

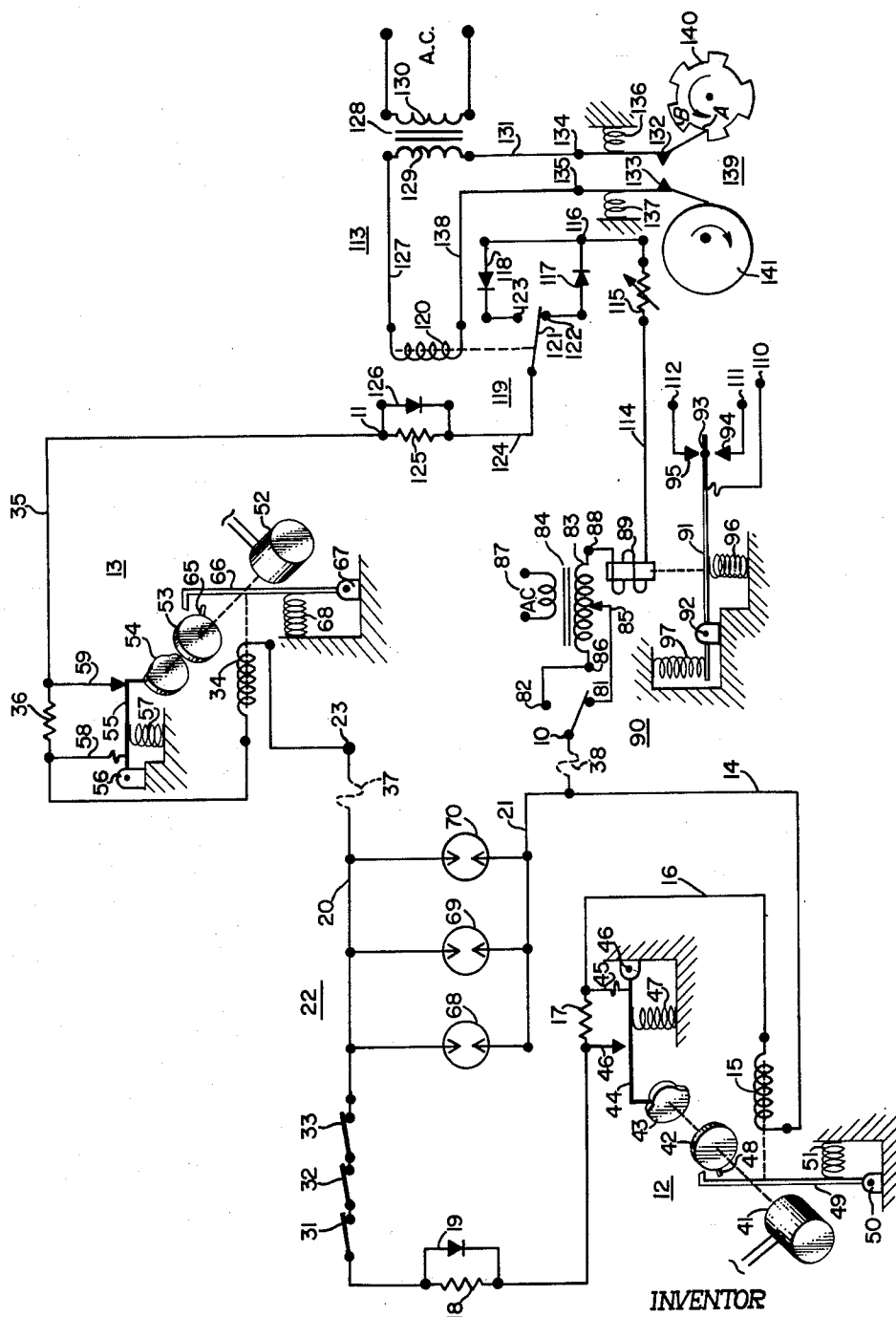
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SUPERVISORY SYSTEM

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SUPERVISORY SYSTEM

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My invention relates generally to supervisory condition detecting systems and more particularly to a new approach toward "tamper proofing" supervisory systems to be utilized in the capacity of a burglar alarm or security system.

It is an object of my invention to provide a system which will be virtually impossible to defeat. An examination of prior art systems and circuits indicates that the most generally known type of security system utilizes a closed loop of wire running throughout an area to be supervised which has a constant current running there-through. By sensing the presence of this constant current, these prior art systems thereby provide a supervisory function. If this constant current should fail to be sensed an indication is had that an unauthorized entry has been made which will serve to break the supervisory loop. However, systems of these prior art types are known to have a very substantial drawback in that they are amenable to tampering procedures which will serve to make them ineffective. My experience in the security systems field has indicated that these prior art systems are amenable to this "tampering" because, by nature of their design, they used a fixed and readily determinable resistance characteristic together with a fixed and readily determinable voltage source characteristic. A person experienced in the field of "burglar alarm defeating" may, with knowledge of the circuitry involved, readily determine a fixed resistance value or a fixed voltage value and in turn replace one or both of these fixed values with a substitute component to, in effect, delete a portion of the supervisory circuitry. My invention provides a system wherein the resistance characteristic of the supervisory leg is constantly varied and wherein the voltage source polarity is constantly varied. Thus, in view of the constant variations, it is impossible for a potential intruder to defeat the circuit by substitution of equivalent components since no fixed substitution is possible in view of the constant variations.

It is an object of my invention to provide a system having a supervisory leg with a constantly varying resistance characteristic and having a further component with resistance characteristics specifically designed to be supplementary to the given resistance of the supervisory leg at all times which is adapted for use with a voltage providing unit designed to supply a constantly changing voltage polarity characteristic.

It is a further object of my invention to provide a system having constantly changing resistance characteristics which utilizes apparatus for randomly varying and reversing the voltage applied across a supervisory leg and a supplementary impedance component.

These and other objects of my invention will be apparent from a reading and a consideration of the appended specification, claims and drawing, in which:

The sole FIGURE is a schematic drawing of an embodiment of my invention showing means for accomplishing the voltage reversing and resistance varying objectives.

Referring now to the drawing, that portion of the drawing showing means for varying the resistance characteristic will be considered first. From the standpoint of the consideration of the resistance varying aspects, junction points 10 and 11 may be considered input terminals for a source of voltage.

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Shown generally at numeral 12 is a synchronous motor operated cam mechanism adapted to intermittently open and close a shunting switch. The cam-switch mechanism 12 is located at the end of the supervisory line or at a position remote from the local station. Shown generally at numeral 13 is another synchronous motor operated cam switch mechanism adapted to alternately close a shunting switch. The cam-switch mechanism 13 is located within the supervisory or local station. These motor operated cam-switch mechanisms will be discussed in more detail later.

Between the junction points 10 and 11 a current loop is formed through the following components: A transmission line 38 and a lead 14 connect the junction point 10 with a synchronizing solenoid 15. A lead 16 connects the other side of the solenoid through a resistor 17 to a resistor 18 having a rectifier 19 connected in parallel therewith. A lead 20 connects the other side of resistor 18 through normally closed security detection switches 31, 32 and 33 to one terminal of a second synchronizing solenoid 34. The other terminal of synchronizing terminal 34 is connected by lead 35 through resistor 36 to the junction point 11 which, as stated previously, may be considered a terminal for source voltage with respect to the variable resistance aspect of the security loop.

Each of the resistances, 17 and 36, are adapted to be alternately and complementarily shunted. In other words, when one resistance appears within the circuit loop the other will not and vice versa. The shunting means for resistor 17 includes a synchronous motor 41 connected in a driving relation to cam discs 42 and 43. The cam disc 43 has a peripheral configuration which is adapted to coact with shunting bar 44 through the fixed flexible lead 45 which is permanently connected from one side of the resistor 17 to the shunting bar 44, and a shunting contact 46 which is connected to the other side of resistor 17. Shunting bar 44 has a fixed pivot point 46 and a spring 47 which serves to bias the bar against the periphery of cam 43.

The cam 42 of the synchronizing mechanism has a peg 48 thereon which is adapted to coact with and be intercepted by a synchronizing stop arm 49 for the purpose of "locking" the synchronizing motor at a specified position within its rotational mode. The synchronizing stop arm 49 operated by solenoid 15 is affixed at one end by a pivot 50 and is biased away from the stop 48 by a spring 51. Thus, when a synchronizing pulse is received through solenoid 15, the stop arm 49 is brought into a position wherein it will coact with the peg 48 to stop the synchronous motor 41 in a specified position.

The resistor 36 has a shunting apparatus incorporated therewith that is identical to the shunting apparatus for resistor 17 which consists of a synchronous motor 52 adapted to be connected to a suitable source of alternating current, cam discs 53 and 54, a shunting arm 55 which is pivoted at point 56 and biased by spring 57, a fixed flexible lead 58 which connects shunting arm 55 to one side of resistor 36, a contact 59 which is adapted to coact with shunting arm 55 to shunt the resistor 36 as a result of the rotation of cam disc 54. Also included in the structure is a stop peg 65 on the cam disc 53 and a synchronizing stop arm 66 including a synchronizing stop arm pivot point 67 and stop arm bias spring 68 which is adapted to coact with stop peg 65.

Connected between leads 20 and 21 are normally open condition responsive switches 68, 69 and 70. The resistor 18 together with the rectifier 19 serves a purpose with respect to the voltage or source reversing function and is unimportant to the resistance or impedance variance aspect of my invention. While I have shown fixed resistors which are adapted to be shunted by the described shunting mechanisms, it will be obvious to those

skilled in the art that these fixed resistors could be replaced by variable resistances which would be varied in a complementary fashion so that the sum of the two resistances would always be equal to a fixed given resistance value.

The resistor 17 together with its shunting mechanism and the resistor-rectifier combination of 18 and 19 are contemplated to be placed in a remote position and serve somewhat in the capacity of end of line resistors. The normally closed condition responsive switches 31, 32 and 33 will be dispersed throughout a detection loop, as will normally open detectors 68, 69, and 70.

A pair of fold lines, 37 and 38 indicate transmission lines which serve to connect the detection loop with the central station. All components which are shown at the right of the fold lines 37 and 38 are contemplated to be contained within a central station unit.

Referring now to that portion of the central station which is to the right of the junction points 10 and 11, a single pole double throw switch having a movable contact 80 and fixed contacts 81 and 82 connects junction point 10 to secondary 83 of transformer 84 at either of two possible positions. When movable contact 80 is in its lower position and coacting with contact 81, the junction point 10 is connected to a tap 85 of the secondary 83. When the movable contact 80 is in its upper position and coacting with contact 82, lead 86 of secondary 83 is connected to junction point 10. When junction point 10 is connected to tap 85, a lower magnitude voltage is applied to joint junction point 10 for normal supervisory operation. Placing the switch in its upper position serves to provide a higher magnitude voltage for the purpose of synchronizing the pair of resistance shunting mechanisms in a manner to be discussed later. The primary winding 87 of the transformer 84 is energized by a suitable source of alternating current. Terminal 88 is connected to winding 89 of a three position relay 90. Relay 90 has a movable arm 91 which is pivoted about a point 92 and which carries contact 93. A movable arm 91 operates between a de-energized position in which the contact 93 makes electrical connection with a stationary contact 94, a second position where a movable contact 93 makes no contact and to an upper energized position where the movable contact 93 makes electrical connection with a stationary contact 95. A pair of springs, 96 and 97 serve to bias movable arm 91 against the lower contact 94. A first degree of energization of the relay causes a movable arm to operate against the springs 96 and 97 until it reaches a mid-position between the contacts 94 and 95 in which movable contacts 91 complete no circuit. Further energization of the winding 89 causes the arm 91 to overcome the spring biasing to an extent whereby arm 91 will be deflected upward to allow contacts 93 to mate with contact 95. Contacts 93, 94 and 95 are connected respectively to outlet terminals 110, 111 and 112 which are intended to be connected to suitable alarm apparatus, not shown. In the specific embodiment shown, the three position relay is shown in its center or normal supervisory position.

Reversing voltage producing circuit 113 which includes a random switching device has a conductor 114 connected from the lower terminal of relay 90 through a variable current adjusting resistor 115 to a junction 116. Connected to junction 116 is a pair of diodes 117 and 118, the cathode of one and the anode of the other being connected to junction 116. A relay 119 which is comprised of a winding 120 and which operates a single pole double throw switch including a movable contact arm 121 and stationary contacts 122 and 123 serves to connect movable contact 121 to the opposite electrodes of the rectifiers 117 and 118 through the fixed contacts 122 and 123 respectively. The movable contact 121 is connected by a conductor 124 through a resistor 125 to the terminal 11. A rectifying diode 126 is connected in parallel with the resistor 125 with the direction of easy current flow being towards the contact 121.

The upper terminal of relay winding 120 is connected by a conductor 127 to a secondary winding 129 of power transformer 128, the primary 130 of which is energized by a suitable source of alternating current which may be the same as energized winding 87. The opposite terminal of winding 129 is connected by a conductor 131 to a contact 132 of a pair of mating electrical contacts 132 and 133. The contacts 132 and 133 pivot about points 134 and 135 respectively, and are normally biased apart by respective spring members 136 and 137. Contact 133 is connected by a conductor 138 to the lower terminal of relay winding 120 thus completing the circuit. The random switching device 139, in addition to including contacts 132 and 133, also includes a slow moving cam 140 which slowly rotates and changes the position of contact point 132. Also included is a second cam 141 which is eccentrically mounted to oscillate the contact 133 into and out of contact with 132. The position of slow moving cam 140 causes the "on" time of the contacts 67 and 68 to be varied in a completely random fashion since the periphery of cam 140 is made of completely random width notches or valleys. Whenever the cam 141 causes the contact 133 to mate with the contact 132, a circuit is closed which energizes relay 113 to operate contact 121 from its de-energized position in which it is connected with stationary contact 122 and into contact with the upper stationary contact 123. It will be apparent that the switching of contact arm 121 will be in a random time as determined by the position of the cams 140 and 141.

Operation

From the standpoint of voltage polarity reversing characteristics, presently to be considered, the resistors 17 and 36 and the solenoids 15 and 34 may be regarded as unimportant impedances within the detector loop. A junction point 23 and the junction point 10 may be considered as output terminals of the central station. A pair of transmission lines 37 and 38 connect the output terminals 10 and 23 of the central station to the supervisory loop 22. A current path may be traced in the detector loop through the solenoid 15, the resistor 17, lead 16, the resistor 18, lead 20, normally closed detector switches 31, 32, and 33, lead 20, the transmission line 37 and back to the output terminal 23. Connected in parallel with the resistor 18 is the diode 19 which is identical with the diode 126 in the central station. The direction of easy current flow is toward terminal 10. The value of resistance 18 is identical with the value of the resistance 125 for reasons which will become apparent from the following discussion.

Considering now the voltage polarity reversing aspects of the circuit in more detail, it will be noted that in the above described series circuit, when the terminal 86 of winding 83 is positive a current path may be traced from top terminal 85 (considering that the contacts 80 and 81 of the S.P.D.T. switch are in the normal operate position, as shown) through the switch contacts 80 and 81, through transmission line 38, lead 14, solenoid 15, lead 16 and resistor 17 resistor 18, normally closed condition responsive switches 31, 32 and 33, lead 20 and transmission line 37 to terminal 23, then through solenoid 34, lead 35, lead 38, switch contacts 55 and 59 thus shunting resistor 36, lead 35 and through diode 126 thus shunting resistor 125, through contacts 121 and 122, rectifier 117, junction point 116, variable resistor 115, lead 114 and through relay winding 89 back to terminal 88 of the secondary winding 83. It will be noted that during this half-cycle of operation, current flows through resistance 18 in the remote or end of line station but bypasses the equal resistance 125 in the central unit by flowing through the parallel diode 126.

On the half-cycle of alternating current supply at winding 83 during which the terminal 88 is instantaneously positive, no current flows in this circuit because of rectifying diode 117. Thus it is apparent that half-cycle di-

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rect current pulses are flowing in the circuit. Under normal operating conditions the resistor 115 is adjusted so that sufficient current is flowing in the circuit to maintain the relay winding 89 sufficiently energized to move the relay arm 91 away from contact 94 and to its center position as shown in the drawing. Under these conditions contact 93 makes no connection with either of contacts 94 or 95 and the alarm apparatus which is connected to contacts 110, 111 and 112 is not actuated. This alarm, not shown, may be any conventional type such as bells, lights, or other suitable equipment.

As the eccentric cam 141 revolves, the contact 133 is brought into electrical connection with the contact 132. During this interval of time, a current path may be traced from one terminal of the secondary 129 of transformer 128 through conductor 127, relay coil 120, conductor 138, contacts 132 and 133 and through lead 131 back to the other terminal of secondary 129.

The energization of relay 119 causes contact 121 to move up and make physical connection with stationary contact 123. A new current path may now be traced in the series circuit of the alarm system. During the half-cycle of A.C. energization when the terminal 88 of secondary 83 is instantaneously positive, a current path may be traced through relay coil winding 89, conductor 114, variable resistor 115, junction point 116, rectifier 118, contacts 121 and 123, lead 124, resistor 125, lead 35, switch contact 59, shorting bar contact 55, flexible lead 58 and to solenoid 34 and through terminal 23 to transmission line 37, from transmission line 37 through lead 20, normally closed condition sensors 31, 32 and 33, and diode 19 thus shunting resistance 18, lead 16 and resistor 17, solenoid 15 and lead 14, transmission line 38, junction point or terminal 10, contacts 81 and 82 back to tap 85 on secondary 83. It will be noted that under this condition of operation current is flowing through resistor 25 and is being bypassed around resistor 18 by diode 19. Since the diodes 19 and 126 are symmetrical and since the resistances 18 and 125 are identical, the current flowing in each of the two circuits is equal but opposite in direction. The current through winding 89 of relay 90, therefore, is the same no matter whether the contact 121 of relay 119 is in its upper or its lower position and the three position relay 90 will remain in its center position as long as normal conditions of operation are encountered.

As the slowly rotating cam 140 moves from its present position as shown in the drawing in which the contact arm 132 is resting in a valley A of the periphery of the cam to the raised portion B of the periphery of the cam, the contact arm 132 is moved toward contact arm 133. This has the effect of changing the length of time or portion of a rotating cycle of cam 141 that contact 133 is in electrical connection with contact 132. It thus effects a change in the portion of time during which relay 119 is energized. It will be noted that the cycle is determined by the time duration taken for one revolution of cam 141 since the contacts 132 and 133 are closed and opened once during each revolution of cam 141. Since slow moving cam 140 is designed with completely random width elevated and depressed portions about its periphery, it becomes very difficult for anyone attempting to defeat the system to determine when the direction of current flow through the circuit energized by winding 83 will change from one direction to the other.

For the purposes of illustration I have shown, in the drawing, a system for reversing the direction of current flow which utilizes the cam actuated switches and a pair of diodes 117 and 118 that are adapted to be switched as a result of the cam action. Obviously any method of reversing current flow could be utilized. Of course, it is more desirable to accomplish the reversing at random intervals. In place of the alternating current embodiment which I have shown, the invention could be carried out by using a direct current operating source and then

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reversing its polarity by a switching arrangement. Or, the pair of diodes 117 and 118 could be replaced by a single diode adapted to have its leads reversed by a double pole double throw cross-over switch. Or, the current reversing aspect could be accomplished by electronic means as for example, electronic means adapted to close a switch in the presence of some erratic function such as a certain level of static charge in the air.

Consideration of the invention will now be given to the significance of resistors 17 and 36 and their associated shunting circuits 12 and 13. As stated previously, the circuit is designed to maintain either resistance 17 or resistance 36 within the series loop at all times. This objective is accomplished by the use of the two motor driven cam mechanisms 12 and 13. As indicated previously in the discussion of the voltage polarity reversing aspect, while polarity is reversing randomly and continuously, the level of current flow through the supervisory loop and through resistance 36 and supervisory relay 90 remains substantially constant. In normal operation, since only one of the two resistances 17 and 36 are in this series loop, the varying or complementary resistance components will not effect this level of current flow.

Since both motor-cam mechanisms 12 and 13 are identical, a detailed description of one will suffice to describe the operation of both. Referring to mechanism 12, a synchronous motor 41 having its leads connected to a suitable source of alternating current has cam discs 42 and 43 fixably mounted upon its driving shaft which is indicated by the dotted line extending from motor 41 through the centers of discs 42 and 43. Since the cam 43 is designed to drive shunting arm or contact 44 up against contact 46 only during 180 degrees, or any fixed number of degrees, the mechanism 13 must then shunt resistor 36 during a complementary number of degrees such that either resistor 17 or resistor 36 is shunted during an entire 360 degrees of rotation.

It is essential that the two motor-cam mechanisms 12 and 13 operate in synchronism. Thus, means are provided to synchronize the two systems at periodic intervals in order to maintain this proper synchronous balance. The solenoids 15 and 34 together with synchronizing stop arms 49 and 66 and cam discs 42 and 53 serve this purpose. At such time as an operator is desirous of performing a synchronizing function, movable switch contact 80 may be deflected to make contact with the switch contact 82. As may be readily seen from the drawing this action will cause a greater number of turns of secondary 83 to be connected in circuit with the detection and supervisory loop. The greater number of turns then will cause a voltage of higher magnitude to be applied to in turn cause a higher magnitude current to flow throughout the circuit during a correction or synchronizing period. The solenoids 15 and 34 are of such a design whereby they will not be energized by normal supervisory current flow, but will be energized in the presence of the higher current flow created by the increased current flow resulting from the correcting switch action. When solenoids 15 and 34 are energized, they will pull their respective stop arms 49 and 66 in toward the respective cams 42 and 53. The cam discs 42 and 53 have their respective stop pegs placed in a predetermined position on their peripheries such that, when the stop arms 49 and 66 are in the energized position, the pegs will serve to stop or "lock" the motors 41 and 42 in a proper position with respect to each other so that the necessary complementary alternate shunting of the two resistances 17 and 36 can be accomplished. The solenoids 15 and 34 are maintained energized for a sufficient period of time whereby the synchronous motors 41 and 52 should have completed a revolution under normal operating conditions. When this normal revolution time interval has been completed, both motors should be "locked" by reason of the stop arms 49 and 66 having intercepted the pegs 48 and 65.

Thus, the mechanisms are in synchronism and the movable switch contact 80 may be deflected to its "normal operate" position which is to the lower position and in contact with the switch contact 81. If desired, the cams may be connected to motors 41 and 52 by suitable clutch means, not shown, whereby the cams can be locked for synchronizing purposes without locking the motors.

While the specific embodiment of the invention shown and described utilizes a pair of alternately shunted resistors, any form of current impeding component could as well be used. Also, instead of completely shunting either of the pair of resistors, components 17 and 36 could be replaced by variable resistors which could be complementarily varied in a manner whereby the pair would provide a constant total impedance.

As discussed previously, the system incorporates two different types of detectors or sensors which are the normally closed sensors 31, 32 and 33 and the normally open sensors 68, 69, and 70. The normally open type of detector may, for example, comprise a thermostatic element that closes its contacts upon a predetermined rise in temperature to indicate a fire. The normally closed switches or detectors may comprise a type of switch which, upon the opening of a window or door, interrupts the series circuit. In the event that one of the sensors 68, 69 or 70 is caused to close, the resistance 18 and its shunting diode 19 as well as resistance 17 will be shorted out of the circuit and the current to relay 90 increases such that the movable arm 91 of the relay 90 will be deflected to its upper position whereby the contacts 93 will mate with the contact 95 to close a circuit to suitable alarm apparatus. If a break should occur in the series loop such as if a transmission line should be cut, or if one of the normally closed detectors 31, 32, or 33 should be caused to open, current would then fail to flow through the relay coil 89 and resultantly, movable arm 91 would drop to in turn cause contacts 93 to mate with contact 94 to close a second circuit to a suitable alarm mechanism.

Under certain conditions it may be desirable to eliminate the resistor-rectifier combination 18—19 and 125—126. These resistor-rectifier combinations serve a function in the circuit in providing an extra variable in the end of line resistance since resistor 18 is shunted at irregular intervals by the rectifier 19. However, since end of line resistance is varied by the alternate shunting of resistor 17, the teachings of my invention may be carried out without the resistor-rectifier combination of 18 and 19 together with its correlative unit comprised of the resistor 125 and the rectifier 126.

Tampering with the system disclosed in my invention will be virtually impossible from a practical standpoint. A well known way of defeating ordinary types of supervisory systems having current flowing through them is to replace the end of line resistance with an equivalent resistor at some point along the transmission line and thus de-energize the supervisory loop. However, since I have provided an end of line resistance 17 which is alternately switched with a resistance 36 contained within the local station, such a replacement will not be possible since a tampering agent will have no way of knowing when such an end of line resistance should be across the line and when it should not be.

It should be apparent to those skilled in the art that it would be virtually impossible to defeat the system which I have disclosed in my invention. While a specific embodiment of my invention has been shown for the purpose of illustration, many modifications to this embodiment might be made and still remain within the scope of my invention. For this reason, I request that my invention be limited only by the scope of the appended claims.

I claim:

1. Circuit supervising apparatus comprising: a supervisory station having therein source voltage means, current reversing means, alarm actuating means, first impedance means and means for alternately shunting said first

impedance means; a line to be supervised having therein second impedance means and means for alternately shunting said second impedance means; means connecting said line, said alarm actuating means, said current reversing means, said first impedance means and said second impedance means in series and across said source means; said impedance shunting means for said first impedance means and said impedance shunting means for said second impedance means being adapted to complementarily shunt their respective impedance means in a manner whereby the total impedance of the current loop remains substantially constant; and said alarm actuating means being sensitive to a deviation from a normal level of current flow and being adapted to actuate alarm means in the presence of an abnormal level of current flow.

2. Apparatus as in claim 1 including means for synchronizing said first and second impedance shunting means comprising comparatively high magnitude voltage responsive stop actuating means associated with each of said first and second impedance means and means for applying a voltage to said circuit of a higher magnitude than normal operating voltage to cause said stop actuating means to intercept stop means on each of said impedance shunting means to thereby hold them in a predetermined position as long as the higher magnitude voltage is applied.

3. In supervisory apparatus including, a detector loop, source voltage means first and second complementarily shunted impedance means, means sensitive to an abnormal current flow and means connecting said detector loop, said first and second impedance means and said means sensitive to abnormal current flow in series relationship across said source means, the improvement comprising: current reversing means adapted to reverse the flow of current through said detector loop and through said pair of impedance means comprising; a pair of cam means including eccentric cam means and a camming means having an irregular peripheral configuration; a pair of contact arms having biasing means adapted to bias one of each of said pair of contact arms against either of said pair of cam means, a source of relay energizing voltage, relay coil means, means connecting said pair of contact arms in a controlling relation with said relay coil means and said relay energizing source so that the contact time interval of said contact arms will determine the interval of energization of said relay coil; a pair of asymmetric current control devices connected in opposition, and means controlled by said relay means for alternately connecting either of said pair of asymmetric current control devices in series with said detector loop and said alarm circuit closing means.

4. In supervised circuitry comprising a supervisory station and means responsive to deviations from a constant level of current flow in a circuit to be supervised for providing an indication of deviations from a predetermined current flow level and means continuously varying the impedance of said station; a circuit to be supervised including further means for continuously varying the impedance of said circuit; means connecting said circuit to said supervisory station, said means for continuously varying said impedance of said station and said impedances of said circuit being synchronously complementary in operation so that the sum of the impedances of said station and of said circuit is maintained at a predetermined level; further means continuously reversing the direction of current flow through said station and said circuit to be supervised at irregular intervals, said current reversing means comprising a pair of asymmetric current control devices having their paths of easy current flow connected in opposition adapted to be alternately connected in series with the current loop established by said supervisory station and said loop to be supervised; and means alternately connecting either of said asymmetric current devices in said current loop at alternate random

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time intervals so that current flow through said current loop will be reversed at a rate determined by said alternate connecting means.

5. In a condition sensing system having a supervisory station and a circuit to be supervised: variable impedance means connected at intervals in said supervisory station and said circuit to be supervised; means synchronously and complementarily varying said variable impedance means in an inverse relationship so that the total impedance of said circuit remains constant; a source of energizing potential; alarm actuating means responsive to variations from a predetermined level of current flow; means for randomly reversing the direction of current flow through said supervisory station and said circuit to be supervised; and means connecting said alarm actuating means, said pair of synchronously varied impedance means and said circuit to be supervised through said current reversing means to said source of energizing potential.

6. Apparatus for supervising an electrical circuit comprising: a circuit to be supervised; a source of power; said circuit including a plurality of impedance means and means for continuously varying said plurality of impedance means in a synchronous and complementary manner

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whereby a constant total impedance is maintained providing a constant signal level in said circuit; indicating means connected to said circuit and responsive to deviations of said signal of a constant level to provide an indication thereof; current reversing means for reversing the direction of current flow through said circuit to be supervised; and means connecting said circuit to be supervised through said current indicating means and said plurality of impedance means to said source of power.

7. In circuit supervising apparatus having means for reversing the direction of current flow at random intervals: a circuit to be supervised; first and second complementarily varied impedance means; alarm actuating means sensitive to an abnormal flow of current; means for complementarily varying said first and second impedance means in a manner whereby said first and second impedance means always provide a constant total impedance; a source of voltage including means for randomly reversing the polarity thereof; and means connecting said circuit to be supervised through said first and second impedance means and said alarm actuating means to said source of voltage.

No references cited.