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CIRCUIT INTERRUPTER

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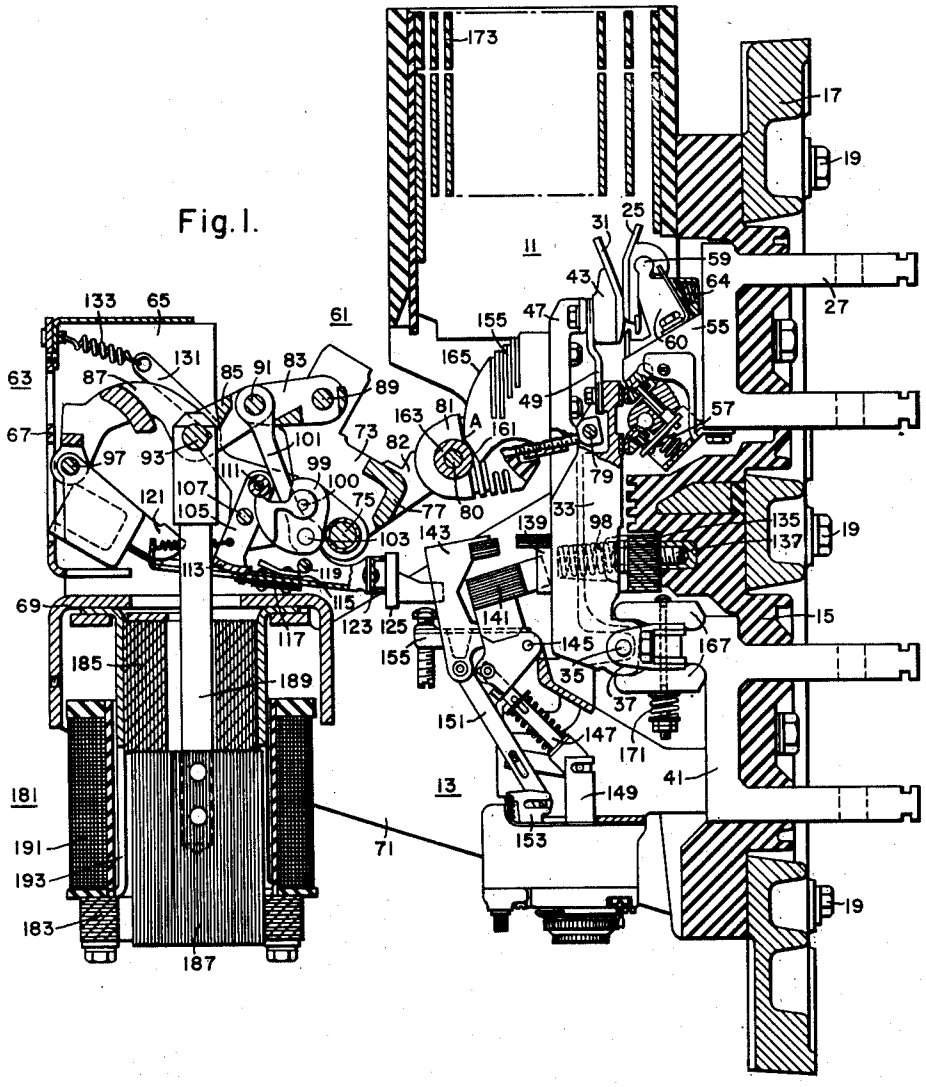
Fig. 1.



WITNESSES

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CIRCUIT INTERRUPTER

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Fig. 2.

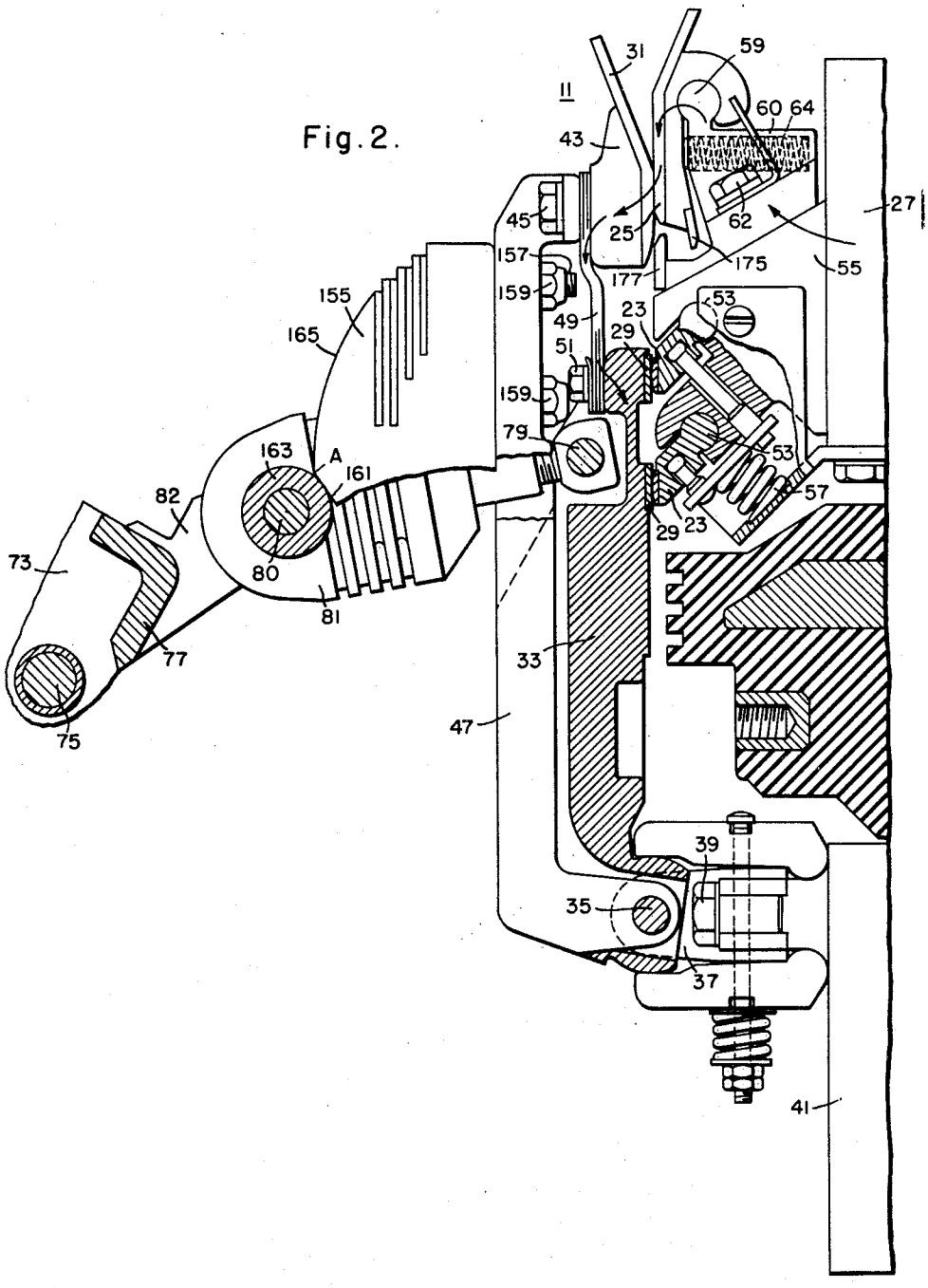

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Fig. 3.

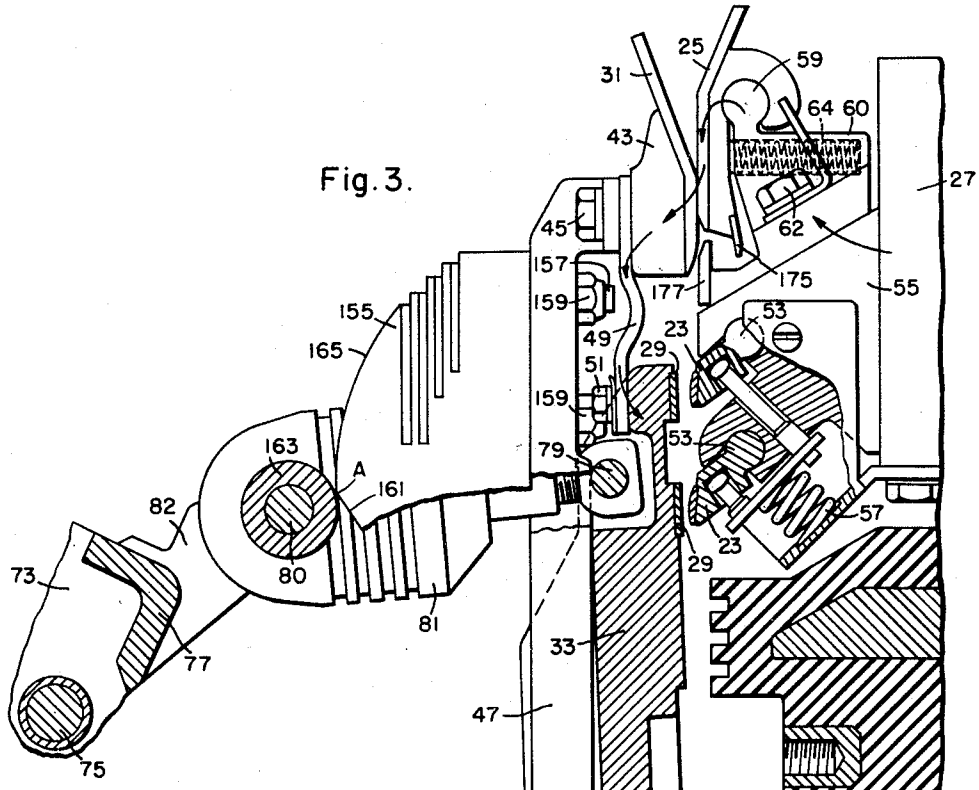
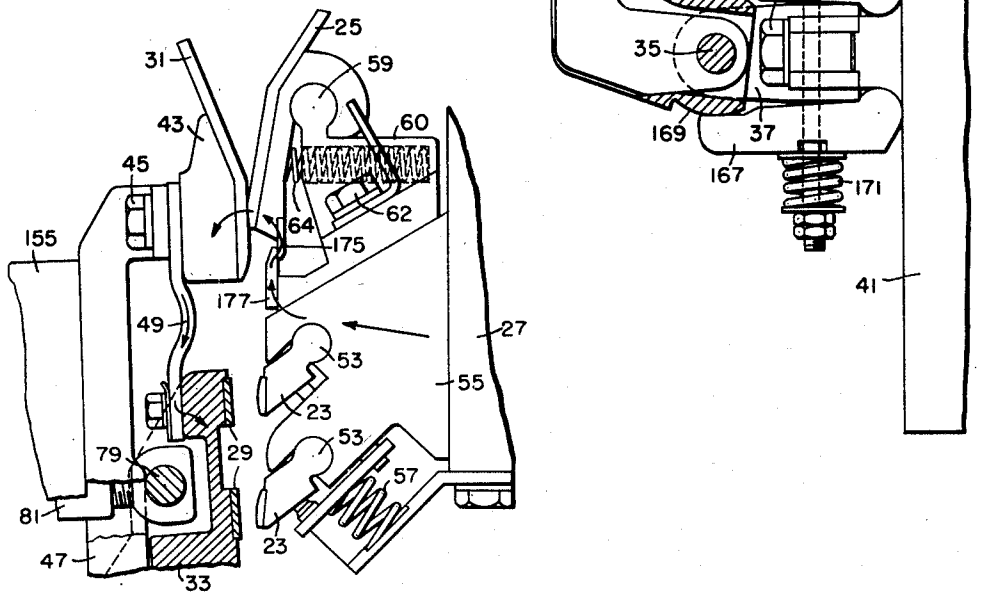


Fig. 4.



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CIRCUIT INTERRUPTER

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Application May 16, 1955, Serial No. 508,395

5 Claims. (Cl. 200—146)

This invention relates to circuit interrupters and more particularly to contact structures for air circuit interrupters.

An object of the invention is to provide an improved circuit interrupter embodying stationary and moving arcing contacts having auxiliary contact means effective during separation of the arcing contacts to direct the arc toward the arc chamber.

Another object of the invention is to provide a circuit interrupter embodying sets of stationary and moving main and arcing contacts in which the moving arcing contact is separately mounted and remains motionless at its maximum contact pressure during engagement and disengagement of the main contacts.

Another object of the invention is to provide a circuit interrupter embodying an improved contact structure comprising separately mounted moving main contact means and moving arcing contact means having means for holding the moving arcing contact means stationary until the moving main contact means has moved a predetermined distance in opening direction.

Another object of the invention is to provide a circuit interrupter embodying an improved contact structure wherein stationary and movable contacts provide a current loop which tends to maintain the contacts closed in the closed contact position, the current loop being shifted to a path where it tends to blow the arc away from the contacts upon contact separation.

The invention, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawings.

In said drawings:

Figure 1 is a vertical sectional view taken through the center pole of a three pole circuit interrupter embodying the principles of the invention;

Fig. 2 is an enlarged sectional view of the contact structure for one of the poles of the circuit interrupter;

Fig. 3 is an enlarged view similar to Fig. 2 but showing the contact structure in the position with the main contacts separated and the arcing contacts about to separate; and

Fig. 4 is a positional view of a position of Fig. 3 showing the contact arms in the position they assume when the arcing contacts are about to separate.

Referring to Fig. 1 of the drawings, the circuit interrupter includes a plurality of pole units each comprising a separable contact structure indicated generally at **11** and an overcurrent trip device indicated generally at **13**. The contact structure and trip device for each pole of the circuit interrupter are mounted on separate insulating bases **15** which are rigidly secured to a metal panel **17** by means of screws **19**. Since the pole units are alike, only one will be described herein.

The contact structure comprises stationary main contacts **23** and a stationary arcing contact **25** all supported on the inner end of a U-shaped terminal conductor **27**

(Fig. 1) the legs of which extend through suitable openings in the base **15** and panel **17**. Cooperating with the stationary main contacts **23** and the stationary arcing contact **25**, respectively, are movable main contacts **29** and a movable arcing contact **31**. The movable main contacts **29** are rigidly mounted on a channel-shaped main switch arm **33** pivotally mounted at its lower end on a pin **35** supported in a bracket **37** which is rigidly mounted by means of bolts **39** (only one being shown) on a lower U-shaped terminal conductor **41**. The movable arcing contact **31** is mounted on a contact carrying member **43** rigidly mounted by means of bolts **45** (only one being shown) on the upper or free end of an arcing contact arm **47** which is also pivoted on the pin **35**. A flexible conductor **49** has its upper end secured by the bolts **45** to the movable arcing contact and its lower end secured by bolts **51** to the upper end of the main contact arm **33**.

The main stationary contacts **23** (Fig. 2) are pivotally supported by means of pivot means **53** in bearing openings in an extension **55** of the terminal **27**, and are biased by means of a common spring **57** into engagement with the movable main contacts **29** in the closed position of the circuit interrupter. The stationary arcing contact **25** is pivotally supported by means of pivot means **59** on a bracket **60** secured by means of bolts **62** (only one being shown) to the terminal extension **55**, and is biased by means of a spring **64** into engagement with the movable arcing contact **31**.

The movable contact structure is normally maintained in the closed position by an operating mechanism indicated generally at **61** (Fig. 1) mounted in a U-shaped frame **63**. The frame **63** comprises spaced side members **65** and a connecting cross member **67** and is supported on a platform **69** which forms a cross member of a main bracket comprising a pair of spaced side members **71** joined at their outer ends by the cross member or platform **69**. The platform extends substantially across the width of the circuit interrupter and the side members **71** are rigidly secured to the panel **17** on the outer sides of the two outer pole units.

The operating mechanism includes a lever **73** pivotally mounted on a pivot pin **75** supported in the side members **65** of the frame **63**. The lever **73** comprises a pair of spaced levers rigidly joined by an angle member **77** which extends across all of the poles of the interrupter. The angle member **77** is operatively connected to the main movable switch arm **33** by means of an insulating connecting member **81** and a pivot pin **79** in the main switch arm. The other end of the connecting member **81** is pivotally connected to the angle members **77** by means of a pivot pin **80** and a bracket **82** rigid with the angle member **77**. There is a connecting member **81** for each pole of the circuit interrupter connecting the angle members **77** to the main moving contact member **33** for each pole unit so that, upon operation of the lever **73**, the movable contact structure for all these poles move in unison.

An operating linkage comprising toggle links **83**, **85** and **87** is provided to hold the lever **73** and consequently, the movable contacts in the closed position and to operate the movable contacts to open and closed positions. The toggle link **83** is pivotally connected to lever **73** by a pivot pin **89** and the toggle link **85** is connected by a knee pivot pin **91** to the toggle link **83** and by a knee pivot pin **93** to the toggle link **87**. The toggle link **87** is pivotally mounted on a fixed pivot **97** in the frame **63**.

The linkage **83**, **85**, **87** comprises two toggles, one of which **83**, **85** functions as a tripping toggle and the other **85**, **87** as a closing toggle. The tripping toggle is normally slightly underset above a line drawn through the centers of the pivot pins **89**, **93** and the closing toggle **85**, **87** is normally slightly underset below a line drawn through the centers of the pivot pins **91**, **97**.

The tripping toggle 83, 85 is normally biased in a direction to cause its collapse by components of the springs 57 and 64 and springs 98 (only one being shown) which bias the moving main contact structure for the several poles of the interrupter in opening direction and bias the connecting members 81 toward the left (Fig. 1). The tripping toggle 83, 85 is normally prevented from collapsing by means of a main latch member 99 pivoted on a pin 100 and connected by a link 101 to the knee pin 91 of the tripping toggle, the link 101 being connected to the latch member 99 by a pin 103.

The main latch 99 is held in latching position by an intermediate latch lever 105 pivoted on a pin 107 in the frame 63. The latch lever 105 carries a latch roller 111 which normally engages the main latch 99 to releasably hold the latter in holding position. The latch lever 105 at its lower end carries a latch member 113 which normally engages a latch member 115 on a lightload latch member 117 pivoted on a pin 119 in the frame 63. The latch lever 105 and the member 117 are biased to their latching positions by a spring 121 tensioned between the posts. Rigidly mounted on the right hand end of member 117 is a trip bar 123 which extends across all of the poles of the interrupter and has secured thereto an insulating bracket 125 for each pole of the interrupter cooperating with the trip device 13 for the corresponding pole unit.

As long as the main latch 99 is held in latching position by the latching mechanism just described, the tripping toggle 83, 85 will, through the link 101, be held in the position shown in which the interrupter contacts are held in closed position. The closing toggle 85, 87 is normally prevented from collapsing by a shouldered support member 131 pivoted on the pin 107 and biased by a spring 133 into supporting engagement with the knee pin 93 of the closing toggle.

The circuit interrupter is tripped open by operation of the trip device 13 for any pole of the interrupter. The trip device may be of any suitable type, preferably of the type fully disclosed and claimed in copending application Serial No. 514,304, filed June 9, 1955, by M. E. Horn, B. G. Tremblay and F. E. Florschutz, now Patent No. 2,813,170, issued November 12, 1957, and assigned to the assignee of the present invention.

Since the specific trip device does not form a part of this invention, only a brief description thereof is given herein. The trip device comprises a U-shaped magnet yoke 135 mounted on the base 15 by means of a screw 137 and having pole pieces 139 (only one being shown) straddling the moving contact arms 33 and 47 so as to be energized by the current flow therein. A long-time-delay armature 141 and a short-time-delay armature 143 are provided, both of which are pivoted on a pin 145. The armature 141 is connected by a linkage 147 to a long-time-delay means 149, and a link 151 connects the armature 143 to a short-time-delay means 153. A trip member 155, also pivoted on the pin 145, is disposed to be operated by the trip device to engage the bracket 125 of its associated pole and actuate the trip bar 123 to effect release of the latch lever 105. When the latch lever 105 is released, the force of the springs 57 and 98 biasing the main movable switch arm 33 in opening direction, and which is transmitted through the connecting members 81 to the lever 73, causes the tripping toggle 83, 85 to collapse upwardly and effects opening movement of the movable main switch arms 33 for all of the poles of the breaker.

Means is provided to hold the movable arcing contact arm 47 stationary with full contact pressure until the movable main contacts have separated a predetermined distance from the stationary main contacts. This means comprises a cam member 155 (Figs. 2 and 3) rigidly secured to the moving arcing arm 47 by means of bolts 157 and nuts 159. Cooperating with a cam surface 161, on the cam member 155, is a roller 163 rotatable on the pin 80, which pivotally connects the lever 73 to the connecting member 81. It will be remembered that the connecting member 81 is connected by the pin 79 to the moving main contact arm 33. In order to open the contacts, the lever 73 moves in a counterclockwise direction about the pivot 75, moving the roller along the cam surface 161. The configuration of the cam surface 161 is such that during the early part of the opening movement and until the roller 163 reaches a point A on the cam member 155, the roller 163 holds the cam member and, hence, the movable arcing contact arm 47 stationary in the fully closed position. During this early movement, the counterclockwise movement of the lever 73 and the leftward movement of the connecting member 81 moves the moving main contact arm 33 in opening direction until the pin 79 engages the arcing contact arm 47. At this time the roller 163 is at the point A, in which position it is shown in Fig. 3. Thereafter, during the opening movement, it moves along an arcuate surface 165 of the cam member 155 which, it will be noted, is struck around the center of the pin 79 with the pin in contact with the arcing contact arm 47. By this means, the two moving contact arms 33 and 47 are locked together for unitary movement during the rest of the opening operation.

During opening and closing operations, and in the closed position, good electrical contact is provided at the pivoted end of the movable main contact arm 33 by means of spring biased contact members 167, which are pivoted on the bracket 37 adjacent the terminal conductor 41, and biased into engagement with opposed arcuate surfaces 169 on the contact arm 33 by a spring 171.

The main current path through the interrupter is from the upper terminal 27, through the main stationary contacts 23, the main moving contacts 29, the main contact arm 33 and through the contact members 167 to the lower terminal 41. A parallel current path is formed from the upper terminal 27 through the stationary arcing contact 25, the moving arcing contact 31, through the flexible conductor 49, the main moving contact arm 33 and the contact members 167 to the lower terminal 41, as indicated by the arrows in Fig. 3. The magnetic effect of the current loop through the arcing contacts in the closed contact position tends to blow the arcing contacts on, thus permitting the interrupter to carry its rated interrupting current for the duration of the short time delay provided by the short-time-delay means.

The current loop through the arcing contacts would, upon separation of the arcing contacts, tend to blow the arc downward away from the arc chute 173 (Fig. 1). This is prevented and the arc is blown upwardly into the arc chute by changing the path of the arcing current at the instant the arcing contacts separate. This is effected by an auxiliary contact 175 (Figs. 2, 3 and 4), on the stationary arcing contact, engaging a fixed secondary contact 177 on the bracket 60, to stop the movement of the stationary arcing contact during an opening operation. As seen in Fig. 4, when the contact 175 engages the contact 177, the arcing current path changes from that shown by the arrows in Fig. 2 to the path indicated by the arrows in Fig. 4, so that as the arcing contacts separate, the current loop blows the arc drawn between the arcing contacts upwardly into the arc chute (Fig. 1).

After the arcing contacts separate, the main switch arm 33 and the arcing contact arm 47 together move to the fully open position as the tripping toggle 83—85 (Fig. 1) collapses upwardly. The closing toggle 85—87 does not immediately collapse following release of the latch mechanism since it is held by the support member 13. During the unlatching movement of the main latch 99, a cam (not shown) thereon engages the tail of the support member 131 and moves this member in a clockwise direction about its pivot 107 to disengage the shoulder thereon from beneath the pin 93 whereupon the clos-

ing toggle 85—87, being no longer supported, collapses downwardly under its own weight and the weight of the moving armature of the closing solenoid which will be described later. Collapse of the closing toggle 85—87 causes the tripping toggle 83—85 to be reset to thrust transmitting position and also effects resetting of the latch mechanism to latching position. The operating mechanism is now in condition for a closing operation.

The circuit interrupter is closed automatically by energization of a closing solenoid 181 (Fig. 1) which is in effect either manually or by automatic means. The closing solenoid 181 comprises a fixed magnet yoke 183 and a fixed core member 185 mounted on the underside of the platform 69. A movable armature 187 is attached to the lower end of an operating rod 189 which extends upwardly and has its upper end pivotally connected to the knee pin 93 of the closing toggle 85—87. An energizing coil 191 is supported on the lower end of a supporting bracket 193 having its upper end fastened to the platform 69.

In the closed position of the interrupter, the armature 187 is held in its raised position (Fig. 1). When the breaker is tripped open, the closing toggle 85—87 collapses downwardly permitting the armature 187 to assume its lower or unattracted position. Thereafter, upon energization of the coil 191, the armature 187 is attracted upwardly and acts through the rod 189 to straighten the closing toggle 85—87 and close the contacts.

The action of the contact structure during a closing operation is the reverse of that of the opening operation. As the closing toggle 85—87 (Fig. 1) is straightened, the lever 73 is moved in a clockwise direction about its pivot 75 thrusting the connecting member toward the right. At the same time, the roller 163, traveling along the surface 165 of the cam 155, together with the connecting member 81 and the pin 79 locks the main switch member 33 and the arcing contact arm 47 together for unitary movement in closing direction. At the time the roller 163 reaches the point A on the cam 155, the moving arcing contact 31 has engaged the stationary arcing contact 25 and moved it to the fully closed position with full contact pressure applied thereto. At this time, the contacts and the parts are in the position shown in Fig. 3. Continued movement of the lever 73 acts through the connecting member 81 and pin 74 to move the main switch arm to the fully closed position (Fig. 2) the roller 163 moving along the surface 161 of the cam 155 to positively hold the arcing contact arm 47 in the closed position during this last portion of the closing action. At the end of the closing operation, the support 131 (Fig. 1) is moved by the spring 133 to its supporting position under the knee pin 93 of the closing toggle 85—87 and, since the tripping toggle 83—85 was reset and relatched when the closing toggle collapsed during the opening operation, the toggle linkage 83—85—87 is now held in thrust transmitting position. This, through the lever 73 and connecting member 81, holds the main switch member 33 in the closed position, and by means of the roller 163 and cam 155 holds the arcing contact arm 47 in the closed position.

The invention provides a circuit interrupter having a contact structure in which the moving arcing contact is held stationary in the fully closed position under full contact pressure while the main moving contacts are moved a predetermined distance in opening direction after which the moving main and arcing contacts move in unison to the open position, the stationary and moving arcing contacts being so arranged that at the instant of separation the current path therethrough is shifted to a path wherein the magnetic effect tends to blow the arc drawn between the arcing contacts outwardly into the arc extinguisher.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from the spirit of the invention.

We claim as our invention:

1. In a circuit interrupter, a plurality of stationary contacts, a plurality of cooperating movable contacts, separate movable switch arms supporting said movable contacts, operating means operable to move one of said switch arms to open and closed positions comprising a pair of toggle links, a knee pivot connecting said toggle links together, one of said toggle links being mounted on a fixed pivot, a pin pivotally connecting the other of said toggle links to one of said switch arms and disposed to engage the other of said switch arms after a predetermined movement of said one switch arm in opening direction, a separate cam member rigidly secured to the other of said switch arms, a cam surface on said cam member concentric with said fixed pivot, a roller on said knee pivot engaging said cam surface to permit said toggle to move said one switch arm in opening direction until said pin engages said other switch arm while holding said other switch arm in closed position, a second cam surface on said cam member concentric with said pin when said pin is in engagement with said other switch arm, said second cam surface being engageable by said roller when said pin engages said other switch arm to permit collapse of said toggle while locking said switch arms between said roller and said pin for movement in unison to the open position.

2. In a circuit interrupter, a fixed support member, stationary main and arcing contacts pivotally mounted on said fixed support member, movable main and arcing contacts cooperating with said stationary main and arcing contacts in the closed position to form parallel current paths through said main and arcing contacts, a main movable switch arm supporting said main movable contact, a separate movable switch arm supporting said movable arcing contact, operating mechanism operable to move said movable switch arms to open and closed positions, a cam member on said separate switch arm cooperating with a part movable with said operating mechanism during an opening operation to first hold said separate switch arm in the closed position while said main movable switch arm moves a predetermined distance and then to effect unitary movement of both of said switch arms to open position, and normally open auxiliary contact means comprising a stationary auxiliary contact mounted on said fixed support member at a point remote from the pivot of said stationary arcing contact, a movable auxiliary contact mounted on said stationary arcing contact at the end thereof remote from the pivot of said stationary arcing contact and engageable with said stationary auxiliary contact upon separation of said arcing contacts to move the current path through the arcing contacts away from the pivot of said stationary arcing contact.

3. In a circuit interrupter, a stationary contact structure comprising a fixed conducting support member, a pivoted contact having pivot means pivotally mounting said contact on said support member and biased to provide contact pressure in the closed position, a fixed secondary contact rigid with said support member at a point remote from said pivot means, a movable contact cooperating with said pivoted stationary contact to draw an arc, said contacts forming a current loop extending through said pivot means of said stationary contact the magnetic forces of which current loop force the pivoted stationary contact against the movable contact in the closed position thereof, an auxiliary contact on said pivoted stationary contact remote from said pivot means and engageable with said secondary contact upon separation of said stationary and movable contacts to move said current loop inwardly away from said pivot means to a point remote from said pivot means whereby the mag-

netic force of said current loop moves the arc outwardly away from said contacts.

4. In a circuit interrupter, an arc extinguisher, a fixed contact support member, a stationary contact structure adjacent said arc extinguisher comprising a pivoted contact biased to provide contact pressure in the closed position, pivot means pivotally supporting said contact on said fixed support member, a secondary contact rigidly mounted on said fixed support member at a point remote from said pivot means, a movable contact cooperating with said stationary contact to draw an arc, said stationary and movable contacts forming a current loop through said pivot means the magnetic forces of which loop force the pivoted stationary contact against said movable contact in the closed position thereof, and an auxiliary contact on the end of said pivoted stationary contact remote from said pivot means engaging said fixed secondary contact upon separation of said movable and stationary contacts, said secondary contact and said auxiliary contact when engaged forming a current loop inwardly remote from said pivot means to magnetically force the arc outwardly away from said contacts and toward said arc extinguisher.

5. In a circuit interrupter, a fixed contact support member, a stationary contact having one end pivoted on said fixed support member and the other end free, pivot means for said stationary contact, a secondary contact on the

free end of said stationary contact remote from said pivot means, a movable contact cooperating with said stationary contact to draw an arc, biasing means biasing said pivoted stationary contact to provide contact pressure in the closed position of said movable contact, operating means operable to move said movable contact to open and closed positions, said contacts forming a current loop extending through the pivoted end of said stationary contact, the magnetic forces of said current loop forcing said pivoted stationary contact against said movable contact in the closed positions, an auxiliary contact on said support member inwardly remote from said pivot means and engaged by said secondary contact on the free end of said pivoted stationary contact during an opening movement of said movable contact, and said secondary and auxiliary contacts upon separation of said contacts moving said current loop from the pivoted end of said stationary contact to the free end thereof so that the magnetic forces of said current loop force the arc outwardly away from said contacts.

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