said casing supporting said contact arms at the ends thereof remote from said movable contacts for pivotal movement between said closed circuit position and a first open circuit position, overcentering-spring actuated toggle means for operating said contact arms between said closed circuit position and said first open circuit position, said toggle means being pivotally connected to said contact arms intermediate the ends thereof for operation thereof between said closed circuit position and said first open circuit position, means biasing said contact arms for pivotal movement about said toggle pivotal connection thereto to a second open circuit position, said releasable means being respnsive to overcurrent conditions for releasing the supported ends of said contact arms to allow pivotal movement thereof to said second open circuit position without collapsing said toggle.

13. A circuit breaker according to claim **12**, including a tie bar operatively connecting said contact arms for conjoint movement, and wherein said releasable supporting means and said toggle means are common to all of said contact arms.

14. A circuit breaker according to claim **12** further including means providing a reverse current path adjacent each said contact arm that provides electrodynamic reaction between current flowing in said contact arm and in said reverse current path for providing a force for operating said arm toward said second open circuit position.

15. A circuit breaker according to claim **13** further including means providing a reverse current path adjacent each said contact arm that provides electrodynamic reaction between current flowing in said contact arm and in said reverse current path for providing a force for operating said arm toward said second open circuit position.

16. A circuit breaker according to claim **14** wherein said releasable means has a portion releasably supporting said contact arm, said portion being shiftable to a releasing position solely responsive to the level of the electrodynamic reaction between each said contact arm and said reverse current path to release said contact arms for movement to said second open circuit position in response to electrodynamic reaction above a given level and to maintain said contact arm in its supported position at all levels below said given level.

17. A circuit breaker according to claim **13** further including a pair of guide members mounted in said casing adjacent the opposite ends of said common tie bar, an aligned guide slot in each of said guide members, a guide pin at each end of said common tie bar, said guide pin

being slidable in said guide slots, said guide pin cooperating with said releasable means for releasably supporting said common tie bar and for guiding said end of said common tie bar for conjoint movement of said contact arms to said second open circuit position.

18. A circuit breaker according to claim **17** wherein each of said poles is provided with overcurrent release means operatively connected to said releasable means and wherein said releasable means is operable in response to overcurrent in any pole to allow movement of said contact arms to said second open circuit position.

19. A circuit breaker according to claim **12** wherein said contact-arm operating means includes an overcentering-spring actuated toggle for each of said contact arms, and common handle means connecting said toggles for simultaneous operation, each of said poles having separate releasable means.

20. A circuit breaker according to claim **19** further having means including a trip bar controlling the collapse of said toggles for normally maintaining said contact arms in said closed circuit condition, and coupling means between said trip bar and each of said contact arms responsive to the movement of one of said contact arms to said second open circuit position for driving said trip bar to a toggle collapsing position causing opening of all of the other poles of said circuit breaker.

21. A circuit breaker according to claim **20** wherein said coupling means in each pole is a pivoted member mounted adjacent the supported end of each of said contact arms and having a portion in the path of movement of said arm from said closed circuit position to said second open circuit position and having a second portion adjacent said trip bar whereby the movement of any one of said contact arms to said second open circuit position causes said pivoted member to drive said trip bar to release said toggles.

22. A molded case circuit breaker including a movable contact and a companion contact, a contact arm, said movable contact being mounted adjacent one end of said contact arm for movement therewith between closed and two alternative open circuit positions, first releasable means pivotally supporting the end of said contact arm remote from said movable contact for movement between said closed circuit position and a first open circuit position, overcentering spring operating means for moving said contact arm between said closed circuit position and said first open circuit position, said operating means including an intermediate pivot connected to said contact arm between the ends thereof, means biasing said contact arm for pivotal movement about said intermediate pivot to a second open circuit position, said first releasable means being responsive to severe overcurrent conditions for releasing the pivotally supported end of said contact arm to allow movement thereof to said second open circuit position, and second current responsive latch means releasable to effect contact-opening operation of said overcentering spring operating means.

23. A molded case circuit breaker including a movable contact and a companion contact, a contact arm, said movable contact being mounted adjacent one end of said contact arm for movement therewith between closed and two alternative open circuit positions, first releasable means pivotally supporting the end of said contact arm remote from said movable contact for movement between said closed circuit position and a first open circuit position, overcentering spring operating means for moving said contact arm between said closed circuit position and said first open circuit position, said operating means including an intermediate pivot connected to said contact arm between the ends thereof, means biasing said contact arm for pivotal movement about said intermediate pivot to a second open circuit position, said first releasable means being responsive to severe overcurrent conditions for releasing the pivotally supported end of said contact arm to allow movement thereof to said second open circuit position, and means providing a reverse current path adjacent said contact arm that provides an electrodynamic reaction between current flow in said contact arm and in said reverse current path for providing a force to operate said contact arm toward said second open position.

24. A multipole circuit breaker having a movable contact and a companion contact in each pole thereof, a plurality of contact arms, each of said movable contacts being mounted adjacent one end of a respective one of said contact arms for movement therewith between closed and alternative open circuit positions, overcurrent responsive means releasably supporting said contact arms at their other ends for pivotal movement when supported between said closed circuit position and a first open circuit position, operating means for moving said contact arms between said closed circuit position and said first open circuit position, said contact arms being pivotally connected intermediate the ends thereof to said operating means, and means biasing said contact arms about the intermediate connection thereof to said operating means for movement to a second open circuit position, said overcurrent responsive means being effective for releasing the supported end of said contact arms to allow pivotal movement thereof to said second open circuit position in response to an overcurrent, and means responsive to the operation of any of said contact arms toward said second open position for causing said operating means to operate all said contact arms to said first open position.

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