May 12, 1936. L. K. SWART 2,040,219

ELECTRICAL PROTECTIVE SYSTEM

Filed March 14, 1935

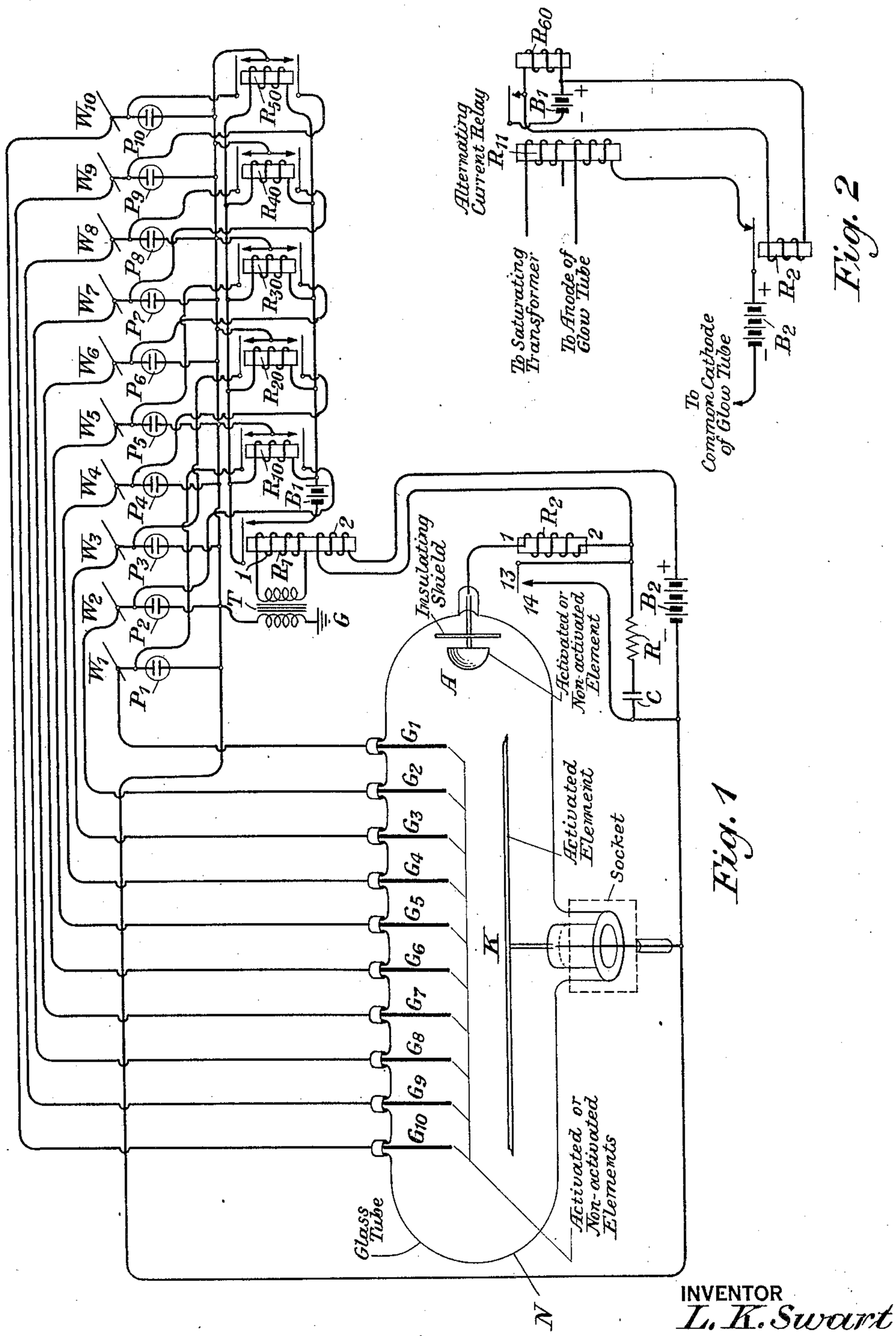

Fig. 1

Fig. 2

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Patented May 12, 1936 2,040,219

UNITED STATES PATENT OFFICE

2,040,219

ELECTRICAL PROTECTIVE SYSTEM

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Application March 14, 1935, Serial No. 11,176

6 Claims. (Cl. 179—78)

This invention relates to electrical protective systems and more particularly to arrangements for simultaneously grounding a plurality of circuits when induced voltages above a predetermined value have become impressed upon anyone of said circuits and to provide for the testing of the protective apparatus.

Protector blocks each having two electrodes spaced by an air gap which breaks down at a predetermined potential are used at present in the telephone art for the protection 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 reactor is interposed in the ground connection of each pair of these protector blocks or in the common ground connection of all of the protector blocks. This resistor or reactor carries all the operating current of the blocks.

At present, low voltage protector blocks as commonly used have an operating range around 350 peak volts. To provide operation of the protective devices at a fixed predetermined value of potential, a gas discharge device with a multiplicity of actuating electrodes may be shunted around the protector blocks and, according to this invention, operation of the protective relay equipment may be obtained at a fixed operating voltage depending upon the design of the tube. This voltage can be made to lie above the normal operating voltages applied to the conductors and below the minimum of the protector blocks.

Gas tube devices can be designed to operate at a particular potential. Hence the operating potential of the protective equipment of this invention which involves such devices, will remain constant within a few per cent. for all ordinary temperatures, etc.

In accordance with this invention potential may be applied at a remote point for the purpose of operating the relay protective equipment and thus provide methods of testing this equipment whenever desired.

This invention and the principles underlying it, some of which have been described hereinabove, will be better understood from the description hereinafter following when read in connection with the accompanying drawing in which Figure 1 represents one embodiment of the invention and Fig. 2 represents a modification of some of the apparatus shown in Fig. 1.

In Fig. 1 reference characters W_1 to W_{10}, inclusive, represent ten of a multiplicity of conductors. Each of these conductors may be connected to ground through an individual protector block as shown and a common reactor T, this reactor being shown as a winding wound about a core, which may be of iron or alloys of iron and of the saturating type. The various protector blocks are designated P_1 to P_{10}, inclusive. The lower terminal of each of these blocks is connected to upper terminal of the primary winding of the transformer or reactor T and the upper terminal of each of said protector blocks is connected to one of the corresponding conductors W_1 to W_{10}, respectively. Each of the various protector blocks may include two carbon electrodes spaced from each other by a gap of predetermined width.

The secondary winding of the transformer T is connected to one of the windings of the alternating current relay R_1. The armatures and contacts of relays designated R_{10}, R_{20}, R_{30}, R_{40} and R_{50} are associated with the protector blocks P_1 to P_{10}, the windings of all of these relays being connected in parallel, or in series parallel, in series with the battery B and the armature and contact of the relay R_1. When the relay R_1 becomes operated, current will flow from the battery B_1 over the armature and contact of the relay R_1 and through the windings of relays R_{10} to R_{50}, inclusive. The heavy duty contacts of tnese relays provide paths in shunt with the various protector blocks P_1 to P_{10} and thus pass current from the conductors W_1 to W_{10}, inclusive, through the primary winding of the transformer T to ground.

Each of the line conductors W_1 to W_{10}, inclusive, is connected to one of the electrodes G_1 to G_{10}, respectively, of the gas tube N. These electrodes may be of any size and configuration and may or may not be coated with activated material. A large electrode or cathode K is enclosed within the tube N and this is connected to the upper terminal of the primary winding of the transformer T. This cathode K is also connected to the negative terminal of a battery B_2 and to the contact 14 of a relay R_2 and to one side of the condenser C. Also, there is an electrode A within the tube N which is connected to terminal 1 of the winding of the relay R_2. Terminal 2 of the winding of relay R_2 is connected to the armature 13 of said relay and to the upper terminal of winding 2 (or lower winding) of the relay R_1. The latter terminal of the winding of relay R_1 is also connected to the positive terminal of the battery B_2.

The operation of the short-circuiting relays R_{10} to R_{50} inclusive, not only short-circuits the protector blocks P_1 to P_{10} inclusive, but also short-

circuits the electrodes G_1 to G_{10}, and the cathode K of the tube N. This is discernible from the fact that one of the armatures of each of the relays R_{10} to R_{50} and its contact, shunts one of the electrodes G_1 to G_{10} and the cathode K.

The relay R_2 and condenser C and resistance R perform the functions required in restoring the gas tube N to normal as well as applying a holding current to the winding 2 of the relay R_1 during the interval of time in which the relay R_2 is operated. The operation of the device is as follows: Potentials of either polarity or alternating potentials may be impressed between any of the conductors W_1 to W_{10} and ground by power induction or lightning or any other extraneous source to which the lines may be exposed. When any such potential reaches a value in excess of that required to cause discharge between any one of the electrodes G_1 to G_{10}, inclusive, to the cathode K, current will immediately flow from battery B_2 through the winding 2 of relay R_1, the winding of relay R_2 and from the anode A to the cathode K through the ionized gas of the tube N.

Operation of the relay R_1 immediately takes place, causing the operation of all of the short-circuiting relays R_{10} to R_{50}, inclusive, thereby shunting all of the protector blocks P_1 to P_{10}, inclusive. Electrodes G_1 to G_{10}, inclusive, being connected to the various protector blocks P_1 to P_{10}, respectively, also become shunted to the cathode K of the gas tube N by virtue of the simultaneous operation of all said short-circuiting relays R_{10} to R_{50}.

The current passing from the anode A to the cathode K as above described also produces operation of the relay R_2 causing its armature 13 to close contact 14. This will supply additional current from battery B_2 to the winding 2 of the relay R_1 and thereby maintain relay R_1 operated as long as relay R_2 remains operated. The closure of contact 14 by armature 13 of relay R_2 will withdraw the potential of battery B_2 from the winding of relay R_2 and the anode A of the gas tube N. The withdrawal of the potential from the winding of relay R_2 causes the latter relay to restore to the non-operated condition and the armature 13 will leave contact 14 unless the potential applied to anyone of the electrodes G_1 to G_{10} and cathode K exceeds that required to maintain the gas within tube N ionized.

When armature 13 leaves contact 14, the condenser C becomes charged by battery B_2 through winding 2 of relay R_1. Withdrawal of potential from relay R_2 by armature 13 and contact 14, also reduces the potential between the anode A and the cathode K to a value less than the sustaining value of the glow between those elements and thus deionizes the gas within the tube N. The short-circuiting of the electrodes G_1 to G_{10} to the cathode K by the armatures and contacts of relays R_{10} to R_{50}, inclusive, deionizes the gas between the electrodes G_1 and G_{10} and the cathode K.

As the relay R_2 is of the high speed type, its armature 13 vibrates against contact 14 during the interval of time that the potential between anyone of the electrodes G_1 to G_{10} and K exceeds the breakdown value of the gas between these electrodes. Operation of the relays R_{10} to R_{50}, inclusive, as previously stated, short-circuit the protector blocks P_1 to P_{10}, inclusive, and permits the discharge of current from the various conductors W_1 to W_{10} to ground through the primary winding of transformer T. By virtue of the connection of the secondary winding of transformer T to winding 1 (the upper winding) of relay R_1, the latter relay will be held in the operated position for the duration of the applied potential to anyone of the conductors W_1 to W_{10}. Withdrawal of potential from the various conductors W_1 to W_{10} restores relay R_1 to its normal, unoperated position and the latter relay will restore relays R_{10} to R_{50}, inclusive, to their normal and unoperated positions. The relay R_2 also restores to normal the instant that electrodes G_1 to G_{10} inclusive, become short-circuited to the cathode K. Other and varied arrangements for restoring the gas tube to normal will occur to those skilled in this art and they may be used if desired.

The relay R_1 may be of the multi-contact type performing all the functions of the short-circuiting relays R_{10} to R_{50}, as is well known, and if such a relay is employed, the battery B_1 will not be required. Moreover, the transformer T may be replaced by a multi-contact type of relay. This relay should then, therefore, be one of the saturating type. This relay may be arranged to perform the functions of all of the various short-circuiting relays, as is well known.

The operation of relay R_1 may occur when any one or several or all of the protector blocks P_1 to P_{10} have broken down or when the gas between any one or several or all of the electrodes G_1 to G_{10} of tube N and its cathode K has become ionized. The ionization voltage may be below the breakdown voltages of all of the protector blocks or it may be below the general average of their breakdown voltage values. The tube N is designed so that its ionization voltage will be higher than the normal operating voltages applied to any or all of the conductors W_1 to W_{10}.

In the arrangement shown in Fig. 1, a resistor may be substituted for the transformer T. Moreover, an auto-transformer or a simple saturating reactor may take the place of the transformer T, as is well known.

Fig. 2 shows an alternate arrangement for carrying out the principles of this invention. The alternating current relay R_{11} includes two windings, the upper winding of which may be connected to the secondary winding of transformer T of Fig. 1. The lower winding of relay R_{11} may be connected between the anode A of tube N and the contact of relay R_2 as shown in Fig. 2. The battery B_2 may be connected between the armature of relay R_2 and the cathode K of tube N. The winding of relay R_2 may shunt the winding of short-circuiting relay R_{60} which may be of the multi-contact type, if desired, for simultaneously shunting all of the protector blocks. The battery B_1 and the armature and contact of relay R_{11} may be connected in series with each other and in shunt with the windings of relays R_2 and R_{60}, as shown. In this arrangement, relays R_2 and R_{60} will both always be operated or unoperated, although it will be understood that relay R_2 may be of the high speed or vibratory type, if desired.

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. Apparatus for the protection of a plurality of conductors comprising a gas-filled tube hav-

ing an anode, a cathode, and a plurality of electrodes each of which is connected to one of the conductors, means responsive to a voltage exceeding a predetermined value applied to any one of the various conductors to ionize the gas between the anode and cathode of said tube, and means responsive to the ionization of the gas within said tube to simultaneously ground all of said conductors.

2. Apparatus for the protection of a plurality of circuits, comprising a plurality of protector blocks one terminal of which is connected to one of the circuits, a saturating transformer the primary of which is connected between the other terminal of each of the protector blocks and ground, a gas-filled tube including an anode, a cathode and a plurality of electrodes each of which is connected to one of the circuits, the cathode of the tube being connected to the conductor common to all of the protector blocks, a first relay having two windings, one of which is connected to the secondary winding of the transformer, a second relay, and a source of potential which is connected in series with the second winding of the first relay, the winding of the second relay and the anode and cathode of the tube, the armature and contact of the second relay being connected in series with the winding of the latter relay and the anode and cathode of the tube, and means responsive to the operation of the first relay for simultaneously grounding all of the circuits.

3. Apparatus for the protection of a plurality of conductors, comprising means for simultaneously grounding all of the conductors when the potential applied to any one of the said conductors exceeds a predetermined value, said means comprising a gas-filled tube having a cathode and a plurality of electrodes, each of which is connected to one of the conductors, the cathode of said tube being connected to ground.

4. Apparatus for the protection of a plurality of conductors, comprising a plurality of protector blocks one terminal of each of which is connected to one of the conductors, a reactor connected between the other terminal of each of the protector blocks and ground, a gas-filled tube including a cathode and a plurality of electrodes each of which is connected to one of the conductors, the cathode of the tube being connected to the ungrounded terminal of the reactor, and means responsive to the application of a predetermined voltage to the reactor for simultaneously connecting all of the conductors to ground through said reactor.

5. Apparatus for the protection of a plurality of conductors, comprising a reactor one terminal of which is grounded, a gas-filled tube including an anode, a cathode and a plurality of electrodes each of which is connected to one of the conductors, the cathode being connected to the ungrounded terminal of the reactor, a relay, a source of potential connected in series with the winding of the relay and the anode and cathode of the tube, and means responsive to the operation of said relay for simultaneously grounding all of the conductors through a circuit including said reactor and independent paths provided by each of the electrodes of said tube and its cathode.

6. Apparatus for the protection of a plurality of conductors comprising a plurality of protector blocks one terminal of each of which is connected to one of the conductors, a reactor one terminal of which is connected to the other terminal of each of the protector blocks, the other terminal of the reactor being grounded, a relay the winding of which is connected to said reactor, means responsive to the operation of said relay for simultaneously grounding all of the conductors through said reactor, a gas-filled tube including an anode, a cathode and a plurality of electrodes each of which is connected to one of the conductors, the cathode being connected to the ungrounded terminal of the reactor, and means responsive to the ionization of the gas between the anode and cathode of said tube for operating said relay.

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