March 2, 1954

S. I. LINDELL

2,671,145

CIRCUIT INTERRUPTER CONSTRUCTION

Filed Jan. 9, 1952

4 Sheets-Sheet 1

Fig. 1

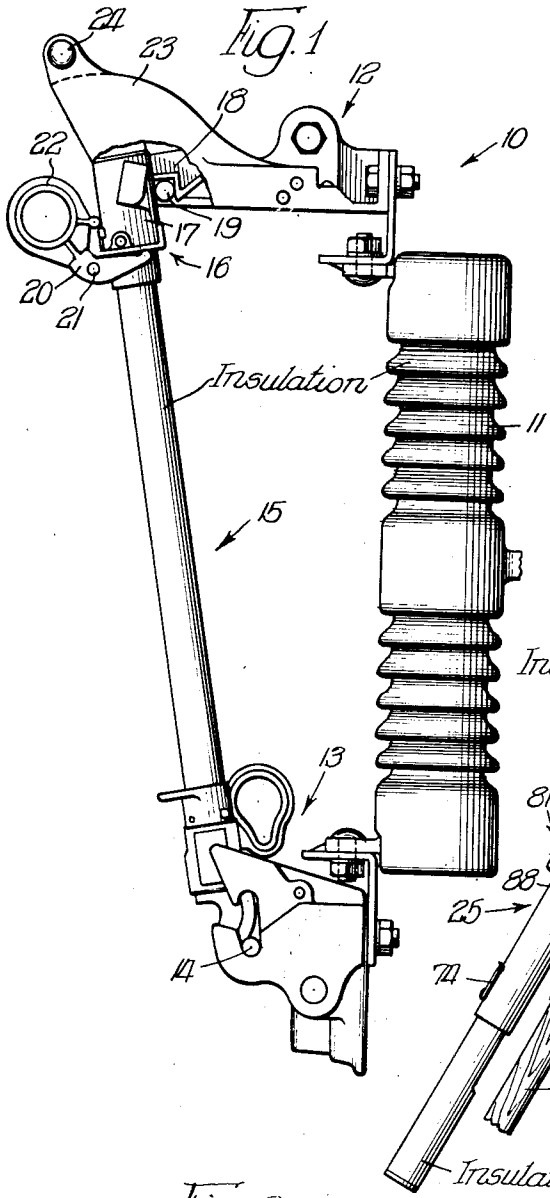


Fig. 3

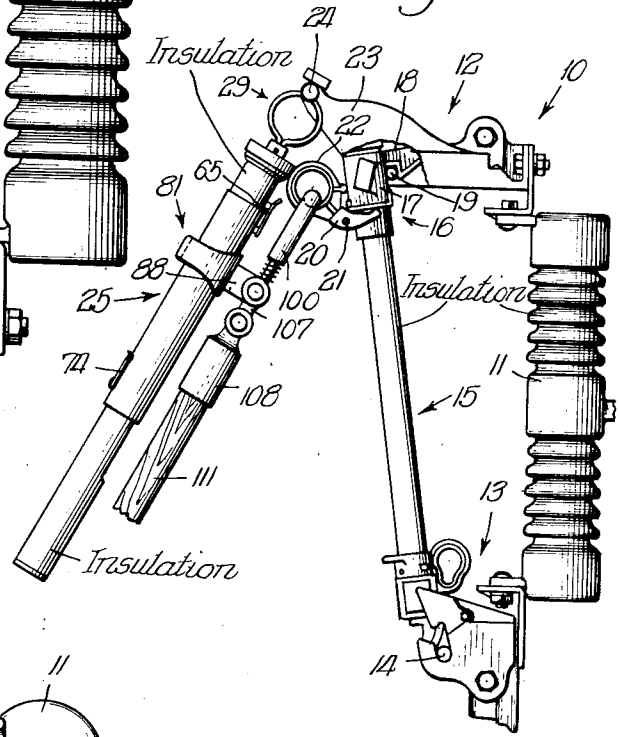
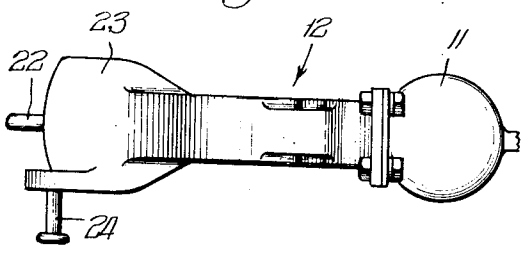


Fig. 2



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Fig. 4

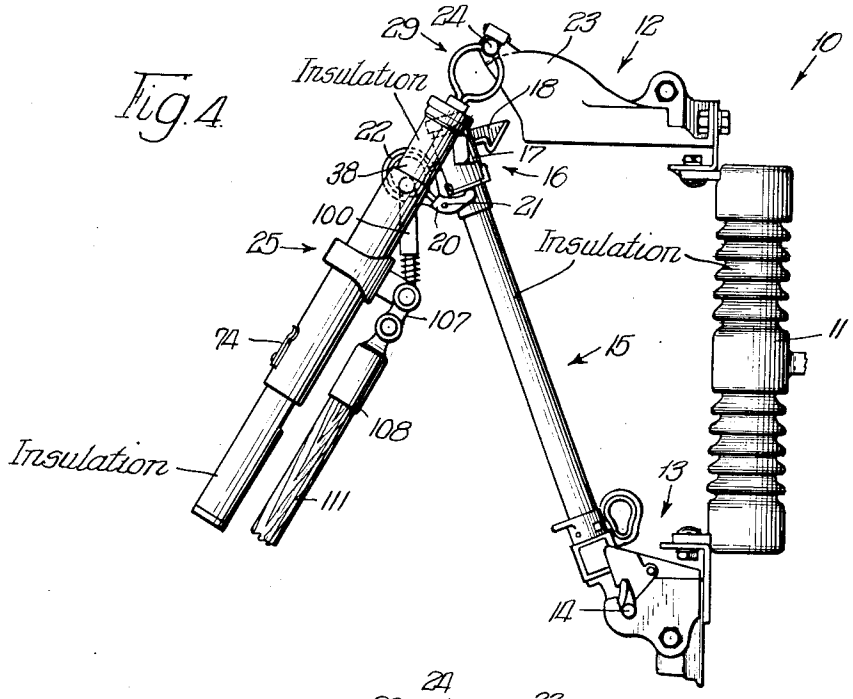
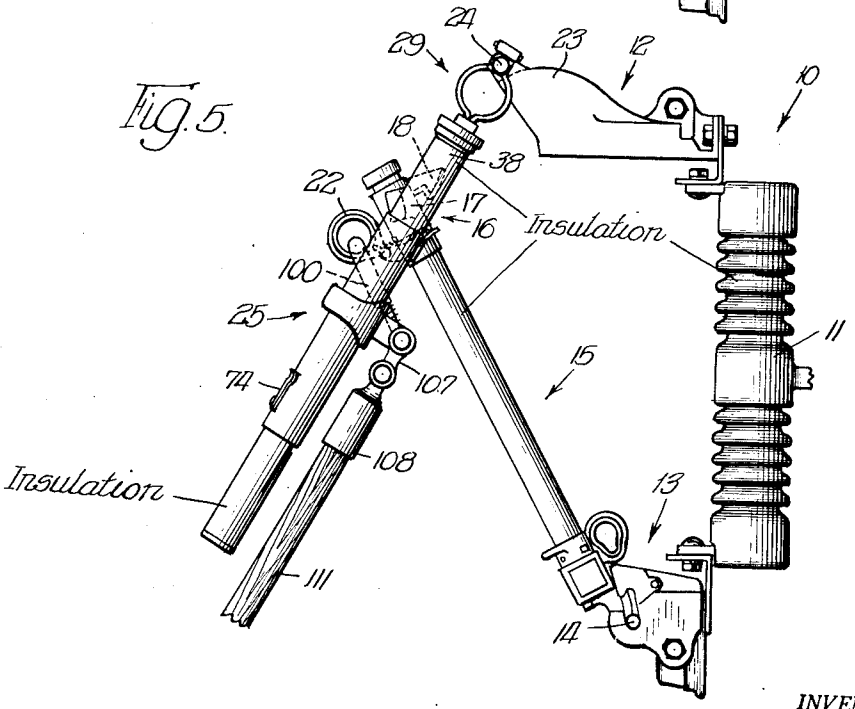


Fig. 5



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CIRCUIT INTERRUPTER CONSTRUCTION

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Fig. 6.

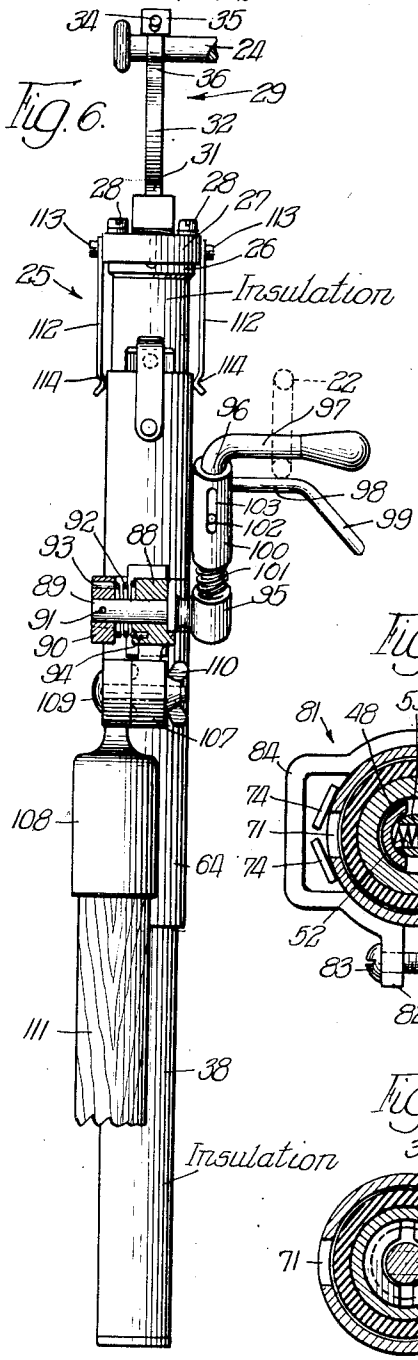


Fig. 8.

Fig. 9

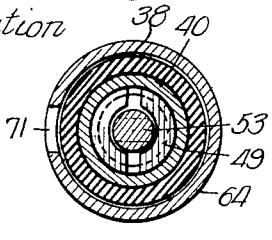
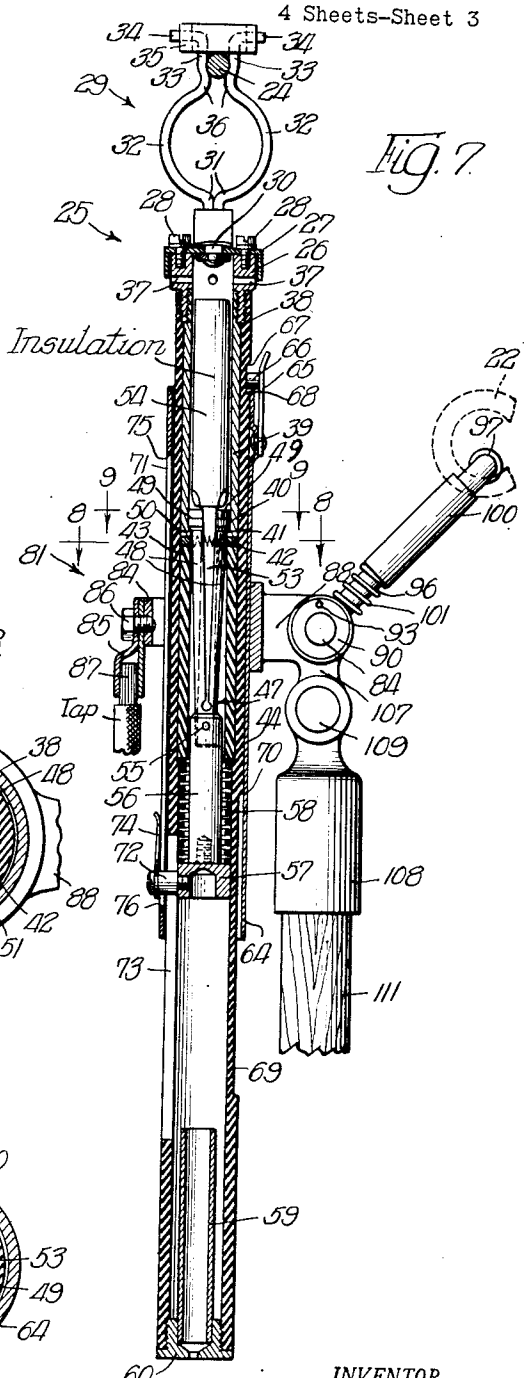


Fig. 7.



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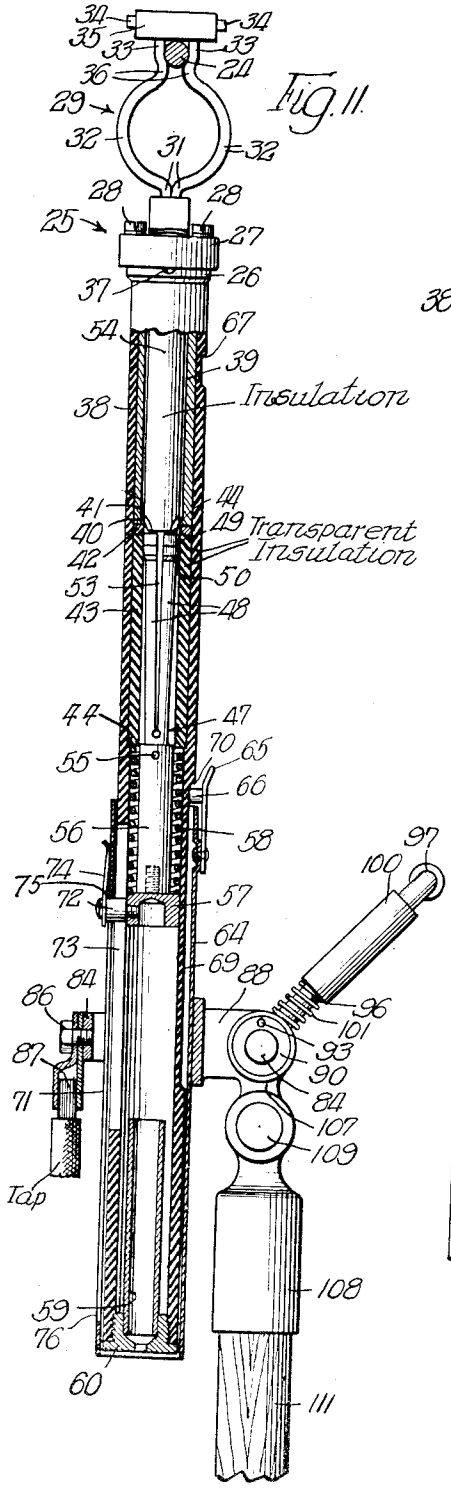
S. I. LINDELL

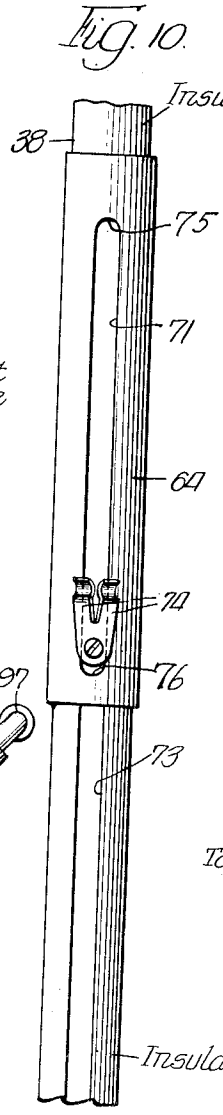
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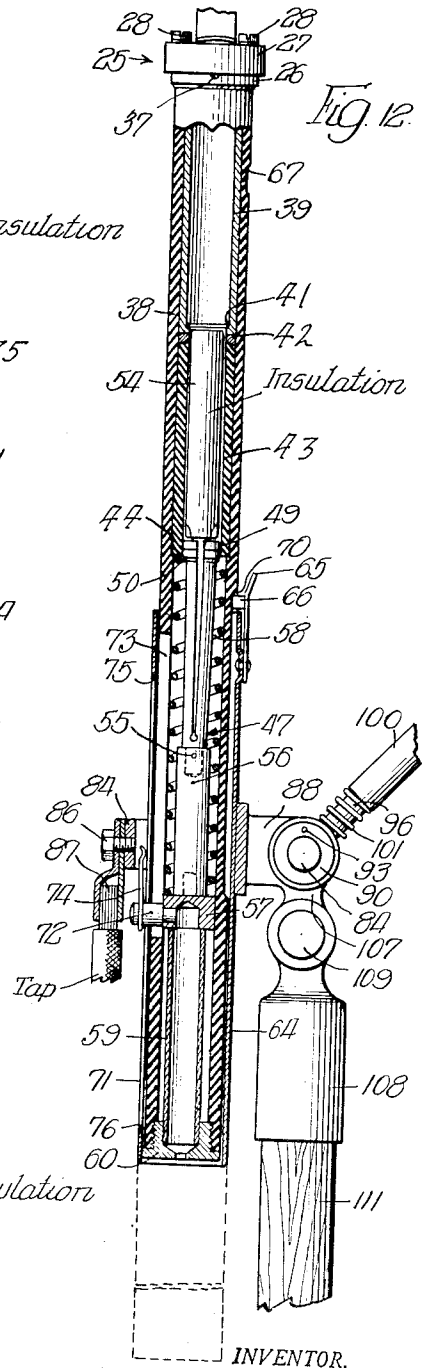
CIRCUIT INTERRUPTER CONSTRUCTION

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4 Sheets-Sheet 4







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Patented Mar. 2, 1954

2,671,145

UNITED STATES PATENT OFFICE

2,671,145

CIRCUIT INTERRUPTER CONSTRUCTION

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

Application January 9, 1952, Serial No. 265,570

18 Claims. (Cl. 200—144)

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This invention relates, generally, to electric circuit interrupters and it has particular relation to circuit interrupters for use in opening disconnecting fuses, disconnecting switches, and the like without arcing between the energized separated parts thereof and for use in making temporary connections to an energized conductor or terminal and for opening and closing the circuit thereto. This invention is an improvement of the invention disclosed in my copending application Serial No. 254,036, filed October 31, 1951, and assigned to the assignee of this application.

Among the objects of this invention are: To provide simple, efficient and economical means for opening a disconnecting fuse, disconnecting switch or the like or for making a temporary line tap with mechanism for opening and closing the circuit without external arcing; to restrain the biased apart contacts of the circuit interrupter from separating by inter-engaging shoulders thereon; to initiate operation of the contacts by movement of a sleeve relative to a tubular housing containing the contacts; to provide a lost motion connection between the sleeve and the contacts so that the same are free to separate under the influence of the means biasing them apart; to form the tubular housing of light transmitting arc extinguishing material so as to make the arc visible and to extinguish the same; to provide for reclosing the contacts under load; to provide a contact arm on the circuit interrupter for engaging a pull ring or the like on the disconnecting fuse or disconnecting switch and to bias the contact arm into contact engagement therewith under pressure; and to provide a circuit connection to the circuit interrupter either by the contact arm or by a separate conductor or both.

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 may be had to the following detailed description taken together with the accompanying drawings, in which:

Figure 1 is a view in side elevation of a conventional form of dropout fuse construction such as that described in more detail in Ramsey United States Patent No. 2,247,700, issued July 1, 1941, certain parts of the terminal assembly at the upper end being broken away in order to illustrate the details of construction;

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Figure 2 is a top plan view of the circuit isolating device or dropout fuse shown in Figure 1;

Figure 3 is a view, in side elevation, of the dropout fuse construction shown in Figure 1, at a reduced scale, and illustrating the application of the auxiliary circuit interrupter of the present invention thereto for effecting the opening of the fuse or disconnecting device without causing arcing between the parts thereof last to separate;

Figures 4 and 5 are views, similar to Figure 3, showing successive stages in the opening of the fuse or disconnecting device by means of the auxiliary circuit interrupter;

Figure 6 is a view at an enlarged scale, certain parts being broken away, illustrating the general construction and arrangement of the auxiliary circuit interrupter, the view being taken looking from right to left with respect to the auxiliary circuit interrupter as illustrated in Figures 3, 4 and 5;

Figure 7 is a longitudinal sectional view of the auxiliary circuit interrupter, the separable contacts being shown in the fully closed position;

Figure 8 is a detail sectional view taken generally along the line 8—8 of Figure 7;

Figure 9 is a detail sectional view taken generally along the line 9—9 of Figure 7;

Figure 10 is a view in side elevation of the tubular auxiliary circuit interrupter, the upper and lower ends being broken away, the construction shown being to illustrate more clearly the lost motion connection between the metallic sleeve slidably mounted on the insulating sleeve and the movable rod-like contact within the circuit interrupter;

Figure 11 is a longitudinal sectional view, similar to Figure 7, showing the relative positions of the parts just after the contacts within the circuit interrupter have separated; and

Figure 12 is a view, similar to Figure 7, showing the relative positions of the parts after the contacts in the circuit interrupter have been moved relatively to the full open position.

Referring now particularly to Figure 1 of the drawings, it will be observed that the reference character 10 designates, generally, a circuit isolating device or switching device which, in this instance, is a dropout fuse construction such as described in more detail in Ramsey Patent No.

2,247,700, issued July 1, 1941, and referred to above. However, it will be understood that the present invention can be used in conjunction with other circuit isolating devices, such as disconnecting switches in which a switch blade is swung from the closed to the open position for the purpose of introducing an air gap into the circuit.

The particular dropout fuse construction 10 includes an insulator 11 which carries terminal assemblies 12 and 13 at its ends for connection to line conductors as will be understood readily. Pivotally mounted at 14 on the lower terminal assembly 13 is a fuse tube that is indicated, generally, at 15. The fuse tube 15 contains a fusible element which is arranged to be ruptured on flow therethrough of excess current and mechanism is provided for automatically unlatching the fuse tube 15 from the upper terminal assembly 12 so that it can fall to the open circuit position. When this occurs, the circuit is interrupted within the fuse tube 15 and the arc incident thereto is extinguished. Ordinarily under fault conditions, the circuit will be interrupted within the fuse tube 15 before it swings out of contact with the upper line terminal assembly 12.

The present invention has to do particularly with the provision of mechanism for effecting the opening of the circuit under load by bodily moving the fuse tube 15 to the open circuit position while it still contains a fuse link that has not been ruptured by overcurrent. Provision is made for accomplishing this while load current is flowing through the fuse tube 15 in such manner that no arc is drawn between it and the upper terminal assembly 12 during the circuit opening operation.

At its upper end the fuse tube 15 has a fuse tube terminal assembly indicated, generally, at 16. This assembly includes a sleeve 17 that is slidable upwardly relative to the fuse tube 15 and formed integrally with the sleeve 17 is a hook 18 which is held in latching engagement with a roller 19 carried by the upper terminal assembly 12. When the fuse link within the fuse tube 15 is ruptured, the sleeve 17 is moved upwardly to such position that the hook 18 no longer engages the roller 19. This same operation can be accomplished by means of an operating arm 20 which is pivoted at 21 on the fuse tube terminal assembly 16. At its outer end the operating arm 20 has a pull ring 22 which is arranged to be engaged by the prong of a switch stick or the contact arm of the auxiliary circuit interrupted to be described hereinafter. When the pull ring 22 is swung in a counterclockwise direction about the pivot 21, the sleeve 17 is moved upwardly so that the hook 18 clears the roller 19. The fuse tube 15 then can be swung or allowed to fall to the open circuit position.

When the fuse tube 15 is operated in the manner just described by the prong of a switch stick engaging the pull ring 22, an arc will be drawn between the portions of the terminal assembly 12 and fuse tube terminal assembly 16 last to separate. As indicated above, such an arc may damage severely these terminal assemblies or it may cause a fault on the circuit. In accordance with the present invention, the fuse tube 15 can be unlatched from the upper terminal assembly 12 and swung to the open position without drawing an arc between the terminal assemblies 12 and 16. The manner in which this is accomplished, generally, is by providing a shunt circuit between the terminal assemblies 12 and 16,

unlatching the fuse tube terminal assembly 16 from the upper terminal assembly 12, swinging the fuse tube 15 to such a position that an air gap is provided between the terminal assemblies 12 and 16 and then interrupting the circuit by separating contacts within the auxiliary circuit interrupter under such conditions that the arc is confined and extinguished quickly. The only modification required in the construction of the circuit breaker 10 for accommodating the auxiliary circuit interrupter comprises providing the sleet hood 23, forming a part of the terminal assembly 12, with a transversely extending conducting arm 24. As will appear hereinafter, this provides a fixed support for the auxiliary circuit interrupter while it is being employed for swinging the fuse tube 15 to open position without arcing between the terminal assemblies 12 and 15.

For the purpose of operating the dropout fuse 10 to the open position without arcing a generally tubular auxiliary circuit interrupter, shown generally at 25, is provided. Its application to the dropout fuse 10 is illustrated in Figure 3 and the details of construction are shown more clearly in Figure 7 to which reference now will be had.

It will be noted that the auxiliary circuit interrupter 25 has a relatively fixed conducting member 26 at its upper end to which a metallic cap 27 is secured by cap screws 28. A conducting eye member 29 is pivoted or swiveled at 39 on the metallic cap 27 and it comprises a pair of resilient contact extensions 31 which are bowed outwardly as indicated at 32 for facilitating entry of the transversely extending conducting arm 24 carried by the sleet hood 23. In order to provide good contact engagement with the conducting arm 24, the upper portions 33 of the extensions 31 are positioned in side by side relationship and biased toward each other by the inherent resiliency of the contact extensions 31. Because of this construction, they grip the conducting arm 24 tightly therebetween. The upper ends 34 of the contact extensions 31 are turned outwardly, as shown, and interfit with a keeper 35 which not only limits the movement apart of the upper portions 33 but also serves as a stop to prevent relative movement between the eye member 29 and the conducting arm 24 when a downward pull is applied to the auxiliary circuit interrupter 25 in a manner to be described.

With a view to resisting upward thrust on the conducting eye member 29, the resilient contact extensions 31 are bowed inwardly as indicated at 36 for engaging the underside of the conducting arm 24. Sufficient lost motion is provided between the upper portions 33 of the contact extensions 31 and the ends of the keeper 35 so as to permit these upper portions 33 to be moved sufficiently far apart so that the conducting arm 24 can pass between the innermost portions of the inwardly bowed portions 36. However, substantial force is required to effect this relative movement which ordinarily will be more than will be exerted for reclosing the contacts of the auxiliary circuit interrupter 25 in a manner to be described.

Again referring to the relatively fixed conducting member 26, it will be observed that it is provided with radial vents 37 to permit ready escape to the atmosphere of gases which may be generated as an incident to the operation of the circuit interrupter 25.

Threaded on and depending from the underside of the conducting member 26 is an insulating

sleeve 38 that is formed preferably of light transmitting material such as methyl methacrylate resin. Within the upper end of the insulating sleeve 38 and threaded into the underside of the conducting member 26 is a conducting sleeve 39 of copper or brass. The lower end 40 of the conducting sleeve 39 constitutes an annular relatively stationary contact which has a radially inwardly directed shoulder 41 the purpose of which will be described presently. At the lowermost end of the conducting sleeve 39 there is provided a ringlike arcing contact 42. Immediately below the arcing contact 42 is an arcing tube 43 which preferably is formed of light transmittting arc extinguishing material such as methyl methacrylate resin. The reason for employing this material is to permit the arc drawn from the arcing contact 42 to be visible exterior to the insulating sleeve 38. The material specified has arc extinguishing properties when it is subjected to the heat of the arc so that it evolves an arc extinguishing gaseous medium which assists in deionizing the arc space and preventing the arc from restriking. Since this construction makes it possible to view the arc and to note that it has been drawn and extinguished, it serves to positively indicate to the lineman that the current carrying circuit has been interrupted. The lower end of the arcing tube 43 bears against a shoulder 44 formed in the insulating sleeve 38 and is thereby held in fixed position against endwise movement.

Slidably mounted within the insulating sleeve 38 is a rod-like relatively movable contact that is designated, generally, at 47. At its upper end the rod-like contact 47 has arms 48 which form a bifurcated end portion having at their extreme upper ends semicircular arcing tips 49 which, as shown in Figure 7, are arranged to have contact engagement with the annular relatively stationary contact 40 at the lower end of the conducting sleeve 39. Underneath each semicircular arcing tip 49 is a shoulder 50 which is arranged to bear against the shoulder 41 and thus frictionally hold the rod-like contact 47 against endwise movement through the insulating sleeve 38 until sufficient force is exerted thereon to overcome the restraining force provided by the interaction of the shoulders 41 and 50.

With a view to holding the semicircular arcing tips 49 in mechanical and electrical contact engagement with the annular relatively stationary contact 40, the arms 48 are formed of resilient material and are so constructed as to be inherently biased away from each other. Additionally a coil compression spring 51, Figure 8, is provided for biasing the upper ends of the arms 48 apart. The coil compression spring 51 is located in a transverse opening 52 in a rod 53 to the upper end of which a trailer 54 is connected. It will be understood that the trailer 54, which is formed of insulating arc extinguishing material, such as methyl methacrylate resin, is movable together with the rod-like contact 47 into the bore in the arcing tube 43 for assisting the same in extinguishing the arc drawn between the arcing contact 42 and the semicircular arcing tips 49. At its lower end the rod 53 is pivoted at 55 to the upper end of a support rod 56 that forms a part of the rod-like movable contact 47. At its lower end the support rod 56 has a head 57 suitably secured thereto. Between the lower end of the arcing tube 43 and the upper side of the head 57 a coil compression spring 58 is stressed. The spring 58 is so designed that, by itself, it does not have sufficient power to disengage the shoulder 50 from the shoulder 41. Accordingly, these shoulders 41 and 50 are sufficient to hold the rod-like contact 47 in the closed position against the biasing force exerted by the coil compression spring 58 until some additional force is applied which is sufficient, in addition to the force exerted by the spring 58, to disengage the shoulder 50 from the shoulder 41. The downward movement of the rod-like contact 47 is limited by a tubular stop member 59 mounted in a suitable fitting 60 at the lower end of the insulating sleeve 38.

With a view to operating the rod-like contact 47 from and to the closed circuit position, there is provided a metallic sleeve 64 which is telescoped over the insulating sleeve 38 and has a length about equal to one half the length thereof. Near its upper end the metallic sleeve 64 carries a spring finger 65 which supports a detent or latch 66 that is arranged to engage a slot 67 so as to hold by frictional engagement the sleeve 64 in the position shown in Figure 7 with respect to the insulating sleeve 38. The lower shoulder 68 of the slot 67 is inclined so as to facilitate the wedging out of the detent or latch 66 from the slot 67 when the metallic sleeve 64 is moved downwardly relative to the insulating sleeve 38. Spaced downwardly from the upper slot 67 is a lower elongated slot 69 in the outer surface of the insulating sleeve 38. The purpose of the elongated slot 69 is to receive the detent or latch 66, as shown in Figure 12, for the purpose of holding the metallic sleeve 64 in the lowermost position and against movement upwardly to a position corresponding to the circuit closed position of the contacts 47 and 40. However, the upper shoulder 70 of the elongated slot 69 is inclined so as to wedge the detent or latch 66 out of the same when sufficient upward force is applied to the metallic sleeve 64 for the purpose of reclosing the contacts 47 and 40. As will hereinafter appear, under certain operating conditions it may be necessary to move the sleeve 64 downwardly past the position shown in Figure 12. It is for this reason that the slot 69 is elongated so as to permit such movement of the detent or latch 66.

There is a lost motion connection provided between the metallic sleeve 64 and the rod-like contact 47. In part this lost motion connection is made up of a longitudinal slot 71 in the metallic sleeve 64 and an arm 72 projecting from the head 57 through a longitudinal slot 73 in the insulating sleeve 38. Contact fingers 74, carried by the projecting end of the arm 72, bear against the outer surface of the metallic sleeve 64, as shown in Figure 10, for the purpose of maintaining good circuit connection between the metallic sleeve 64 and the rod-like contact 47. The upper end 75 of the slot 71 is arranged to engage the upper side of the arm 72 when the sleeve 64 is moved downwardly relatively to the insulating sleeve 38 and continued movement of the sleeve 64 causes the shoulder 50 to disengage the shoulder 41 on the annular stationary contact 40 so as to permit the spring 58 to move the rod-like contact 47 to the open position. When the rod-like contact 47 is to be returned to the closed position, the metallic sleeve 64 is moved upwardly, from the position shown in Figure 12, and the lower end 76 of the slot 71 engages the underside of the arm 72 to move the contact 47 upwardly and to compress the spring 58. It will be understood that the sleeve 64 is moved upwardly sufficiently far so

as to cause the shoulder 50 to override the shoulder 49 and restore the rod-like contact 47 to the position shown in Figure 7.

With a view to moving the metallic sleeve 64 relative to the insulating sleeve 38 for the purpose of effecting operation of the rod-like movable contact 47 into and out of engagement with the annular stationary contact 40, a support bracket 81 is provided, Figure 8, and it is formed of a split construction with spaced ends 82 that are adjustably interconnected by a bolt 83. The support bracket 81 preferably is formed of good conducting material such as brass or copper and, as shown in Figure 7, is located intermediate the ends of the metallic sleeve 64 and is rigidly clamped thereto so as to have good electrical contact engagement therewith. The reason for this is that the support bracket 81 forms a part of the circuit through the auxiliary circuit interrupter 25 in a manner to be described presently. Since the support bracket 81 is movable past the contact finger 74, the former is provided with an offset portion 84 which, as shown in Figure 8, clearly spans the contact finger 74 and permits relative movement with respect thereto.

When it is desired to employ the auxiliary circuit interrupter 25 as a line tap and to open and close the circuit thereto, a terminal 85 can be employed and it can be clamped by a bolt 86 to the offset portion 84 of the support bracket 81. Suitably secured in the terminal 85 is a flexible cable or tap 87 that may be connected to the desired device, such as a transformer or the like, which is to be energized from the circuit to which the conducting arm 24 is connected. It will be understood that the terminal 85 and flexible cable or tap 87 will not be used when the auxiliary circuit interrupter 25 is intended to be used solely for the purpose of opening a disconnecting switch or a disconnecting fuse, such as that illustrated at 10 in Figure 1 of the drawings.

Formed integrally with the support bracket 81 and projecting therefrom is an arm 88, Figure 6, which carries a rockable shaft 89 having a flange 90 secured to one end thereof by a transverse pin 91. Interposed between the arm 88 and the flange 90 is a centering spring 92, one end 93 being anchored to the flange 90 and the other end 94 being anchored to the arm 88. At its outer end the shaft 89 carries a head 95 to which is secured a shank 96 of a contact arm 97. It will be noted that the shaft 89 extends transversely to the longitudinal axis of the tubular auxiliary circuit interrupter 25 and that the shank 96 is inclined at an acute angle to this longitudinal axis when the contact arm 97 is free of engagement of the pull ring 22. The centering spring 92 is arranged to hold the shank 96 and the contact arm 97 in this position. Then when the contact arm 97 is inserted in the pull ring 22 with the conducting eye member 29 in engagement with the conducting arm 24, as shown in Figure 3, the centering spring 92 causes the contact arm 97 to engage the inner surface of the pull ring 22 under substantial pressure and thus provides good electrical contact engagement therewith. As the auxiliary circuit interrupter 25 is operated through the successive stages shown in Figures 4 and 5, the shank 96 is swung further and further away from the centered position, shown in Figure 7, and thus the contact pressure on the pull ring 22 correspondingly increases.

Where it is desired to provide additional contact engagement with the pull ring 22, a contact finger 98, Figure 6, can be employed in conjunction with the contact arm 97. It will be observed that the contact finger 98 has an outturned end 99 which facilitates cooperation with the pull ring 22. The contact finger 98 is carried by a sleeve 100 which is slidably mounted on the shank 96. A coil compression spring 101 urges the sleeve 100 outwardly of the shank 96 and the contact finger 98 toward the contact arm 97. The sleeve 100 is guided on the shank 96 by a pin 102 extending radially from the shank 96 and projecting through a longitudinal slot 103 in the sleeve 100.

It is intended that the tubular auxiliary circuit interrupter 25 will be manipulated by a lineman using a conventional live line stick which is employed in conjunction with various live line tools for operation in connection with circuits that are energized. To accommodate such a device, the arm 88 has an integrally formed depending bracket 107 specially designed for engagement with a detachable fitting 108. The bracket 107 and fitting 108 are arranged to be clamped together by a bolt 109 having a wing nut 110 as shown in Figure 6. It will be observed that the detachable fitting 108 is mounted on the upper end of a live line stick 111 which ordinarily is formed of food that has been specially seasoned and prepared and is carefully tested with respect to its strength and insulating qualities.

In operation the auxiliary circuit interrupter 25, supported by the live line stick 111 is manipulated, as shown in Figure 3, to place the conducting eye member 29 in operative engagement with the transversely extending conducting arm 24 from the sleet hood 23 and the contact arm 97 is threaded through the opening in the pull ring 22. Where it is desired merely to make a line tap, the contact arm 97 will not be inserted in the pull ring 22 and the flexible cable or tap 87 will be connected by the terminal 85 to the support bracket 81. In such case the conducting eye member 29 will be applied to the conducting arm 24 with the circuit interrupter 25 in the open position. Where it is desired to open a disconnecting fuse or disconnecting switch, the circuit interrupter 25 will be applied in the closed position.

Assuming that the circuit interrupter 25 has been applied to the circuit isolating device or disconnecting fuse 10, as shown in Figure 3, then a pull is exerted by the lineman on the live line stick 111 to move the metallic sleeve 64 downwardly over the insulating sleeve 38.

With the circuit interrupter 25 in the closed circuit position, the circuit therethrough can be traced from the conducting arm 24 through the conducting eye member 29 to the relatively fixed conducting member 26. The circuit extends therefrom through the conducting sleeve 39 to the annular relatively stationary contact 40 and thence to the arms 48 of the rod-like movable contact 47. The circuit is carried through the support rod 56 of the contact 47, arm 72 and contact fingers 74 to the metallic sleeve 65. Thence the circuit continues through the support bracket 81, shank 96 and contact arm 97 to the pull ring 22. In this manner the terminal assembly 12, which is relatively stationary, and the fuse tube terminal assembly 16, which is relatively movable, are shunted so that when they separate no arc will be drawn therebetween.

As the metallic sleeve 64 is moved downwardly over the insulating sleeve 38, the detent or latch 66 is cammed out of the slot 67 over the inclined lower shoulder 68. The continued movement downwardly of the metallic sleeve 64 over the insulating sleeve 38 is accompanied by no movement of the rod-like contact since there is the lost motion connection therebetween. The contact fingers 74 bear against the metallic sleeve 64 with only sufficient force to maintain electrical contact engagement therewith. The frictional engagement therebetween is insufficient to disengage the movable contact 47 from the shoulder 41. Continued movement of the metallic sleeve 64, as shown in Figure 11, causes the upper end 75 of the slot 71 to engage the radially projecting arm 72 so as to move the shoulder 50 on the underside of the semicircular arcing tips 49 out of engagement with the radially inwardly directed shoulder 41 on the annular relatively stationary contact 40. This is accomplished by causing the bifurcated upper end portion or arms 48 of the rod-like movable contact 47 to be moved toward each other. As soon as the shoulder 50 is moved out of frictional engagement with the shoulder 41, the coil compression spring 58 then has sufficient power to continue the downward movement of the rod-like contact 47 so that it moves downwardly through the insulating sleeve 38 with a snap action at relatively high speed. The arm 72 moves freely downwardly in the slot 73 and independently of further movement of the metallic sleeve 64. The downward movement of the metallic sleeve 64 ordinarily continues only until the detent or latch 66 slides over the upper shoulder 70 and into the upper end of the slot 69.

Assuming that the circuit in which the device 10 is connected is carrying current, then an arc will be drawn between the semicircular arcing tips 49 and the ring-like arcing contact 42. Such arc will be visible to the lineman on the ground, particularly at night, since the insulating sleeve 38 and the arcing tube 43 both are formed of light transmitting material. The arc will be extinguished within the arcing tube 43 as the trailer 54 is moved into the same because the surfaces thereof evolve in an arc extinguishing medium due to the heat of the arc.

Another indication that the interrupter 25 has opened the circuit is provided by the contact fingers 74 again being located at the lower end of the slot 71. Preferably, they are painted with a contrasting color, such as red, so that their position is readily visible. The lineman, after noting that the arc has been extinguished and that the contact fingers 74 are at the lower end of the slot 71 when the metallic sleeve has been pulled to the position shown in Figure 12, knows that it is then safe to remove the auxiliary circuit interrupter 25 from the arm 24 and permit the circuit isolating device 10 to operate the full open position.

The downward movement of the rod-like contact 47 is arrested when the head 57 engages the upper end of the stop member 59. The relative positions of the parts when the circuit interrupter 25 is in the open position is illustrated in Figure 12.

In the event that the coil compression spring 58 should be unable to move the rod-like contact 47 downwardly in the manner described, continued downward movement of the metallic sleeve 64 with the upper end 75 of the slot 73 in engagement with the arm 72 will cause the rod-like contact 47 to move downwardly from the position shown in Figure 11. In such case, as shown by the broken lines in Figure 12, the metallic sleeve 64 would be moved well past the lower end of the insulating sleeve 38. It is for the purpose of accommodating such extended movement of the metallic sleeve 64 that the slot 69 is elongated for the purpose of accommodating the detent or latch 66, and to permit follow through without injury to the sleeve 38 the stop member 59 preferably is formed of resilient material.

As shown in Figure 12, when the circuit interrupter 25 is in the open position, the upper end of the rod-like contact 47 is substantially closer to the lower end of the conducting sleeve 39 than is the upper end of the metallic sleeve 64 or the spring finger 65 carried thereby. High voltage stress then is concentrated on the upper end of the rod-like contact 47 and any restriking that might take place will occur within the arcing tube 43 and not externally thereto.

When it is desired to reclose the auxiliary circuit interrupter 25, the live line stick 111 is moved upwardly. When this occurs, the lower end 76 of the slot 71 engages the underside of the arm 72 and moves the rod-like contact 47 upwardly until the semicircular arcing tips 49 engage the ring-like arcing contact 42. Continued upward movement of the live line stick 111 causes the semicircular arcing tips 49 to move upwardly until the shoulder 50 again engages the radially inwardly directed shoulder 41. This upward movement of the metallic sleeve 64 on upward movement of the live line stick 111 is permitted since the detent or latch 66 is cammed out of the elongated slot 69 by the inclined upper shoulder 70.

The current carrying capacity of the circuit interrupter 25 can be increased by providing shunting contacts between the conducting member 26 and the metallic sleeve 64. For example, contact fingers 112 can be secured by screws 113 to the conducting member 26 and their lower ends 114 arranged to make electrical contact engagement with the upper end of the metallic sleeve 64. When the circuit interrupter 25 is closed, the circuit through the movable contact 47 is shunted by the contact fingers 112. On movement of the sleeve 64 toward open circuit position, this shunt circuit is opened and the entire flow of current is through the movable contact 47.

Since certain changes can be made in the foregoing circuit interrupter construction and different embodiments of the invention can be made without departing from the spirit and scope thereof, it is intended that all matter 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. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, an insulating housing, a pair of separable contacts within said housing, connector means carried by said housing and connected to one of said separable contacts and arranged and adapted to be detachably connected to said energized conductor or terminal, operating means associated with said housing for effecting opening and closing of said separable contacts including means providing mechanical connection to said live line stick whereby movement thereof

relative to said energized conductor or terminal effects operation of said contacts, and circuit means connected to the other of said separable contacts.

2. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a pair of separable contacts within said housing, connector means having a swivel mounting at one end of said housing and connected to one of said separable contacts and arranged and adapted to be detachably connected to said energized conductor or terminal, operating means associated with said housing for effecting opening and closing of said separable contacts including means providing mechanical connection to said live line stick whereby movement thereof relative to said energized conductor or terminal effects operation of said contacts, and circuit means connected to the other of said separable contacts.

3. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a pair of separable contacts within said tubular housing, connector means carried by one end of said housing and connected to one of said separable contacts and arranged and adapted to be detachably connected to said energized conductor or terminal, a metallic sleeve telescoped over said tubular housing and operatively interconnected with said separable contacts for opening the same on relative movement of said sleeve and housing, support means carried by said sleeve for attachment to said live line stick for moving said sleeve, and circuit means connected through said metallic sleeve to the other of said separable contacts.

4. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a pair of separable contacts within said tubular housing, connector means carried by one end of said housing and connected to one of said separable contacts and arranged and adapted to be detachably connected to said energized conductor or terminal, said connector means including means for cooperating with said conductor or terminal to resist longitudinal movement of said tubular housing in either direction, a metallic sleeve telescoped over said tubular housing and operatively interconnected with said separable contacts for opening and closing the same on relative movement of said sleeve and housing, support means carried by said sleeve for attachment to said live line stick for moving said sleeve, and circuit means connected through said metallic sleeve to the other of said separable contacts.

5. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, connector means carried by one end of said housing and connected to one of said separable contacts and arranged and adapted to be detachably connected to said energized conductor or terminal, a metallic sleeve telescoped over said tubular housing and having a lost motion connection with the other of said separable contacts for opening and closing the same on relative movement of said sleeve and housing, connecting means electrically interconnecting said metallic sleeve and said other contact to maintain a circuit therebetween, support means attached to said sleeve and arranged and adapted to be attached to said live line stick for moving said sleeve, and circuit means connected to said metallic sleeve.

6. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a pair of separable contacts within said tubular housing, connector means carried by one end of said housing and connected to one of said separable contacts and arranged and adapted to be detachably connected to said energized conductor or terminal, spring means biasing said contacts apart endwise of said tubular housing, detent means cooperating with said contacts and acting to hold the same in engagement against the biasing action of said spring means, a metallic sleeve telescoped over said tubular housing and having lost motion connection with the other of said separable contacts for moving the same to overcome the action of said detent means whereupon said spring means moves said contacts to open position, support means carried by said sleeve for attachment to said live line stick whereby relative movement of said sleeve with respect to said housing is effected, and circuit means connected through said metallic sleeve to said other separable contact.

7. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a relatively stationary annular contact coaxially disposed within said housing and having a radially inwardly directed shoulder, a relatively movable rod-like contact coaxially disposed within said housing and having one end bifurcated with a radially outwardly directed shoulder thereon, the arms of said end of said rod-like contact being biased apart for engaging said shoulder on said annular contact to resist endwise movement of said rod-like contact, spring means biasing said rod-like contact for endwise movement away from said annular contact and restrained by said interengaging shoulders, connector means carried by one end of said housing and connected to said annular contact and arranged and adapted to be detachably connected to said energized conductor or terminal, a metallic sleeve telescoped over said tubular housing and having lost motion connection with said rod-like contact for moving the same endwise to disengage said shoulders whereupon said spring means moves said contacts to open position, support means carried by said sleeve for attachment to said live line stick whereby relative movement of said sleeve with respect to said housing is effected, and circuit means connected through said metallic sleeve to said rod-like contact.

8. The invention, as set forth in claim 7, wherein at least a portion of the tubular housing between the contacts in open position is formed of arc extinguishing light transmitting material to indicate externally the drawing of an arc therebetween and for extinguishing the same.

9. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a relatively stationary annular contact coaxially disposed within said housing and having a radially inwardly directed shoulder, a relatively movable rod-like contact coaxially disposed within said housing and having one end bifurcated with a radially outwardly directed shoulder thereon,

the arms of said end of said rod-like contact being biased apart for engaging said shoulder on said annular contact to resist endwise movement of said rod-like contact, spring means biasing said rod-like contact for endwise movement away from said annular contact and restrained by said interengaging shoulders, connector means carried by one end of said housing and connected to said annular contact and arranged and adapted to be detachably connected to said energized conductor or terminal, a metallic sleeve telescoped over said tubular housing and having lost motion connection with said rod-like contact for moving the same endwise to disengage said shoulders whereupon said spring means moves said contacts to open position, support means carried by said sleeve for attachment to said live line stick whereby relative movement of said sleeve with respect to said housing is effected, circuit means connected through said metallic sleeve to said rod-like contact, and spring biased latch means cooperating with said tubular housing and said metallic sleeve for restraining the latter against movement relative to the former in positions corresponding to the closed and open positions of said contacts respectively.

10. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a relatively stationary annular contact coaxially disposed within said housing and having a radially inwardly directed shoulder, a relatively movable rod-like contact coaxially disposed within said housing and having one end bifurcated with a radially outwardly directed shoulder thereon, the arms of said end of said rod-like contact being biased apart for engaging said shoulder on said annular contact to resist endwise movement of said rod-like contact, spring means biasing said rod-like contact for endwise movement away from said annular contact and restrained by said interengaging shoulders, connector means carried by one end of said housing and connected to said annular contact and arranged and adapted to be detachably connected to said energized conductor or terminal, a metallic sleeve telescoped over said tubular housing and having lost motion connection with said rod-like contact for moving the same endwise to disengage said shoulders whereupon said spring means moves said contacts to open position, support means carried by said sleeve for attachment to said live line stick whereby relative movement of said sleeve with respect to said housing is effected, circuit means connected through said metallic sleeve to said rod-like contact, said tubular housing having two longitudinally spaced external grooves, and spring biased latch means carried by said metallic sleeve for engaging said grooves to restrain said metallic sleeve against movement relative to said housing in positions corresponding to the closed and open positions of said contacts respectively, said grooves and latch means being so related that on application of predetermined force to said sleeve the restraining action of the former is overcome and said sleeve can be moved in one direction or the other to effect opening or closing of said contacts.

11. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a relatively stationary annular contact coaxially disposed within said housing and having a radially

inwardly directed shoulder, a relatively movable rod-like contact coaxially disposed within said housing and having one end bifurcated with a radially outwardly directed shoulder thereon, the arms of said end of said rod-like contact being biased apart for engaging said shoulder on said annular contact to resist endwise movement of said rod-like contact, spring means biasing said rod-like contact for endwise movement away from said annular contact and restrained by said interengaging shoulders, connector means carried by one end of said housing and connected to said annular contact and arranged and adapted to be detachably connected to said energized conductor or terminal, a metallic sleeve telescoped over said tubular housing and having lost motion connection with said rod-like contact, said lost motion connection comprising a longitudinal slot in said metallic sleeve and an arm projecting radially from said rod-like contact through said slot with relative movement therebetween being limited by the ends thereof, movement of said sleeve in one direction relative to said housing with one end of said slot in engagement with said arm causing disengagement of said shoulders whereupon said spring means moves said contacts to open position and movement of said sleeve in the opposite direction relative to said housing with the other end of said slot in engagement with said arm causing movement of said rod-like contact toward said annular contact, support means carried by said sleeve for attachment to said live line stick whereby relative movement of said sleeve with respect to said housing is effected, and circuit means connected through said metallic sleeve to said rod-like contact.

12. A circuit interrupter for connection to an energized conductor or terminal and adapted to be manipulated by a live line stick comprising, in combination, a tubular insulating housing, a relatively stationary annular contact coaxially disposed within said housing and having a radially inwardly directed shoulder, a relatively movable rod-like contact coaxially disposed within said housing and having one end bifurcated with a radially outwardly directed shoulder thereon, the arms of said end of said rod-like contact being biased apart for engaging said shoulder on said annular contact to resist endwise movement of said rod-like contact, spring means biasing said rod-like contact for endwise movement away from said annular contact and restrained by said interengaging shoulders, connector means carried by one end of said housing and connected to said annular contact and arranged and adapted to be detachably connected to said energized conductor or terminal, a metallic sleeve telescoped over said tubular housing and having lost motion connection with said rod-like contact, said lost motion connection comprising a longitudinal slot in said metallic sleeve and an arm projecting radially from said rod-like contact through said slot with relative movement therebetween being limited by the ends thereof, movement of said sleeve in one direction relative to said housing with one end of said slot in engagement with said arm causing disengagement of said shoulders whereupon said spring means moves said contacts to open position and movement of said sleeve in the opposite direction relative to said housing with the other end of said slot in engagement with said arm causing movement of said rod-like contact toward said annular contact, sliding contact means carried by said radially projecting arm and engaging said metallic sleeve to provide elec-

trical contact therewith, support means carried by said sleeve for attachment to said live line stick whereby relative movement of said sleeve with respect to said housing is effected, and circuit means connected to said metallic sleeve.

13. Mechanism for opening a high voltage circuit isolating device such as a disconnecting fuse, disconnecting switch or the like normally carrying line current comprising, in combination, an elongated circuit interrupter having a relatively fixed conducting member at one end for attachment to a stationary energized conducting part of said circuit isolating device and a relatively movable conducting member adapted to be carried by a live line stick, a contact arm swingably mounted on said movable member to rock about an axis transverse to the longitudinal axis of said circuit interrupter and arranged and adapted to engage a movable energized conducting part of said circuit isolating device, a centering spring cooperating with said contact arm to bias the same to a position at an angle to the longitudinal axis of said circuit interrupter when it is out of engagement with said movable energized conducting part, and arranged to exert substantial contact pressure thereon when in engagement therewith and said contact arm is thereby swung toward said circuit interrupter, relatively fixed and movable contacts in said circuit interrupter connected respectively to said fixed and movable conducting members, movement of said movable conducting member away from said fixed conducting member effecting separation of said movable energized conducting part from said stationary energized conducting part while maintaining a shunt circuit therebetween through said contacts, and operating means responsive to said movement of said movable conducting member away from said fixed conducting member for effecting separation of said contacts.

14. A circuit interrupter comprising, in combination, a tubular insulating housing, a relatively stationary annular contact coaxially disposed within said housing and having a radially inwardly directed shoulder, a relatively movable rod-like contact coaxially disposed within said housing and having one end bifurcated with a radially outwardly directed shoulder thereon, the arms of said end of said rod-like contact being biased apart for engaging said shoulder on said annular contact to resist endwise movement of said rod-like contact, spring means biasing said rod-like contact for endwise movement away from said annular contact and restrained by said interengaging shoulders, a sleeve telescoped over said tubular housing and having lost motion connection with said rod-like contact for moving the same endwise to disengage said shoulders whereupon said spring means moves said contacts to open position, and operating means connected to said sleeve for moving the same relative to said housing.

15. The invention, as set forth in claim 14, wherein at least a portion of the tubular housing between the contacts in open position is formed of arc extinguishing light transmitting material to indicate externally the drawing of an arc therebetween and for extinguishing the same.

16. A circuit interrupter comprising, in combination, a tubular insulating housing, a conductor extending into said housing from one end having a relatively stationary contact at its inner end, a relatively movable contact within said housing for engaging said relatively stationary contact, spring means for biasing said movable contact for endwise movement through said housing away from said stationary contact, means holding said contacts in engagement, and a metallic sleeve telescoped over said tubular housing and having lost motion connection with said movable contact for moving the same endwise to disengage said contacts and permit said spring means to move the same apart.

17. A circuit interrupter comprising, in combination, a tubular insulating housing, a conductor extending into said housing from one end having a relatively stationary contact at its inner end, a relatively movable contact within said housing for engaging said relatively stationary contact, spring means for biasing said movable contact for endwise movement through said housing away from said stationary contact, means holding said contacts in engagement, a metallic sleeve telescoped over said tubular housing and having lost motion connection with said movable contact for moving the same endwise to disengage said contacts and permit said spring means to move the same apart, and stop means limiting the movement of said movable contact away from said stationary contact to a position where the distance therebetween is less than the distance between said stationary contact and said metallic sleeve.

18. A circuit interrupter, comprising, in combination, a tubular insulating housing, a conductor extending into said housing from one end having a relatively stationary contact at its inner end, a relatively movable contact within said housing for engaging said relatively stationary contact, a coil compression spring biasing said movable contact away from said stationary contact, latch means holding said contacts in engagement against the biasing force of said spring, a metallic sleeve telescoped over said tubular housing and having lost motion connection with said movable contact for unlatching said latch means on movement to a predetermined position along said tubular housing away from said stationary contact to permit said spring to separate said contacts, and stop means limiting the movement of said movable contact away from said stationary contact to a position where the distance therebetween is less than the distance between said stationary contact and said metallic sleeve.

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