

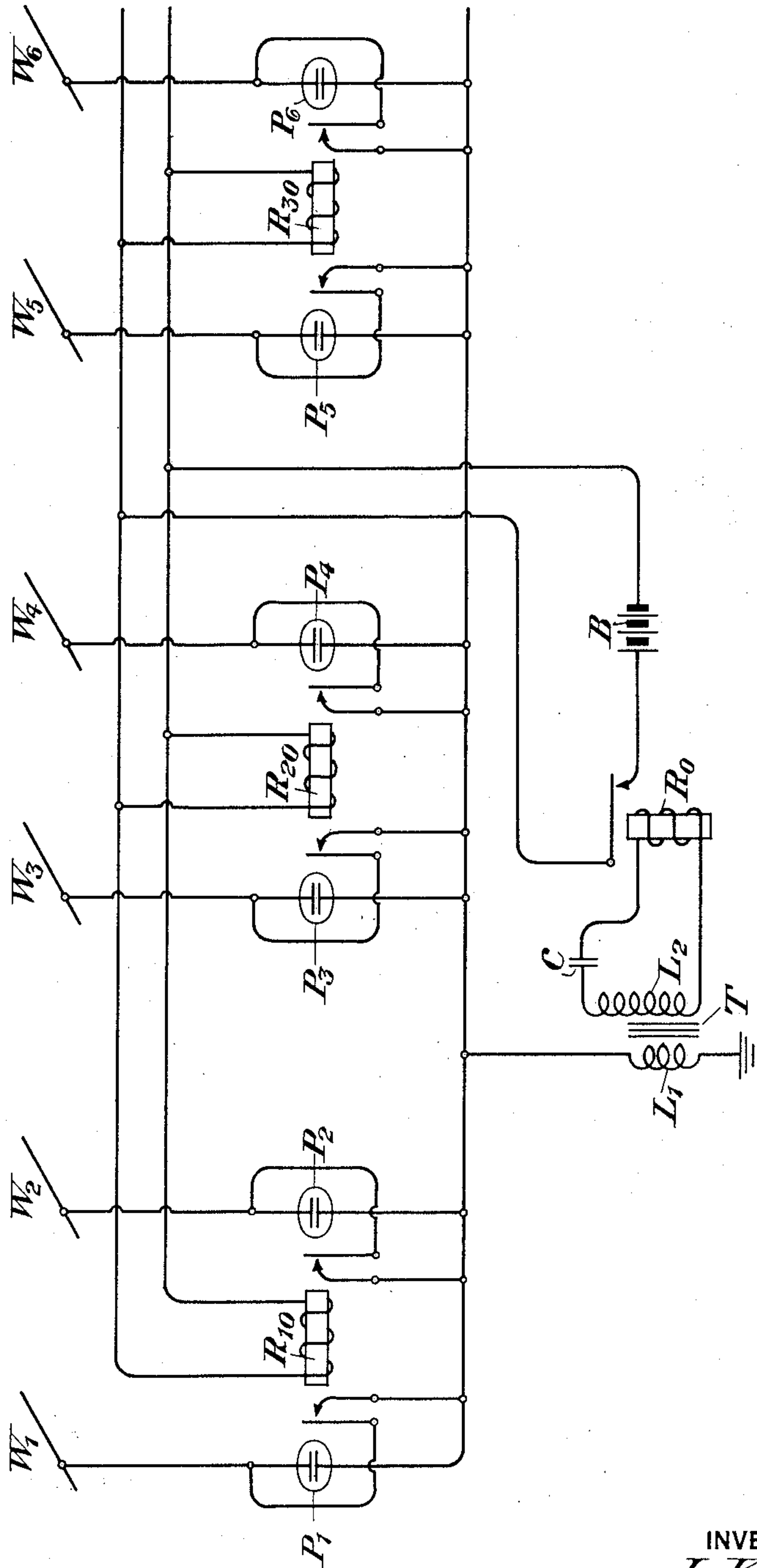
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ELECTRICAL PROTECTIVE SYSTEM

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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 simultaneously grounding a plurality of circuits when induced voltages become impressed thereon.

A pair of protective blocks each having an air gap which breaks down at a predetermined potential, have recently been used in the telephone art for the protection of each of a number of telephone circuits from high voltages set up therein by one or more sources extraneous to the circuits themselves. In these arrangements a resistor or a saturating reactor is interposed in the ground connection of each pair of such protective blocks. The resistor or the reactor, as the case may be, carries all the operating current of the two blocks associated therewith. In these arrangements, moreover, the impedance drop across the resistor or the reactor is rectified by a rectifier which may be of the copper oxide type. The rectified current is applied to the winding of a relay which, when operated, shunts both of the protective blocks so that any induced current or currents may be carried through the heavy duty contacts of the relay.

A plurality of pairs of protective blocks and a plurality of relays, one corresponding to each of the pairs of protective blocks, have been associated with a plurality of telephone circuits running substantially parallel to each other, each exposed to the same inductive effect. There has been found to arise frequently a condition where some of the various relays will be operated and some unoperated, because the inductive effect was not sufficiently large to cause the gaps of all of the associated protective blocks to become broken down. This condition created a considerable hazard since the circuits connected to those protective blocks and relays which had been operated, were grounded, while those circuits connected to the protective blocks and circuits which had not been operated, were maintained at potentials considerably above ground. Of course, this condition is highly undesirable and may be ob-

viated by suitable arrangements for simultaneously grounding all of the circuits.

The copper oxide rectifier forming part of the protective equipment of the prior art which has been briefly described hereinabove, seems quite unsatisfactory. The characteristics of the rectifier rapidly change with age. Moreover, this rectifier seldom returns to its original state after a severe application of voltage, or after the passage of a large current. And, furthermore, its characteristics continually change with variations in temperature. All of these matters substantially affect the sensitivity of the device and reduce its range of operation. Any arrangement dependent upon the operation of such a device is especially undesirable.

This invention is intended to provide a protective system for a plurality of conductors or circuits which will be of simple construction and will be free from the difficulties mentioned hereinabove. It is one of the objects of the invention that this protective system causes the simultaneous grounding of all of the conductors or circuits when an extraneous inductive effect becomes impressed upon any one of the various conductors or circuits. One of the features of this invention lies in the employment of a saturating reactor of any type in combination with an alternating current relay, both being common to all of the conductors or circuits requiring protection.

While this invention will be pointed out with particularity in the appended claims, the invention both as to its further objects and features, 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 reference characters W_1 to W_6 inclusive, represent six of a plurality of conductors or circuits which may be supported by a common protector pole. Each of these conductors may be connected to ground through an individual protective block and a common reactor designated L_1 , this reactor being shown as a wind-

ing having a saturating core preferably of iron forming one of the elements of a transformer. The various protective blocks are designated P_1 to P_6 inclusive. The lower terminal of each of these blocks is connected to the upper terminal of the reactor L_1 , and each upper terminal is connected to one of the conductors W_1 to W_6 . Each of the various protective blocks may include two carbon electrodes spaced from each other by a gap of predetermined width which may, for example, be .003 inches. The two electrodes may be supported in a porcelain holder which is so shaped as to insure the normal existence between these electrodes of said gap of predetermined width.

The transformer T includes, in addition to the winding L_1 and the saturating core, a secondary winding L_2 . The secondary winding L_2 of this transformer may have a greater number of turns than the primary winding L_1 and, therefore, all impressed voltages will be stepped up in a well known manner.

The winding L_2 is connected in series with a condenser C and with the winding of a sensitive alternating current relay R_0 . The relay R_0 includes an armature which is normally spaced from its associated contact. This contact becomes closed only when the relay is operated and remains closed as long as sufficient energy is supplied to its winding.

The condenser C does not form an indispensable element of the arrangement, but it may, if desired, be used to tune the circuit in series with the winding of the relay R_0 to some definite frequency, for example, 25 or 60 cycles, which may be the frequency of current transmitted over nearby power circuits. By so tuning the circuit, the time and energy required to operate the relay R_0 will be a minimum.

The winding of the relay R_0 is preferably one of high impedance. If this winding be of low impedance, the transformer T may be arranged to step down impressed voltages, and this may be accomplished by reducing the number of turns on its winding L_2 below the number on its winding L_1 , as is well known in the art.

The relays designated R_{10} , R_{20} and R_{30} are associated with the protective blocks P_1 to P_6 inclusive. The windings of all of these relays are connected in parallel relationship, the parallel circuit being in series with a battery B and the armature and contact of the relay R_0 . When the relay R_0 becomes operated, current will flow from the battery B over the armature and contact of the relay R_0 and through the windings of the relays R_{10} , R_{20} and R_{30} , and the armatures of these relays will become simultaneously attracted.

The armatures at the left of the relays R_{10} , R_{20} and R_{30} and their associated heavy duty contacts, provide paths in shunt with the

protective blocks P_1 , P_3 and P_5 respectively, and those armatures at the right of these relays and their associated contacts, provide similar shunt paths around the protective blocks P_2 , P_4 and P_6 . Thus, the operation of all of the relays R_{10} , R_{20} and R_{30} will simultaneously shunt all of the protective blocks through the shunt circuits provided by the armatures of these relays. By shunting all of the protective blocks, the various conductors W_1 to W_6 inclusive, will be simultaneously grounded through the reactor L_1 and the corresponding heavy duty contacts of the relays R_{10} , R_{20} and R_{30} .

The manner in which the apparatus of this invention operates, is as follows: When an extraneous voltage becomes induced in any one of the various conductors W_1 to W_6 , the protective block associated with the conductor so impressed will discharge a substantial current and that current will flow through the reactor L_1 to ground. A somewhat higher voltage will send the current through the condenser C to the winding of the relay R_0 , the condenser functioning to reduce the time required to build up a substantial current through this winding. The relay R_0 will become operated and its armature will close its associated contact as long as appreciable current becomes impressed upon its winding. While the relay R_0 remains operated, the battery B will transmit current through the windings of the relays R_{10} , R_{20} and R_{30} , and this current will divide equally between these windings. The armatures of all of these relays will be simultaneously attracted, one of the armatures of each relay establishing a path in shunt with one of the various protective blocks, and therefore, all of the conductors W_1 to W_6 will be connected to ground through the armatures of the various relays R_{10} , R_{20} and R_{30} and their contacts, and the reactor L_1 .

The saturating coil L_1 has the property of exhibiting a marked decrease in impedance upon increase in current, and vice versa, thereby limiting the voltage drop across its terminals and simultaneously limiting the voltage applied through the winding L_2 to the winding of the relay R_0 . Tests carried out on the arrangement shown in the drawing, have indicated certain very desirable features. One of these was the speed of operation; the tests showed that the time required for short-circuiting all of the protective blocks and connecting the various conductors to ground was reduced to about .025 seconds. Another very important feature was the large range of currents causing the operation of the relay R_0 ; the tests showed that the relay R_0 operated when current flowing to ground through the reactor L_1 was about as low as 1 ampere. Current of about 350 amperes was transmitted through the winding L_1 and no damage was

done to the winding of the relay R_0 , although it operated. These tests indicated that considerably higher currents, i. e., currents of 500 amperes or more, would properly operate the arrangement and that these higher currents would cause voltage drops across the winding L_1 not exceeding 10 to 12 volts.

While the three relays R_{10} , R_{20} and R_{30} , shown in the drawing, have six armatures which are employed to short-circuit the six protective blocks, it will be understood that a single relay may be employed instead thereof, this relay having a plurality of armatures and corresponding contacts, one armature and a corresponding contact being employed for short-circuiting one of the various protective blocks.

While the winding of the relay R_0 is shown connected to the secondary winding L_2 of the transformer T , it will be understood that the secondary winding L_2 may be dispensed with and that the winding of the relay R_0 may be connected across the terminals of the winding L_1 , either directly or indirectly through the condenser C . If the secondary winding L_2 is dispensed with, the winding L_1 may, if desired, be arranged as an auto-transformer, the terminals of the secondary of which will be connected to the winding of the relay R_0 .

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 the invention and the scope of the appended claims.

What is claimed is:

1. Protective apparatus for a plurality of signaling circuits exposed to inductive or other interference comprising a common saturating reactor of inductance, a quick acting alternating current relay the winding of which is coupled to said reactor, said reactor being highly saturated so that wide margins of current which may become impressed upon the reactor from any one or all of the signaling circuits will operate the alternating current relay without damage, and means responsive to the operation of said relay to simultaneously ground all of said circuits.

2. The combination of a plurality of signaling circuits which may be exposed to inductive or other interference, a plurality of protector blocks one associated with each of said circuits, a saturating transformer the primary of which is connected in common to all of said circuits through the corresponding protector blocks, a quick acting alternating current relay the winding of which is connected to a secondary of said transformer, said transformer having a core structure of iron so that the potential supplied to the quick acting alternating current relay will be

substantially constant for wide margins of current which may flow through the primary winding of the transformer from any or all of the signaling circuits, and means responsive to the operation of said relay to simultaneously shunt all of said protector blocks.

3. Protective apparatus for a plurality of conductors transmitting signals comprising a plurality of protector blocks, a saturating reactor in common with all of said blocks and carrying a wide range of currents, an alternating current relay coupled to said saturating reactor, the armature of said alternating relay being attracted and remaining attracted as long as said reactor supplies appreciable current to its winding, a plurality of short-circuiting relays the windings of which are connected in parallel relationship and in series with the armature of said alternating current relays, and means responsive to said short-circuiting relays to simultaneously shunt all of said protector blocks.

4. Protective apparatus for a plurality of conductors transmitting signals comprising a saturating transformer the primary of which is grounded, a quick acting alternating current relay which becomes operated and remains operated as long as appreciable current is supplied to its winding, a condenser interconnecting the secondary of said transformer and the winding of said alternating current relay, said transformer having a core structure of iron so that the potential supplied to the quick acting alternating current relay will be substantially constant for wide margins of current which may flow through the primary winding of the transformer from any or all of the conductors transmitting signals, and means responsive to the operation of said alternating current relay to simultaneously ground all of said conductors.

5. Protective apparatus for a plurality of conductors transmitting signals comprising a saturating reactor of inductance common to said conductors, a quick acting alternating current relay, a condenser interconnecting the winding of said alternating current relay and said reactor, said reactor being highly saturated so that wide margins of current which may become impressed upon the reactor from any one or all of the conductors transmitting signals will operate the alternating current relay without damage, and means responsive to the operation of said alternating current relay to simultaneously ground all of said conductors.

In testimony whereof, I have signed my name to this specification this 3rd day of April 1931.

LELAND K. SWART.