April 21, 1970 L. V. CHABALA ET AL 3,508,178

HIGH VOLTAGE SWITCH HAVING AUXILIARY LATCH OPERATING MEANS FOR THE CURRENT INTERRUPTER

Filed April 3, 1968 3 Sheets-Sheet 1

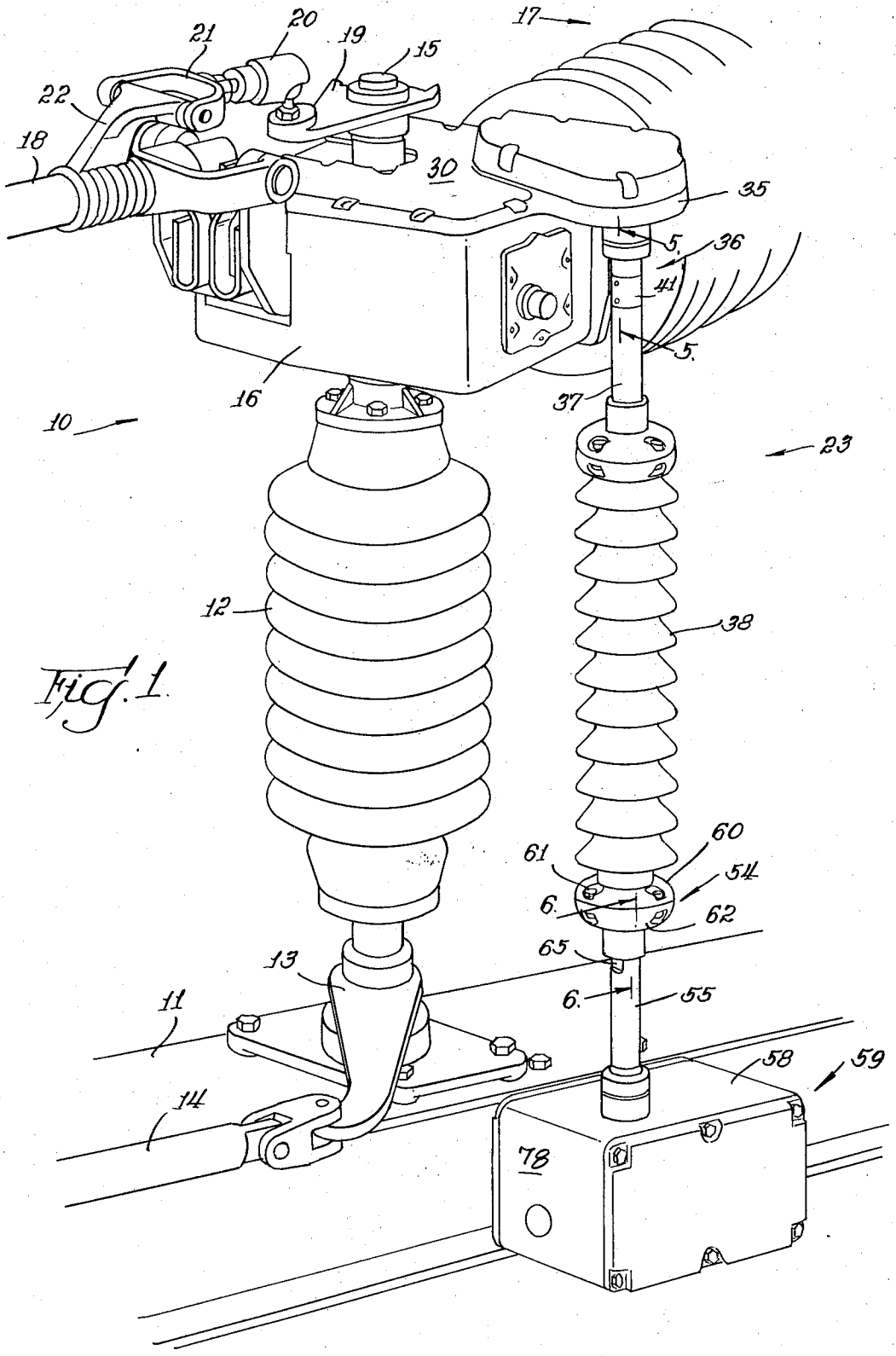


Fig. 1

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Fig. 2

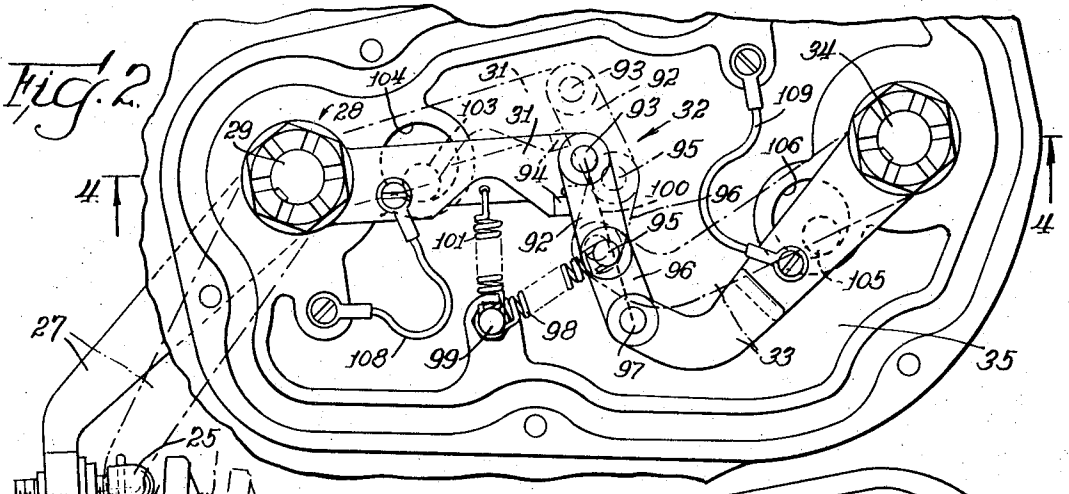


Fig. 3

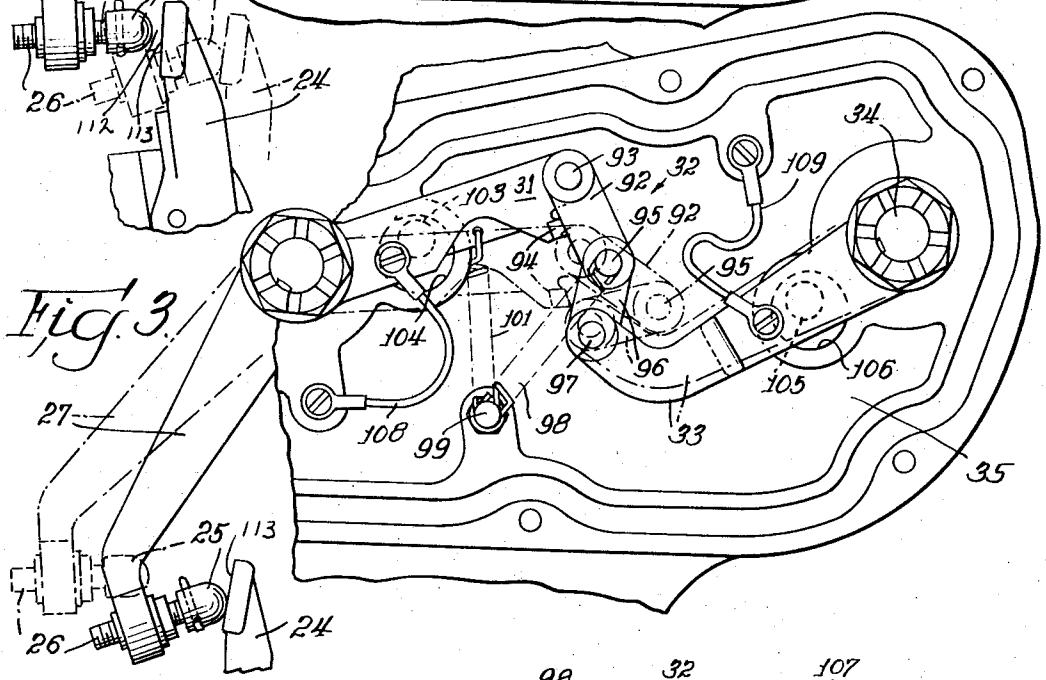
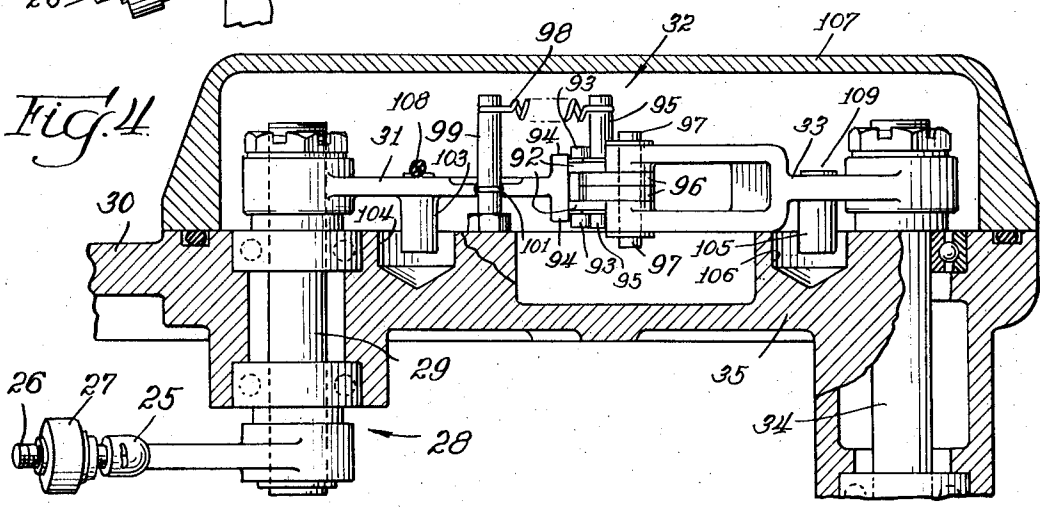


Fig. 4



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Fig. 5

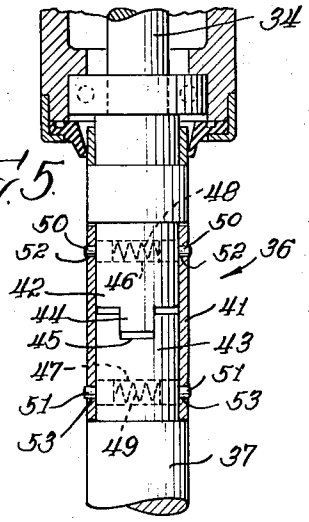


Fig. 8

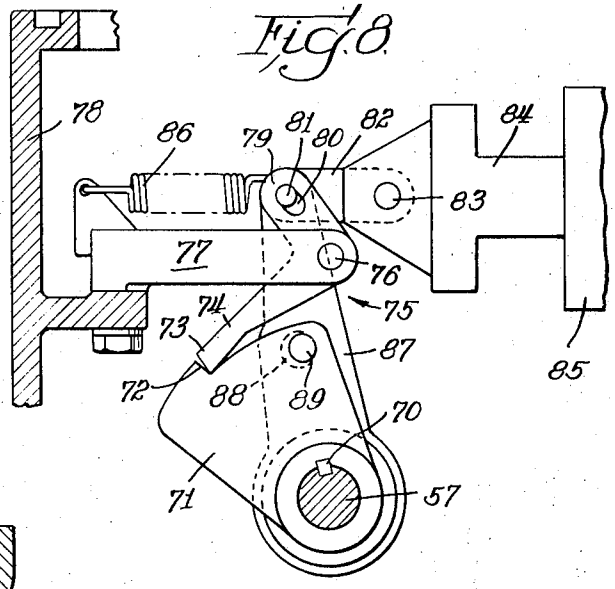


Fig. 6

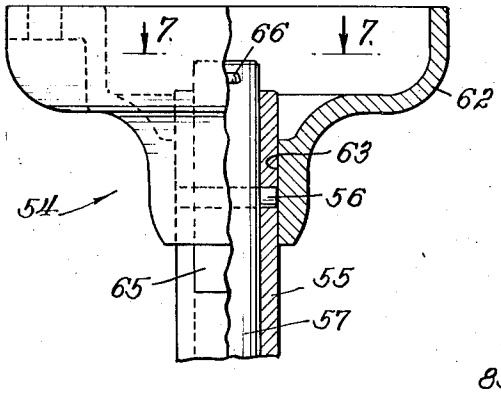
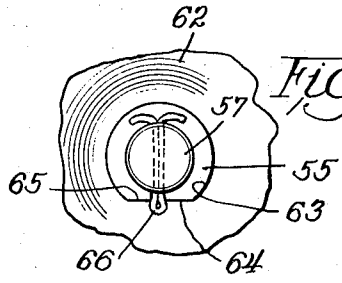


Fig. 7



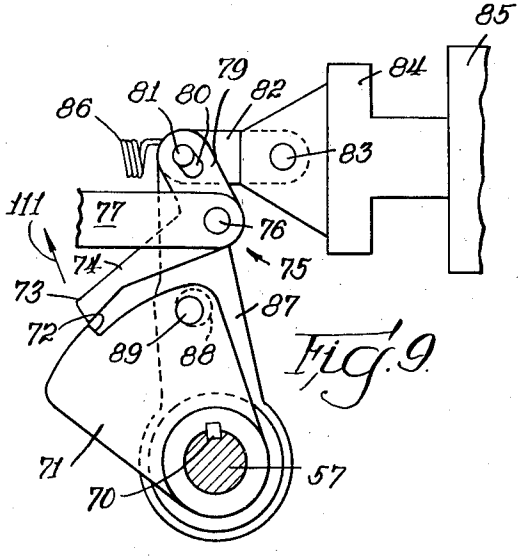


Fig. 9

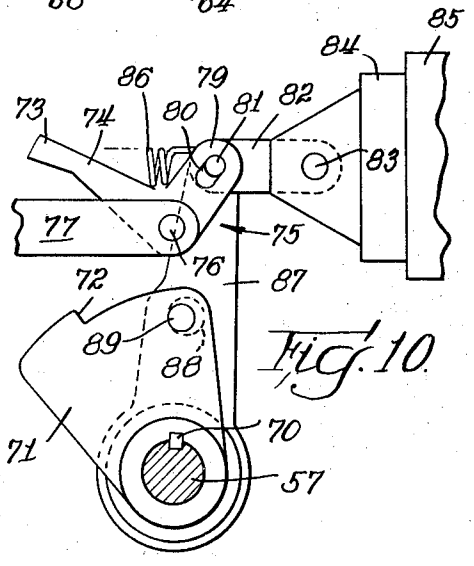


Fig. 10

United States Patent Office 3,508,178 Patented Apr. 21, 1970

3,508,178

HIGH VOLTAGE SWITCH HAVING AUXILIARY LATCH OPERATING MEANS FOR THE CURRENT INTERRUPTER

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Int. Cl. H01h 3/02, 9/00, 31/00
U.S. Cl. 335—1 12 Claims

ABSTRACT OF THE DISCLOSURE

A collapsible toggle linkage interconnects an auxiliary trip operator and the latch that restrains spring operated current interrupting means to permit resetting of the latch independently of return of the auxiliary trip operator to non-operated position and an auxiliary latch permits operation of the auxiliary trip operator only when a solenoid operator is energized.

This invention is an improvement over the construction disclosed in Lindell et al. Patent 3,116,391, issued Dec. 31, 1963.

In that patent there is disclosed a spring operated latch released mechanism for opening the contacts of current interrupting means connected in series with a disconnecting switch blade which is subsequently opened. The latch is released and the switch blade is swung to the open position by switch operating mechanism that has substantial inertia and requires a substantial time, particularly to release the latch. In the patent a solenoid operated auxiliary trip operator is arranged to release the latch separately from and in advance of its release by the switch operating mechanism. In that construction there is the possibility that the auxiliary trip operator may not return to its non-operated position with the result that the latch is held in the unlatched position or is not permitted to reset. Further, the trip operator may be inadvertently caused to perform its function without the solenoid being operated. This may result in undesired tripping of the current interrupting means.

Among the objects of this invention are: To arrange for the return of the latch that holds current interrupting means against operation after it has been tripped by auxiliary operating means independently of the return of the auxiliary operating means to its non-operated position; to accomplish this by a collapsible toggle linkage interconnecting the auxiliary operating means and a lever that engages and releases the latch; to prevent operation of the auxiliary operating means except on energization of a solenoid provided for this purpose; and to employ an auxiliary latch for preventing false operation of the auxiliary operating means which is moved to unlatched position on energization of the solenoid.

According to this invention a toggle linkage interconnects the solenoid operated auxiliary trip operator and the lever that releases the latch of the current interrupting means. After the latch has been released to open the contacts of the current interrupting means, the toggle linkage is arranged to collapse in order to permit the latch to reset and the lever to return to its non-operated position independently of the return of the trip operator to its non-operated position. An auxiliary latch prevents operation of the auxiliary trip operator until the solenoid is energized whereupon the auxiliary latch is moved to unlatched position and the auxiliary trip operator is rotated to drive through the toggle linkage and rotate the lever that releases the latch of the current interrupting means.

In the drawings: FIG. 1 is a perspective view of a portion of a combination disconnecting switch and current

interrupter in which this invention is embodied. FIG. 2 is a top plan view of the collapsible toggle linkage employed in the construction shown in FIG. 1 and shows by full lines the non-operated position of the mechanism and by broken lines the operated position of the mechanism before collapse of the toggle linkage. FIG. 3 is a view, similar to FIG. 2 and shows by full lines the operated position of the toggle linkage which is shown by broken lines in FIG. 2, and by broken lines the collapsed position of the toggle linkage. FIG. 4 is a vertical sectional view taken generally along the line **4—4** of FIG. 2. FIG. 5 is a vertical sectional view taken generally along the line **5—5** of FIG. 1 and shows the details of construction of the flexible joint. FIG. 6 is a vertical sectional view taken generally along the line **6—6** of FIG. 1, certain parts being shown in elevation to illustrate the details of construction of the slip joint. FIG. 7 is a horizontal view taken generally along the line **7—7** of FIG. 6. FIG. 8 is a plan view of the solenoid operated linkage arranged to operate the auxiliary trip mechanism with a cam lock shown in the locked non-operated position, certain parts being shown in section. FIG. 9 is a view, similar to FIG. 8, and shows the linkage on energization of the solenoid and with the auxiliary latch lever moved out of engagement with the cam lock. FIG. 10 is a view, similar to FIG. 9, and shows the final position of the linkage operated by energization of the solenoid.

In FIG. 1 the reference character **10** designates, generally, switch means which constitutes a portion of one phase of a three phase switch described in more complete detail in the patent above referred to. If desired, the switch means **10** can be employed for single phase operation. The switch means **10** includes a base **11**. The operating means for the switch means **10** includes a rotatable insulator **12** that is suitably journaled at its lower end on the base **11** and has an arm **13** connected to an operating link **14**. At its upper end the insulator **12** has an upstanding shaft **15** which extends through a metallic spring mechanism housing **16** that is held stationary by a current interrupter that is indicated, generally, at **17**. Disconnecting switch blade **18** is rotatably mounted on the mechanism housing **16**. It is arranged to be operated on rotation of the shaft **15** through a switch crank **19** that is connected by a link **20** to a clevis **21** which, in turn, is rotatably connected to an arm **22** that extends from the switch blade **18**. On rotation of the insulator **12** by suitable operation of the operating link **14**, the latch in the mechanism housing **16** is released to permit the current interrupter **17** to interrupt the circuit. Continued rotation of the insulator **12** causes the switch blade **18** to swing to open circuit position followed by recharging of the spring in the mechanism housing **16** which is held by a latch and reclosure of the contacts in the current interrupter **17**.

Because of the inertia of the rotatable insulator **12** and parts connected thereto, a substantial time is required for effecting the tripping of the latch in the mechanism housing **16** and opening of the contacts in the current interrupter **17**. Accordingly, as disclosed in the patent above referred to, provision was made for tripping the latch by auxiliary operating means having substantially less inertia and therefore a lesser operating time than is required for the tripping of the latch by rotation of the insulator **12**. While the auxiliary latch tripping mechanism of the above patent was satisfactory under normal operating conditions, it was found that its operation might be impaired under certain adverse operating conditions. In the event that, for some reason, the auxiliary trip operator did not automatically return to its non-operated position, the latch might be held in the operated position and would not be permitted to reset. Accordingly, the spring in the mechanism housing **16** would not be held against operation and the contacts in the current interrupter **17**, which

should have been held in the closed position, would be operated to the open position and thus proper operation of the switch means **10** would be interfered with. Also there was the possibility that the auxiliary trip mechanism intended to be operated on energization of a solenoid would be operated inadvertently which would cause a false operation of the switch means **10**. In accordance with this invention provision is made for overcoming these possible improper operations through the use of auxiliary trip or independent operating means indicated, generally, at **23**.

In FIGS. 2, 3 and 4 there is indicated at **24** an extension of the main latch for the spring in the mechanism housing **16** which is arranged to open the contacts in the current interrupter **17**. When the main latch extension **24** is rotated from the full line position shown in FIG. 2 to the broken line position, the latch is operated to release the spring in the mechanism housing **16** to permit it to open the contacts of the current interrupter **17**. As pointed out above, that operation can be effected through rotation of the insulator **12** but a substantial time is required to accomplish it. Using the auxiliary trip or independent operating means **23**, the contacts in the current interrupter **17** can be opened in a relatively short time such as within 8 cycles of 60 cycle alternating current.

The main latch extension **24** is arranged to be engaged by a plastic nose **25** which is carried by an adjusting screw **26** which is threaded in the distal end of an arm **27** that forms a part of a trip lever which is indicated, generally, at **28**. The trip lever **28** includes a shaft **29**, FIG. 4, that is journaled in a cover **30** for the mechanism housing **16** and has fastened to its upper end an arm **31**. The distal end of the arm **31** is connected by collapsible linkage means, indicated generally at **32**, FIG. 2, to the distal end of an arm **33** which is secured to the upper end of a shaft **34** which is journaled in an extension **35** of the mechanism housing **16**. The lower end of the shaft **34** is connected by a flexible joint, shown generally at **36** in FIG. 5, to a shaft **37** which is secured to the upper end of and is rotatable with an insulator **38**. The insulator **38** has substantially the same length as the insulator **12** in order to provide the required degree of insulation for the mechanism housing **16** and energized parts connected thereto but it is substantially smaller in diameter since it is not required to transmit the torque required to be transmitted by the insulator **12**.

In FIG. 5 the details of construction of the flexible joint **36** are shown. The flexible joint **36** includes a sleeve **41** that is telescoped over the juxtaposed reduced diameter ends **42** and **43** of the shafts **34** and **37**. A key section **44** depends from the lower end of the shaft **34** for insertion in a slot **45** in the upper end of the shaft **37**. Transverse apertures **46** and **47** are provided in the reduced diameter ends **42** and **43** for receiving coil compression springs **48** and **49** that urge detents **50** and **51** outwardly into openings **52** and **53** near the upper and lower ends of the sleeve **41**. The flexible joint **36** constructed as described permits a limited degree of flexing between the upper end of the rotatable insulator **38** and the shaft **34** to accommodate slight misalignment therebetween.

At its lower end the rotatable insulator **38** has a slip joint that is indicated, generally, at **54** and the details of construction are shown more clearly in FIG. 6. The slip joint **54** includes a sleeve **55** which is secured against rotation by a transverse pin **56** to the upper end of a shaft **57** which extends through and is journaled in a top wall **58**, FIG. 1, of a metallic housing **59** that is suitably secured to one side of the base **11**. The slip joint **54** also includes a flange **60** that is secured to the lower end of the rotatable insulator **38** and is connected by bolts **61** to a mounting flange **62** which is telescoped over the upper end of the sleeve **55**. An opening **63**, FIG. 7, extends through the lower portion of the mounting flange **62** for receiving the upper end of the sleeve **55**. The opening **63** has a flat side to provide non-rotatable engagement with a flat side **65** of the sleeve **55**. A cotter pin **66** extends through the upper end of the shaft **57** to prevent disassembly of the slip joint **54**. By employing the slip joint **54** which permits limited relative longitudinal movement between the rotatable insulator **38** and the sleeve **55**, it is unnecessary to position the metallic housing **59** with a great deal of precision on the base **11**. Also expansion and contraction of the various parts is accommodated through a limited extent by the slip joint **54**.

As pointed out the shaft **57** extends into the metallic housing **59**. In FIG. 8 it will be observed that a key **70** secures a cam lock **71** to the shaft **57** so that they rotate conjointly. As pointed out above it is desirable to prevent inadvertent rotation of the shaft **57** in order to prevent inadvertent tripping of the current interrupter **17** to the open position. For this purpose a shoulder **72** is formed on the cam lock **71** and is arranged to be engaged by a distal end **73** of an arm **74** which forms a part of an auxiliary latch lever that is indicated, generally, at **75**. The auxiliary latch lever **75** is pivoted at **76** on a support **77** which extends inwardly from a side wall **78** of the metallic housing **59**. Another arm **79** of the auxiliary latch lever **75** has a slot **80** near its distal end for receiving a transverse pin **81** to make pivotal and sliding connection to a link **82** which is pivotally connected at **83** to an armature **84**. An electrically energizable solenoid **85** is arranged to attract the armature **84** for rotating the shaft **57** against the force of a retraction spring **86**. The driving connection to the shaft **57** from the link **82** is effected through a driving arm **87** that is freely rotatably mounted on the shaft **57**. A lost motion opening **88** is formed in the driving arm **87** for receiving a driving pin **89** that extends inwardly from the cam lock **71**.

On energization of the solenoid **85**, the armature **84** is attracted so as to move to the right to the position shown in FIG. 9 which is accompanied by rotation of the auxiliary latch lever **75** and movement of the distal end **73** out of the path of the shoulder **72** on the cam lock **71**. During this interval the driving arm **87** is rotated through a limited extent to bring the opposite side of the lost motion opening **88** into engagement with the driving pin **89**. This lost motion not only provides for movement of the distal end **73** of the arm **74** out of the path of the shoulder **72** but also it permits the armature **74** to accelerate without any load being applied thereto. The continued movement of the armature **84** to the right rotates the driving arm **87** to the position shown in FIG. 10 where the auxiliary latch lever **75** is swung to the position there shown and the shaft **57** has been rotated to the extent indicated.

This rotation of the shaft **57** is accompanied by a corresponding rotation of the rotatable insulator **38** and similar rotation of the arm **33**, FIG. 2, from the position shown by full lines to the position shown by broken lines. Because of the connection provided by the collapsible linkage means **32**, the trip lever **28** is rotated from the position shown by full lines to the position shown by broken lines with the result that the plastic nose **25** engages the distal end of the main latch extension **24** and moves it to the unlatched position whereupon the contacts in the current interrupter **17** are opened.

As pointed out above, there is the possibility that the arm **33** might not return to its position shown by full lines in FIG. 2. This might occur because of the armature **84** having been retained in the operated position shown in FIG. 10. Accordingly, it is desirable that provision be made to permit the trip lever **28** to return to the untripped or full line position shown in FIG. 2. It is for this purpose that the collapsible linkage means **32** is provided. It includes a pair of links **92**, FIGS. 2, 3 and 4, that are connected

by a pivot pin **93** to the distal end of the arm **31** which forms a part of the trip lever **28**. Stops **94** on the upper and lower sides of the arm **31** are engaged by the juxtaposed sides of the links **92** to limit their movement in a clockwise direction relative to the arm **31**. At their other ends the links **92** are connected by a pivot pin **95** to a pair of links **96** which are positioned between the links **92** and are connected by a pivot pin **97** to the distal end of the arm **33** which rotates with the shaft **34** that is connected by the flexible joint **36** to the rotatable insulator **38**. In order to hold the links **92** and **96** in the overcenter position shown in FIG. 2 and to return them to that position, a coil tension spring **98** is connected at one end to the pivot pin **95** and at the other end to a spring anchor **99** which extends upwardly from the cover **30** of the mechanism housing **16**. In FIG. 2 it will be observed that the coil tension spring **98** holds the links **92** and **96** in such position that the pivot pin **95** is slightly to one side of a line **100** which interconnects the pivot pins **93** and **97**. In this position due to the reaction between the links **92** and the stops **94**, the links **92** and **96** function as a compression member between the pivots **93** and **97** and transmit the rotation of the arm **33** to the arm **31** of the trip lever **28**. A coil tension spring **101** interconnects the spring anchor **99** and the arm **31** of the trip lever **28** to return it to the untripped or non-operated position indicated by full lines in FIG. 2.

It is desirable to limit the extent of rotation of the trip lever **28** and of the arm **33**. For this purpose, as shown more clearly in FIG. 4, a boss **103** depends from the arm **31** and extends into a cavity **104**. In like manner a boss **105** extends from the arm **33** into a cavity **106**.

In order to protect the trip lever **28**, collapsible linkage means **32** and arm **33** from the weather, a cover **107** is arranged to overlie them and to be connected by suitable means to the cover **30**. Flexible shunts **108** and **109** interconnect the cover **30** and the arms **31** and **33** for the purpose of maintaining all of these parts at the same potential.

In describing the operation of the auxiliary trip or independent operating means **23** it will be assumed that the main latch extension **24** occupies the position shown by full lines in FIG. 2 and that the trip lever **28**, collapsible linkage **32** and arm **33** occupy the positions similarly shown in this figure. The solenoid **85**, FIG. 8, is energized to attract the armature **84**. The auxiliary latch lever **75** is rotated in the direction indicated by arrow **111**, FIG. 9, to the unlocked position before any movement of the cam lock **71** takes place because of the lost motion provided by the lost motion opening **88** in the driving arm **87** and the driving pin **89** extending thereinto from the cam lock **71**. This lost motion permits the armature **84** to accelerate for more readily rotating the insulator **38** and parts rotatable therewith on continued movement of the armature **84** to the position shown in FIG. 10. Because of the stop **94**, the links **92** and **96** function as a compression member and, on rotation of the arm **33** to the position shown by broken lines in FIG. 2, the trip lever **28** is rotated from the position shown by full lines to the position shown by broken lines. As a result of rotation of the arm **31** of the trip lever **28** and due to the reaction between the links **92** and the stops **94**, the pivot pin **95** is moved from one side of the line **100** connecting the pivots **93** and **97** to the opposite side and to the position shown by broken lines in FIG. 2 which corresponds to the broken line position of the arm **27** and the tripped or operated position of the main latch extension **24** shown by broken lines in FIG. 2.

In the event that the retraction spring **86**, FIG. 8, were unable to return the arm **33** to the full line position shown in FIG. 2 but rather it were to remain in the position shown by full lines in FIG. 3, then the spring **101** acts to return the trip lever **28** to the position shown by broken lines in FIG. 3 in which case the linkage means **32** further collapses from its position shown by broken lines in FIG. 2 to the position shown by broken lines in FIG. 3 In this figure the positions of the main latch extension **24**, trip lever **28** and arm **33** shown by full lines correspond to the positions of these same parts shown by broken lines in FIG. 2. Now it will be apparent that the main latch extension **24** will be free to reset by the return of the trip lever **28** to the non-operated position by the coil tension spring **101** independently of the movement of the arm **33** and rotatable insulator **38** to the non-operated position. As a result there is no interference with the subsequent recocking of the spring in the mechanism housing **16** and reclosure of the contacts of the current interrupter **17**.

Under normal operating conditions, as soon as the solenoid **85**, FIG. 8, is deenergized, the retraction spring **86** returns the armature **84** to the position here shown. The opposite side of the lost motion opening **88** engages the driving pin **89** and through the cam lock **71** the shaft **57** is rotated to the non-operated position with the auxiliary latch lever **75** returned to the latched position shown in FIG. 8. The coil tension spring **98**, FIG. 2, acts to return the linkage means **32** from the collapsed position shown in either FIG. 2 or FIG. 3 to the overcenter position shown in FIG. 1.

As pointed out, the lost motion provided by the opening **88** and the driving pin **89** permits the armature **84** to accelerate and move a slight distance before rotating the shaft **57**. Thus, an impact is applied to the insulator **38** to accelerate it and the parts rotatable therewith. This impact is transmitted through the collapsible linkage means to the trip lever **28** and the plastic nose **25** which initially is spaced, as indicated at **112** and adjusted by screw **26**, from a face **113** of the main latch extension **24**. This permits the application of a substantial impact to the main latch extension **24** for moving it to unlatched position.

What is claimed as new is:

1. Switch means comprising:
a current interrupter,
means biasing said current interrupter to open position,
a latch holding said current interrupter closed,
operating means for tripping said latch to open said current interrupter, and
auxiliary trip means operable independently of said operating means to trip said latch including:
a pivoted first arm arranged to trip said latch,
a pivoted second arm arranged to be rotated by independent operating means, and
collapsible linkage means interconnecting the distal ends of said arms for releasing said latch to return to latched position independently of return of said auxiliary trip means to non-operated position.

2. In switch means including a current interrupter biased to open position and held closed by a latch with operating means to trip said latch to open said current interrupter and auxiliary trip means operable independently of said operating means to trip said latch, the improvement wherein
said auxiliary trip means includes:
collapsible linkage means for releasing said latch to return to latched position independently of return of said auxiliary trip means to non-operated position, said collapsible linkage means comprising:
a first link pivoted at one end to the distal end of a first arm arranged to trip said latch,
a second link pivoted at one end to the distal end of a second arm arranged to be rotated by independent operating means,
means pivotally interconnecting the other ends of said links,
stop means on said first arm, and
spring means biasing said first link into engagement with said stop means and said

links to a position in which the pivotal connection therebetween lies to one side of a line interconnecting their pivotal connections to said arms and rotation of said second arm causes rotation of said first arm to trip said latch and to shift said links to another position in which said pivotal connection is shifted to the opposite side of said line and said first arm is permitted to return to its non-operated position independently of said second arm.

3. Switch means according to claim 2 wherein

said spring means is connected to said means pivotally interconnecting said other ends of said links, and

additional spring means bias said first arm to non-operated position.

4. The switch means according to claim 3 wherein means connect said additional spring means to said first arm.

5. The switch means according to claim 2 wherein stop means individual to each of said arms limit the rotation thereof through predetermined extents.

6. The switch means according to claim 2 wherein

said auxiliary trip means also includes auxiliary operating means for releasing said latch by force transmitted through said collapsible linkage means, and

auxiliary latch means prevent operation of said auxiliary trip means until released by energization of said auxiliary operating means.

7. The switch means according to claim 6 wherein said operating means includes

a rotatable insulator connected at one end to said collapsible linkage means, and

solenoid operated means connected to the other end of said rotatable insulator.

8. The switch means according to claim 7 wherein said auxiliary latch means includes means to prevent rotation of said rotatable insulator and to be moved to unlatched position on energization of said solenoid operated means.

9. The switch means according to claim 8 wherein lost motion connecting means between said rotatable insulator and said solenoid operated means effect unlatching of said auxiliary latch means in advance of the start of rotation of said insulator.

10. The switch means according to claim 7 wherein

a flexible joint interconnects said one end of said rotatable insulator and said collapsible linkage means, and

a slip joint interconnects said other end of said rotatable insulator and said solenoid operated means.

11. In combination:

a current interrupter biased to open position,

a latch holding said current interrupter closed,

trip means for tripping said latch to open said current interrupter, and

auxiliary trip means for tripping said latch including:

a rotatable member,

means interconnecting said rotatable member and said latch,

a driving arm rotatable on said rotatable member,

an armature connected to a distal end of said driving arm,

a solenoid for operating said armature to rotate said driving arm,

a cam lock secured to said rotatable member adjacent said driving arm, and

lost motion connecting means between said driving arm and said cam lock to allow said armature and said driving arm to move initially independently of said cam lock and said rotatable member on energization of said solenoid.

12. The combination according to claim 11 wherein:

said cam lock has a shoulder,

an auxiliary latch lever is arranged to engage said shoulder and prevent rotation of said rotatable member, and

means interconnect said auxiliary latch lever and said armature to move said latch lever out of the path of said shoulder before said cam lock is rotated by said armature.

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D. M. MORGAN, Assistant Examiner

U.S. Cl. X.R.

74—520; 200—48, 153; 335—174, 191