Aug. 24, 1937. T. BIRKENMAIER 2,091,135

RECLOSING SWITCH

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FIG. 1.

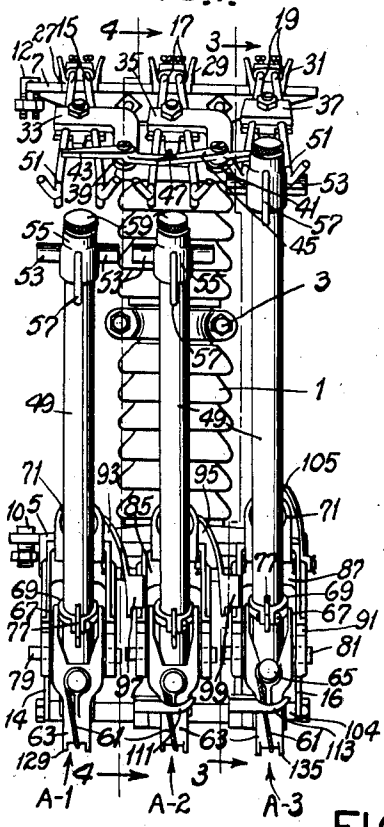

FIG. 15.

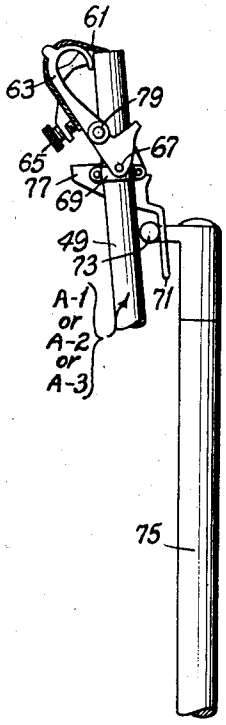

FIG. 8.

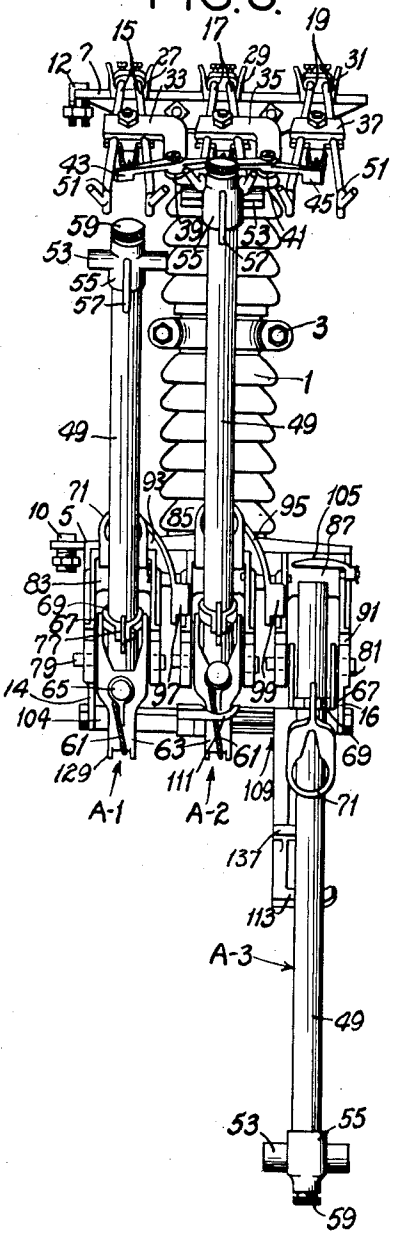

FIG. 14.

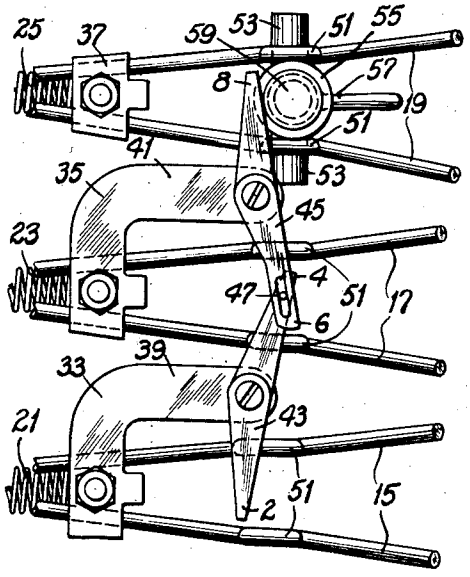

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FIG. 2.

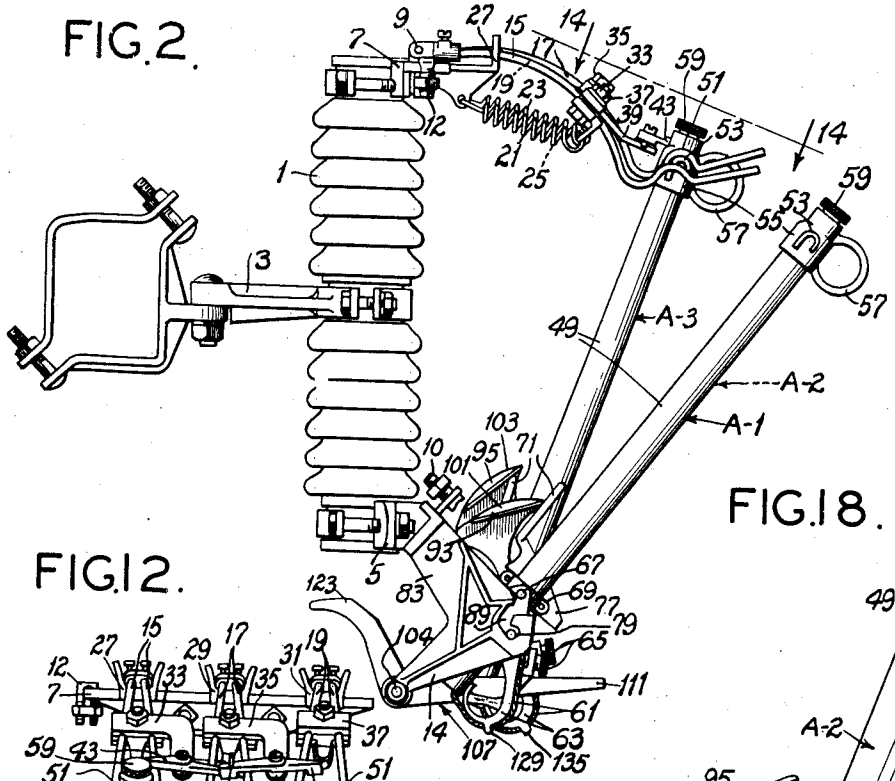

FIG. 12.

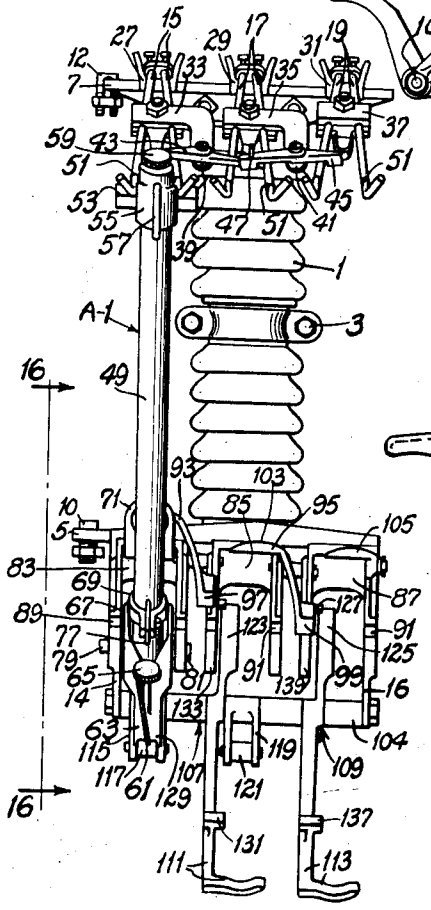

FIG. 18.

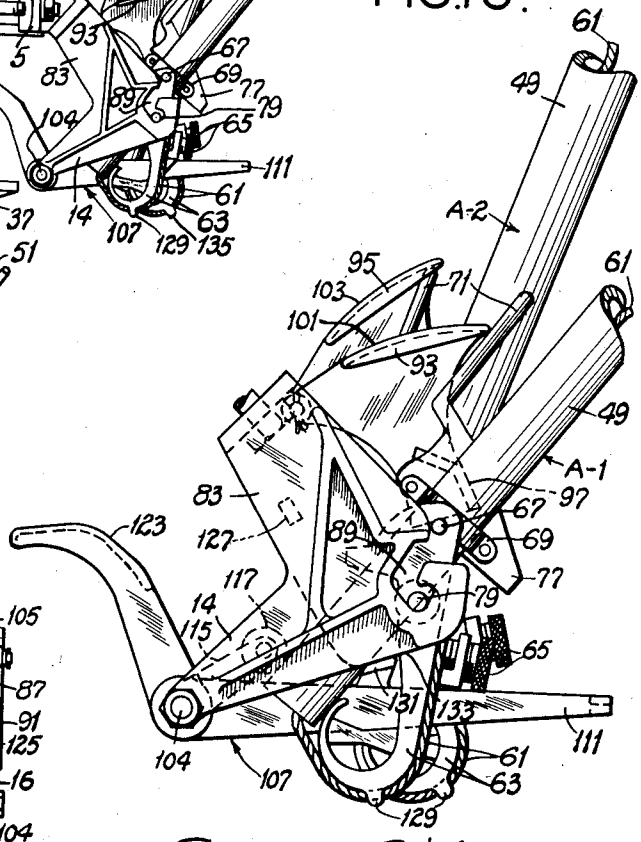

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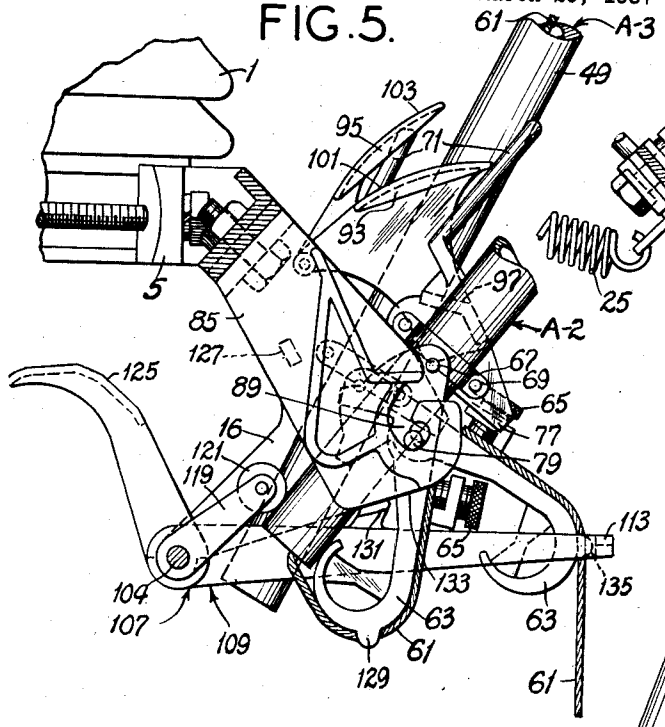
FIG. 5.



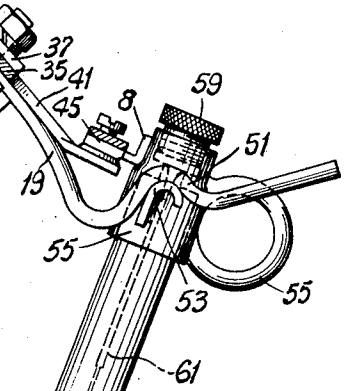
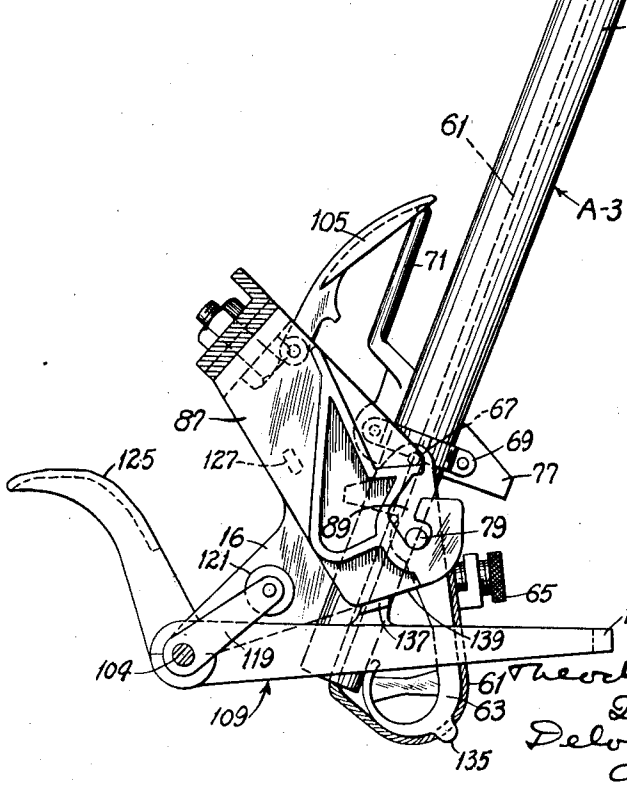


FIG. 3.



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RECLOSING SWITCH

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FIG. 6.

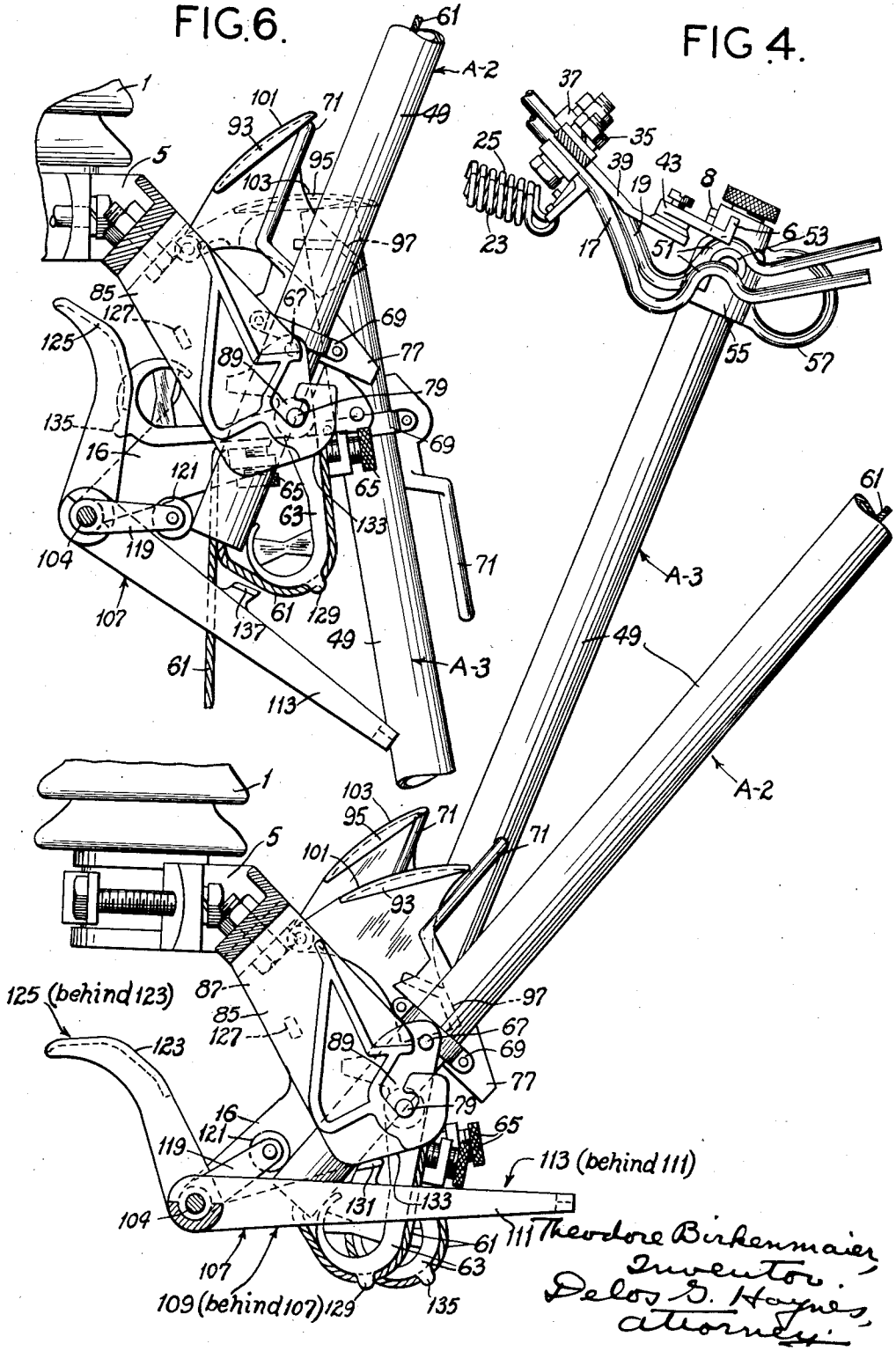

FIG. 4.

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FIG.7.

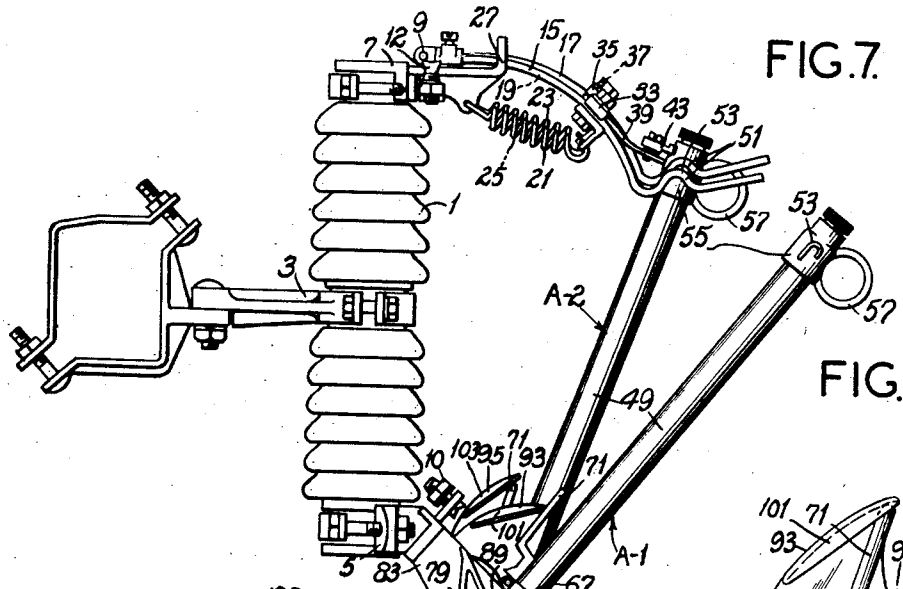


FIG.16.

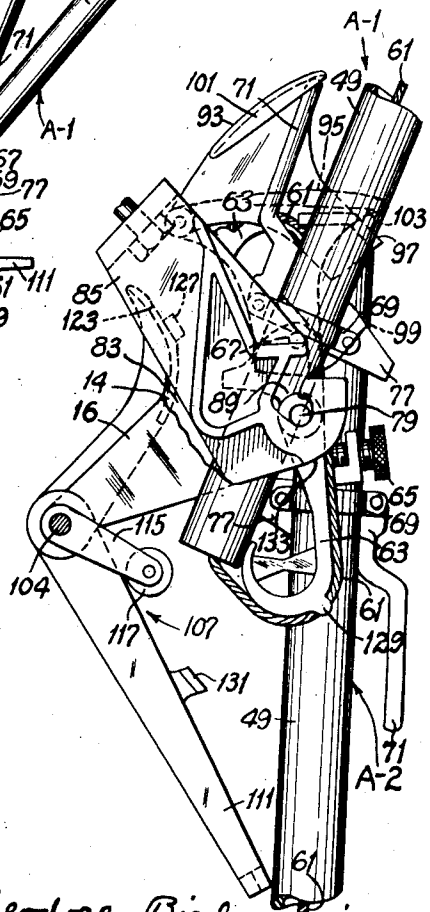
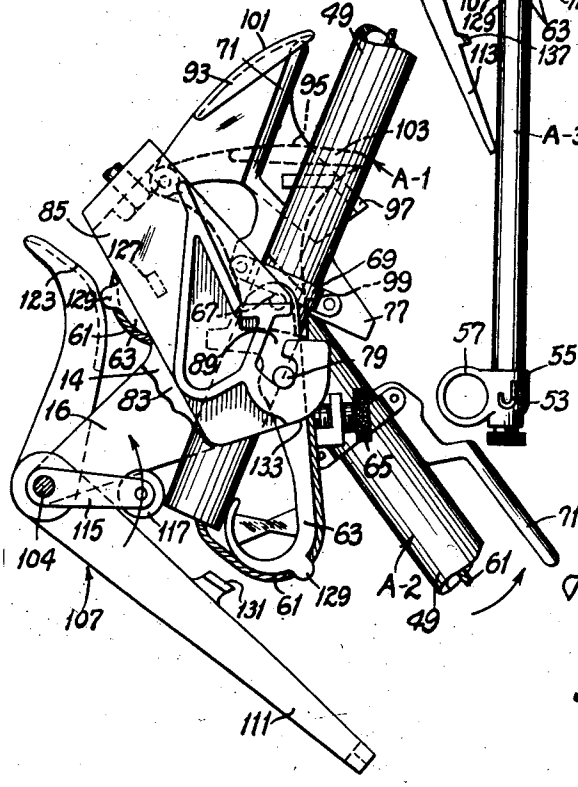


FIG.17.



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RECLOSING SWITCH

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FIG.9.

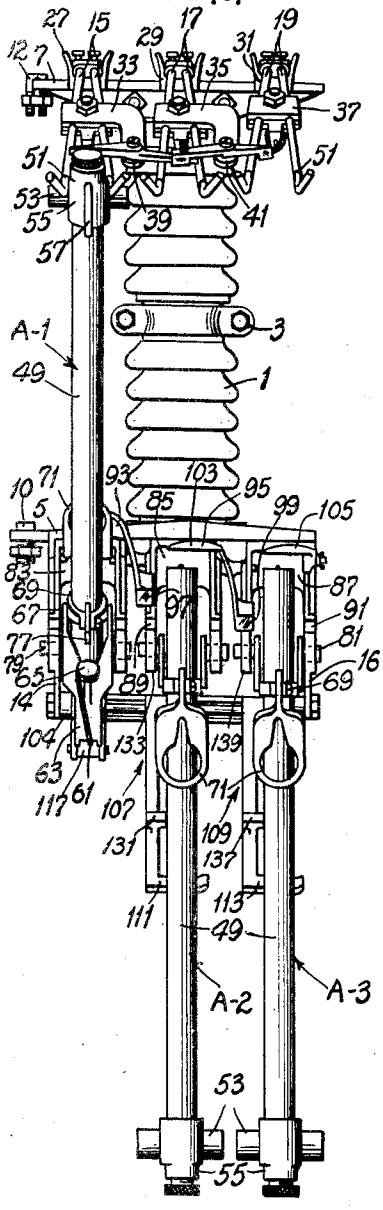
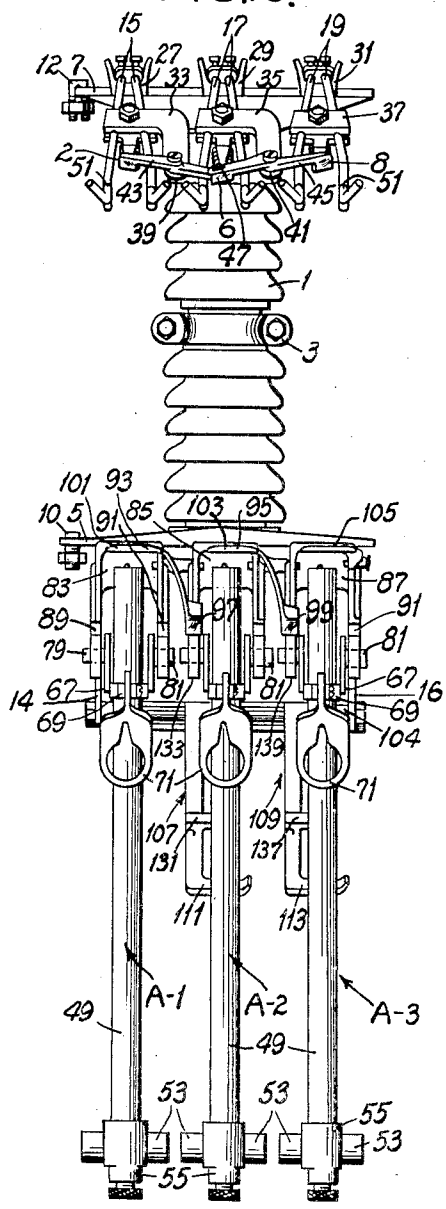


FIG.10.



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RECLOSING SWITCH

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FIG. 11.

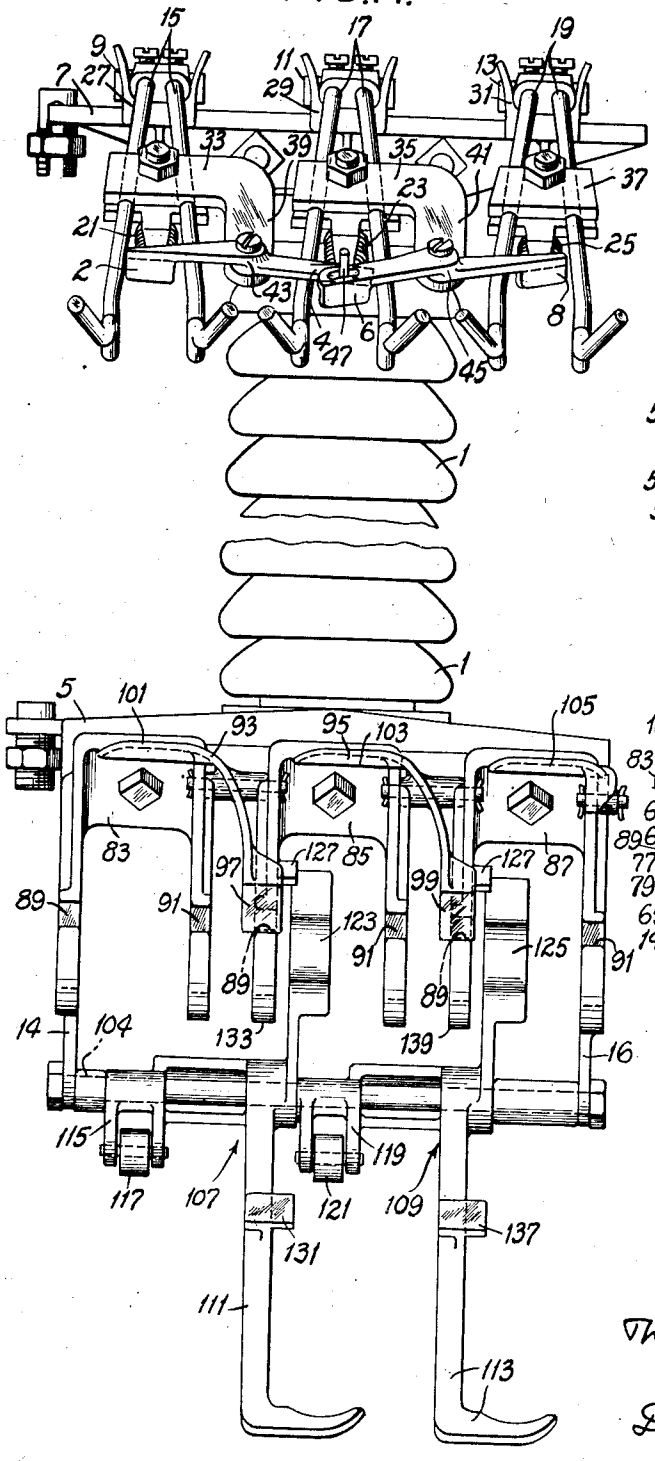
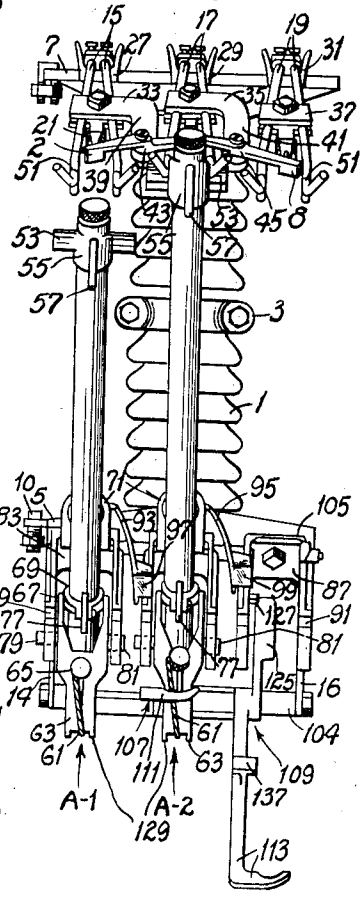


FIG. 13.



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Patented Aug. 24, 1937 2,091,135

UNITED STATES PATENT OFFICE

2,091,135

RECLOSING SWITCH

Theodore Birkenmaier, St. Louis, Mo., assignor to W. N. Matthews Corporation, St. Louis, Mo., a corporation of Missouri

Application March 29, 1937, Serial No. 133,566

25 Claims. (Cl. 200—126)

This invention relates to switches, and with regard to certain more specific features, to reclosing fuse switches.

Among the several objects of the invention may be noted the provision of a reclosing fuse switch in which, when one fuse blows, another is reclosed; the provision of apparatus of the class described in which interlocking means necessitates proper serial application of the fuses to the apparatus whereby proper serial reclosure operation is determined; the provision of apparatus of this class in which reliability of operation is obtained by eliminating all springs in the interlocking and reclosure components of the mechanisms; and the provision of apparatus of this class which is simple in form and operation. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which is illustrated one of various possible embodiments of the invention,

Fig. 1 is a front elevation showing the switch in fused condition and ready for operation;

Fig. 2 is a left-hand side elevation of Fig. 1;

Fig. 3 is a fragmentary, enlarged, vertical section taken substantially on line 3—3 of Fig. 1;

Fig. 4 is a fragmentary, enlarged, vertical section taken substantially on line 4—4 of Fig. 1;

Fig. 5 is a fragmentary view similar to the lower portions of Fig. 4 but with bell-crank 107 removed and showing the fuse holder of Fig. 3 just after it has blown but before it has moved through the major part of its travel;

Fig. 6 is a view similar to Fig. 5 showing said blown fuse holder gravitated to a position so as to force a preceding fuse holder into closed position;

Fig. 7 is a view similar to Fig. 2 but showing positions of parts after the apparatus has progressed through the operations illustrated by Figures 5 and 6;

Fig. 8 is a right-side elevation of Fig. 7, being a front elevation of the apparatus and showing one fuse blown;

Fig. 9 is a view similar to Fig. 8 after a second fuse has blown;

Fig. 10 is a view similar to Fig. 9 after a third fuse has blown;

Fig. 11 is a fragmentary, enlarged view similar to Fig. 10 but showing all of the fuse holders removed;

Fig. 12 is a view similar to Fig. 11 (on a reduced scale corresponding to Fig. 10) showing a first re-loaded fuse holder re-applied;

*Fig. 13 is a view similar to Fig. 12 but showing a second re-loaded fuse holder re-applied;

*Fig. 1 may be considered in sequence after Fig. 13 and as showing a third re-loaded fuse holder re-applied.

Fig. 14 is an oblique view taken on line 14—14 of Fig. 2;

Fig. 15 is a fragmentary side elevation showing an inverted fuse holder supported on a puller stick;

Fig. 16 is a section taken on line 16—16 of Fig. 12, but showing a second fuse holder in place with the parts in their positions prior to swinging the second fuse holder to closed-circuit position;

Fig. 17 is a view similar to Fig. 16 showing the second fuse holder swinging up into circuit closing position; and,

Fig. 18 is a view similar to Fig. 17 showing the second fuse holder finally swung into position.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to Figures 1 and 2, there is shown at numeral 1 an insulator supported on a bracket 3. At its lower end the insulator has clamped thereto a bracket 5, and at its upper end a bracket 7. Line wire connectors 10 and 12 are attached to the brackets 5 and 7 respectively.

The bracket 7 has three pivots 9, 11 and 13 (Fig. 11) for pivoting three line terminals consisting of sets of resilient conducting bars 15, 17 and 19, respectively. The sets of conducting bars 15, 17 and 19 are normally pulled downwardly by springs 21, 23 and 25, respectively, until they engage stops 27, 29 and 31, respectively. The springs 21 and 23 are fastened to special holding brackets 33 and 35, respectively; whereas the spring 25 is fastened to another type of holding bracket 37.

The brackets 33 and 35 have side arms 39 and 41, respectively, which pivotally carry rocker arms 43 and 45, respectively (Figures 11 and 14). The left-hand end 2 of rocker arm 43 is in general alignment with the center line between the conductor bars 15, whereas the right-hand end 4 extends across the center line between conductor bars 17. The left-hand end 6 of rocker 45 is adjacent the right-hand end 4 of rocker 43 and on the center line between conductor bars 17. The right-hand end 8 of rocker 45 is on a center

line between conductor bars 19. As shown in Figures 11 and 14, a pin-and-slot connection 47 between the ends 4 and 6 of the rocker arms 43 and 45 respectively causes them to move together angularly but in opposite directions, and at the same time permits of relative vertical movements necessitated by the fact that the brackets 33 and 35 are on bars 15 and 17 respectively, which bars have independent movement, as will appear.

The respective pairs of bars 15, 17 and 19 are notched near their ends, as shown at 51, to springingly receive upper contact gudgeons 53 of tubular fuse holders A1, A2 and A3.

Each fuse holder A1, A2 and A3 comprises an insulating tube 49 having an upper terminal-engaging element in the form of a hollow top contact 55 formed with said gudgeons 53 and a puller ring 57, and being closed by a screw cap 59 for holding in place the upper end of a fuse link 61, the latter passing downwardly through the tube 49, through its open lower end and around the curved end of a lever 63 (Fig. 3). The link 61 is attached to the lever 63 at a screw clamp 65. Each lever 63 constitutes a lower terminal-engaging element.

Each lever 63 is pivoted at 67 to a clamping collar 69 held to the respective insulating tube 49. Each clamp 69 holds a supporting member 71 formed as a notched eye for receiving a gudgeon 73 of a puller stick 75, so that an inverted fuse holder may be invertedly supported on the end of the stick as shown in Fig. 10 for lifting it into position (Fig. 15). The clamp 69 also supports a stop 77, the function of which is to limit the relative opening movement between the tube 49 and lever 63.

Each lever 63 carries oppositely located gudgeons 79 and 81, the left-hand gudgeons 79 being longer than the right-hand gudgeons 81 and of smaller diameter, the respective trunnions for said gudgeons (to be described) being of corresponding diameters, so as to provide insurance against the wrong application of a fuse holder and to lift the barrier latch when removing the fuse.

The lower bracket 5 carries line terminals consisting of three inverted U-shaped castings 83, 85 and 87 (Fig. 11) for the fuse holders A1, A2 and A3, respectively. These U-shaped castings, on the left-hand walls thereof, carry the smaller recesses 89 forming the trunnions for the small gudgeons 79. On the right-hand walls thereof they carry the larger recesses 91 forming the trunnions for the larger gudgeons 81. Thus it will be seen that when the fuse links 61 are fastened between contacts 55 and clamps 65, that the levers 63 may be rigidly held against their respective tubes 49; and that the gudgeons 79 and 81 may be applied to their respective recesses 89 and 91 for rotation of the respective fuse holders A1, A2 and A3 from inverted positions toward contact position of the upper gudgeons 53 in the recesses 91 of the resilient conductor bars 15, 17 and 19, respectively.

In order to prevent the application of fuse holder A2 to its bearing supports until the fuse holder A1 has been rotated into contact position; and in order to prevent the application of fuse holder A3 to its bearing supports until the fuse holder A2 is rotated into contact position, interlock members 93 and 95 are pivoted adjacent to the castings 83 and 85, respectively. These interlock members 93 and 95 carry stops 97 and 99, respectively, which when down, as shown in Fig. 11, interfere with the application of the left-hand gudgeons 79 of the adjacent fuse holder A2 or A3 as the case may be, so that said fuse holders may not be applied to their bearing supports 89 and 91. But when the fuse holder A1 is rotated into contact position (Fig. 12), then its eye 71 contacts a portion 101 of the interlock member 93 to raise the stop 97 to clear the left-hand opening 89 of the adjacent bracket so that the gudgeons 79 of the next fuse holder A2 may be applied and rotated into position (Fig. 13). Likewise, when the fuse holder A2 is rotated, its eye 71 contacts the portion 103 of the next interlocking member 95 to clear the stop 99 of that member from the adjacent opening 89 on member 87, so that fuse holder A3 may be applied to its empty bearing supports (Fig. 13) and rotated into position (Fig. 1).

Incidentally, the portions 101 and 103 of the interlock members 93 and 95 form individual water and ice protecting hoods over the open ends of the fuse holders A1 and A2 when said fuse holders are in their depending positions such as shown in Fig. 10. To provide a like protection for the fuse holder A3, hood 105 is pivoted to the casting 87. However, the hood 105 has no interlock form nor function.

From the above it will be seen that the fuse holder A1 if loaded, inverted and supported as shown in Fig. 15 may have its gudgeons 79 and 81 applied to the bearing supports 89 and 91 of the casting 83. This may be done at any time, because there is no interlock against it. Before rotation of the fuse holder A1 to an upper position, the stop 97 is down so as to prevent a corresponding application of the fuse holder A2 into position in its supporting casting 85. This also means that the stop 99 is down to prevent application of the fuse holder A3 to its supporting casting 87.

If the lineman wishes to apply the fuse holder A2, he must, after having placed fuse holder A1 in its bearing supports, rotate the holder A1 into circuit-closing position. This places the gudgeons 53 in the notches 51, thereby promptly closing the circuit between brackets 5 and 7. Then inasmuch as the corresponding stop 97 has been raised (Fig. 12), he may invert and support the next fuse holder A2 on the gudgeon 73 (according to the showing in Fig. 15) and apply the fuse holder to the next supporting casting 85 which is now clear. When the fuse holder A2 is supported in inverted position, the stop 99 is down so that the fuse holder A3 may not be applied to its supporting casting 87. After the fuse holder A2 has been rotated into circuit-closing position (Fig. 13), then the fuse holder A3 may likewise be applied into its casting 87 and rotated up into circuit-closing position.

From the above it will be seen that there is only one possible order of application of the fuse holders and that is A1, A2 and A3 serially from left to right. There will now be explained the means by which only the proper fuse holder is exclusively left in circuit-closing position. This is accomplished by means of the upper rockers 43 and 45. For example, when the fuse holder A1 is rotated into circuit-closing position (Fig. 12), the rockers 43 and 45 are rotated so that the portions 4 and 6 at the center are forwardly positioned (see also Figures 11 and 14). Hence when the fuse holder A2 is thrown into circuit-closing position the portions 4 and 6 of the bars 43 and 45 are thrown back so that the left-hand

end 2 of bar 43 forces out the upper end of the fuse holder A1 so that its gudgeons 53 leave their respective notches 51 of conductor bars 15. The fuse holder A1 then assumes the position shown in Fig. 13. It goes no further for reasons which will be shown.

Likewise, when the fuse holder A3 is thrown into circuit-closing position as shown in Fig. 1, its upper casting 55 strikes the right-hand end 8 of the rocker arm 45, thereby sending the left-hand end 6 of the rocker arm 45 forwardly to force the fuse holder A2 from circuit-closing position to the position shown in Fig. 1. This leaves the fuse holder A3 in circuit-closing position, ready to have its fuse blown upon overload or short circuit.

It remains to explain how the mechanism operates whereby fuse holder A2 is thrown back into circuit-closing position when the fuse holder A3 blows; and how thereafter the fuse holder A1 is thrown back into circuit-closing position when the fuse in fuse holder A2 blows. It is to be kept in mind that when a fuse in a holder blows, thereafter the respective lever 63 on the respective holder is no longer rigid but free to pivot at its respective pivots 67. The limit of this pivoting is until the lever 63 strikes a stop 77 on the respective tube 49. In Fig. 5, the link 61 is shown as blown in the holder A1, and the respective tube 49 has dropped, due to the action of the gudgeons 79, 81, and to the downwardly pushing action of the respective conductor bars 19 (not shown in Fig. 5). This forces down the respective pivot 67. Next there is a rotation on the gudgeons 79 and 91 (Fig. 6) as the lever 63 opens further from the respective tube 49. Thus the upper gudgeons 53 descend out of the notches 51 and thereafter the respective tube 49 may rotate on gudgeons 79, 81 to the depending position shown in Fig. 7.

To effect reclosure operation a lay shaft 104 is supported behind the castings 83, 85 and 87 on end arms 14 and 16. This lay shaft pivotally supports two bell cranks 107 and 109 (Fig. 11). These have forwardly extending levers 111 and 113, respectively, which are adapted to be contacted by the descending fuse holders A2 and A3, respectively. The bell crank 107 includes an arm 115 having a roller 117, and the bell crank 109 has a corresponding arm 119 and roller 121. The bell crank 107 also has a toe piece 123 and the bell crank 109 has a corresponding toe piece 125. It should be understood in the case of the bell crank 107, that the lever 111, the arm 115 and the toe piece 123 are all rigidly related and rotate together; and that in the case of the bell crank 109, the arm 113, the lever 119 and the toe piece 125 are all rigidly related and rotate together independently of bell crank 107.

Returning now to a position of parts in which all of the fuse holders are out (Fig. 11) of their supported positions in castings 83, 85 and 87; the bell cranks 107 and 109 will be in the depending positions shown in Fig. 11, with the toes 123 and 125 against stops 127. The first fuse holder A1 may now be applied invertedly in castings 83. Upon rotation of the fuse holder A1 into circuit-closing position no function of either bell crank 107 or 109 occurs (Fig. 12).

Next, the fuse holder A2 may be invertedly applied to be supported in its casting 85 (Figures 15 and 16). Thereupon, upon rotating fuse holder A2 into circuit-closing position (Fig. 17), a lug 129 on its lower lever 63 strikes the toe 123 of the depending bell crank 107, thereby causing said bell crank to rotate counterclockwise and first sends its roller 117 over the lower end of the tube 49 of the fuse holder A1. Fuse holder A1 (at this time in circuit-closing position) is so related to roller 117 that the latter may springingly ride up over the lower end of the fuse holder A1 and thereafter rest thereon by gravity. There is enough spring in the mechanism to permit of this passing, non-return function. Thereafter the roller 117 is supported on the upper side of the lower end of the tube 49 of the fuse holder A1. Continued rotation of the fuse holder A2 to circuit-closing position has the effect of pushing the right-hand end 4 of rocker 43, whereby the fuse holder A1 is thrown out of circuit-closing position (Figures 13 and 18). This raises the roller 117 and cocks the arm 111 in raised position. The lever 63 of the fuse holder A1 at this time is still rigidly positioned and the movement of the lower end of the tube 49 moves up the roller 117. This moves the bell crank 107 counterclockwise until its stop 131 strikes an edge 133 of casting 85. This limits the outward movement of the fuse holder A1 and predetermines the position of arm 111 of the bell crank 107.

Likewise, when the fuse holder A3 is invertedly applied to its casting 87 and rotated upwardly, the first action is for a lug 135 on its then rigid lever 63 to contact the toe 125, thus forcing the roller 121 to springingly ride over the lower corner of the tube 49 of the fuse holder A2 which is then temporarily in circuit-closing position.

Then as the fuse holder A3 is forced into circuit-closing position, its upper end strikes the right-hand end 8 of the upper rocker 45 so that the left-hand end of rocker 45 forces the unblown fuse holder A2 from circuit closing position. The fuse holder A2 then rotates forwardly and its lower end forces up the roller 121 (Fig. 4) so that the bell crank 109 is rotated counterclockwise until its lever 113 is in upward position corresponding to the upward position of the lever 111 and the lug 137 thereof contacts an edge 139 of the casting 87. This limits the outward movement of the fuse holder A2 and sets the lever 113.

The apparatus is then in position as shown in Figures 1 and 2. Upon a short-circuit or an overload, the fuse 61 in fuse holder A3 blows. Thereupon, the tube 49 of the fuse holder A3 moves downwardly (Fig. 5) and rotates relatively to the corresponding lever 63 (Fig. 6). Ultimately it gravitates down with the lever 113. The lever 113 moves clockwise and the roller 121 depresses the lower end of the tube 49 of the fuse holder A2 (Figures 5 and 6). Fuse holder A2 is rotated counterclockwise into circuit-closing position, and assumes the current-carrying functions of the fuse holder A3 after a short interval of time (Figures 7 and 8). The roller 121 rides down the lower end of the tube 49 of the fuse holder A2, springingly riding over the lower end in its final position under urging from the descending fuse holder A3 on the lever 113 (Fig. 6).

If the line is not cleared, or upon a subsequent overload or short circuit, the fuse in the fuse holder A2 may blow; whereupon the holder A2 moves downwardly in the same way and rotates outwardly so that its tube 49 contacts the lever 111 to rotate the bell crank 107 clockwise, thereby forcing down the roller 117 on the lower end of the fuse holder A1 so as to force said fuse holder A1 counterclockwise into circuit-closing position (Fig. 9). The roller 117 is also springingly forced down off the lower end of its tube 49.

Finally, if and when the fuse in fuse holder A1 blows, the fuse holder A1 rotates into inverted open-position (Fig. 10). The lineman finding all fuses blown removes all of the fuse holders (Fig. 11) and re-fuses and then applies them as above described (Figures 12, 13 and 1). It is of course apparent that if he notes a switch with only the fuse holder A1 in circuit-closing position, he may remove the blown fuse holders A2 and A3 and re-fuse them. He then replaces them and rotates them into circuit-closing positions in the order above described; or if A1 and A2 are in position, A3, if blown, may be removed and re-fused.

Among the advantages of the invention may be noted the fact that a lineman in order to operate the device needs to learn only to remove blown fuse holders, re-fuse them, and re-apply them (as many as have been blown) in order from left to right and as they are consecutively applied to immediately rotate them into line-closing positions. No levers or trips need to be manipulated.

As the first fuse holder is immediately rotated into line-closing position, the line is re-established in a minimum time by the first fuse holder that is reapplied. Then as the subsequent fuse holders are applied to circuit-closing position, those formerly applied are automatically thrown out of circuit-closing positions until the last fuse holder A3 is as shown in Fig. 1. The others are then in open-circuit position, cocked and ready to be thrown into circuit-closing positions automatically as subsequent fuses blow. No current interruption occurs after the fuse holder A1 is closed into circuit, because the succeeding ones are consecutively thrown into circuit-closing position before preceding ones are thrown out of circuit-closing position for cocking. It will be seen that during the instant that one fuse holder comes into contact and the preceding fuse holder is going out of contact, the circuit is closed through two fuses which means that the circuit is never interrupted after the fuse holder A1 has once been placed in circuit-closing position.

It will be seen that the closing operations are due entirely to the torque effected by the weight of, and outward swing of the fuse tubes. Thus a mechanical advantage is provided for the weight of each fuse holder whereby positive closure is effected by gravity only and without springs or auxiliary relay devices of any kind.

Because of the interlocks, it is impossible for a lineman to improperly apply fuse holders or to bring about an arrangement of parts which would cause jamming of failure to operate.

It will be understood that although the embodiment described refers to a plurality of three fuse holders, that a switch incorporating a plurality of two or more than three may be designed to incorporate the invention described and claimed herein.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In apparatus of the class described, a circuit, a plurality of pairs of line terminals associated therewith, fuse holders having terminal-engaging elements, said fuse holders being entirely removable from the line terminals, interlock means requiring that each fuse holder be applied to its respective line terminal and moved substantially toward closed-circuit position before the next fuse holder can be applied.

2. In apparatus of the class described, a circuit, a plurality of pairs of line terminals associated therewith, fuse holders having terminal-engaging elements, said fuse holders being entirely removable from the line terminals, interlock means requiring that each fuse holder be applied to its respective line terminal and moved substantially toward closed-circuit position before the next fuse holder can be applied, and means whereby, as successive fuse holders are forced into circuit-closed position, preceding fuse holders move from previously assumed closed-circuit positions to cocked, open-circuit positions.

3. In apparatus of the class described, a circuit, a plurality of pairs of line terminals associated therewith, fuse holders having terminal-engaging elements, said fuse holders being entirely removable from the line terminals, interlock means requiring that each fuse holder be applied to its respective line terminal and moved substantially toward closed-circuit position before the next fuse holder can be applied, means whereby, as successive fuse holders are forced into circuit-closed position, preceding fuse holders move from previously assumed closed-circuit positions to cocked, open-circuit positions, and means whereby the blowing of holders in circuit cause them to successively move precedingly cocked holders into circuit in the inverse order of their applications to the circuit.

4. In apparatus of the class described, a plurality of pairs of line terminals, fuse holders having terminal-engaging elements, said fuse holders being entirely removable from the line terminals, interlock means requiring that each fuse holder be applied to its respective line terminal and moved toward closed-circuit position before the next fuse holder can be applied, and means whereby as successive fuse holders are forced into circuit-closed position preceding fuse holders move from their closed-circuit positions to cocked positions, means automatically causing the last-applied fuse holder to move to open circuit position upon blowing, said preceding cocked fuse holders moving to re-closed positions in the reverse order of their application to circuit-closed position.

5. In apparatus of the class described, a plurality of pairs of line terminals, fuse holders having terminal-engaging elements, said fuse holders being entirely removable from the line terminals, interlock means requiring that each fuse holder be applied to its respective line terminal and moved substantially toward closed-circuit position before the next fuse holder can be applied, means whereby as successive fuse holders are forced into circuit-closed position, precedingly applied fuse holders move from their closed-circuit positions to cocked positions, means automatically causing a fuse holder last-applied to circuit-closing position to move to open-circuit position upon an overload, said preceding cocked fuse holders moving to reclosed positions in reverse order.

6. In apparatus of the class described, a plurality of line terminals, fuse holders, terminal-engaging elements thereon, said terminal-engaging elements being applicable to said line terminals to close a circuit, fuses in the fuse holders, mech-

anisms associated therewith adapted to be held in predetermined positions by the fuses so that said fuse holders may remain in circuit-closing positions, said mechanisms being adapted upon blowing of the respective fuses to permit gravitational movement of the respective fuse holders to open-circuit positions, means whereby when one fuse holder is placed in closed-circuit position another one is placed in cocked position ready to be thrown into circuit-closing positions, and gravitationally actuated means whereby as a fuse holder moves from closed-circuit position its weight moves an adjacent fuse holder from cocked to closed-circuit position.

7. In apparatus of the class described, a plurality of line terminals, fuse holders, terminal-engaging elements thereon, a terminal-engaging element being applicable to a respective line terminal, the fuse holder being rotatable thereon to contact another line terminal to close a circuit, fuses in the fuse holders, mechanisms associated therewith adapted to be held in predetermined positions by the fuses so that said fuse holders may be forced to and remain in circuit-closing positions, said mechanisms being adapted upon blowing of the respective fuses to permit swinging gravitational movement of the respective fuse holders on one terminal-engaging element to open-circuit positions, means whereby when one fuse holder is swung into closed-circuit position an adjacent one is partially swung out and into a cocked position ready to be thrown back into circuit, and gravitationally actuated means whereby as a fuse holder swings out from closed-circuit position the torque due to its weight swings an adjacent fuse holder from cocked to closed-circuit position.

8. In apparatus of the class described, a plurality of line terminals, fuse holders, terminal-engaging elements thereon, said terminal-engaging elements being applicable to said line terminals, fuses in the fuse holders, mechanisms associated therewith adapted to be held in predetermined positions by the fuses so that said fuse holders may remain in circuit-closing positions, said mechanisms being adapted upon blowing of the respective fuses to permit gravitational movement of the respective fuse holders to open-circuit positions, means whereby when one fuse holder is in closed-circuit position the others are in cocked positions ready to be thrown into circuit, and gravitationally actuated means whereby as a fuse holder moves from closed-circuit position its weight moves an adjacent fuse holder from cocked to closed-circuit position, and means whereby said fuse holders must be re-applied to the apparatus after re-fusing in an inverse order to their order of blowing.

9. In apparatus of the class described, a plurality of line terminals, fuse holders, terminal-engaging elements thereon, said terminal-engaging elements being applicable to said line terminals, fuses in the fuse holders, mechanisms associated therewith adapted to be held in predetermined positions by the fuses so that said fuse holders may remain in circuit-closing positions, said mechanisms being adapted upon blowing of the respective fuses to permit gravitational movement of the respective fuse holders to open-circuit positions, means whereby when one fuse holder is in closed-circuit position the others are in cocked positions ready to be thrown into circuit, gravitationally actuated means whereby as a fuse holder moves from closed-circuit position its weight moves an adjacent fuse holder from cocked to closed-circuit position, and means whereby said fuse holders must be re-applied to the apparatus after re-fusing in an inverse order to their order of blowing, successively closed fuse holders re-opening previously closed ones to cocked positions, the one last to be closed maintaining the circuit, and the others moving serially to cocked positions.

10. In apparatus of the class described, a plurality of pairs of line terminals, fuse holders having terminal-engaging elements, means whereby one terminal-engaging element on each fuse holder may be applied to and pivoted to one line terminal, the other terminal-engaging element being adapted by swinging movement of the fuse holder to contact the other line terminal, interlock means adapted when a preceding fuse holder is in open-circuit position to prevent application of a succeeding fuse holder, but permitting said succeeding fuse holder to be applied when said preceding fuse holder has been moved substantially toward circuit-closing position.

11. In apparatus of the class described, a plurality of pairs of line terminals, fuse holders having terminal-engaging elements, means whereby one terminal-engaging element on each fuse holder may be applied to and pivoted to one line terminal, the other terminal-engaging element being adapted by swinging movement of the fuse holder to contact the other line terminal, interlock means adapted when a preceding fuse holder is in open-circuit position to prevent application of a succeeding fuse holder, but permitting said succeeding fuse holder to be moved toward circuit-closing position when said preceding fuse holder has been moved substantially toward circuit-closing position, said fuse holders comprising tubular members having open bottoms which are downwardly directed when the fuse holders are in or near circuit-closing positions, and means associated with said interlocks comprising protecting hoods adapted to cover said openings when the respective fuse holders gravitate to inverted positions substantially away from closed-circuit positions.

12. In apparatus of the class described, a plurality of pairs of line terminals, fuse holders having upper and lower terminal-engaging elements and adapted to be dependingly supported from their lower terminal-engaging elements and to be rotated so that the respective upper terminal-engaging elements close contact with the respective line terminals, means whereby when a succeeding fuse holder is rotated into connected position a preceding one is removed from connected position but cocked for reconnection, and means whereby upon blowing of the fuse holder which is left in circuit-connected position it moves from circuit-closing position and the preceding fuse holder moves from cocked position back into circuit-closing position.

13. In apparatus of the class described, a plurality of pairs of line terminals, fuse holders having terminal-engaging elements and adapted to be dependingly supported from their lower terminal-engaging elements and to be rotated so that upper terminal-engaging elements close contact with respective ones of said line terminals, means whereby when a succeeding fuse holder is rotated into connected position a preceding one is removed from connected position but cocked for reconnection, and means whereby upon blowing of the fuse holder which is left in circuit-connected position it moves from circuit-

closing position and the preceding fuse holder moves from cocked position back into circuit-closing position, and means for forcing an operator to apply a fuse holder and rotate it substantially toward circuit-closing position before the next succeeding fuse holder can be applied.

14. In apparatus of the class described, a plurality of pairs of line terminals, fuse holders having terminal-engaging elements and adapted to be dependingly supported from their lower terminal-engaging elements and respectively on line terminals and adapted to be rotated so that upper terminal-engaging elements close contact with certain of said line terminals, means whereby when a succeeding fuse holder is rotated into connected position a preceding one is removed from connected position but cocked for reconnection, means whereby upon blowing of the fuse holder which is left in circuit-connected position it moves from circuit-closing position and the preceding fuse holder moves from cocked position back into circuit-closing position, and means for forcing an operator to apply a fuse holder and rotate it into circuit-closing position before the next succeeding fuse holder can be applied, each application of the fuse holder and rotation into circuit-closing position automatically throwing a preceding fuse holder out of circuit-closing position.

15. In apparatus of the class described, a plurality of pairs of line terminals, fuse holders having terminal-engaging elements and adapted to be dependingly supported and to be rotated so that respective upper terminal-engaging elements close contact with respective ones of said line terminals, means whereby when a succeeding fuse holder is rotated into connected position a preceding one is removed from connected position but cocked for reconnection, and means whereby upon blowing of the fuse holder which is left in circuit-connected position it moves from cocked position back into circuit-closing position, means for forcing an operator to apply a fuse holder and rotate it into circuit-closing position before the next succeeding fuse holder can be applied, each application of the fuse holder and rotation into circuit-closing position automatically throwing a preceding fuse holder out of circuit-closing position, and thereafter each blowing of a fuse holder forcing into circuit-closing position a precedingly applied and cocked fuse holder.

16. In apparatus of the class described, pairs of spaced line terminals, fuse holders having terminal-engaging elements, means associated with certain of the terminal-engaging elements for supporting the fuse holders on certain of the line terminals whereby the respective fuse holders may be rotated into positions with their other terminal-engaging elements contacting certain of said line terminals, levers pivoted at said last-named line terminals and having arms extending to be contacted by adjacent terminal-engaging elements of adjacent fuse holders, and organized so that a fuse holder coming into line contact forces an adjacent fuse holder out of contact.

17. In apparatus of the class described, pairs of spaced line terminals, fuse holders having terminal-engaging elements, means associated with certain of the terminal-engaging elements for supporting the fuse holders on certain of the line terminals whereby the respective fuse holders may be rotated into positions with their other terminal-engaging elements contacting certain of said line terminals, levers pivoted at said last-named line terminals and having arms extending to be contacted by adjacent terminal-engaging elements of adjacent fuse holders, and organized so that a fuse holder coming into line contact forces an adjacent fuse holder out of contact, and means requiring in normal operation that a given fuse holder be moved to engagement before the next fuse holder may be applied for engagement.

18. In apparatus of the class described, pairs of line terminals, fuse holders having pairs of terminal-engaging elements, certain of the terminal-engaging elements of the fuse holders being adapted to be pivoted in certain line terminals, the other pairs of terminal-engaging elements being movable into contact with the other line terminals respectively, means whereby the movement of successive fuse holders into circuit-closing position causes removal of preceding fuse holders from circuit-closing position to cocked positions, and means between the respective fuse holders adapted to be moved into positions upon the successive closures of the fuse holders so that the preceding fuse holders are limited in their movement from their circuit-closing positions to said cocked positions.

19. In apparatus of the class described, pairs of line terminals, fuse holders having pairs of terminal-engaging elements, certain of the terminal-engaging elements of the fuse holders being adapted to be pivoted in certain line terminals, the other pairs of terminal-engaging elements being movable into contact with the other line terminals respectively, lever means whereby the movement of successive fuse holders into circuit-closing position causes removal of preceding fuse holders from circuit-closing position to cocked positions, and bell-crank means between the respective fuse holders adapted to be moved into positions upon the successive closures of the fuse holders so that the preceding fuse holders are limited in their movement from their circuit-closing positions to said cocked positions.

20. In apparatus of the class described, pairs of line terminals, fuse holders having pairs of terminal-engaging elements, certain of the terminal-engaging elements of the fuse holders being adapted to be pivoted in certain line terminals, the other pairs of terminal-engaging elements being movable into contact with the other line terminals respectively, lever means whereby the movement of successive fuse holders into circuit-closing position causes removal of preceding fuse holders from circuit-closing position to cocked positions, and bell-crank means between the respective fuse holders adapted to be moved into positions upon the successive closures of the fuse holders so that the preceding fuse holders are limited in their movement from their circuit-closing positions to said cocked positions, said bell-cranks being adapted to be contacted by fuse holders moving to circuit-opening positions to force adjacent cocked fuse holders to circuit-closing positions.

21. In apparatus of the class described, pairs of line terminals, fuse holders having pairs of terminal-engaging elements, certain of the terminal-engaging elements of the fuse holders being adapted to be pivoted in certain line terminals, the other pairs of terminal-engaging elements being movable into contact with the other line terminals respectively, fuses in the fuse holders, mechanisms associated with the fuse holders held in given positions by the fuses when unblown but releasing the fuse holders from

closed- to open-circuit positions when the fuses blow, means whereby the movement of successive fuse holders into circuit-closing position causes removal of preceding fuse holders from circuit-closing position to cocked position, bell-crank means between the respective fuse holders adapted to be moved into positions upon the successive closures of the fuse holders so that the preceding fuse l.. ders are limited in their movement from their circuit-closing positions to said cocked positions, said fuse holders when said fuses blow being permitted by said mechanisms associated therewith to gravitate onto the respective bell-cranks to force the adjacent unblown fuse holders from cocked to circuit-closing positions respectively.

22. In apparatus of the class described, pairs of line terminals, fuse holders having pairs of terminal-engaging elements, certain of the terminal-engaging elements of the fuse holders being adapted to be pivoted in certain line terminals, the other pairs of terminal-engaging elements being movable into contact with the other line terminals respectively, means whereby the movement of successive fuse holders into circuit-closing position causes removal of preceding fuse holders from circuit-closing position to cocked position, bell-crank means between the respective fuse holders adapted to be moved into positions upon the successive closures of the fuse holders so that the preceding fuse holders are limited in their movement from their circuit-closing positions to said cocked positions, the fuse holders in their cocked positions forcing said bell-crank means to positions to be engaged by blown fuse holders as they move from circuit-closing positions.

23. In apparatus of the class described, a plurality of pairs of line terminals, tubular fuse holders, lower terminal-engaging elements on the fuse holders and upper terminal-engaging elements thereon, portions of said holders extending downwardly from the lower terminal-engaging elements, bell-crank means between fuse holders having a part engageable by the lower portion of a first fuse holder when said fuse holder is swung into closed-circuit position and another portion swingable thereby into the line of movement of a second fuse holder, a second means between fuse holders whereby when the said first one is swung into circuit-closing position, the second one is moved from circuit-closing position, said portion of the bell-crank associated with the second fuse holder being forced by said first holder until the bell-crank reaches a state whereby said second fuse holder is held in an open circuit but cocked position, said bell-crank having a third element which, in its last-named position of the bell-crank, is adapted to be contacted by the first-named fuse holder when it moves from circuit-closing position to force said part associated with the second-named fuse holder to send the second fuse holder from cocked to circuit-closing position.

24. In apparatus of the class described, pairs of line terminals, fuse holders having pairs of terminal-engaging elements, certain of the terminal-engaging elements of the fuse holders being adapted to be pivoted in certain line terminals, the other pairs of terminal-engaging elements being movable into contact with the other line terminals respectively, means whereby the movement of successive fuse holders into circuit-closing position causes removal of preceding fuse holders from circuit-closing position to cocked position, bell-crank means between the respective fuse holders adapted to be moved into positions upon the successive closures of the fuse holders so that the preceding fuse holders are limited in their respective movements from their circuit-closing positions to said cocked positions, the fuse holders in their cocked positions forcing said bell-crank means to positions to be engaged by blown fuse holders as they move from circuit-closing positions, said bell-crank means functioning under the circuit opening movements of the fuse holders to force adjacent cocked fuse holders into circuit-closing positions.

25. In apparatus of the class described, pairs of line terminals, fuse holders having pairs of terminal-engaging elements, certain of the terminal-engaging elements of the fuse holders being adapted to be pivoted in certain line terminals, the other pairs of terminal-engaging elements being movable into contact with the other line terminals respectively, means whereby the movement of successive fuse holders into circuit-closing position causes removal of preceding fuse holders from their respective circuit-closing positions to cocked positions, bell-crank means between the respective fuse holders adapted to be moved into positions upon the successive closures of the fuse holders so that the preceding fuse holders are limited in their movements from their circuit-closing positions to said cocked positions, the fuse holders in their cocked positions forcing said bell-crank means to positions to be engaged by blown fuse holders as they move from circuit-closing positions, said bell-crank means functioning under the circuit-opening movements of the fuse holders to force adjacent cocked fuse holders into circuit-closing position, said bell-crank means after reclosure of the fuse holders from cocked position moving to starting positions, and the successive closing fuse holders moving said bell-crank means to positions where they will cooperate to limit movement of a preceding fuse holder from a circuit-closing position to a cocked position.

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