

Dec. 17, 1957

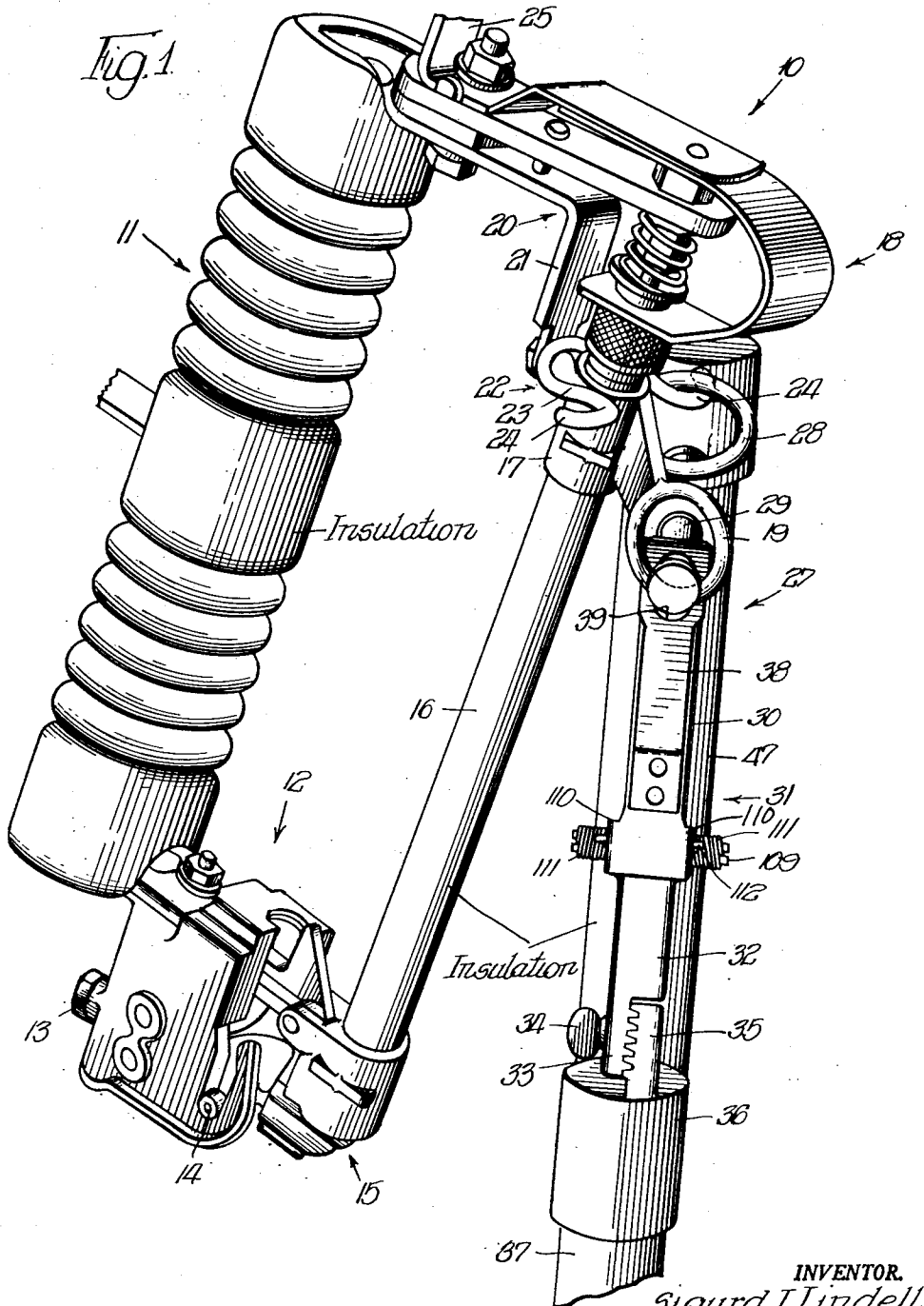
S. I. LINDELL

2,816,984

CIRCUIT INTERRUPTER CONSTRUCTION

Original Filed Feb. 24, 1954

5 Sheets-Sheet 1



INVENTOR.
Sigurd I. Lindell,
BY
Robert R. Lockwood
att'y

Dec. 17, 1957

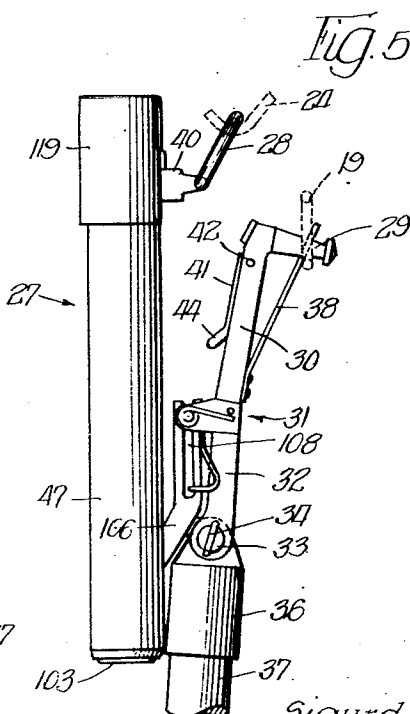
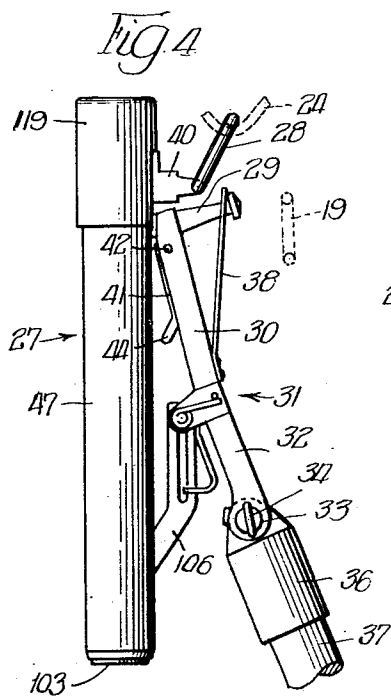
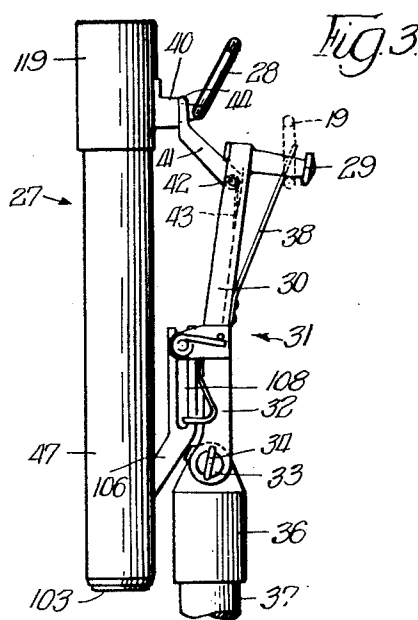
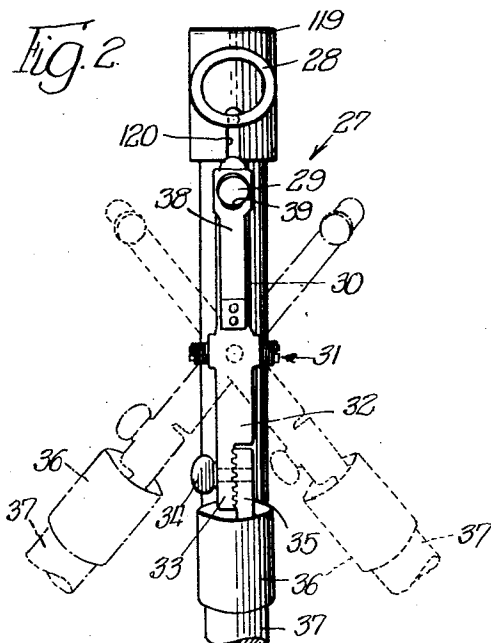
S. I. LINDELL

2,816,984

CIRCUIT INTERRUPTER CONSTRUCTION

Original Filed Feb. 24, 1954

5 Sheets-Sheet 2



INVENTOR.
Sigurd I. Lindell,
BY
Robert R. Lockwood

Att'y

Dec. 17, 1957

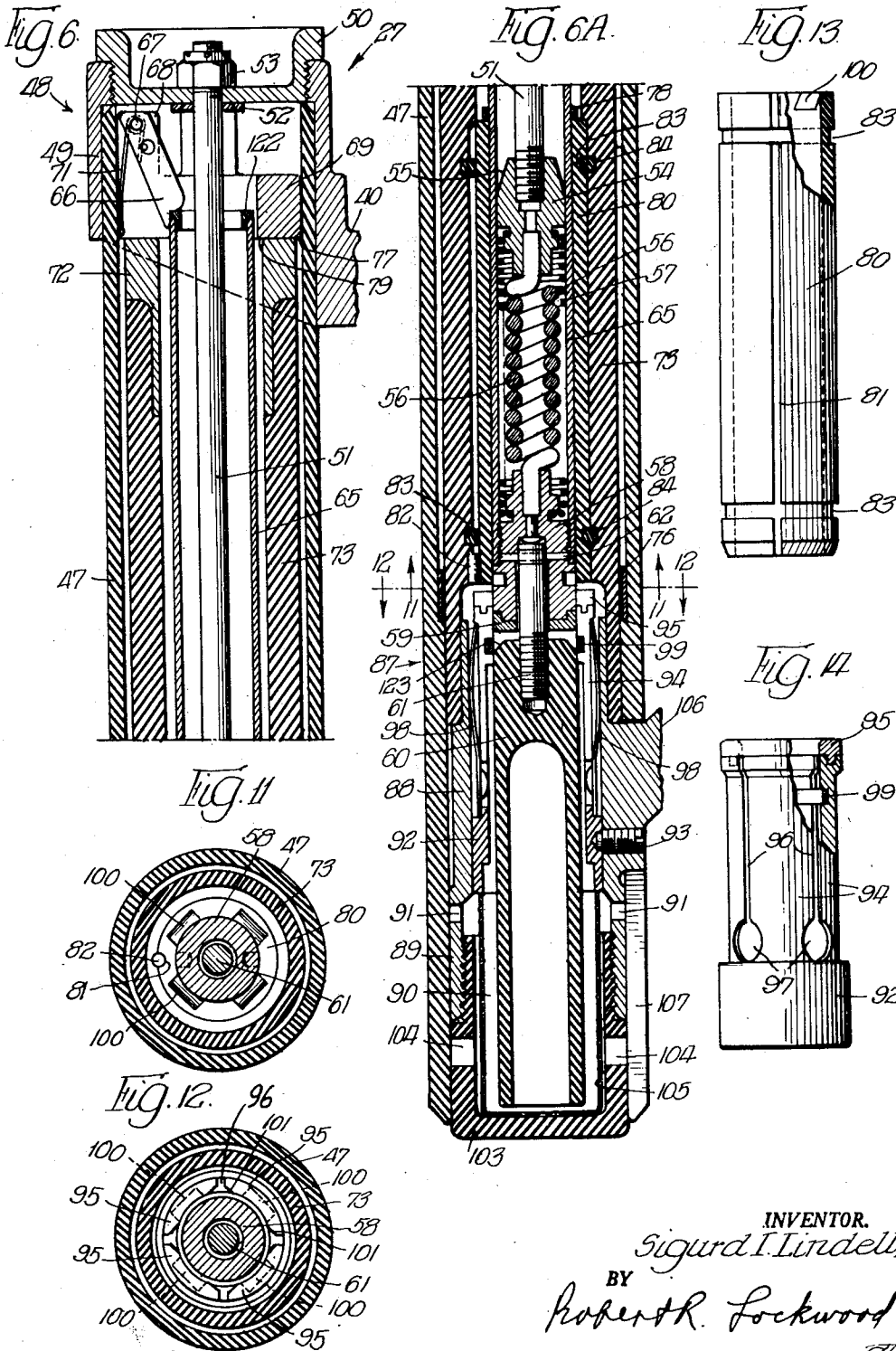
S. I. LINDELL

2,816,984

CIRCUIT INTERRUPTER CONSTRUCTION

Original Filed Feb. 24, 1954

5 Sheets-Sheet 3



INVENTOR.
Sigurd I. Lindell,
BY
Robert H. Lockwood
att.

Dec. 17, 1957

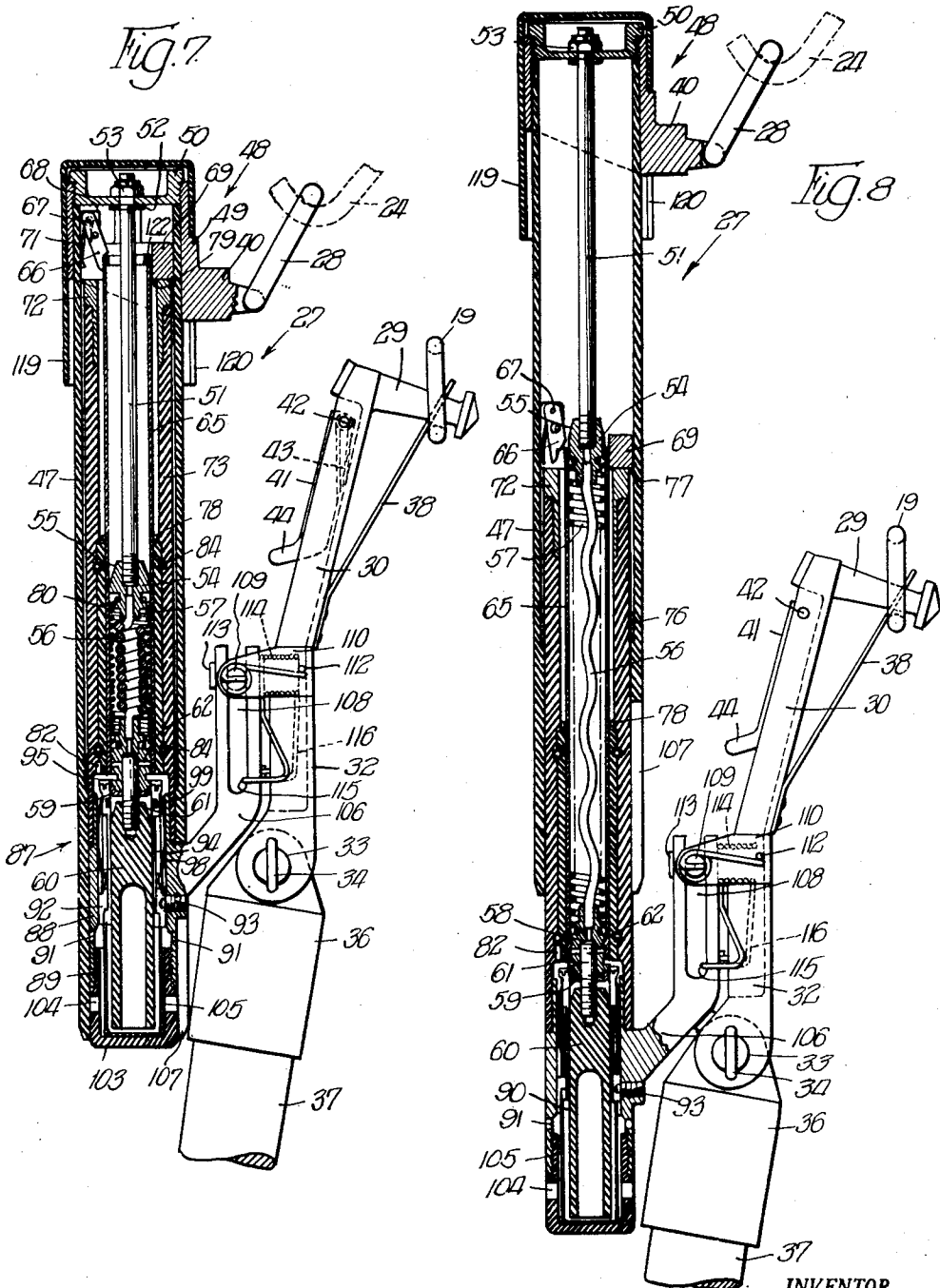
S. I. LINDELL

2,816,984

CIRCUIT INTERRUPTER CONSTRUCTION

Original Filed Feb. 24, 1954

5 Sheets-Sheet 4



INVENTOR.
Sigurd I. Lindell,
BY
Robert R. Lockwood
att'y.

Dec. 17, 1957

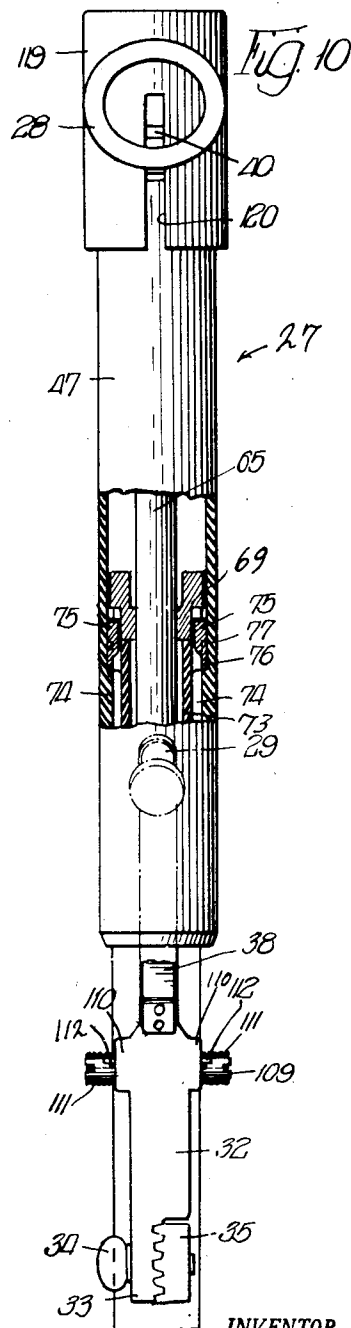
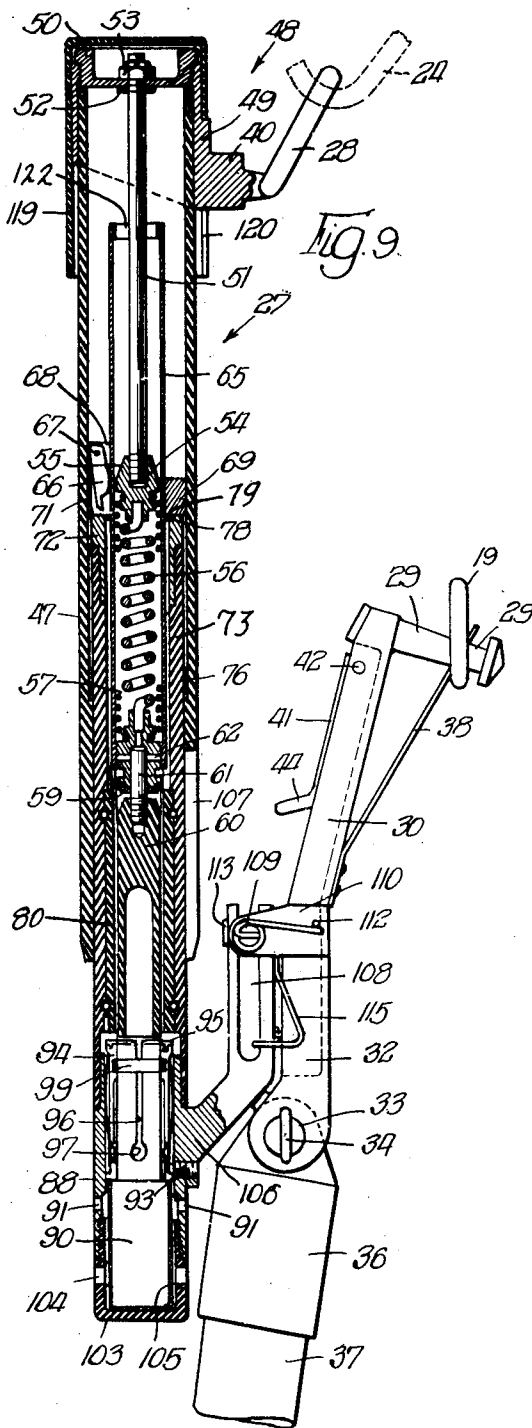
S. I. LINDELL

2,816,984

CIRCUIT INTERRUPTER CONSTRUCTION

Original Filed Feb. 24, 1954

5 Sheets-Sheet 5



INVENTOR.

Sigurd I. Lindell.

BY

BY
Robert R. Lockwood

Atty.

1

2,816,984

CIRCUIT INTERRUPTER CONSTRUCTION

Sigurd I. Lindell, Chicago, Ill., assignor to S & C Electric Company, Chicago, Ill., a corporation of Delaware

Original application February 24, 1954, Serial No. 412,182. Divided and this application May 27, 1957, Serial No. 661,756

7 Claims. (Cl. 200—114)

This invention relates, generally, to high voltage circuit interrupters, and it has particular relation to the construction of auxiliary circuit interrupters used in conjunction with high voltage isolating devices, such as disconnecting fuses, disconnecting switches and the like, for opening them without external arcing while they are carrying line current. This invention constitutes an improvement over the constructions disclosed in Lindell Patent Nos. 2,671,142 and 2,671,145, both dated March 2, 1954, and assigned to the assignee of this application. This application is a division of application Serial No. 412,182, filed February 24, 1954.

Among the objects of this invention are: To flexibly mount the auxiliary circuit interrupter on a support that is adapted to be carried by a live line stick for manipulation into and out of operative engagement with the separable energized current carrying terminals or contacts of the circuit isolating device; to provide a rigid mechanical connection between the live line stick and the movable contact or terminal of the circuit isolating device to permit positive control thereof for swinging it either to the open position or reclosing it should the operator change his mind and decide not to complete the opening of the circuit; to permit relative movement of the interrupter unit with respect to the axis of the live line stick as the pin or stud of the stick follows the path taken by the movable contact on the circuit isolating device; to position an eye on the interrupter for engagement with a horn or stud on the stationary line terminal or contact of the circuit isolating device and incline the same with respect to the longitudinal axis of the live line stick in order to facilitate engagement with the horn or stud; to employ spring biased universal joint means for positioning the interrupter to facilitate engagement with the horn or stud by the eye and then permit moving of the live line stick sidewise to cause a pin carried thereby to engage a ring, or like device, on a movable contact or terminal of the load isolating device; to hold the flexibly mounted interrupter in fixed position with respect to the live line stick when the interrupter is not to be used for interrupting the circuit; to enclose the major portion of the interrupter within an insulating housing; to make connection with one of the separable contacts of the interrupter by a rigid conducting arm extending into the insulating housing; to provide for removing as a unit the circuit interrupting parts of the interrupter most likely to be eroded or consumed following repeated circuit opening operations; to control the position of the arc drawn on separation of the contacts in the auxiliary circuit interrupter in order to prevent it from impinging on contact surfaces or corners of contact fingers likely to be damaged; to provide for the ready escape of the products of the arc past one of the contacts; to mount a set of separable contacts for conjoint movement within the housing during which a spring is stressed and then releasing one of the contacts to move with a snap action away from the other to draw an arc and interrupt the circuit; to extinguish the arc thus drawn; to limit the separation of the contacts; and to coordinate the separation of the contacts as biased by the spring with the separation of the terminals or contacts of the circuit isolat-

2

ing device whereby there is no likelihood of an arc re-striking between these terminals or contacts.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

This invention is disclosed in the embodiment thereof shown in the accompanying drawings and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of this invention, reference can be had to the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a perspective view of a circuit isolating device, such as a disconnecting fuse showing how the auxiliary circuit interrupter of the present invention can be applied thereto, the particular circuit isolating device being that disclosed in Lindell Patent No. 2,745,923, issued May 15, 1956, and assigned to the assignee of this application;

Figure 2 is an elevational view showing how the auxiliary circuit interrupter is mounted on a live line tool for relative movement in opposite directions with respect to its longitudinal axis in a plane parallel to the plane containing the same;

Figure 3 is an elevational view showing how the auxiliary circuit interrupter can be held in fixed position with respect to the live line stick when it is desired to employ the latter solely for manipulating a disconnecting fuse or disconnecting switch blade;

Figure 4 is an elevational view showing the first step employed in applying the auxiliary circuit interrupter to a circuit isolating device;

Figure 5 is an elevational view showing the second step employed in applying the auxiliary circuit interrupter to a circuit isolating device, this view showing the auxiliary circuit interrupter positioned so as to provide a shunt circuit between the separable energized current carrying terminals or contacts of the circuit isolating device;

Figures 6 and 6A taken together provide a longitudinal sectional view, at an enlarged scale, showing the internal details of construction of an auxiliary circuit interrupter embodying this invention;

Figure 7 shows a longitudinal sectional view of the auxiliary circuit interrupter at a reduced scale and illustrates how it is mounted on the live line stick, the connections being the same as described for Figure 5;

Figure 8 is a view, similar to Figure 7, showing the auxiliary circuit interrupter in extended position with the latch for holding the separable contacts in engagement in tripped position and just before any movement of these contacts takes place;

Figure 9 is a view, similar to Figure 8, but showing the contacts in the auxiliary circuit interrupter separated with one contact being withdrawn into the bore of the liner of arc extinguishing material;

Figure 10 is a view, partly in elevation and partly in section, showing the auxiliary circuit interrupter extended to its fullest extent, the section being taken at right angles to the section shown in Figure 9;

Figure 11 is a sectional view taken generally along the line 11—11 of Figure 6A;

Figure 12 is a sectional view taken generally along the line 12—12 of Figure 6A and looking in the direction opposite to the direction in which Figure 11 is taken;

Figure 13 is a view, in side elevation, of the liner of arc extinguishing material; and

Figure 14 is a view, partly in side elevation and partly in section, of the inner contact sleeve.

Referring now particularly to Figure 1 of the drawings, it will be observed that the reference character 10 designates, generally, a circuit isolating device of the disconnecting fuse type. As pointed out hereinbefore, the details of construction of the circuit isolating device 10 are set forth in Lindell Patent No. 2,745,923, issued May 15, 1956. Accordingly, only a general description of this device will be set forth here. While particular reference is made to a disconnecting fuse device, it will be understood that the present invention can be employed where the fuse tube of the disconnecting fuse is replaced by a metallic conducting tube or it can be used in conjunction with a disconnecting switch that is modified suitably for adaptation to be used in conjunction with the auxiliary circuit interrupter mounted on a live line stick as described hereinafter.

The circuit isolating device or disconnecting fuse 10 includes an insulator 11 which is arranged to be stationarily mounted on a cross arm or the like and has a lower terminal contact member 12 carrying a connector 13 for connection to a line terminal. Pivoted at 14 on the lower terminal contact member 12 is a lower current carrying member 15 that is positioned at the lower end of a fuse tube 16. At its upper end the fuse tube 16 has an upper current carrying member 17 which is positioned in contact engagement with a normally energized contact member 18 carried by the upper end of the insulator 11. In order to remove the upper current carrying member 17 from contact engagement with the terminal contact member 18, the former is provided with an eye or pull ring 19 of conducting material for receiving the prong of a live line tool. In accordance with conventional practice, the fuse tube 16 is manipulated by inserting the prong of the live line tool in the eye or pull ring 19 for swinging the upper current carrying member 17 into or out of contact engagement with the terminal contact member 18.

For purposes more fully disclosed in Lindell Patent No. 2,745,923, issued May 15, 1956, the terminal contact member 18 includes an L-shaped reinforcing bar 20 having a downwardly extending arm 21 which carries a guide 22. The guide 22 is employed, in part, for guiding the upper current carrying member into proper contact engagement with the terminal contact member 18. The guide 22 includes forwardly extending arms 23 at the outer ends of which are transversely extending horns or studs 24. Provision is made for connecting the energized line conductor to the terminal contact member 18 through a terminal pad 25. It will be understood that the upper portion of the terminal pad 25 (not shown) carries a connector or like device to facilitate connection of the energized line conductor thereto.

It is often necessary to open the circuit isolating device or disconnecting fuse 10 while it is carrying load current. When such operation is performed, an arc is drawn between the upper current carrying member 17 and the terminal contact member 18 which is likely to damage the parts which are contacted by the arc and also, where other circuits are involved, is likely to fault one or more circuits in the event that the arc is drawn and should jump to another circuit or the ground. Also, there is the likelihood of injury to the operator. In accordance with the present invention, provision is made for safely and expeditiously opening the circuit isolating device 10 while it is carrying line current. It is for this purpose that the auxiliary circuit interrupter, shown generally at 27, is employed. It will be observed that it includes an eye member 28 which is rigid therewith and is arranged to engage one of the horns or studs 24. When the auxiliary circuit interrupter 27 is so positioned, one terminal of it is connected to the terminal contact member 18. Connection to the upper current carrying member 17 is provided by contact means in the form of a pin or prong 29 rigidly mounted and extending transversely of a support member or strut 30 that is preferably formed of aluminum and on which the auxiliary circuit interrupter 27 is flexibly mounted by a universal joint that, generally, is shown at 31 and the de-

tails of construction of which will be set forth hereinafter. The support member or strut 30 has an extension member 32, the lower portion of which forms a claw bracket 33 that is arranged to be secured by a clamp screw 34 to a corresponding claw bracket 35 that is formed integrally with an aluminum fitting 36 at the upper end of a live line stick 37 that is formed preferably of wood or like insulating material. Generally the live line stick 37 is considered to include the fitting 36 and the claw bracket 35 and may be so considered here.

Since the pin or prong 29 on the support member 30 loosely engages the eye or pull ring 19, it is desirable to insure that contact engagement therewith is maintained. For this purpose a contact spring 38 is secured to the support member 30 and extends angularly outwardly therefrom for engagement with one side of the eye or pull ring 19. Since the contact spring 38 moves relatively to the pin or horn 29, it is provided with an elongated opening 39 to permit such relative movement.

As shown more clearly in Figure 2 of the drawings, the universal joint 31 permits the auxiliary circuit interrupter 27 to rock with respect to the live line stick 37 in a plane parallel to the longitudinal axis of the live line stick 37 for swinging the fuse tube 16 from the closed to the open position and vice versa. Figures 3, 4 and 5 of the drawings show how the auxiliary circuit interrupter 27 can rock in a plane at right angles to this plane for manipulation with respect to the circuit isolating device 10 for engaging the same.

In Figure 3 of the drawings, it will be observed that the eye member 28 is positioned at an obtuse angle with respect to the auxiliary circuit interrupter 27 and is formed integrally with a contact arm 40. The reason for positioning the eye member 28 at this angle is to facilitate its being moved into engagement with the horn or stud 24. By placing it at an angle, it is possible for the lineman to see through the opening therein from his position at the lower end of the live line stick 37. Thus he is able to correlate the movement of the eye member 28 with the position of the horn or stud 24.

In some instances it is desirable to manipulate the live line stick 37 with the auxiliary circuit interrupter 27 rigid therewith instead of being flexibly mounted thereon. For example, when the lineman wishes to employ the live line stick 37 solely for the purpose of performing an operation without using the auxiliary circuit interrupter 27, it is desirable to provide for this rigid mounting thereof. For this purpose a brace 41 is pivoted at 42 on the upper end of the support member or stud 30 and it is arranged to be biased to the retracted or operative position by a spring 43. At its outer end the brace 41 has a bifurcated portion 44, the arms of which fit around the contact arm 40. Thus, when the brace 41 is swung from the retracted position to the position shown in Figure 3, it holds the auxiliary circuit interrupter 27 in the position here shown. As will appear hereinafter, provision is made for biasing the auxiliary circuit interrupter 27 to the position shown in Figure 4 relative to the support member or stud 30. Accordingly the auxiliary circuit interrupter 27 is rigidly supported with respect to the live line tool 37 when the brace 41 is swung to its position as shown in Figure 3.

The details of construction of the auxiliary circuit interrupter 27 are shown more clearly in Figures 6 and 6A of the drawings to which reference now will be had. It will be observed that the auxiliary circuit interrupter 27 is of elongated cylindrical construction. It includes a tubular insulating housing 47 that is formed of suitable insulating material, such as a phenolic condensation product. For purposes of reference, the upper end of the housing 47 is referred to as the inner end and at this inner end there is mounted a stationary contact assembly that is shown, generally, at 48. The stationary contact assembly 48 includes a pull ring cap 49 that is formed preferably of aluminum and with which the contact arm

5

40 and eye member 28 are integrally cast. The cap 49 is secured by adhesive means to the inner end of the housing 47 and its upper end is closed by a screw plug 50. Depending from the screw plug 50 is a rigid conductor rod 51. The inner end of the rod 51 is secured to the screw plug 50 by a snap washer 52 on the underside and a nut 53 on the upper side. At its outer end the rod 51 has a cam terminal 54 which is provided with a latch engaging surface 55, the purpose of which will be set forth presently. Depending from the cam terminal 54 are a flexible conductor 56 and a coil spring 57 coiled with initial tension, the latter being positioned around the former as shown. The lowermost ends of the flexible conductor 56 and coil spring 57 are connected to a movable first arcing contact 58 at the lowermost end of which there is an annular contact insert 59 formed of a material which is resistant to erosion due to impingement of an arc thereon. It will be understood that the stationary contact assembly 48 includes those parts just enumerated beginning with the pull ring cap 49 and concluding with the annular contact insert 59.

In order to confine the arc drawn from the annular contact insert 59 on operation of the auxiliary circuit interrupter 27 to open a circuit under load, there is provided a trailer 60 that is formed of a material, such as methylmethacrylate resin, which is adapted to evolve an arc extinguishing medium when it is subjected to the heat of an arc. As will appear hereinafter, the trailer 60 is arranged to be drawn into the bore of a tube which itself gives off an arc extinguishing medium. In order to cause the trailer 60 to move conjointly with the movable first arcing contact 58, a trailer stud 61 is screwed into the upper end of the trailer 60 and it extends into the movable first arcing contact 58 where it is pivotally held by a transversely extending trailer stud pin 62. There is a limited clearance between the outer surface of the trailer stud 61 and the opening in the annular contact insert 59 and in the movable first arcing contact 58 so as to permit a limited degree of movement of the trailer 60 with respect thereto. This permits it to be positioned in the bore into which it is drawn somewhat flexibly.

A tubular metallic sleeve 65, preferably formed of aluminum, is threaded at its outer end onto the movable first arcing contact 58 and it extends upwardly into the housing 47 toward its inner end. At the inner end of the metallic sleeve 65, there is a trigger 66 which is pivotally mounted at 67 between arms 68 of a trigger frame stop 69. A grasshopper spring 71 cooperates with the trigger 66 to bias it into latching engagement with the inner end of the tubular metallic sleeve 65.

Secured by screws or other suitable means to the underside of the trigger frame stop 69 is a metallic tube end insert 72 that preferably is formed of aluminum. The insert 72 is secured by suitable means to the inner end of an inner insulating sleeve 73 that preferably is formed of a phenolic condensation product. The inner insulating sleeve 73 is arranged to be slidably mounted within the tubular insulating housing 47. It is desirable that the inner insulating sleeve 73 be guided for movement within the housing 47 so that it is non-rotatable axially with respect thereto. For this purpose, as shown in Figure 10, longitudinally extending slots or grooves 74 are provided in diametrically opposite positions in the outer surface of the inner insulating sleeve 73 and tongues or pins 75 project thereinto. The tongues or pins 75 are carried by a ring 76 that is secured to the inner surface of the housing 47 near its outer end. The upper side of the ring 76 constitutes a stop for engaging the underside 77 of the trigger frame stop 69 for limiting the extent that the inner insulating sleeve 73 can be withdrawn from the housing 47, this position being shown in Figure 10 of the drawings.

It will be recalled that the metallic sleeve 65 is slidable with the movable first arcing contact 58. As shown in Figure 9 of the drawings, it is movable inwardly of the

6

housing 47 and through the inner insulating sleeve 73. Its movement with respect thereto is limited by a stop ring 78 that is secured to the outer surface of the metallic sleeve 65. The stop ring 78 is arranged to engage a shoulder 79 on the underside of the trigger frame stop 69.

As pointed out hereinbefore, the trailer 60 is drawn into a bore, the surface of which is capable of evolving an arc extinguishing material. For this purpose a liner 80, formed preferably of methylmethacrylate resin, is positioned in the inner insulating sleeve 73 at its outer end. The liner 80 is illustrated in Figure 13 where it will be observed there is provided a longitudinally extending groove 81 arranged to cooperate with a locating pin 82, Figure 6, for positioning the liner 80 in a predetermined location with respect to the inner insulating sleeve 73. It is desirable that there be a fairly snug fit between the outer surface of the liner 80 and the inner surface of the insulating sleeve 73. Since provision is made for removing the liner 80, it is not possible to secure this snug fit by cementing the liner 80 into the sleeve 73. Instead annular grooves 83 are provided in the outer surface of the liner 80 near its end and O rings 84 of neoprene or like material are positioned in these grooves to seal off the space between the liner 80 and the sleeve 73 to prevent arc products from entering this space and thus preventing restriking of the arc in this space when current is being interrupted and a high recovery voltage is encountered.

Cooperating with the stationary contact assembly 48 is a movable contact assembly that is indicated, generally, at 87 in Figure 6A of the drawings. It includes a metallic contact sleeve 88 that is formed preferably of aluminum which has an extension 89 at its lower end forming a chamber 90 to receive the products of the arc. Radial vents 91 serve to place the chamber 90 in communication with the atmosphere when the inner insulating sleeve 73 and parts associated therewith are withdrawn from the housing 47, for example, to the position shown in Figure 8 of the drawings. Within the metallic contact sleeve 88 is an inner contact sleeve 92 which is secured in predetermined position therein by a contact locating screw 93. It will be understood that the metallic contact sleeve 88 is secured to the outer end of the inner insulating sleeve 73 by suitable adhesive or other means.

As shown more clearly in Figure 14 of the drawings, the contact sleeve 92 is provided with four upwardly extending flexible contact fingers 94 which have contact tips 95 of material which is arc resistant. The inner ends of the contact fingers 94 are arranged to have peripheral contact engagement with the movable first arcing contact 58 and more particularly with the annular contact insert 59, the arc being drawn between the latter and the contact tip 95 on one of the contact fingers 94. The contact fingers 94 are separated by relatively wide slots 96 which extend longitudinally from the inner end to openings 97. The purpose of the relatively wide slots 96 is to provide for free escape of the products of the arc drawn as described and to permit them to flow outwardly into the chamber 90 where they can be readily vented to the atmosphere. The contact fingers 94 are biased inwardly by spring fingers 98. Since the trailer 60 is required to move through the opening defined by the flexible contact fingers 94, provision is made to limit their inward movement when not in engagement with the movable first arcing contact 58. For this purpose a contact retaining ring 99 is employed as shown in Figure 14, the size of the ring 99 is such that, while the contact fingers 94 are freely movable into engagement with the periphery of the movable first arcing contact 58, as soon as it and the annular contact insert 59 are withdrawn, the spring fingers 98 bias the contact fingers 94 inwardly but only to a limited extent which is determined by the contact retaining ring 99.

With a view to locating the arc incident to operation of the circuit interrupter 27 so that a minimum of erosion

of the contact tips 95 takes place, the outer end of the liner 80, as shown in Figure 11, is provided with out-flared grooves 100, each groove being individual to one of the contact fingers 94. In Figure 12 of the drawings, the outline of the grooves 100 is shown by broken lines. It will be observed that the grooves 100 are centered with respect to the contact tips 95. Also it will be noted that the inner edge portions 101 of the contact tips 95 are machined off so that the arc is drawn or initiated at the edge of the area defined by the broken line outline of the grooves 100 from which it is repelled and moved onto the defined area by gas generated from the surface of the trailer 60.

Referring again to Figure 6 of the drawings, it will be observed that the outer end of the extension 89 is closed by a hollow light transmitting plug 103 which is threaded into position. The reason for employing a material which is light transmitting for the plug 103 is to permit the lineman to note the formation of the arc drawn on separation of the first arcing contact 58 from the contact tip 95 on the flexible contact fingers 94 which constitute a second arcing contact. By noting the flash of the arc and its extinction, the lineman is apprised of the fact that the circuit has been completely opened and that it is safe to remove the auxiliary circuit interrupter 27 from connection to the circuit isolating device 10.

Additional venting of the chamber 90 and the interior of the plug 103 is provided by radial vents 104. A screen 105 inside of the plug 103 extends over the vents 104 and over the vents 91. The screen 105 is formed preferably of metallic material which assists in cooling the arc products and preventing their escape to the atmosphere. In addition, it prevents to a limited degree the ingress of foreign material.

Integral with and extending radially from the metallic contact sleeve 88 is a conducting arm 106. As shown in Figure 6A of the drawings, the conducting arm 106 extends radially through a slot 107 in the outer end of the housing 47. Conducting arm 106 has a portion 108, Figure 8, that is parallel to the housing 47 and has an H-shaped cross-section. At its upper end the portion 108 of the conducting arm 106 carries a rod 109 which extends through arms 110 rigid with the support member or strut 30. The rod 109 permits the auxiliary circuit interrupter 27 to swing in the plane of the drawing with respect to the support member or strut 30 as shown in Figures 7 and 8. Springs 111, Figure 10, interacting between the rod 109 and pins 112 mounted on the arms 110 act to bias the auxiliary circuit interrupter 27 in a clockwise direction with respect to the live line stick 37 or to bias the latter in a counterclockwise direction with respect to the former.

In order to permit swinging movement of the auxiliary circuit interrupter 27 in a plane at right angles to the plane of its movement about the axis of the rod 109, a transverse shaft 113 of larger diameter than rod 109 extends through and is journaled in the bifurcated end portion 108 of the conducting arm 106 into a pocket in the support member or strut 30. The rod 109 extends through and is carried by the shaft 113. A centering spring 114 surrounds the transverse shaft 113 with one end 115 bearing against one side of the portion 108 of the conducting arm 106 and the other end 116 bearing against the corresponding side of extension 32 of the support member or strut 30 when the interrupter 27 is centered with respect to the live line stick 37. The function of the spring 114, which is pretensioned, is to center the auxiliary circuit interrupter 27 with respect to the longitudinal axis of the live line stick 37 or to bias it back to this position when the latter is swung relatively to the former as shown in Figure 2 by the broken line positions of the live line stick 37 on opposite sides of the position shown by full lines where it is aligned with the auxiliary circuit interrupter 27.

It is desirable to enclose the stationary contact assembly

48 at the inner or upper end of the tubular insulating housing 47. For this purpose a removable insulating cap 119 extends over the inner or upper end of the housing 47 and encloses the contact assembly 48. The cap 119 may be formed of neoprene or other flexible insulating material. It has a longitudinally extending slot 120 on one side for accommodating the contact arm 40.

When the auxiliary circuit interrupter 27 is in the fully closed position with the inner insulating sleeve 73 telescoped therein, there are no exposed energized parts on the side away from the live line stick 37. Aside from the fitting 36 on the live line stick 37 and the parts associated with the support member or strut 30, the only energized exposed parts are the eye member 28, contact arm 40 and the conducting arm 106. The insulating housing 47 and the insulating cap 119 serve to enclose all other conducting parts which are energized when the eye member 28 engages the horn or stud 24 of the energized terminal contact member 18.

It is highly desirable that provision be made for quickly and easily dismantling the auxiliary circuit interrupter 27 for the purpose of permitting inspection of the parts, such as the contact 58, contact fingers 94, the trailer 69 and the liner 80. The dismantling of the circuit interrupter 27 can be accomplished by removing the insulating cap 119, loosening the nut 53 and removing the screw plug 50. The screws holding the trigger frame stop 69 to a metallic tube end insert 72 can be removed and the inner insulating sleeve 73 with associated parts then can be removed through the outer end of the housing 47. The trailer 60 then can be removed from the inner insulating sleeve 73 together with the movable first arcing contact 58, metallic sleeve 65, the flexible conductor 56, spring 57, cam terminal 54, and conductor rod 51. Next the plug 103 is unscrewed from the extension 89 and the screen 105 is withdrawn. On removal of the contact locating screw 93, the inner contact sleeve 92 can be removed to permit inspection of the contact fingers 94 and contact tips 95. The liner 80 is next pushed out of the inner insulating sleeve 73 for inspection. The arcing contact 58 with the tubular metallic sleeve 65 and stop ring 78 can be employed for this purpose.

In operation the lineman manipulates the live line stick 37, as shown in Figure 4, first to a position where the eye member 28 engages the horn or stud 24. Then the live line stick 37 is swung sidewise about the axis of the rod 109 to position the pin or prong 29 within the eye or pull ring 19. Contact therewith is maintained by the contact spring 38. Assuming that the circuit isolating device 10 is carrying current, the circuit between the upper current carrying member 17 on the upper end of the fuse tube 16 and the energized terminal contact member 18 is shunted through the auxiliary circuit interrupter 27. Then the lineman exerts a longitudinal downward pull on the live line stick 37 with the pin or prong 29 positioned in the eye or pull ring 19 as shown in Figure 5. This initial movement causes the upper current carrying member 17 to be moved out of engagement with the terminal contact member 18 of the circuit isolating device 10 and the current flow formerly therethrough is transferred to the auxiliary circuit interrupter 27.

This initial movement of the live line stick 37 is accompanied by an outward movement of the inner insulating sleeve 73 from the insulating housing 47. While the rigid conductor rod 51 of the stationary contact assembly 48 remains stationary, the other parts of the contact assembly 48 move, as shown in Figure 8. The reason for this is that the trigger 56 is in engagement with the inner end of the tubular metallic sleeve 65 and the trigger 66, being mounted on the trigger frame stop 69 which is attached to the metallic tube end insert 72, moves with the inner insulating sleeve 73 along with the conducting arm 106. The annular contact insert 59 of the movable first arcing contact 58 remains in contact engagement with the inner ends of the flexible contact fingers 94 and

the contact tips 95. The flexible conductor 56 is extended as is the coil spring 57 which is stressed.

The movement of these parts continues to the position shown in Figure 8 where the trigger 66 has just engaged the latch engaging surface 55 on the cam terminal 54 and has been moved out of latching engagement with the inner end of the tubular metallic sleeve 65. For illustrative purposes it is pointed out that the inner insulating sleeve 73 moves through about $5\frac{3}{4}$ " from the position shown in Figure 7 to the position shown in Figure 8 of the drawings where the trigger 66 has been moved out of latching engagement with the inner end of the metallic sleeve 65. This distance is such that the gap formed between the upper current carrying member 17 and the terminal contact member 18 at this time is sufficiently great so that there is no likelihood of an arc striking therebetween. As soon as the trigger 66 is actuated, the spring 57 retracts the movable arcing contact 58 and the trailer 60 into the bore of the liner 80. An arc is drawn between the annular contact insert 59 on the contact 58 and one of the contact tips 95 on the contact fingers 94. As the trailer 60 moves through the contact tips 95 and into the bore of the liner 80, one end of the arc is confined between the outer surface of the trailer 60 and the surface of one of the outflared grooves 100. The other end is confined between the bevelled upper end 123 of the trailer 60 and the inner surface of the liner 80. As the contact 58 continues to move inwardly under the influence of the coil spring 57, the arc is confined between the outer surface of the trailer 60 and the inner surface of the liner 80 where it is extinguished.

Since the first arcing contact 58 substantially fills the bore in the liner 80, the products of the arc can not flow upwardly therethrough. Rather they flow downwardly past the contact tips 95 and into the chamber 90. As shown in Figure 8 of the drawings, the chamber 90 is well below the outer end of the housing 47 and as a result the products of the arc and the gas pressure incident thereto can be relieved through the vents 91 in the extension 89 and through the vents 104 in the plug 103.

As shown in Figure 9 of the drawings, the first arcing contact 58 moves inwardly of the housing 47 until the stop ring 78 engages the shoulder 79 on the underside of the trigger frame stop 69. For illustrative purposes, it is pointed out that the length of this stroke is $4\frac{3}{8}$ ". In this circuit open position there is still substantial tension applied by the coil spring 57 to the movable arcing contact 58 and the same is held in the retracted position shown in Figure 9.

While the extent of movement of the live line stick 37 thus described is sufficient to effect opening of the circuit through the interrupter 27, a further movement of the live line stick 37 is possible and desirable in order to provide a greater separation between the contact 58 and the contact fingers 94. In the embodiment of the invention disclosed, this further movement is of the order of $3\frac{1}{8}$ " to the position shown in Figure 10. The spring 57 is further tensioned until the ring 76 engages the underside 77 of the trigger frame stop 69. By providing for this further travel and tensioning of the spring 57 abrupt stopping of the live line stick is avoided and severe shock to the interrupter 27 is obviated.

The live line stick 37 then is manipulated so as to disengage the pin or prong 29 from the eye or pull ring 19. The fuse tube 16 then swings downwardly under the influence of gravity to the open position. Then the live line stick 37 is moved upwardly to lift the eye member 23 off of the horn or stud 24. Afterwards the auxiliary circuit interrupter 27 can be manually restored to the closed position shown in Figures 6 and 7 by moving the inner insulating sleeve 73 inwardly of the tubular housing 47 until the trigger 66 again is in position where it engages the inner end of the metallic sleeve 65. The spring 57 goes solid and acts as a strut to transmit compressive force therethrough to cause contact 58 to engage the con-

tact fingers 94. In that position the annular contact insert 59 on the first arcing contact 58 is telescoped with the inner ends of the contact fingers 94 and the contact tips 95 thereon.

In the event that some obstruction should prevent the first arcing contact 58 and the trailer 60 from moving from their positions shown in Figure 8 to the open circuit position shown in Figure 9 under the influence of the spring 57, there is still a margin of movement of the inner insulating sleeve 73 which will effect the separation of the contacts and the opening of the circuit even though the spring 57 is ineffective to do so. In Figure 8 of the drawings, it will be observed that there is still some distance between the shoulder 77 on the metallic tube end insert 72 and the ring 76. As shown in Figure 10 and as described hereinbefore, the outward movement of the inner insulating sleeve 73 is limited by the ring 76 engaging the underside 77 of the trigger frame stop 69. This further extent of movement is of the order of $2\frac{1}{2}$ " in a particular embodiment and is sufficient to disengage and withdraw the movable contact assembly 87 sufficiently far away from the first arcing contact 58, which is held against movement by the flexible conductor 56 that goes taut under these circumstances, to open the circuit and extinguish the arc. The inner insulating sleeve 73 moves downwardly together with the liner 80 and movable contact assembly while, as stated, the arcing contact 58 remains stationary. The arc is drawn and extinguished then in the bore of the liner 80 as above described.

In the event that it is not desired to depend on the flexible conductor 56 for holding the contact 58 stationary, reliance can be placed on a ring 122, Figure 6, secured to the inner end of the metallic sleeve 65. The inner periphery of this ring 122 projects over the cam terminal 54 sufficiently far that the latter will not pass through the former. The metallic sleeve 65 then is held stationary and, since it is threaded on the contact 58, it holds its stationary also.

The flexible conductor 56 can be omitted if sufficient contact engagement between the inner surface of the metallic sleeve 65 and the cam terminal 54 is provided as a conducting path for current flow. The latter can be provided with contact fingers to provide additional engagement with the former to increase the current carrying capacity. The spring 57 can be formed of relatively good conducting material, such as beryllium, copper, to carry the current during the interrupting operation.

By reversing the foregoing described sequence of operations, it is possible to close the circuit isolating device 10. In such case the interrupter is operated first to the open circuit position and then is applied to the device 10 also in the open circuit position. Then the interrupter is closed and next the device 10 is operated to the closed position. Finally the interrupter 27 is removed from the device 10 after service has been restored.

Since certain changes can be made in the foregoing construction and different embodiments of the invention can be made without departing from the spirit and scope thereof, it is intended that all matters shown in the accompanying drawings and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

What is claimed as new is:

1. In combination, a circuit isolating device, such as a disconnecting fuse, disconnecting switch or the like, having upper and lower terminal members in insulated spaced relation and an elongated conducting member pivoted at one end to said lower terminal member and carrying at the other end contact means engageable with a part of said upper terminal member for completing the circuit between said terminal members and permitting opening of the same by separation thereof, pull ring means on said conducting member below said part of said upper terminal member for detachably receiving one terminal of an auxiliary circuit interrupter, and a conducting arm carried at its inner end by said upper terminal member no further

away from the pivot of said elongated conducting member than said part of said upper terminal member and extending generally normal to the plane of swinging movement of said conducting member with its outer end terminating alongside said contact means for detachably receiving over said outer end another terminal of the auxiliary circuit interrupter.

2. In combination, a circuit isolating device, such as a disconnecting fuse, disconnecting switch or the like, having upper and lower terminal members in insulated spaced relation and an elongated conducting member pivoted at one end to said lower terminal member and carrying at the other end contact means engageable with a part of said upper terminal member for completing the circuit between said terminal members and permitting opening of the same by separation thereof, pull ring means on said conducting member below said part of said upper terminal member for detachably receiving one terminal of an auxiliary circuit interrupter, and a conducting arm carried at its inner end by said upper terminal member between said part and said pull ring means and extending generally normal to the plane of swinging movement of said conducting member with its outer end terminating alongside said contact means for detachably receiving over said outer end another terminal of the auxiliary circuit interrupter, said conducting arm having its outer end portion curved away from the direction of opening movement of said conducting member to reduce the likelihood of said other terminal of said auxiliary circuit interrupter slipping off of the same.

3. In combination, a circuit isolating device, such as a disconnecting fuse, disconnecting switch or the like, having upper and lower terminal members in insulated spaced relation and an elongated conducting member pivoted at one end to said lower terminal member and carrying at the other end contact means engageable with a part of said upper terminal member for completing the circuit between said terminal members and permitting opening of the same by separation thereof, pull ring means on said conducting member below said part of said upper terminal member for detachably receiving one terminal of an auxiliary circuit interrupter, and a generally V-shaped guide member of conducting material having its central portion secured to said upper terminal member and having arms extending forwardly on opposite sides of said conducting member generally in the direction of opening movement thereof with the outer ends of said arms terminating along opposite sides of said contact means and being curved rearwardly for detachably receiving over said outer ends on either side of said conducting member another terminal of the auxiliary circuit interrupter.

4. A circuit interrupter comprising, in combination, upper and lower line terminal members adapted to be held in fixed insulated spaced relation, a fuse tube adapted to receive a fuse link and pivotally mounted at its lower end to swing into and out of engagement with said terminal members and to be latched at its upper end, and a generally Z-shaped conducting member substantially rigid throughout its entirety with one end portion rigidly secured to said upper line terminal member, the intermediate portion extending downwardly along said fuse tube, and the other end portion extending outwardly past said fuse tube in closed position for receiving one terminal of an auxiliary circuit interrupter for shunting said upper line member and a terminal at the upper end of said fuse tube to permit separation of the same without arcing, said other end portion of said Z-shaped conducting member constituting an anchor for said one terminal of said auxiliary circuit interrupter and acting to hold the same stationary on application of a pull thereto by said auxiliary circuit interrupter.

5. A circuit interrupter comprising, in combination, upper and lower line terminal members adapted to be

held in fixed insulated spaced relation, a fuse tube adapted to receive a fuse link and pivotally mounted at its lower end to swing into and out of engagement with said terminal members and to be latched at its upper end, and a generally Z-shaped conducting member substantially rigid throughout its entirety with one end portion rigidly secured to said upper line terminal member, the intermediate portion extending downwardly along said fuse tube, and the other end portion being generally U-shaped with the central portion rigidly secured to the lower end of said intermediate portion and the arms thereof extending outwardly in flared apart relation past said fuse tube in closed position for receiving on either arm one terminal of an auxiliary circuit interrupter for shunting said upper line terminal member and a terminal at the upper end of said fuse tube to permit separation of the same without arcing, either of said arms constituting an anchor for said one terminal of said auxiliary circuit interrupter and acting to hold the same stationary on application of a pull thereto by said auxiliary circuit interrupter.

6. A circuit interrupter comprising, in combination, line terminal members in fixed insulated spaced relation; an elongated conducting member pivoted at one end to one of said line terminal members and carrying at the other end contact means engageable with a part of the other line terminal member for completing a circuit between said line terminal members and permitting opening of the same by separation thereof, a generally Z-shaped conducting member substantially rigid throughout its entirety with one end portion rigidly secured to said other line terminal member, the intermediate portion extending downwardly along said conducting member, and the other end portion extending outwardly past said conducting member for receiving one terminal of an auxiliary circuit interrupter for shunting said part on said other line terminal member and said contact means to permit separation of the same without arcing, said other end portion of said Z-shaped conducting member constituting an anchor for said one terminal of said auxiliary circuit interrupter and acting to hold the same stationary on application of a pull thereto by said auxiliary circuit interrupter.

7. A circuit interrupter comprising, in combination, line terminal members in fixed insulated spaced relation, an elongated conducting member pivoted at one end to one of said line terminal members and carrying at the other end contact means engageable with a part of the other line terminal member for completing a circuit between said line terminal members and permitting opening of the same by separation thereof, a generally Z-shaped conducting member substantially rigid throughout its entirety with one end portion rigidly secured to said other line terminal member, the intermediate portion extending downwardly along said conducting member, and the other end portion being generally U-shaped with the central portion rigidly secured to the lower end of said intermediate portion and the arms thereof extending outwardly in flared apart relation past said conducting member for receiving on either arm one terminal of an auxiliary circuit interrupter for shunting said part on said other line terminal member and said contact means to permit separation of the same without arcing, either of said arms constituting an anchor for said one terminal of said auxiliary circuit interrupter and acting to hold the same stationary on application of a pull thereto by said auxiliary circuit interrupter.

References Cited in the file of this patent

UNITED STATES PATENTS

444,019	Richards	Jan. 6, 1891
1,910,022	Legg	May 23, 1933
1,953,807	Jackson et al.	Apr. 3, 1934
2,555,158	Schultz	May 29, 1951
2,665,415	Kojis	Jan. 5, 1954