

Nov. 8, 1927.

1,648,508

E. O. SCHWEITZER

AUTOMATIC RECLOSING CIRCUIT BREAKER SYSTEM

Original Filed Dec. 6, 1918

3 Sheets-Sheet 1

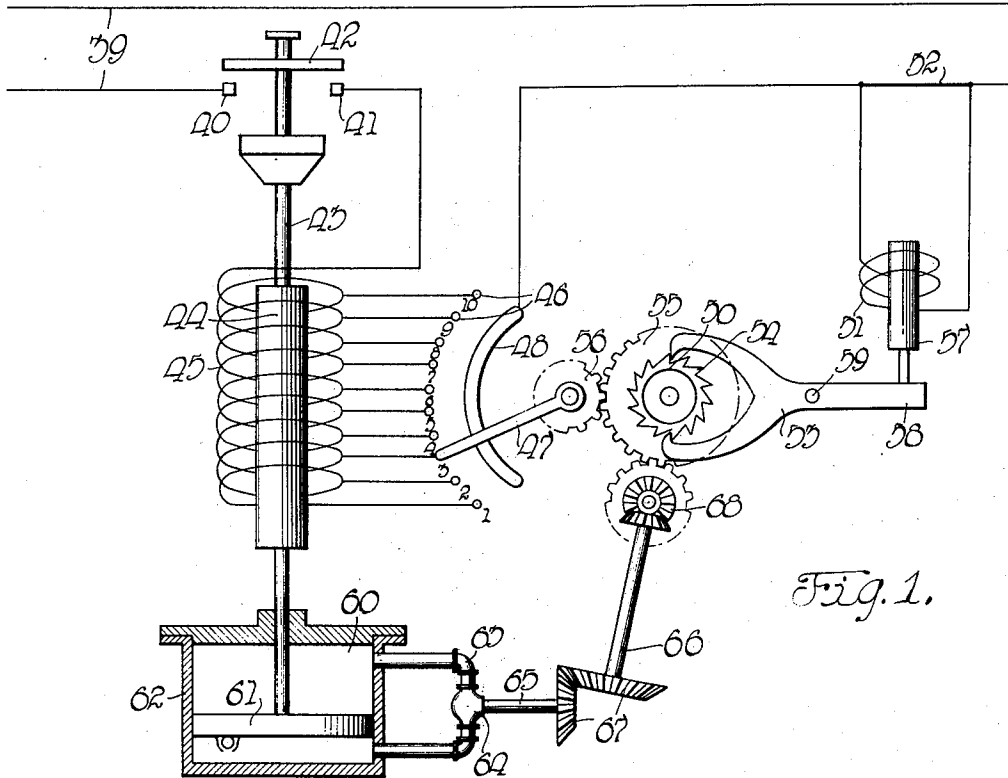


Fig. 1.

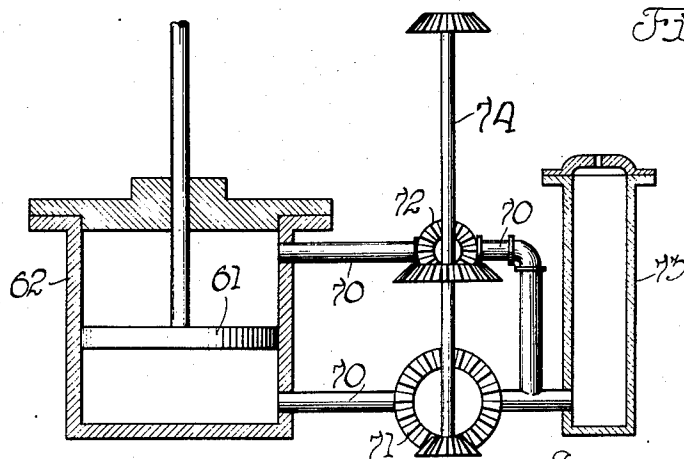


Fig. 2.

Inventor
Edmund O. Schweitzer.
By *Brown, Berkeley & Steiner*
Attorneys.

Nov. 8, 1927.

1,648,508

E. O. SCHWEITZER

AUTOMATIC RECLOSING CIRCUIT BREAKER SYSTEM

Original Filed Dec. 6, 1918

3 Sheets-Sheet 2

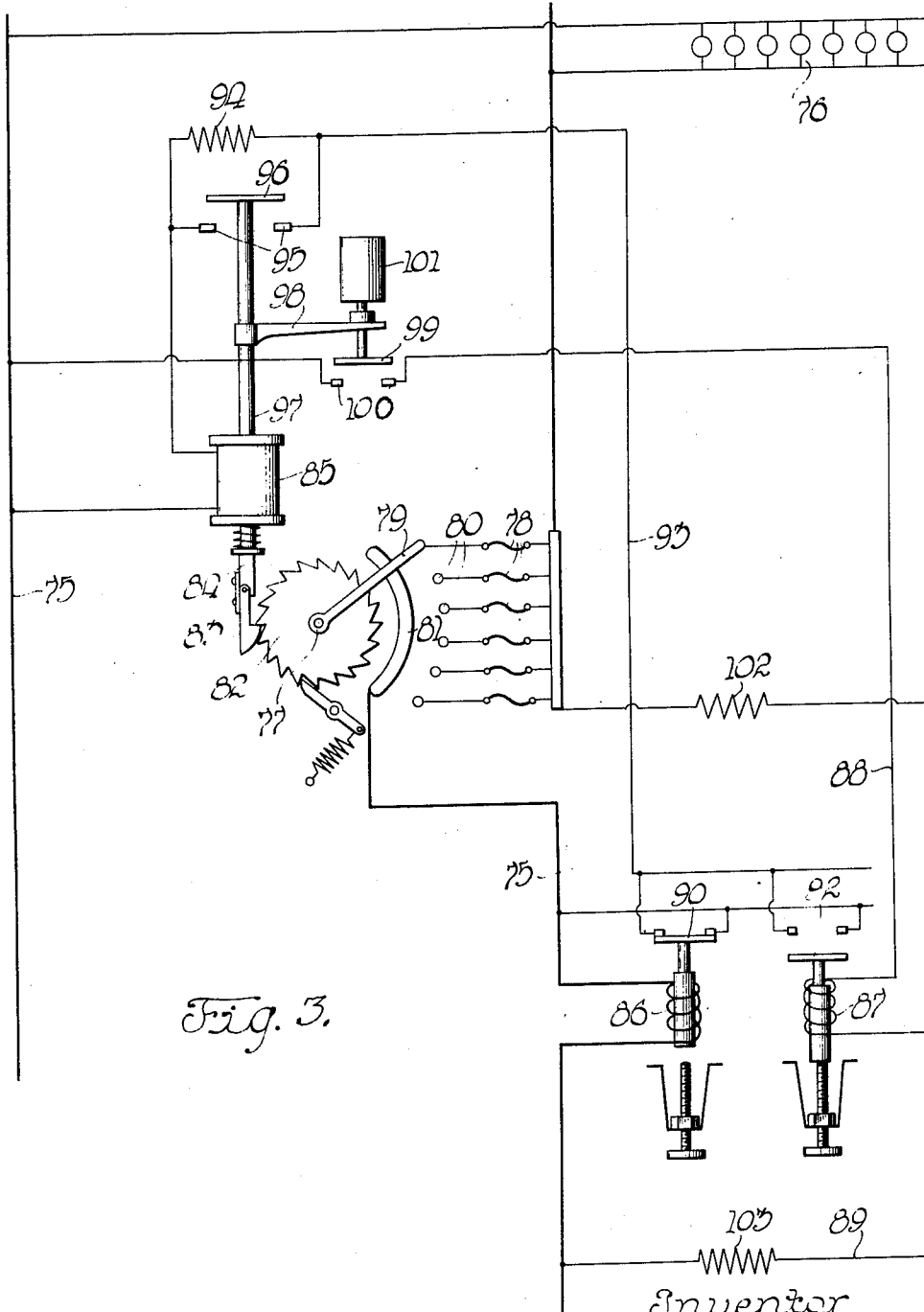


Fig. 3.

Inventor
Edmund O. Schweitzer
By *Praeger & Co.*
Attorneys

Nov. 8, 1927.

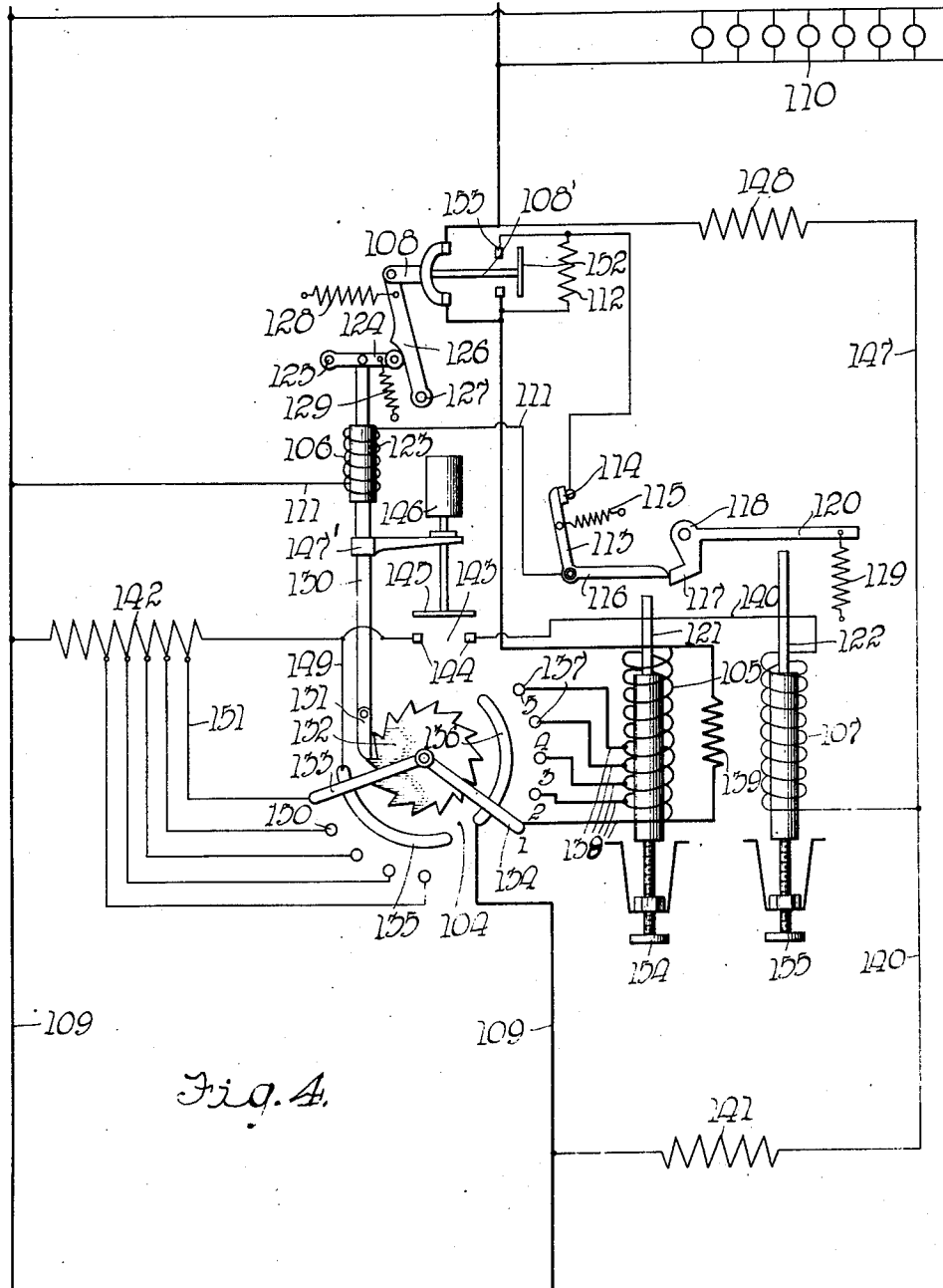
1,648,508

E. O. SCHWEITZER

AUTOMATIC RECLOSING CIRCUIT BREAKER SYSTEM

Original Filed Dec. 6, 1918

3 Sheets-Sheet 3



Inventor
Edmund O. Schweitzer
By *Paul D. Biddle*
Attorneys

UNITED STATES PATENT OFFICE.

EDMUND O. SCHWEITZER, OF CHICAGO, ILLINOIS.

AUTOMATIC RECLOSING CIRCUIT-BREAKER SYSTEM.

Original application filed December 6, 1918, Serial No. 265,488. Divided and this application filed December 1, 1919. Serial No. 341,750.

My present invention is particularly designed to provide means for measuring the approximate maximum demand of small consumers of electrical energy, such as residence consumers and is divisional of my prior application for patent, No. 265,488, filed December 6, 1918.

As pointed out in my prior application, the cost of the service to the customer must depend in some degree upon the manner in which power is demanded, and therefore the central station is interested in the rate at which the power is used, as well as the amount of power required. Therefore, my prior application provided a method and means determining the approximate maximum demand for electrical power which is suitable for use in the case of small consumers, but which need not be limited to that use.

In the prior application referred to I employ preferably a plurality of fusible elements of progressively larger capacity and manual means for connecting the next higher fuse when one has been blown on an overload. Simultaneously with the manual connection of the next higher fuse indication is made to show the maximum demand of the consumer up to that time, and means is also provided to prevent retrograde movement of the manual resetting means.

However, the switching means for causing the current to act upon the fuses successively in accordance with their size may be automatically controlled or operated where desired. With this in view I have designed the subject matter of the present application which was divided out of my prior application.

In three forms of the present device, I have shown a novel switching means for progressively connecting the fuses automatically as the same are blown. Thus, as a fuse is blown a switching element is automatically actuated to bring the next higher fuse in series with the circuit.

Where automatic operation is desired, I need not rely upon fuses, but may employ other means sensitive to current flow, such as an electromagnet controlling the breaking of the circuit. The windings of the electromagnet are provided with means to make the same responsive to greater current flow only, after each operation of the device. This may be done by shunting out or switching out a part

of the windings at each interruption, although I do not limit myself to this arrangement.

After the given maximum has been exceeded, it is not desirable to reconnect the load in some cases until it has been reduced, and I provide means in conjunction with the above automatic disconnecting and graduating means for preventing the reconnection of the load until the same has been reduced below a predetermined value. Therefore, while I shall describe several wiring systems as representative of installations with which my invention may be advantageously associated, the invention need not be limited to the disclosure, but is of sufficient utility to facilitate installation in various other electrical systems.

Other objects and advantages will appear from the following detail description, taken in connection with the accompanying drawings, in which:

Figure 1 is a semi-diagrammatic view of a form of the invention employing a sectionalized solenoid for controlling the circuit;

Figure 2 is a modified form of the invention shown in Fig. 1;

Figure 3 is a diagrammatic view of another form of the invention; and

Figure 4 is a modified form of the invention shown in Figure 3, illustrating the use of a sectionalized solenoid in lieu of fuses.

Figures 1 and 2 illustrate diagrammatically a mechanism embodying a certain feature of my invention in which I employ the windings of a solenoid as the sensitive elements instead of employing fuses.

The line 39 is provided with the contacts 40—41, and a switching or contacting member 42 for bridging the contacts 40 and 41. This switching member is connected by a stem 43 to the core 44 of a solenoid 45. The winding of the solenoid 45 has a plurality of taps 46' taken out therefrom, and these taps are provided with contacts, such as 46, which are engageable with a movable switch arm 47, for connecting more or less of the turns of the solenoid in series with the line 39. The switch arm 47 is adapted to connect the contacts 46 progressively to the arcuate bar contact 48, which contact is connected to one side of the line. The switch arm 47 is controlled by an escapement mechanism which is operated by a solenoid 51 connected

in series relation with the line, the solenoid 51 being shunted by a resistance 52. The escapement mechanism comprises a forked member 53, cooperating with the ratchet wheel 54, which ratchet wheel is connected by the gears 55 and 56 to the movable switch arm 47. A spring, not shown, tends to move the switch arm 47 in a clockwise direction, this movement being controlled by the escapement mechanism. The fork 53 and the ratchet 54 permit of a step of the switch arm 47 forward only, after the forked member 53 has been rocked back and forth. The solenoid 51 has a core 57 which is connected to the tail 58 of the forked pawl 53. The pawl is pivoted at 59.

The lower end of the solenoid core 44 is connected to a dash pot 60 having a suitable plunger 61, fitting within a cylinder 62. The dash pot is preferably filled with oil and the speed of the descent of the plunger and switch member is controlled by a by-pass 63 having a valve 64, which in the present construction is controlled simultaneously with the movement of the switching arm 47, so that the closing of the switch 42 will be delayed for a greater period after each opening thereof. The means by which this is accomplished comprises the valve stem 65, a shaft 66, and a plurality of bevel gears 67 and 68, connecting said shaft to said stem and to the gear 55, respectively.

The operation of the system is as follows: Assuming that the switch arm 47 is set at the step numbered 1, so that all of the coils of the solenoid 45 are included in series in the line it will be apparent that upon the occurrence of a certain current flow through the line, the switch 42 will be opened. The solenoid 51 being normally in series relation, is energized so long as the switch 42 is closed. As soon as the switch 42 is opened, the core 57 of the solenoid 51 drops, causing the forked pawl 53 to permit the ratchet wheel 54 to escape by one step and as a consequence the switch arm 47 is advanced to the next contact, cutting out a certain portion of the windings of the solenoid 45 in order that more current will be required to operate the switch and the solenoid. The descent of the switch arm 42 is controlled by the dash-pot 62. The windings of the solenoid are accurately graduated so that operation of the switch 42 to open the circuit will not occur until a definite predetermined value of current is reached. The maximum demand may, therefore, be indicated by the position which the switch arm 47 occupies at the end of the period during which maximum demand is to be determined. A suitable dial may be connected with the switch arm where desired. It is apparent that the solenoid 51 must be energized in order to complete the motion of the forked member 53 to permit the switch arm 47 to take one step forward.

Of course, it will be understood that the means described in connection with Figure 1 for controlling the speed of descent of the solenoid core 44 need not be employed should it be desired to omit the same.

In Figure 2, the controlling means for the core 44 is shown in modified form. In this case the motion of the plunger 61 and the dash pot 62 may be controlled in either direction by suitable valve means for permitting the escape and entry of the oil to opposite sides of the piston 61. In such cases the by-pass 70 is provided, as shown in Figure 2 with two valves operated by gears 71 and 72, respectively, said by-pass 70 being connected to a stand pipe 73 so that different rates of flow above and below the piston 61 may be secured. The shaft 74 is suitably geared to the escapement mechanism 50 as above described and to said gears 71 and 72. It will be noted that the gear ratio of the gears 72 is different from the ratio of the gears 71, so that movement of the shaft 74 may close the one valve more rapidly than the other in order to secure the difference in operation described.

It will be apparent that instead of employing a dash-pot which permits the switch 42 to close automatically, I may provide a ratchet or detent mechanism which will hold the switch 42 open until the consumer releases the mechanism to permit it to close. This is desirable under certain circumstances where the act of the operator is required for reducing the load.

I have observed that it is undesirable to close the circuit until the load has been reduced to a certain amount and in Figures 3 and 4 I have indicated embodiments of my invention in which the stepping forward of the maximum demand switching meter is delayed until the load is reduced below a certain predetermined value.

In Figure 3 I have shown the main line conductor 75 to which a load 76 is connected, through the meter. The line 75 has in series therewith a switch device 77, adapted to switch one of a series of fuses 78 into series relation with the circuit. A switching arm 79 is adapted to engage the contacts 80 and connect them with the arcuate contact 81 in succession, in accordance with the demand of the load 76. The switch arm 79 is adapted to be actuated by a ratchet wheel 82 having an operating pawl 83 carried by the lower end of the core 84 of an electromagnet 85. The circuit of the operating magnet or solenoid 85 is controlled by the series relay 86 and by the load sensitive relay 87, which is connected in shunt with the line, by means of the conductors 88 and 89. The operating solenoid 85 is adapted to be actuated only when it has its circuit closed either at the contact 90 or at the contact 92 through the conductor 93. A resistance 94 in the circuit

of the solenoid 85 is adapted to be shunted at the contact 95 by the movable switching element 96 when the solenoid is deenergized to shunt out the resistance for increasing the power of the solenoid during the stepping movement of the switch arm 79. The core 84 of the solenoid 85 is provided with a stem 97, which controls the switch 96 and which also has an arm 98 thereon controlling a movable contacting element 99, which makes and breaks the circuit 88 of the load sensitive or shunt relay 87. The contact plate or switch 99 is adapted to bridge the contacts 100 to close the circuit 88 of said relay 87. This contact plate 99 is controlled by a dash-pot 101 which prevents bridging of the contacts 100 until the predetermined period has elapsed after the deenergization of the solenoid 85.

The load sensitive relay 87 is bridged across the main 75 on the line side of the maximum demand switching device 77, but is shunted by a resistance 102 which is connected in series with the load 76 so that the windings of the relay 87 will not be energized so long as the load exceeds the predetermined value. If the load is reduced below the point where the shunting action of the same upon the windings of the relay 87 is effective the relay is energized to close the contacts 92. A suitable resistance 103 is included in the circuit of the relay 87 so that the flow of current in shunt of the maximum demand device through the resistances of 102 and 103 will be negligible.

The form of the device shown in Figure 3 embodies the principle disclosed in my prior application referred to hereinbefore, with the addition of the automatic means for testing the load to determine whether the same has been reduced, and for thereafter advancing the switching arm to the next larger size of fuse. This form of the device is particularly adapted for use by small consumers in view of the automatic features thereof.

It will be apparent that instead of employing fuses in the automatic system, I may employ switch means which will open the main circuit when the amount of current flowing to the load exceeds a predetermined amount, and the sensitiveness of this switching means may be automatically changed at each opening of the circuit, so that it will operate successively on larger loads only. I have illustrated diagrammatically in Figure 4 a system employing a switch adapted to cut out sections of an electromagnet, instead of the fusible element for opening the circuit.

Referring in detail to Figure 4, a switching device 104 is provided in series with relay 105, an operating solenoid 106 and a load sensitive relay 107. I also provide a switch 108 in series with the line wires 109, which latter have the load 110 connected thereto. The switch 108 is closed under the

influence of the operating solenoid 106, as hereinafter explained.

The circuit 111 of the operating solenoid 106 is normally closed through a resistance 112 by a movable switch 113, engaging a stationary contact 114, the switch 113 being held in closed position under the tension of the spring 115. The switch 113 comprises preferably a bell crank lever having the free arm 116 thereof engageable by a detent 117 pivoted at 118 and maintained normally in the position shown in Figure 4 by means of a spring 119 engaging the free arm 120 thereof.

The arm 116 is disposed adjacent the core 121 of the series relay 105 to be actuated thereby, and the arm 120 of the detent is disposed adjacent the core 122 of the load sensitive relay 107, to be actuated thereby. The switch 113 is opened only when the solenoid 105 is energized, and it is engaged with the detent 117 at such times, the detent being released by energization of the load sensitive relay 107 as explained later. The arm 116 of the switch 113 serves to maintain the detent in the position shown in Figure 4 under normal conditions.

The core 123 of the solenoid 106 is maintained in the position shown, normally, by means of the energization of said solenoid, and said core maintains the main switch 108 closed by virtue of a lever 124 pivoted at 125 and engaging a cam 126, pivoted at 127 and connected to said switch 108. The switch is closed against the tension of a spring 128. The core is maintained in the upward position against the tension of a spring 129.

The core 123 of the operating solenoid 106 is provided with an extension 130 carrying a pawl 131, engaging in the ratchet teeth 132 of a wheel forming a part of the switching member 104. The ratchet wheel 132 carries a pair of switch arms 133 and 134 gliding upon arcuate plates 135 and 136, respectively. The switch arm 134 is adapted to engage in succession a plurality of contacts 137 tapped from the winding of the solenoid 105 by means of conductors 138. A low resistance 139 is shunted around the solenoid 105 so that in normal operation a slightly smaller size of wire may be employed in the solenoid in order to carry the necessary current.

The solenoid 107, responsive to load conditions, is shunted across the line by the circuit 140, this circuit having interposed therein a fixed resistance 141 and a variable resistance 142. The circuit is interrupted at 143 and the conductors are provided with contacts 144 to be bridged by a contacting plate 145 connected to a dash pot 146, the operation of the dash-pot being controlled by an arm 147' extending from the stem 130 of the core of the solenoid 106. The circuit 140 of the solenoid 107 is shunted by means of a conductor 147 through a resistance 148 to the

load side of the line wire 109. Thus, it will be seen that a shunt composed of a conductor 140, 147, resistances 141 and 148 is placed around the solenoid 107.

5 The conductor 140 is tapped by a conductor 149, the conductor 149 connecting with the plate 135. The free end of the arm 133 contacts successively with a plurality of contact elements 150, the same being tapped
10 from the resistance 142 by means of conductors 151.

The switch 108 carries an extension 108' having a contacting plate 152 carried thereby adapted to engage contacts 153 for shunting the resistance 112 when the solenoid 106 is first energized. The reason for this is that less energy is required for holding the solenoid 106 in the uppermost position than in raising the same so that when the solenoid
20 raises its core the latter serves to close the switch 108 and open the switch 152, thereby throwing the resistance 112 in series with the winding of the solenoid 106 and reducing the required energy for maintaining the
25 core 123 thereof in the position shown.

A pair of set screws 154 and 155 serve to adjust the cores 121 and 122 respectively of the solenoids 105 and 107.

The operation of this circuit is as follows:
30 Assuming the parts to be in the condition shown and that a load in excess of the amount corresponding to contact 1 of the relay 105 is connected to the main 109, the series relay 105 will be energized, the core
35 thereof striking the arm 116 and opening the switch contacts 113, thereby deenergizing the circuit of the operating solenoid 106 and permitting the core thereof to descend under the action of the spring 129 to
40 open the main switch 108. At the same time the resistance 112 is shunted out of the circuit of the operating solenoid 106, by means of the switch 152 bridging the contact 153, preparatory to the reenergization
45 of said solenoid. When the core 123 of the solenoid 106 descends the contacting member 145 is released except for the effect of the dashpot 146, and after a definite period of time the contacts 144 of the load sensitive relay 107 are bridged, thereby placing
50 the said relay in condition to test the line as to the amount of load connected thereto. If the result of this test establishes that the amount of the load connected to the line is less than its predetermined maximum as controlled by the relation of the resistances 141, 142 and 148, the load sensitive relay 107 is energized moving the arm 120 of the detent 117 upward to release the arm 116 of
60 the switching member 113, thereby again closing the circuit of the operating solenoid 106, and returning the parts to normal. The downward movement of the plunger of the operating solenoid 106 operates the pawl and
65 ratchet 131-132, to set the switching arm

134 forward one step, cutting out a certain proportion of the windings of the series relay 105.

At the same time, the switching arm 133 connected to the ratchet wheel 132 is also
70 advanced by one step in order to change the proportion of the resistance 142 with respect to the resistance 148 so that upon the succeeding step a larger load may be connected to the line without preventing the closing
75 of the switch 108. The setting of the switch arm 134 with respect to the stationary contacts 137 is a measure of the maximum demand which has previously been made upon the system, and it will be apparent that any
80 suitable means may be connected with the switch arm 134 to indicate through an opening in the housing of the device or on a dial just what the maximum demand has been
85 up to that time.

It will thus be apparent that in the embodiment of Figures 3 and 4 the line will be opened upon the occurrence of a predetermined load and after a definite period the load is tested to determine whether the same is excessive or not and if the test indicates that the load is not excessive the line is then closed and will be opened again only upon the occurrence of a predetermined load larger than that which caused the first opening of the line. The position of the element which is sensitive to current flow is a measure of the maximum demand. It is apparent that the time element might be varied automatically as is done in Figure 1, but I
90 have not deemed it necessary to illustrate the same.

Without further elaboration, the foregoing will so fully explain the gist of my invention, that others may, by applying current knowledge, readily adapt the same for use under various conditions of service. Thus the feature of changing the setting of the load sensitive relay 107 by readjusting resistance 142 may be omitted if desired, so that the load must be reduced manually below a fixed amount before the main switch will again be closed regardless of the previous maximum demand. Similarly in
105 either the structure of Fig. 1 or Fig. 4, by omitting the multiple connections for decreasing the sensitiveness of the overload solenoid, the circuit may be opened each time at the same load, thus merely indicating how many times the consumer has exceeded the predetermined safe load, and in case it is exceeded too many times, moving arm 47 or 134 completely off the contacts, under which circumstances the circuit will remain open until some employee of the company comes to locate the trouble. This last operation is obviously inherent in the multiple connection also. The foregoing and many other adaptations and modifications may
110 readily be made by those skilled in the art
115
120
125
130

without eliminating certain features which may properly be said to constitute the essential items of novelty involved, which items are intended to be defined and secured to me by the following claims.

I claim:—

1. In combination, a circuit, circuit breaking means responsive to a predetermined value of current flow for breaking the circuit, means operative after the circuit is broken for changing the responsiveness of said circuit breaking means, means for automatically closing the circuit breaking means, and means for preventing the closing of said circuit breaking means until the load resistance of the circuit is increased to a predetermined value.

2. In combination, a circuit supplying a load, an electro-magnetic circuit breaker in said circuit, and means responsive to the current flow through the circuit for reducing the sensitiveness of said circuit breaker after each operation of the same so as to increase its current carrying capacity.

3. In combination, a circuit supplying a load, an electro-magnetic circuit breaker in said circuit having a predetermined sensitiveness, and means responsive to the current flow through said circuit for changing the predetermined sensitiveness of said circuit breaker when the circuit is broken so as to increase the current carrying capacity of the circuit breaker.

4. In combination, a circuit, a circuit breaker interposed therein, means for changing the sensitiveness of said circuit breaker to cause the same to respond successively to higher current values, and means controlled by said circuit breaker responsive to the current in said circuit after each operation of the breaker.

5. In combination, a circuit, a sectionalized electro-magnetic circuit breaker therein, a switch for varying the sensitiveness of said circuit breaker, means for controlling the circuit after an interruption by said breaker, and means for automatically resetting the switch to reduce the sensitiveness of said breaker.

6. In combination, a circuit, a sectionalized electro-magnetic circuit breaker therein said breaker having open and closed positions, a switch for varying the sensitiveness of said circuit breaker, means for controlling the circuit after an interruption by said breaker, and means for automatically resetting the switch to reduce the sensitiveness of said breaker, upon changing said breaker from one of said first positions to the other.

7. In combination, a circuit, a circuit breaker, means for resetting said breaker, means controlling said resetting means, and means for successively varying the sensitiveness of said controlling means upon repeated interruptions.

8. In combination, a circuit, a circuit breaker, means for resetting said breaker, means controlling said resetting means, and means for successively varying the sensitiveness of both said controlling means and said breaker upon repeated interruptions.

9. In combination, a circuit, an overload circuit breaker of variable sensitivity, resetting means, regulating means of variable sensitivity, timing means determining an interval between the operation of said breaker and regulating means, and means actuated only after the regulating means has been active and upon resetting of said breaker to readjust the sensitivity of said breaker and regulating means.

10. In combination, a circuit, an overload circuit breaker of variable sensitivity, said breaker having open and closed positions, resetting means, timing means determining a minimum time interval between opening and resetting of said breaker, and means operated only upon changing said breaker from one of said first positions to the other for varying the sensitivity thereof.

11. In combination, a circuit supplying current to a load, a sectionalized electro-magnetic unit, connections for operating said unit as a circuit breaker, and means for automatically decreasing the windings of the electro-magnetic unit used when the circuit is opened.

12. In combination, a circuit, a load-sensitive element having a given current carrying capacity, circuit breaking means actuated by said element, and means for automatically diminishing the sensitiveness of said element when the circuit is broken so as to increase its given current carrying capacity and to thus enable the circuit breaking means to be closed during a slight abnormal flow of current.

13. In combination, a circuit supplying a load, an electro-magnetic circuit breaker in said circuit, and means for automatically reducing the sensitiveness of said circuit breaker after each operation of the same so as to permit of it remaining closed even during an abnormal flow of current.

14. In combination, a circuit, circuit breaking means in said circuit, and means for automatically varying the sensitiveness of such circuit breaking means after each operation thereof so as to permit of the closing of the circuit even during an abnormal flow of current.

15. In combination, a circuit, circuit breaking means in said circuit, and electrically operated means for automatically varying the sensitiveness of said circuit breaking means after each operation of the same to increase its current carrying capacity.

16. In combination, a circuit, circuit breaking means in said circuit, means for

varying the sensitiveness of said circuit breaking means after each operation thereof, means for resetting the said circuit breaking means, and means for controlling
5 the resetting means.

17. In combination, a circuit, circuit breaking means in said circuit, means for varying the sensitiveness of said circuit breaking means after each operation thereof
10 of to permit of its being closed during an abnormal flow of current, and means for controlling the current flow around the circuit breaking means when same is opened.

18. In combination, a circuit, circuit
15 breaking means in said circuit, means for varying the sensitiveness of said circuit breaking means, means for resetting the said circuit breaking means, and means for limiting the current flow around the circuit
20 breaking means and for controlling the resetting means when normal conditions become established.

19. In combination, a circuit, circuit breaking means in said circuit, means for
25 resetting the said circuit breaking means,

means for controlling the resetting means, and means for varying the sensitiveness of said circuit breaking means and said controlling means.

20. In combination, a circuit, circuit
30 breaking means in said circuit, means for resetting the said circuit breaking means, regulating means for limiting the current flow around the circuit breaking means and
35 for controlling the resetting means, and means for varying the sensitiveness of said circuit breaking means and said regulating means.

21. In combination, a circuit, means for automatically breaking the said circuit when
40 the electrical current therein reaches a given value, and means for automatically changing the breaking means so as to provide one having a different sensitiveness to the electrical current in the circuit after each break-
45 ing operation.

In witness whereof, I hereunto subscribe my name this 29th day of November, 1919.

EDMUND O. SCHWEITZER.