

Nov. 16, 1943.

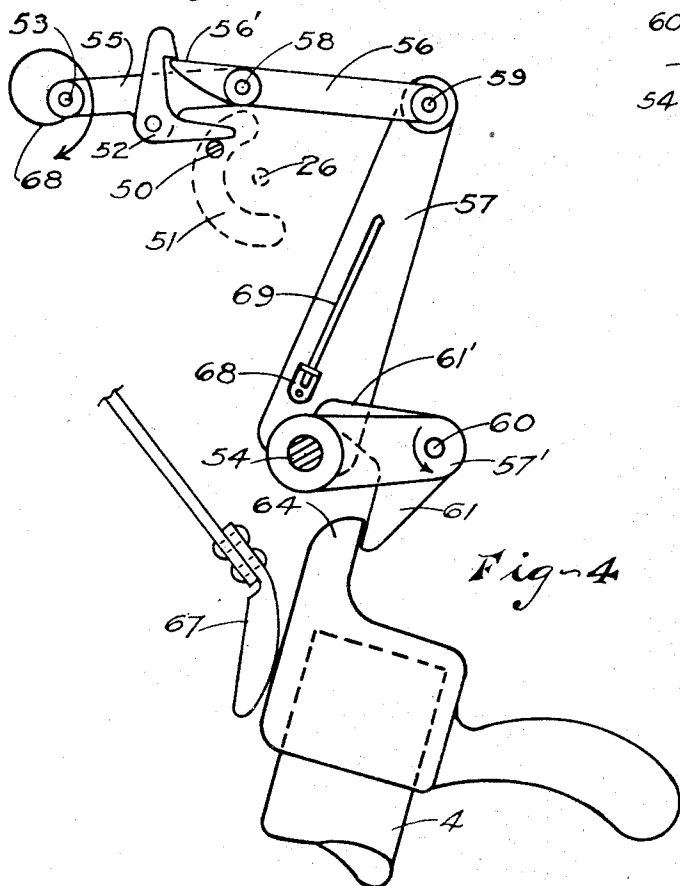
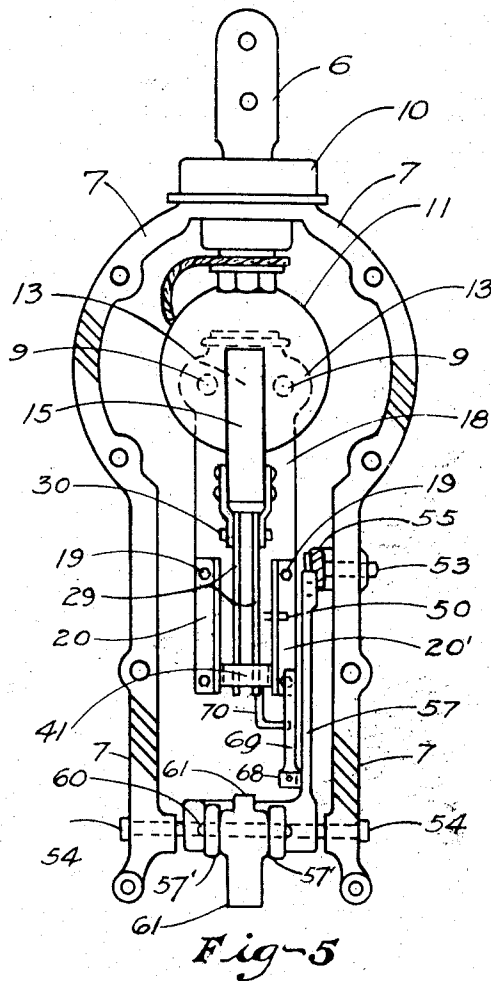
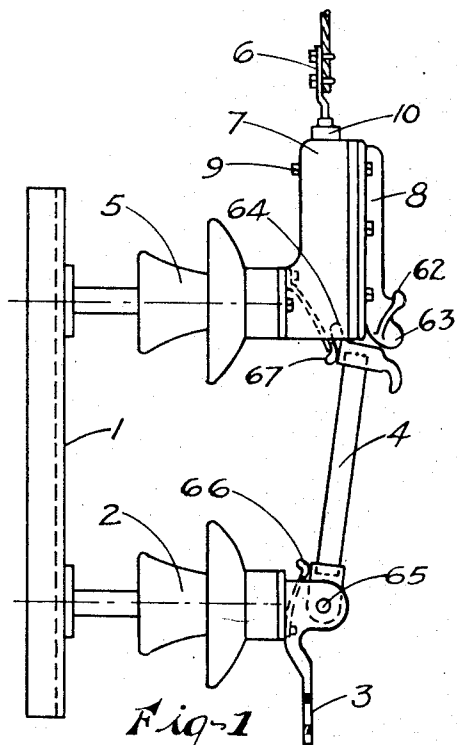
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2,334,339

ELECTRIC SWITCH SYSTEM

Filed Feb. 2, 1942

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

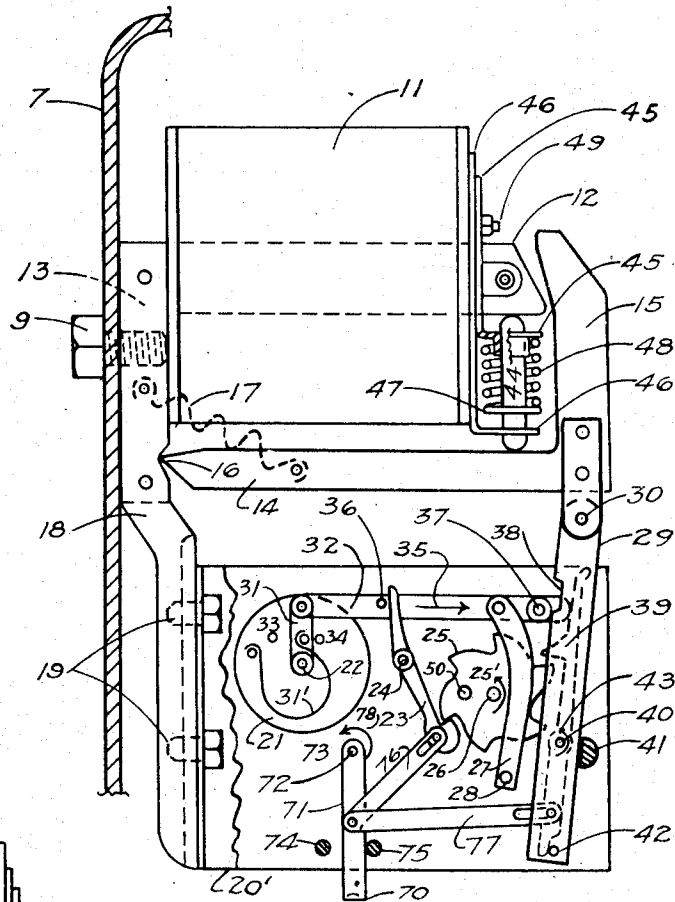


Fig-2

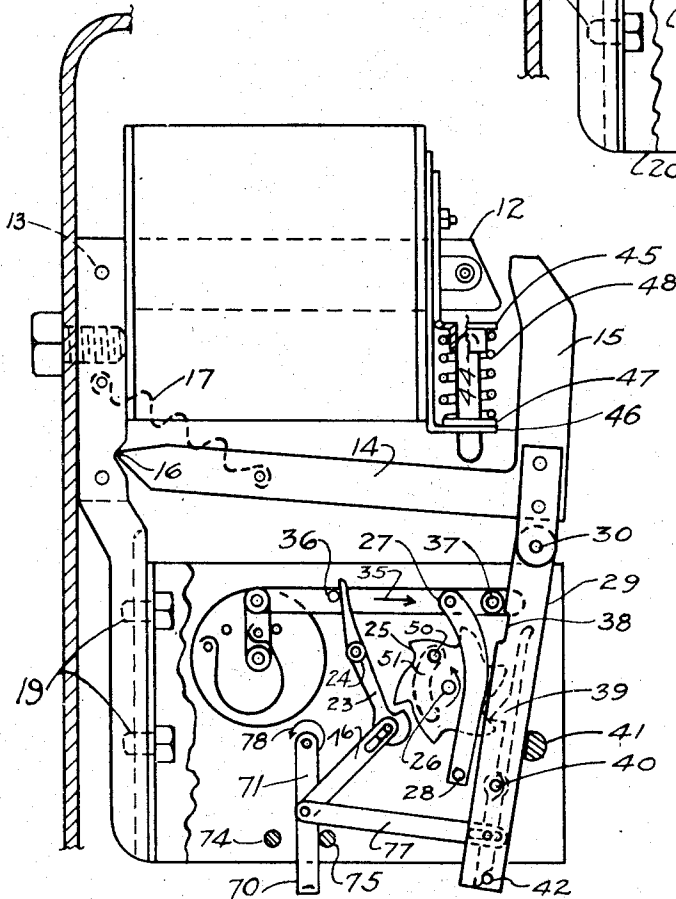


Fig-3

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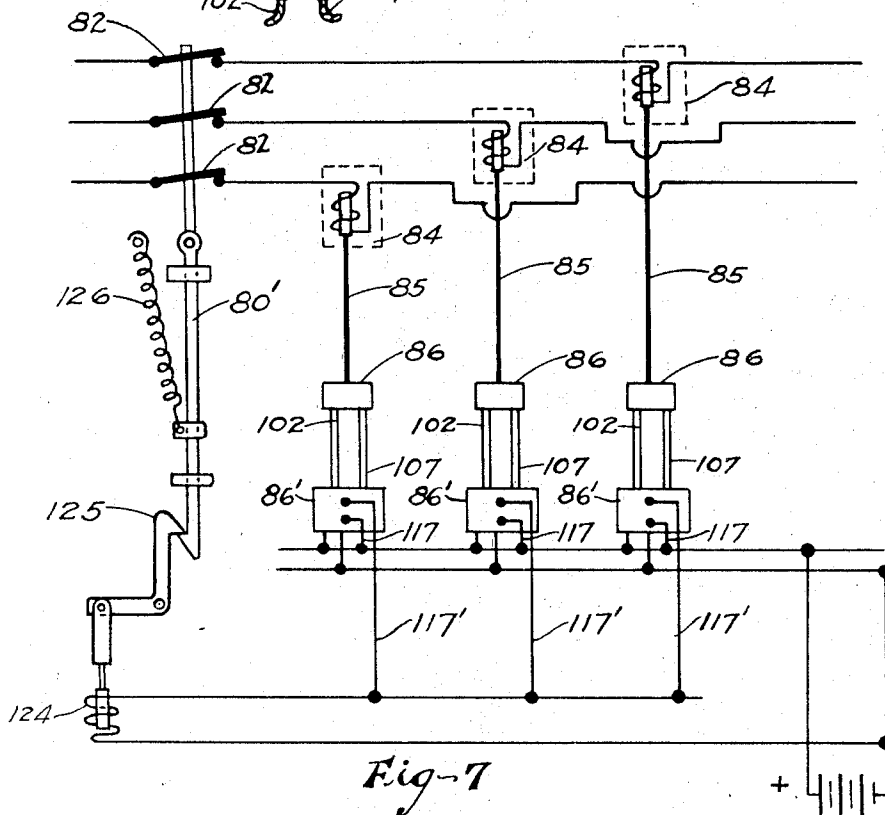
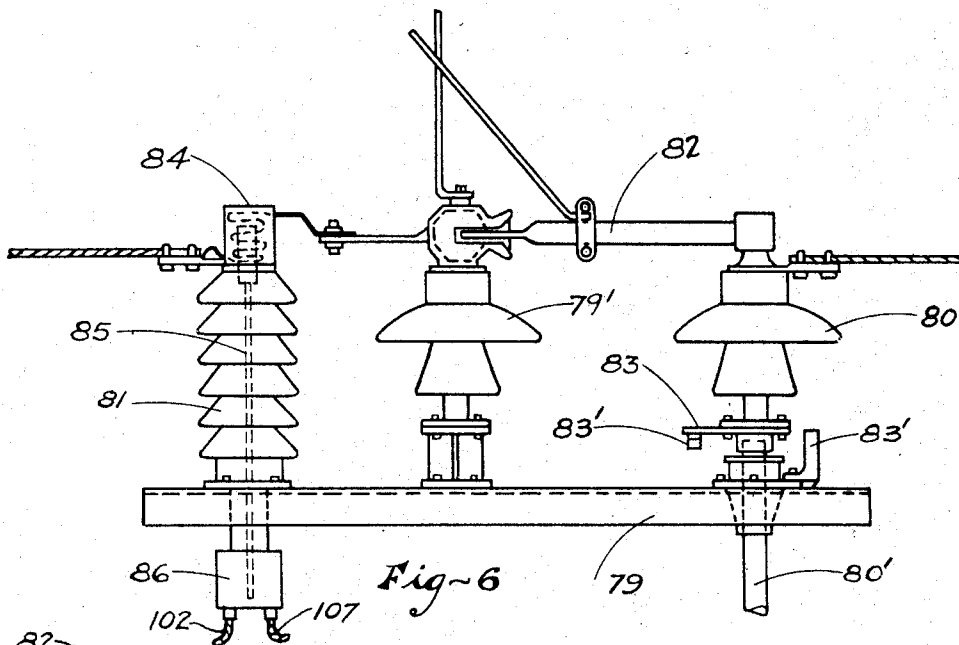
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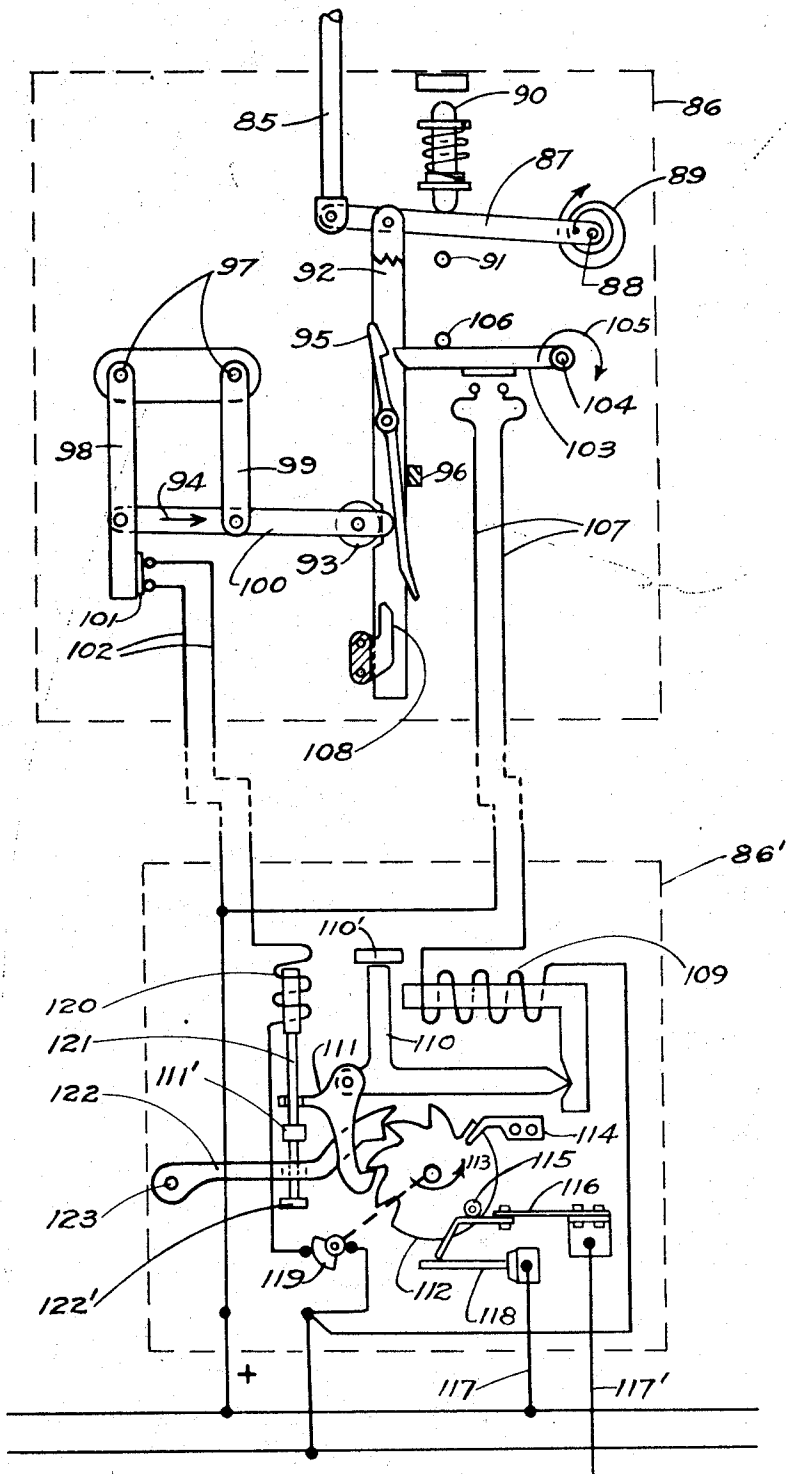


Fig-8

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ELECTRIC SWITCH SYSTEM

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8 Claims. (Cl. 200—108)

The invention relates to automatic switches, and particularly to switches which automatically open the circuit only when permanent trouble has developed, but which do not open the circuit if the trouble is merely transient.

One purpose is to provide a switch suitable for feeding one section of a circuit which is all fed through an automatic oil circuit breaker that opens automatically upon overload. Such a switch acts to isolate its section of the circuit from the rest provided permanent trouble has developed in that section, whereby service can be resumed on all other parts of the circuit. Another purpose is to provide a means whereby one long circuit can readily be subdivided into successive sections. Another purpose is to provide a device for opening a circuit if and only when overload conditions have been immediately followed by no-load conditions for a predetermined number of times successively.

One form of device embodying the invention is shown in Fig. 1; the control coil and mechanism of the device are shown in side view at Fig. 2; Fig. 3 is similar to Fig. 2 but with parts in the no-load positions; Fig. 4 shows in side view the switch-release mechanism; and Fig. 5 is a front view of the mechanism with the cover 8 removed.

Another form of the invention which is suitable for operating a three phase air break switch is indicated in Fig. 6, which shows one unit of a three-phase switch. Fig. 7 is a diagram for one method of wiring the control circuits for the three-phase installation, and Fig. 8 shows the details of the overload notching devices.

As shown in Fig. 1, a base 1 supports the insulator 2 upon which are mounted the line terminal 3 and the pivotally movable switch arm 4. Upon the insulator 5 are mounted the other line terminal 6, the housing 7 with its cover 8, and also the latch which engages and holds in contact the switch arm 4. Within the housing 7, the mechanism shown in Fig. 2 is supported by the bolts 9, 9. Through the insulator 10 the circuit goes from 6 through the housing 7 to the solenoid coil 11, whose magnetic circuit includes the stationary parts 12, 13, and the movable parts 14, 15 which rock about the V hinge 16 and which are partially counter-balanced by the two springs 17. The supporting block 18 is secured to 13, it provides recesses for two bolts 9, 9 and it supports by the screws 19—19 the two side plates 20, 20' of the notching unit. Between the plates 20, 20' are the inertia wheel 21 on its pivot 22, the ratchet 23 on its pivot 24,

the notch wheel 25 on its pivot 26, the guide-bar 27 on its pivot 28, and the double ratchet-bar 29 which is pivotally connected at 30 with the rocker 14, 15. Figs. 2 and 3 show these parts, with plate 20 removed.

The arm 31 turns freely about the pivot 22 between the limits of the pins 33, 34 which are set in the wheel 21; a suitable spring 31' biases the arm 31 and the pin 34 towards one another; and the bar 32 is pivotally connected to 31 and to 27 so that it can travel approximately longitudinally. Another spring indicated by the arrow 35 biases the bar 32 in the direction indicated. The pin 36 in arm 32 is engageable with ratchet 23, and the roller 37 which is mounted on 32 rolls along one edge of the bar 29 or drops into the notch 38, due to the bias of spring 35. The ratchet 39 is pivoted at 40 between the two sides of the bar 29; the rivet pin 42 spaces the two sides of the bar 29 and also serves as a stop for the ratchet 39; and a spring indicated by the arrow 43 biases 39 in the direction indicated. The guide 41 spaces the two sides 20, 20', and serves also to direct the vertical travel of bar 29 and its ratchet 39.

Figure 2 shows the parts at the top of their travel, the movable stop pin 44 acting to prevent 14, 15 from rising any closer to the core 12. Two guides 45, 46 guide the pin 44; the collar 47 is securely attached to the pin 44, and the spring 48 biases the pin 44 downwardly until the collar 47 comes against the stop 46. The bolts and nuts at 49 hold the stops 45, 46 and slots in 45 allow adjustment of 45 up and down, thereby changing at will the tension on the spring 48 without changing the positions of the pin 44.

A suitable spring, indicated by the arrow 25', biases the notch wheel 25 counter-clockwise as indicated by the arrow, and as the wheel 25 rotates a pin 50 secured to the wheel 25 travels through the slot 51 in the side plate 20'. See Fig. 3. The end of the pin 50 is beyond the plate 20' and is engageable with the tail of the latch 52, as shown in Fig. 4. The tail of latch 52 is offset so that the pin 50 does not enter the plane occupied by 55, 56, 57, or 59. The pivots 53 and 54 are stationary and are supported inside the housing 7. The linkage members 55, 56, and 57 are joined by the movable pivots 58 and 59, and the latch 52 engages with the end 56' of the member 56. The clevis 57' is part of the member 57, and the pivot 60 supports the latch 61 which is biased by a suitable spring in the direction shown by the arrow, the portion 61' acting as a stop against the hub of the member 57.

The cover 3 carries a drip-groove 62 and two wing-guides 63 between which the upper end of the switch arm 4 is guided as the arm is closed. The upper end of the arm 4 has a projection 64 which is engaged and held by the latch 61. The arm 4 is pivoted at 65 and the spring contacts 66 and 67 press outwardly against 4 biasing it clockwise around the pivot 65. A spring arm 69 is attached at 68 to the arm 57. The arm 57 has a projection 68 to which is secured the spring arm 69. This is in the same plane as the projection 70 of the arm 71 which is pivoted at 72.

Operation is as follows. Under no-load conditions the armature 14-15 is at its lowest position, shown in Fig. 3, and the ratchet-bar 29 is also down. When normal load comes on the line the solenoid 11 exerts enough pull to lift the armature 14-15 up. When 14 comes in contact with the stop pin 44 it encounters the pressure of the spring 48, which is sufficient to hold the armature against further upward travel. When the ratchet-arm 29 is in this mid-position the notch 38 is at the roller 37 and therefore the spring 35 moves the bar 32 against the ratchet 39, thereby releasing 39 from the notch-wheel 25. At the same time the pin 36 releases the latch 23 from holding the wheel 25, which is therefore free to turn and so it is rotated counter-clockwise until the pin 50 reaches the lower end of the slot 51, thereby stopping the wheel 25 at its reset position.

Whenever overload conditions occur, the pull of the solenoid 11 is enough to lift the armature 14-15 against gravity and against the tension of the spring 48 until the pin 44 comes against the core 12, as shown in Fig. 2. Now if the overload is suddenly succeeded by no-load conditions, as when the main oil circuit breaker opens, then the armature 14-15 is released to drop to the no-load position. In doing this the bar 29 is dropped quickly, and there is not time for the roller 37 to enter the slot 38 before the slot has passed beyond the roller. Such motion of the roller 37 is retarded by the inertia of the wheel 21, for the roller 37 cannot be moved without partially rotating the heavy wheel 21.

Since the ratchet 39 is thus not moved by the end of the bar 32, it engages with one of the teeth of the notch-wheel 25 and moves it clockwise one tooth, whereupon the latch 23 engages and holds the wheel. Now if a second overload condition occurs and is followed immediately by the opening of the circuit breaker and no-load conditions, then the ratchet 39 again turns the wheel 25 another tooth. A third overload-to-no-load operation will turn the wheel 25 another tooth, making a total of three notches from the reset position. As the third notch motion is made the pin 50 engages with the tail of the latch 52, thereby disengaging 52 from 56'. This releases the toggle 55, 58, 56 so that 57 can rotate counter-clockwise about its pivot 54, carrying with it the latch 61 and so releasing the projection 64 on switch arm 4. Impelled by the spring contacts 66 and 67, the arm 4 swings outwardly and downwardly thereby opening the main electric circuit between 3 and 6.

As the arm 57 completes its switch-opening motion, the spring 69 engages the extension 70 of the arm 71 and partially rotates the arm 71 around the pivot 72. The member 76 moves the latch 23, and member 77 moves latch 39, thereby releasing both latches from the wheel 25 which immediately turns counter-clockwise to its re-

set position, due to the biasing spring 25'. Pins 74 and 75 limit the travel of arm 71.

With no pressure against the latch 61, the spring 68 resets the linkage 55, 56, 57 to normal position shown in Fig. 4, and then when the arm 4 is again manually closed it is held by the latch 61 in normal closed circuit position. With the arm 57 in normal position, the spring 78 biases the arm 71 against the stop 75.

After the first or second notching operation, if normal current is established through the main circuit, the armature 14, 15 assumes the mid-position, thereby placing the slot 38 adjacent to the roller 37. Therefore, the spring 35 moves the bar 32 against the latch 39 and the pin 36 moves the latch 23. This releases the wheel 25 which immediately resets, impelled by spring 25'.

By changing the length of slot 51 the reset position of wheel 25 is readily modified, and so the device may be arranged to open the main circuit after any predetermined number of notching operations, limited by the number of teeth in the wheel 25. And whatever the setting of such adjustment, normal current flowing through the circuit at any time before the completion of the predetermined number of notching operations, will cause the wheel 25 to be reset. After such resetting the notching sequence again begins at zero.

The invention may also be used in operating a three-phase switch. Fig. 6 shows a single unit of such a three-pole switch, in which the base 79 supports the stationary switch insulator 79' the rotative switch insulator 80, and the tubular insulator 81. The operating rod 80' rotates the insulator 80 thereby moving the switch arm 82 and also the crank 83 and the interconnecting bar 83', by which the two other poles of the switch are operated.

On top of insulator 81 in a housing 84 is a solenoid in series with the line and corresponding to solenoid 12, 13, 14, 15 in Fig. 2. The insulating rod 85 inside the tubular insulator 81 corresponds to bar 29 in Fig. 2.

Attached to the lower end of insulator 81 is a housing 86 within which are members shown in Fig. 8. The rod 85 is pivoted to the arm 87 which moves about the stationary pivot 88; and the spring 89 biases the arm 87 as indicated, thereby partially counterbalancing the weight of rod 85. The stop pin 90 is similar to stop pin 44 in Fig. 2. The stop 91 limits the downward travel of arm 87, which has the three definite no-load, normal-load and overload positions similar to those explained for the Fig. 2 equipment. The arm 92, the roller 93, the spring 94, the latch 95 and the stop 96 correspond to the parts 29, 37, 35, 39, and 41 in Fig. 2. The pivots 97 are stationary and the links 98, 99 movably support the bar 100 with its roller 93 and its biasing spring 94. The link 98 carries a contact block 101 which closes circuit 102 when bar 100 is moved to the right as the roller 93 drops into the slot in bar 92. The contact arm 103 is pivoted at 104, biased clockwise by spring 105 and limited in its travel by stop 106. At normal-load position latch 95 does not engage arm 103; at overload position 95 engages with arm 103, and when dropping suddenly from overload to no-load position, latch 95 pulls arm 103 downward bridging the two spring terminals of circuit 107 and momentarily closing the circuit 107. At the bottom of its full travel, latch 95 encounters stop 108 which moves 95 counter-clockwise and so releases arm 103, which then returns against stop 106.

At a suitable location the solenoid 109 and its armature 110 operate the latch 111 and so turn the notch wheel 112 one notch against the bias of its spring 113. Stop 114 and pin 115 limit the counter-clockwise movement of wheel 112 and determine its initial position. After the predetermined number of notching operations, the pin 115 presses downwardly on the spring contact 116, thereby closing circuit 117, 117 at 118, as shown in Fig. 8. Operating on the same pivotal shaft with wheel 112 is the circular switch 119 which opens its circuit only when the wheel 112 is at its zero position, and keeps its circuit closed at all other positions of wheel 112. Solenoid 120 by means of rod 121 acts to release 111 from wheel 112 and also lifts the ratchet 122 about its pivot 123 thereby releasing it from wheel 112.

As shown in Fig. 7 each pole of a three-pole installation includes a unit as shown in Fig. 6, and from each housing 86 two circuits, 102 and 107, extend to the housing 86'. These last may be located at any convenient position, and a suitable battery provides current to operate all the devices. In any one of the switch units, overload followed suddenly by no-load conditions will momentarily operate the bar 103 to close circuit 107, thereby energizing the coil 109 and notching the wheel 112 clockwise for one notch. After the predetermined number of such operations successively, the pin 115 acts to close the corresponding circuit 117—117'. This in turn energizes solenoid 124, which releases latch 125 so that spring 126 opens all three switch arms 82—82.

However, if normal current occurs in the same line solenoid before the predetermined number of notching actions has occurred, then the parts in housing 86 assume positions shown in Fig. 8 and so close circuit 102 and energize solenoid 120. This lifts rod 121, thereby releasing wheel 112 as explained, and all members reset to zero position, with the reset circuit being opened at 119. If so desired, the motion of the arm 100 may be further delayed by an inertia member, just as the motion of arm 32 is delayed by member 21.

One familiar with the art can make many variations in different features of the device as shown, without departing from the purposes and principles of this invention. The claims are not to be limited by the particular forms of the invention as shown and described.

I claim:

1. An electric switch system comprising an electric switch biased toward open-circuit position, holding means to hold the switch closed, tripping means operable to release the said holding means, and control means to operate the said tripping means; the said control means comprising solenoid means with an armature movable between two positions, respectively, under conditions of no-load and overload current flow through the switch and operable to assume and to maintain under normal load conditions a definite position intermediate between the said no-load and overload positions, a registering member operable to make a registration only when the solenoid armature moves suddenly from overload to no-load position, operable to be reset to its initial position whenever the solenoid armature stops at its normal-load position, and operable after a predetermined number of successive registrations to cause operation of the said tripping means.

2. An electric switch system comprising an electric switch biased toward open circuit position, holding means to hold the switch closed, a tripping solenoid operable to release the holding means, and electric controls to operate the said solenoid; the said controls comprising solenoid means with an armature movable between two positions, respectively, under conditions of no-load and overload current flow through the switch and operable to assume and to maintain under normal load conditions a definite position intermediate between the said no-load and overload positions, a registering member operable to make a registration only when the solenoid control means respond to a sudden change from overload to no-load conditions, operable to be reset to its initial position by normal-load conditions in the solenoid control means, and operable after a predetermined number of successive registrations to cause the said tripping solenoid to be energized.

3. An electric switch system comprising an electric switch biased toward open circuit position, holding means to hold the switch closed, tripping means operable to release the holding means, and controls to operate the said tripping means; the said controls including a notching member and a solenoid that is responsive to current flow in the electric switch and that has an armature movable between no-load and overload positions and operable under conditions of normal load to assume and to maintain a definite position intermediate between the no-load and the overload positions, the armature being operable to notch up the notching member one step for each sudden movement from overload to no-load position and to cause operation of the said tripping means after a predetermined number of successive notching up operations have occurred and to reset the notching member to its initial position whenever normal load occurs through the said switch.

4. An electric switch system comprising an electric switch biased toward open-circuit position, holding means to hold the switch closed, tripping means operable to release the said holding means, and control means to operate the said tripping means; the said control means comprising a solenoid with an armature operable to take two different positions respectively under overload and no-load conditions of current flow through the switch, and operable under conditions of normal load to assume and to maintain a definite position intermediate between the no-load and the overload positions, a registering member operable to make a registration whenever the said armature moves suddenly from overload to no-load position, and operable to be reset to its initial position when the armature remains at the normal-load position.

5. An electric switch system comprising an electric switch biased toward open-circuit position, holding means to hold the switch closed, tripping means operable to release the said holding means, and control means to operate the said tripping means; the said control means comprising a solenoid with an armature operable to take two different positions respectively under overload and no-load conditions of current flow through the switch and operable under conditions of normal load to assume and to maintain a definite position intermediate between the no-load and the overload positions, a registering member operable to make a registration when-

ever the said armature moves suddenly from overload to no-load position, and operable to be reset to its initial position when the armature remains at the normal-load position, together with retarding means to delay the initiation of the reset operation.

6. An electric switch system comprising an electric switch biased toward open-circuit position, holding means to hold the switch closed, tripping means operable to release the said holding means, and control means to operate the said tripping means; the said control means comprising a solenoid with an armature operable to take two different positions respectively under overload and no-load conditions of current flow through the switch, and operable under conditions of normal load to assume and to maintain a definite position intermediate between the no-load and the overload positions, a registering member operable to make a registration whenever the said armature moves suddenly from overload to no-load position, and operable to be reset to its initial position when the armature remains at the normal-load position, together with means operable by the opening of the said switch to cause the registering member to be reset.

7. In combination, an electric switch and a control system that includes a solenoid with an armature responsive to the flow of current through the said switch and movable from a no-load to an overload position and operable under conditions of normal load to assume and to maintain a definite position intermediate between the no-load and the overload positions, together with means to bias the armature from the overload to the normal-load position more strongly than from the normal-load to the no-load position.

8. In combination, an electric switch and a control system that includes a solenoid with an armature responsive to the flow of current through the said switch and movable from a no-load to an overload position and operable under conditions of normal load to assume and to maintain a definite position intermediate between the no-load and the overload positions, together with adjustable means to bias the armature from the overload to the normal-load position more strongly than from the normal-load to the no-load position.

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