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ELECTRICAL PROTECTIVE SYSTEM

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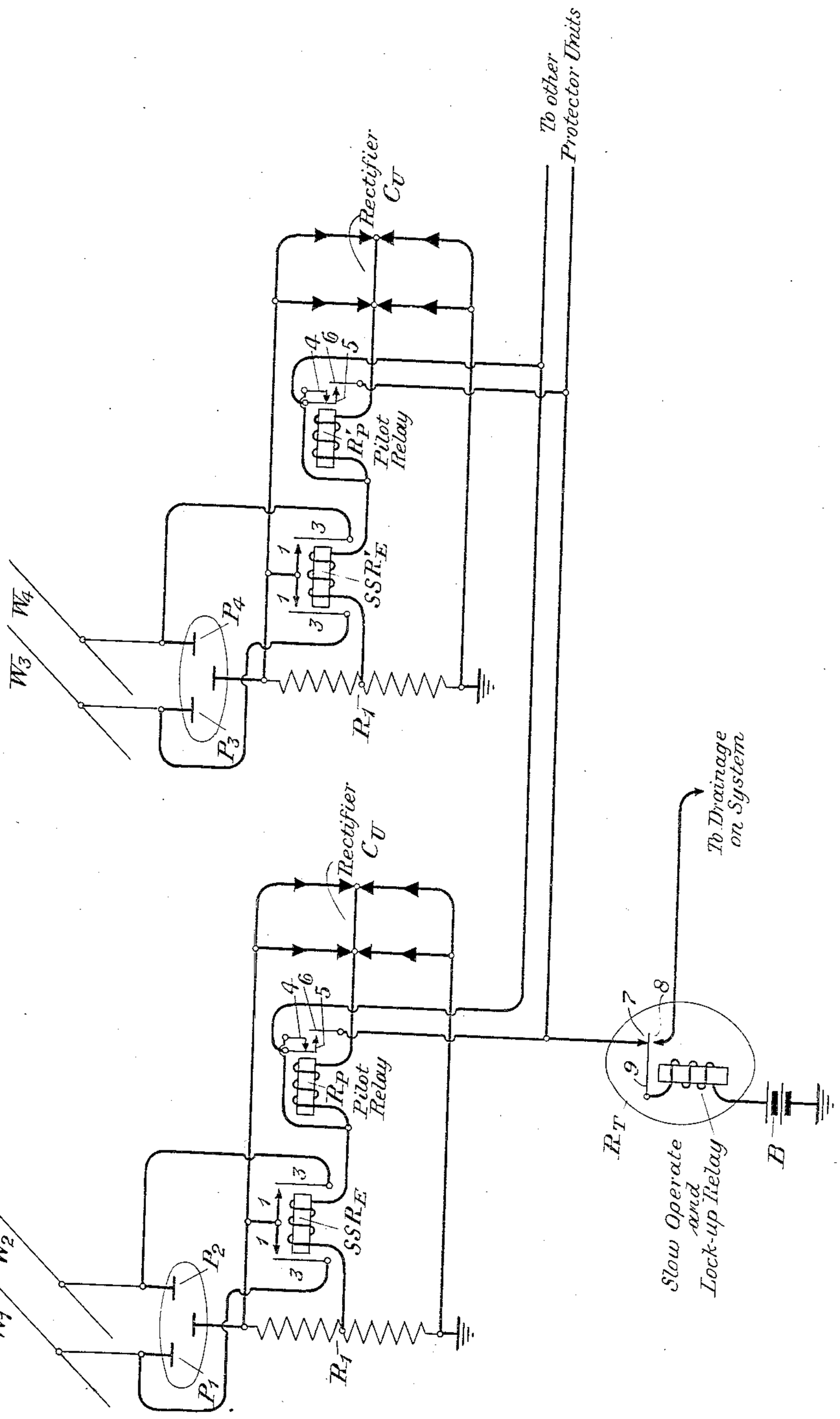

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ELECTRICAL PROTECTIVE SYSTEM

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This invention relates to electrical protective systems. More particularly, this invention relates to arrangements for converting a multi-grounding relay protector arrangement into a unit-type arrangement. The relay protector arrangements of this invention are intended to provide for simultaneously grounding a plurality of circuits or lines when induced voltages exceeding a predetermined value become impressed thereon.

Pairs of protector blocks each having an air gap which breaks down at a predetermined potential are used in the telephone art for the protection of each of a number of telephone circuits or lines from high voltages set up therein by one or more sources extraneous to the circuits or lines themselves. In these arrangements a resistor or a saturating reactor is introduced in the ground connection of each pair of protector blocks. The resistor or the saturating reactor, as the case may be, carries all of the operating current of the two or more protector blocks associated therewith. The impedance drop across the resistor or saturating reactor may be rectified by a rectifier of, for example, the copper oxide type. The rectified current may then be applied to the winding of two or more relays which are connected in series relationship. One of these relays, which may be termed the short-circuiting relay, may be employed to shunt the protector blocks associated with the pair of wires or conductors to which the corresponding resistor or reactor is connected. The second relay of the series circuit, which may be termed a pilot relay, may also be operated from the rectified current and it may be further employed for supplying the potential of a local battery or other source to all the short-circuiting relays associated with the various wires or conductors and the corresponding protector blocks which are connected to these wires or conductors.

It has been found that the inductive effect impressed upon the various wires or conductors may not be sufficiently large to cause the gaps of all of the associated protector blocks to become broken down. In that event some of the various relays will be operated by the voltage produced by the inductive effect while the rest of the relays will remain unoperated. If a few of the units operate there will arise a condition such that unequal potentials of appreciable and perhaps dangerous magnitude will exist between the various wires or conductors along the line of exposure. But in accordance with this invention suitable arrangements are provided for obviating this condition and these arrangements bring about the simultaneous grounding of all of the wires or circuits upon the operation of a single protector unit.

If all of the wires or conductors which may be exposed to inductive interference are protected by a multi-grounding arrangement of the type just described, and if only a single protector block or a pair of protector blocks need be broken down to cause the grounding of all of the wires or conductors at the particular point where the induced voltage may be above a predetermined magnitude, there is a further possibility that a particular pilot relay may be defective in that it will remain operated and thereby maintain all of the wires or conductors grounded for a long period of time. This would require the dispatch of an attendant from a central office to correct the defective pilot relay or replace it or, if this is not done, the various wires or conductors will then remain grounded until the local source of battery supply has completely run down by virtue of the heavy drain of current through the circuits of the various relays. It is obvious that during this entire interval of time when the various wires or conductors are grounded due to a defective condition all telephone or telegraph service over these wires or conductors cannot possibly take place.

This invention is intended to provide a protective system for a plurality of wires or conductors which will be free from the difficulty of total service outage arising from a defect in the operation of the pilot relay or arising, in general, from the persistent application of potential to a single wire or pair of wires. The protective system proposed by this invention is one which will unground the various wires or conductors if the service over these wires or conductors is interrupted for a period longer than a predetermined number of seconds. Thus, in accordance with this invention, if a pilot relay should become defective or if an extraneous potential should persist longer than a predetermined period of time, the various circuits will be operated to unground the various exposed wires or conductors. This invention endeavors, therefore, to automatically disengage the multi-grounding arrangement which is employed therein if the multi-grounding arrangement remains operated for longer than a predetermined interval of time and to convert the protective arrangement from the multi-grounding type to the unit type.

This invention will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing showing one embodiment of the invention merely for the purpose of illustration.

Referring to the drawing, the conductors W_1, W_2, W_3 and W_4 represent four of a plurality of wires or conductors which may be supported, for example, by a common protector pole. Each of these various wires or conductors may be connected to ground through an individual protector

block and a common resistor or reactor. The various protector blocks are designated P_1, P_2, P_3 and P_4, the upper terminal of each block being connected to one of the wires or conductors while the other terminal is connected to a resistor or saturating reactor which is designated R_1. In the arrangement shown in the drawing the protector blocks P_1 and P_2 are associated with a common resistor or reactor R_1, and similarly, the protector blocks P_3 and P_4 are also connected to a common resistor or reactor R_1.

Each of the various protector blocks may include two electrodes which are spaced from each other by a gap of predetermined width which may be, for example, .003 inch. The two electrodes of each protector block may be supported in a porcelain holder which is so shaped as to insure the normal existence between these electrodes of the aforementioned gap of predetermined width. If desired two protector blocks may be combined into a single arrangement having a common electrode and two additional electrodes, as shown, all three electrodes being supported by a porcelain holder, as already described, and the common electrode will, of course, be a part of two protector blocks which operate independently.

The upper and lower terminals of the resistor or reactor R_1 are connected to a copper oxide rectifier arrangement C_U. The midpoints of this copper oxide rectifier arrangement C_U are connected in series with the winding of a pilot relay R_P and the winding of a short-circuiting relay SSR_E and to the midpoint of the resistor or reactor R_1. The contacts 1 of each short-circuiting relay SSR_E are connected to the upper terminal of the corresponding resistor or reactor R_1 while the armatures 3 of each short-circuiting relay are connected to the upper terminals of the respective protector blocks. Thus the armature 3 at the left of the relay SSR_E is connected to the upper terminal of the protector block P_1, the armature 3 at the right of this relay is connected to the upper terminal of the protector block P_2 and the armatures at the left and right of the relay SSR_E' are connected to the upper terminals of the protector blocks P_3 and P_4, respectively.

The back contact 4 of each pilot relay R_P normally rests against its swinger 5. The armature 6 of the various pilot relays R_P, R_P', etc., are connected to the contact 7 of the thermal relay R_T.

When any one of the protector blocks such as P_1 breaks down, there will be a potential impressed across the resistor or reactor R_1. This potential will be rectified by the copper oxide rectifier arrangement C_U, one-half of the cycle being rectified by the upper half of the arrangement C_U while the other half cycle is rectified by the other half of the arrangement C_U. Both portions of the rectified current will flow through the circuit which includes the windings of the relays SSR_E and R_P. The rectified current which flows through these relays is sufficient to cause their operation. The closure of the contacts 1 by the armatures 3 of the relay SSR_E will complete circuits which will shunt the protector blocks P_1 and P_2. These shunt circuits will prevent the induced voltages from being bypassed through the protector blocks P_1 and P_2 and will therefore preserve them against grounding, and the induced voltages will be shunted to ground through the resistor or reactor R_1.

Upon the operation of the pilot relay R_P by the flow of rectified current through its winding, the armature 6 will close the contact of the swinger 5 and open contact 4. This will cause current to flow from the battery B through the winding of the thermal relay R_T and through its armature 9 and back contact 7, over the armature 6 and the swinger 5 of the relay R_P and over the swinger 5 and the contact 4 of each of the other pilot relays R_P', etc., and then through the windings of the relays SSR_E', etc., and over the lower half of the resistor or saturating reactor R_1 to ground. This current through the winding of the relay SSR_E' and similar short-circuiting relays in parallel therewith will operate these short-circuiting relays. The armatures 3 and the contacts 1 of these relays will form circuits which will shunt protector blocks P_3 and P_4 connected to the wires or conductors W_3 and W_4, and the protector blocks connected to other wires or conductors (not shown in the drawing) will be similarly short-circuited. Thus the operation of the pilot relay R_P which is in the protector unit connected to the conductors W_1 and W_2, will cause the operation of the short-circuiting relays of the protector units associated with other pairs of conductors, the current for the operation of these short-circuiting relays being provided by the common battery B.

It will be noted that the operation of the pilot relay R_P and the consequent closure of the swinger 5 by the armature 6 of that relay will at the same time open the circuit of the contact 4 of the same relay. This will prevent the flow of current from the battery B through the winding of the short-circuiting relay SSR_E.

It will be further noted that the operation of any one of the pilot relays will cause the simultaneous operation of the short-circuiting relays of the other protector units and that the protector blocks of all of the other units will be completely shunted upon the operation of any one of the various pilot relays.

In general, the duration of a disturbance which may cause the breakdown of any one of the protector blocks P_1 to P_4 if from lightning will usually last only a few microseconds. If the disturbance is from power induction it will seldom last longer than about six seconds. But if the impressed voltage is caused by contact with a high potential circuit it may last indefinitely, provided the current over the exposed telephone circuit or circuits is not so great as to burn down the conductor. Contact between a high potential circuit and one or more of the various conductors W_1 to W_4 or a defect in the relay arrangement, may cause a lock-up of the entire multi-grounding arrangement and thereby render all the signal circuits inoperative for a considerable period of time until that trouble is cleared. In order to overcome such a situation the relay R_T is chosen to be one of a slow-operating type, preferably of a thermal type, and its winding is introduced in series with the local battery B so that the current flowing from the battery must necessarily pass through the winding of the thermal relay R_T. The relay R_T may be set to operate after a predetermined number of seconds and upon its operation its armature 9 will be removed from contact 7 and close contact 8. Just as soon as the armature 9 leaves contact 7 current can no longer flow from battery B through any of the circuits of the various protector units. It will also be impossible for current to flow through the windings of the various pilot relays, and if these relays are not defective their armatures will be restored to their normal unoperated condition. In fact, the relay R_T may be a type of thermal relay which mechanically locks itself in

its operated condition. It may require for operation a continuous flow of current through its winding for, for example, between ten and thirty seconds, and after operation it may stay locked until it is released either by an attendant or by a circuit which may have a winding coupled to the winding of the relay R_T over which current may flow from a remote source, for example, from the central office, under the control of an attendant at the central office. All of these details of operation will be obvious to those skilled in this art.

If any one of the signal circuits or conductors W_1 to W_4 is in physical contact with a source of external potential, the voltage impressed across the resistor or reactor R_1 associated with that conductor may be sufficient after rectification by the rectifier C_U to cause the operation not only of the pilot relay R_P but also of the short-circuiting relay SSR_E, in which event the protector blocks associated with that particular protector unit will remain completely shunted as long as the contact remains established. But after the lapse of a period of time during which the induced voltage may normally be impressed upon any one of the conductors W_1 to W_4, the relay R_T will operate and open the contact 7 and it will therefore be impossible for any of the relays of the various protector units to be supplied with current from the local battery B. Upon the operation of relay R_T the local battery B will be withdrawn from the windings of all of the various short-circuiting relays, and hence the various wires or conductors W_1 to W_4 will be restored to their normal ungrounded condition and they will no longer be short-circuited by the armatures and contacts of the various short-circuiting relays.

Upon the withdrawal of the local battery B from the various protector units, which were connected in an arrangement in which the local battery supplied the current for simultaneously operating all of the various protector units and if a single protector block or a pair of protector blocks of the same unit was broken down by the application of an excessively high potential across its terminals, the multi-grounding arrangement will then be converted into a unit type of protective arrangement. That is, each unit will then operate independently of the other units. Hence, if an excessively high potential becomes impressed upon the conductor W_3, the gap of the protector block P_3 will be broken down and the potential across the resistor or reactor R_1 will be rectified by the associated rectifier arrangement C_U and the relays SSR_E' and R_P' will become operated. In that event the protector blocks P_3 and P_4 will alone be short-circuited by the armatures and contacts of the relay SSR_E'. The protector blocks of other units (not shown) will not be short-circuited unless a sufficiently high voltage is impressed upon any one of the conductors associated with those protector blocks.

The contact 8 of the relay R_T may, of course, be connected to the midpoint of a drainage coil or to an idle circuit, and in either case the flow of current over the circuit which includes the armature 9 and the contact 8 of the relay R_T may be caused to operate an alarm located, for example, at the central office. This will be apparent to those skilled in the art and is obviously within the scope of this invention.

It will be understood also that the relay R_T may be of a type which will operate after there has been a flow of current through its winding during a predetermined number of seconds, and will release after an additional predetermined number of seconds. It will be further understood that an additional winding may be incorporated in the relay R_T which may be connected over the drainage system from a nearby central office, and this additional winding may be employed for the purpose of disengaging or restoring the relay R_T to its normal condition, as desired, all of which is, of course, understood by those skilled in this art.

While this invention has been shown and described in certain particular arrangements merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of this invention and the scope of the appended claims.

What is claimed is:

1. The combination of a plurality of groups of open wire lines, a plurality of short-circuiting relays each associated with one of said groups of lines and when operated grounding all of said lines, a plurality of pilot relays each associated with one of said groups of lines, rectifying means associated with each group for rectifying voltages exceeding a predetermined value which may be impressed upon any one of said lines, means for transmitting the rectified current through the windings of the corresponding short-circuiting relay and pilot relay, and means responsive to the operation of one of the pilot relays for operating all of the other short-circuiting relays in all of the other groups.

2. The combination of a plurality of groups of open wire lines, a plurality of short-circuiting relays, a plurality of pilot relays, a source of potential, a slow-operating relay, one of said short-circuiting relays and one of said pilot relays being associated with each of said groups of lines, rectifying means associated with each group of lines for rectifying any voltage exceeding a predetermined value which is impressed upon any one of said lines of the corresponding group, means for transmitting the rectified current through the windings of the corresponding short-circuiting relay and the corresponding pilot relay, the operation of each short-circuiting relay grounding all of the lines associated therewith, and means responsive to the operation of any one of the pilot relays for supplying current from said source through the winding of the slow-operating relay and through the windings of all of the short-circuiting relays for operating said short-circuiting relays, the operation of the slow-operating relay preventing potential from said source from being applied to the windings of any of the short-circuiting relays.

3. The combination of a plurality of groups of exposed lines, rectifying means associated with each group of lines, means responsive to the flow of current exceeding a predetermined value through any one of said rectifying means for simultaneously grounding all of the lines in all of the groups, a delay circuit associated with all of the groups of lines, means for operating said delay circuit after all of said lines have become grounded for a predetermined period of time, and means responsive to the operation of the delay circuit for rendering each of said groups of lines independent of the other groups of lines.

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