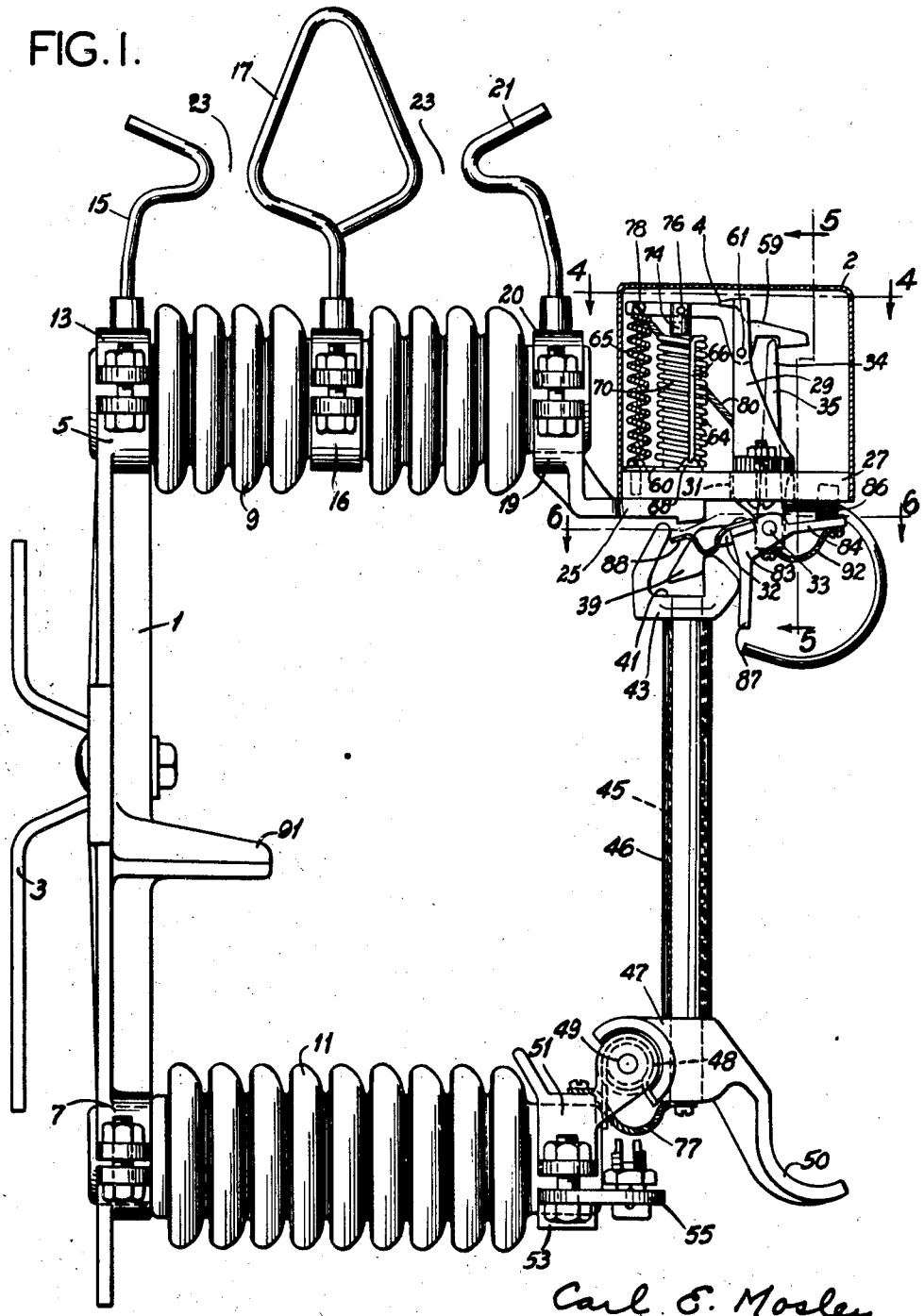
Feb. 22, 1949. C. E. MOSLEY 2,462,212

PROTECTIVE SWITCH

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FIG. 1.



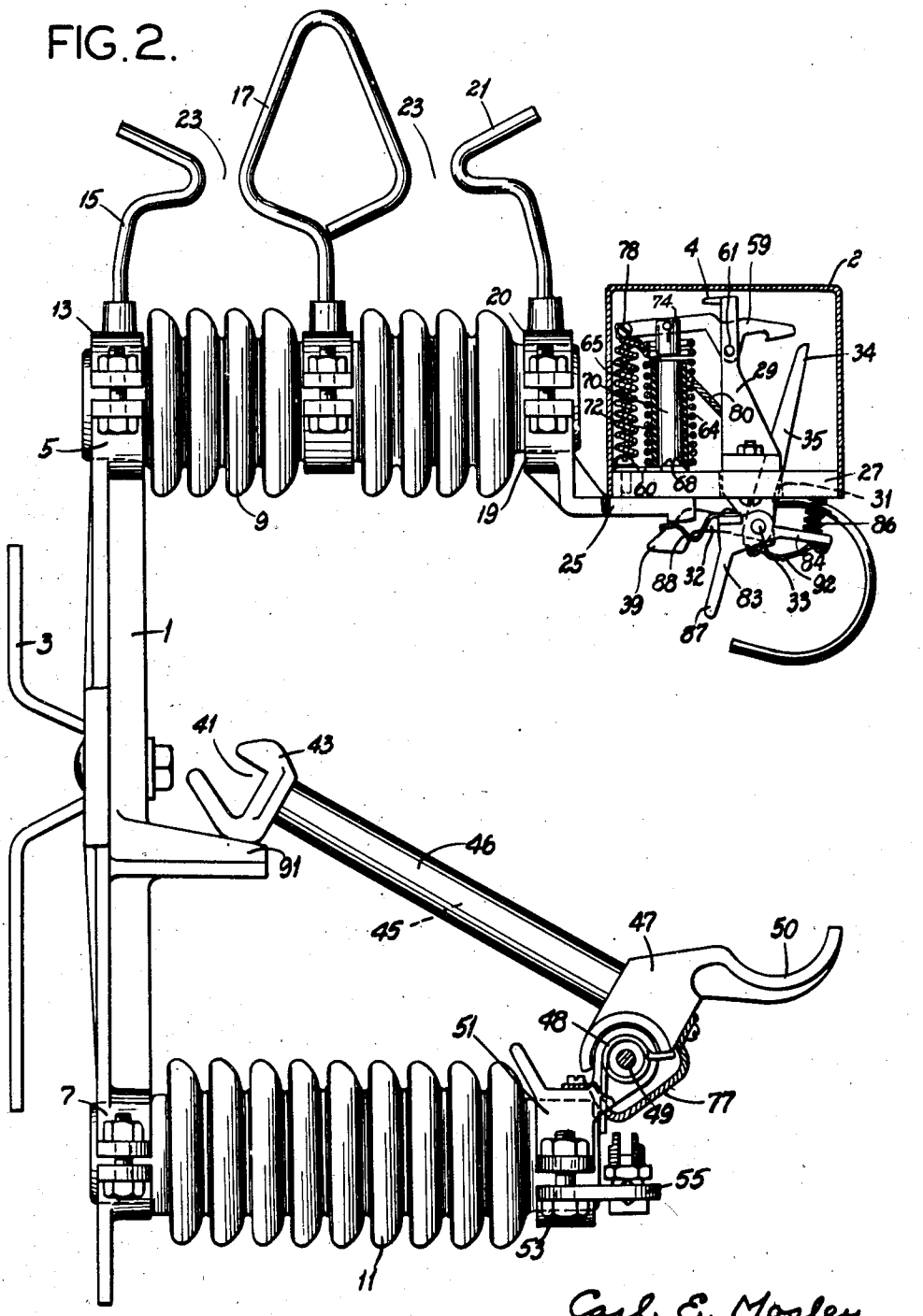
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PROTECTIVE SWITCH

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FIG. 2.



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FIG. 3.

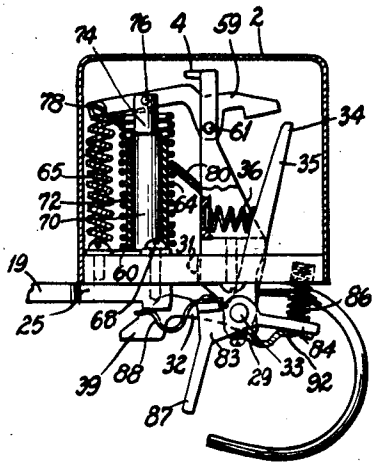


FIG. 4.

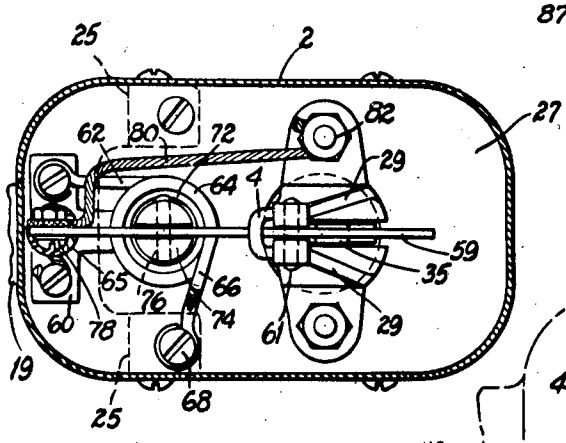


FIG. 5.

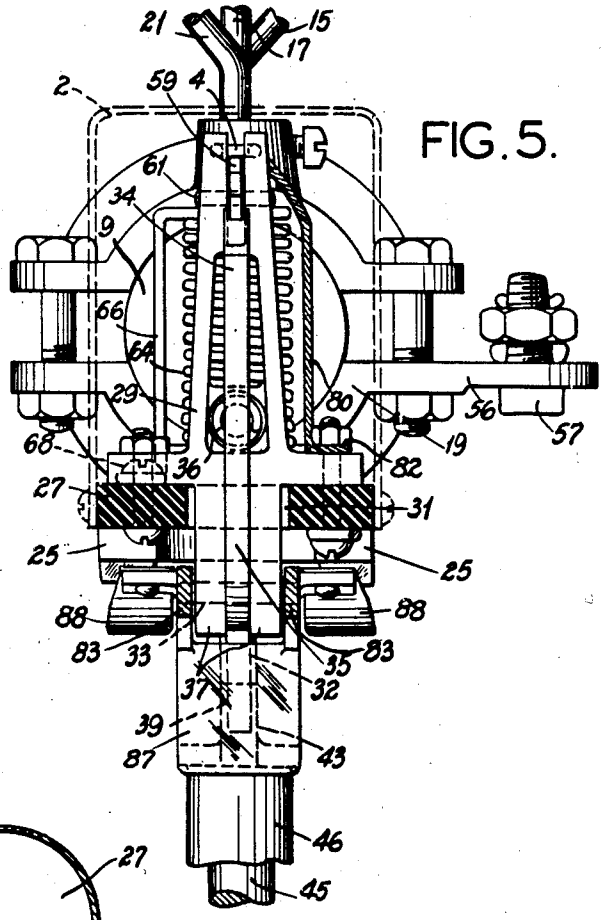
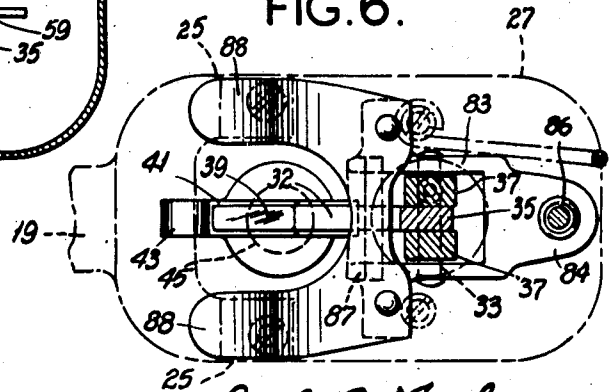


FIG. 6.



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UNITED STATES PATENT OFFICE

2,462,212

PROTECTIVE SWITCH

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Application November 6, 1944, Serial No. 562,096

2 Claims. (Cl. 200—88)

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This invention relates to protective switches, and with regard to certain more specific features, to fuseless electrical cutouts.

The invention is an improvement upon that shown in U. S. Patent 2,349,609, dated May 23, 1944, and that shown in my copending U. S. application, Serial No. 542,106, filed June 26, 1944, for Electrical cutout eventuated as Patent 2,401,656.

Among the several objects of the invention may be noted the provision of a thermally-operated fuseless cutout in which provision has been made for positive operation without damage to the thermal element even when the cutout is subjected to extreme overloads; the provision of a cutout of the class described which after operation under both ordinary and extreme overloads may be reclosed without the necessity for replacing fuses, thermal elements or the like; and the provision of apparatus of this class which is simple, reliable and economical to build, install and operate. 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 side elevation of the device in closed-circuit position, a portion of a cover being broken open;

Fig. 2 is a similar view, showing an open-circuit position as effected under an ordinary overload;

Fig. 3 is a fragmentary view similar to a portion of Fig. 2, showing the operating results of an extreme overload;

Fig. 4 is a horizontal section on an enlarged scale on line 4—4 of Fig. 1;

Fig. 5 is a vertical section on the same scale as Fig. 4 and being taken on line 5—5 of Fig. 1; and

Fig. 6 is a horizontal section on the same scale as Figs. 4 and 5 and being taken on line 6—6 of Fig. 1.

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

In the inventions of said patents, a thermostatic element is used in a circuit. This element in response to overload current and heating opens a latch to release a switch to open-circuit

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position. This scheme is effective over a practical range of operations. I found that in cases of extreme ovedloads, the thermostatic element may become impaired before it can function to open the latch. While the impairment proceeds to a burn-out condition of the thermostatic element, thus opening the circuit, this is not the ideal way in which to open the circuit because it ultimately requires replacement of the thermostatic element. The present invention extends the usefulness of the former inventions above mentioned by causing the cutout to open under extreme overloads without impairing the thermostatic element, so that after the overload conditions have been eliminated the cutout may again be placed in operation simply by reclosing it.

Referring now more particularly to Fig. 1, there is shown a supporting bracket 1 having attached thereto a support 3. Both 1 and 3 are conductors, being connected to neutral or ground. The bracket may be bolted on a pole or a building structure. At the upper end the bracket 1 is provided with a split ring clamp 5. At the bottom of the bracket 1 is a similar clamp 7. The clamp 5 rigidly supports an upper insulator 9 which is associated with one side of the line, and the lower clamp 7 supports a lower insulator 11 associated with the other side of the line.

The one half 13 of the upper clamp 5 carries a grounding electrode 15. Supported by a clamp 16 around the middle waist portion of the insulator 9 is an intermediate electrode 17. At the opposite end of the insulator 9 is a split ring clamp 19, the upper half 20 of which supports a third electrode 21. The electrodes 15, 17, 21 form in series two surge gaps 23 which serve as a lightning arrestor. This grounds transient high-voltage surges of current due to lightning or the like. The surge current will be carried off through the bracket 1, connecting strap 3 and to ground.

The clamp 19 is formed with an extension 56 for a feed line wire connector 57. It also has a bifurcated end portion 25. Screwed to the legs of the bifurcated end 25 is an insulating platform 27. A protective cover is shown at numeral 2. Mounted on the platform 27 is a supporting bracket 29, which extends through a hole 31 in the base 27 and has pivoted to its lower end at 33 an L-shaped latch 35. The latch 35 moves between the depending legs 37 of the bracket 29. Legs 37 in turn extend through the hole 31. The vertical leg 34 of the latch 35 is urged to the right by a spring 36 (Fig. 3). The horizontal

leg 32 of the latch 35 is terminated in a hooked portion 39. This is engaged by U-shaped slot 41 in the upper terminal 43 of a conducting switch bar 45. The switch bar 45 is encased in an insulating tube 46, composed of a suitable material such as fibre. The switch bar 45 extends from a conducting carrier 47 which is hinged at 49 to a split ring clamp 51, fastened to the outer end of the lower insulator 11. The lower half 53 of this clamp 51 is provided with an outgoing line wire terminal 55. A coil spring 48 biases the carrier 47 and switch bar 45 counterclockwise toward open-circuit position. If released at its upper end, the terminal 43 of switch bar 45 moves against conducting lug 91 of the grounded base 1 (Fig. 2). A reclosing hook for a lineman's stick is shown at 50. A pigtail shunt for the pivot 49 is shown at 77.

A catch 59, pivoted at 61 to the bracket 29, normally holds the vertical leg of the latch 35 against pressure of the spring 36 (Fig. 3). A stop 4 limits the throw of the catch 59 to the position shown in Fig. 1. Fig. 1 is a closed-circuit position. The catch 59 also holds the latch 35 against actuating bias of the switch bar terminal 43 on 39.

Attached to the one end of the catch 59 in conductive relation thereto at 78 is a thermostatic element 65. The character of the element 65 is described in Parsons United States Patent 2,121,259, dated June 25, 1938. It consists of bimetallic material wound along a minor helix and the resulting minor-wound material is then wound along a major helix. The bimetallic member so made will expand and contract in the direction of the axis of the major helix when the temperature of the structure 65 is changed. By passing current through the helix its temperature may be changed.

The winding of the minor helix is such as to produce a torsional or twisting effect along the axis of the minor helix when the temperature changes. In accordance with one or the other metal of the bimetallic members being positioned outside or inside of the minor helix, the major helix will expand or contract along its axis when heated. The rule is that the device will contract axially along the axis of the major helix in response to heating when the metal of lesser coefficient of thermal expansion is outside, and the present device is so arranged. Thus when the current passes through the thermostatic element 65, it tends to heat and to contract lengthwise. An advantage of the particular form of the thermostat is that the degree of movement produced in response to current is great while the amount of space occupied by the thermostat is small. It also functions as a compression spring normally tending to push the catch 59 toward the stop 4. It is to be understood that other equivalent thermostatic elements may be used for controlling the catch 59.

The lower end of the thermostatic element 65 is attached to a conducting plate 60. This plate is insulated from other items, being attached to the insulating plate 27. Conductively attached to the plate 60 (through connection 62, Fig. 4) is the lower end of a fixed solenoid coil 64, the latter being composed of a small number of coils of conducting wire of relatively large cross section, for example, 15 coils of No. 11 A. W. G. wire which is .090 inch in diameter. The other end of this coil, through a connection 66 and a conducting screw 68 (the latter passing through the plate 27), is in conductive relation with the bifurcated portion 25 and thus is in conductive relation with the line wire connector 57.

Also in conductive relation with the plate 60 is a conducting electromagnetic core 70 for the coil 64. This core 70 is insulated from the coil 64 by means of a "Bakelite" tube 72. The catch 59 is provided with an armature 74 pivoted at 76. Upon sufficient energization of the coil 64 the armature 74 is attracted to the core 70 against the mechanical expansive action of the thermostat 65. The throw of the catch 59 when releasing the latch 35 is great enough that the armature 74 contacts the core 70 for purposes which will appear. Thus elements 70 and 74 also constitute a first shunt switch. At the point of connection 78 between the catch 59 and the thermostat 65 there is attached a pigtail shunt wire 80 which reaches to a connecting point 82 on the support 29.

A second shunt contact 83 is also pivoted at 33 to the lower end of the bifurcated member 29. This is provided with an extension 84 which operates against a compression spring 86. A pigtail shunt wire 92 connects between its extension 84 and the lower end of the bracket 29. It also carries an operating pad 87 which is engaged by the end 43 of the switch bar 45 when the latter is moved clockwise (compare Figs. 2 and 1). It also carries spring contacts 88 which engage the bifurcation 25 when the switch 45 is in open-circuit position (Fig. 2) and which are disengaged when the switch is in closed-circuit position (Fig. 1). The spring contacts 88 are located on two sides of the plane of action of the members 43 and 39 (Fig. 5). Thus 88 is a second shunt switch.

When the switch is closed (Fig. 1), a circuit is made from the line terminal 57, bracket 29 (including bifurcation 25), screw 68, connection 66, solenoid coil 64, conducting plate 60, thermostatic element 65, shunt wire 80, connection 82, bracket 29, shunt wire 92, pivoted switch member 83, end member 43, switch bar 45, pigtail 77 and thence through clamp members 51 and 53 to the other line terminal 55.

Upon occurrence of an ordinary overload, the increased current heats the thermostatic member 65 and causes it to contract axially, thereby rotating the catch 59 to released position. This releases the latch 35. The end 39 of latch 35 at this time releases the switch end 43. Hence the switch bar 45, under biasing action of spring 48, moves from the Fig. 1 to the Fig. 2 position, thus grounding the side of the line connected to terminal 55.

It will be observed that when the switch bar 45 is moved to closed position the contacts 88 of the switch 83 are out of engagement with the member 25, but as soon as the switch bar 45 moves to open position (Fig. 2) then the switch contacts 88 engage 25. Thus any heavy arcing current is shunted from the part of the circuit including thermostatic element 65 and solenoid coil 64 and directly through the switch 83 to the member 43. Thus this heavy arcing current is prevented from damaging either the solenoid or the thermostatic element. Any arcing occurs between the member 87 or 25 and member 43. Finally, if such an arc is sustained, the feed line becomes grounded or connected to neutral through the arc. The fault current may then increase sufficiently to operate a circuit breaker reclosing device such as an oil circuit recloser in the feed line. This temporarily opens and instantly extinguishes the arc. Such a device is shown in said Patent 2,349,609 and

requires no further explanation here. It may sometimes occur that the arc will become extinguished or break of its own accord without operation of the circuit breaker; or that the circuit will be opened without formation of an arc.

After the thermostatic element 65 has cooled sufficiently the switch may be reclosed, which is done by moving the switch arm 45 from the Fig. 2 to the Fig. 1 position. The first function is for the member 43 to effect a connection through the closed shunt switch 83. This closes the line directly through the shunt contacts 88 before current flows through the thermostatic element 65. Then as the shunt switch 83 reopens, the circuit is closed through the thermostatic element 65 and the solenoid coil 64, all as above described.

Assuming next that an extreme overload occurs, such as 95 amperes, which would soften or melt the thermostatic element 65 before the latter had time enough to contract and cause opening of the circuit, the number of turns in the solenoid coil 64 is arranged such that when a predetermined number of (damaging) amperes is multiplied by said number of turns, the ampere-turns are enough to cause the armature 74 to be drawn toward the core 70, thus instantaneously opening the circuit before the series-connected thermostatic element has time to be damaged. It will also be observed that in this case the armature 74 and core 70 come into conductive relation which promptly shunts out the thermostatic element before the shunt for both the solenoid and the thermostat comes into operation. Thus during the initial few cycles of switch-opening activity, the thermostatic element is already shunted out by a first shunt and protected. This is true even before the shunting switch 83 closed into shunting position to effect a second shunt. From this point on, the action is the same as above described, the second shunt action of the switch 83 thereafter shunting out the solenoid coil 64. It may be observed that the core 70 also performs the usual function of increasing the flux density within the solenoid coil for more efficient armature operation.

From the above it will be seen that the device, like that of the above-mentioned Patent 2,349,609, provides a time-current relationship which coordinates quite closely with the time-load relationship of transformers and other like apparatus connected to the line which is associated with the connector terminal 55. This coordination is effective over a wide range of ordinary overloads. For example, a heavy overload current will cause the line to be opened within a shorter time than a light overload current; and a light overload current requires a greater time within which to open the circuit. This reduces the number of outages.

The improvement herein lies in the fact that while the above advantages are obtained, there is never any extreme overload that will cause the thermostatic element to burn out. Such extreme overloads cause prompt circuit opening under the action of the solenoid instead of under the action of the thermostatic element. While this does not provide the same time-current coordination that the thermostatic element does, it occurs very seldom, and in any event does not interfere with said coordination. Also, it avoids the necessity for replacing thermostatic elements which from time to time would otherwise be burned out when extreme overloads occur.

It will be understood that the number of turns in coil 64 is suitably coordinated with the characteristics of the thermostat 65 so that the latter will not burn out on all currents which do not make coil 64 active in respect to the armature 74. With extremely excessive currents that will burn out thermostat 65, the coil 64 operates armature 74. The specific values above given are merely exemplary and others could be used.

It should be noted that the thermostatic element 65 when cold resiliently holds catch 59 in position to detain the latch 35. It also allows the catch to deflect while the latch 35 returns to detained position as the switch is closed.

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 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. An electrical protective switch comprising a switch arm biased toward an open-circuit position, control means adapted at one position to hold said switch arm against said bias and in a closed-circuit position and at another position to release the switch for biased movement to said open-circuit position, a thermostat operatively connected with said control means in series with the switch arm when the latter is in closed-circuit position and adapted in response to current flowing through the switch arm to heat and cause said release, a solenoid operatively connected with the control means and also connected in series with said switch arm when the latter is in closed-circuit position and responsive to current to release said control means, a first normally open shunt circuit around the thermostat only, a first shunt switch in said first shunt circuit responsive to the switch-arm-releasing action of the solenoid, a second shunt circuit around both the thermostat and the solenoid, and a second shunt switch in said second shunt circuit responsive to initial opening action of the switch arm to close as the switch arm assumes open-circuit positions.

2. An electrical protective switch comprising a main switch arm biased toward an open-circuit position, said switch being liable to draw an arc during opening movement, control means adapted at one position to hold said main switch arm against said bias and in a closed-circuit position and at another position to release the main switch arm for biased movement to said open-circuit position, a thermostat operatively connected with said control means in series with the main switch arm when the latter is in closed-circuit position and adapted in response to current through the main switch arm to heat and cause said release, a solenoid operatively connected with the control means and connected in series with the thermostat and also with said main switch arm when the latter is in closed-circuit position and responsive to current to release said control means, a first normally open shunt circuit around the thermostat only, a first shunt switch in said shunt circuit responsive to switch-arm-releasing action of the solenoid, whereby the thermostat is at once protected from initial heavy current flow, a second shunt circuit around both the thermostat and the solenoid, a second shunt switch in said second shunt circuit and comprising a contact element engageable with the main switch arm and comprising

also a shunting element movable with said contact element, opening of the shunting element being effected after movement of the contact element upon contact with the main switch arm when the latter is moved to closed position, and closing of said shunting element occurring before disengagement of said contact element with the main switch arm when the latter moves toward open-circuit position, thereby protecting the entire control means including the thermostat and solenoid against flow of current through any arc which may be drawn by the opening main switch.

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