

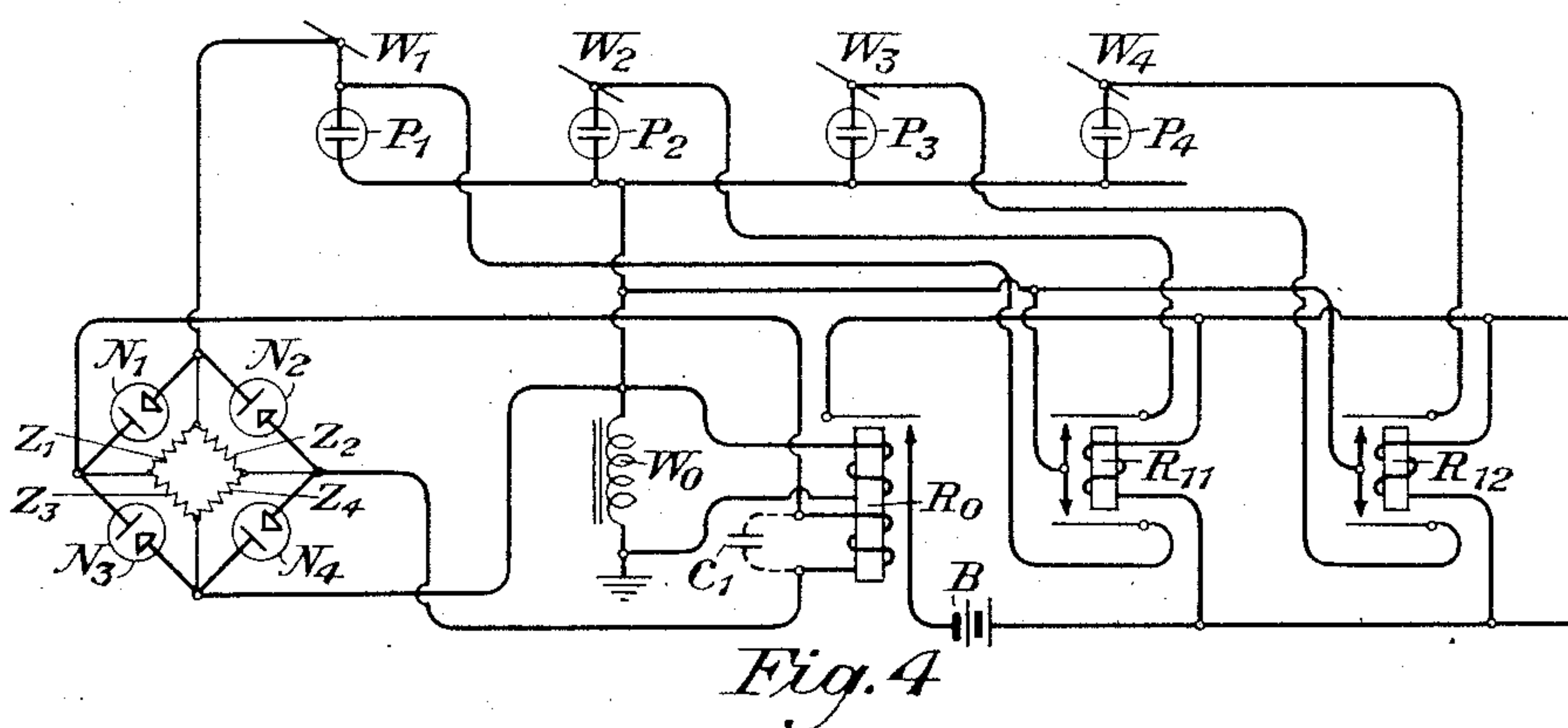
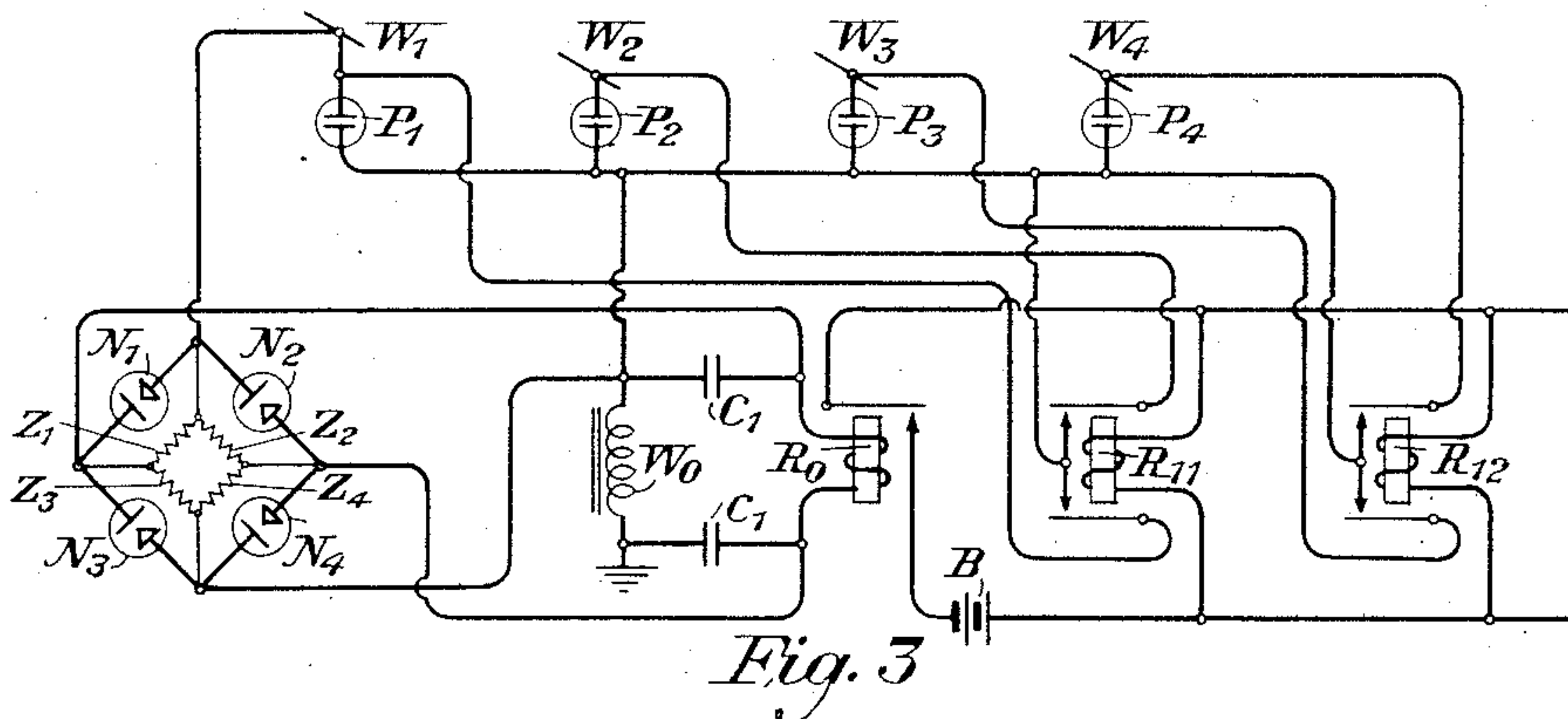
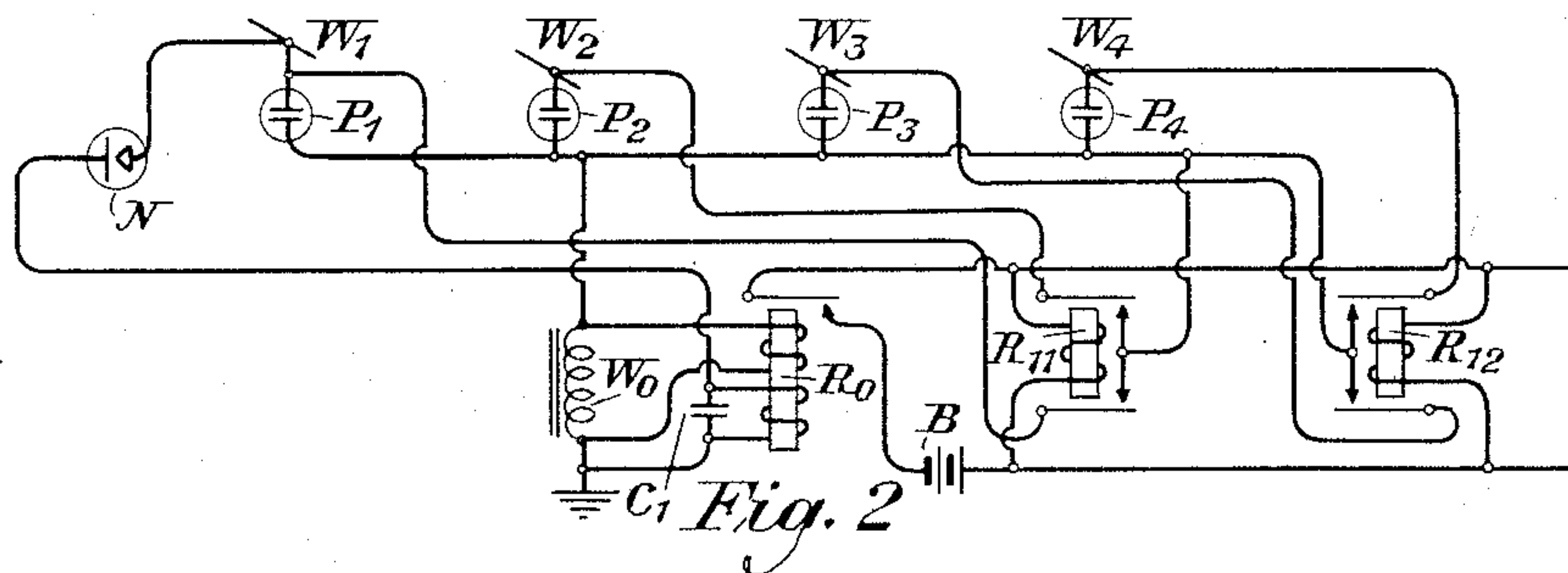
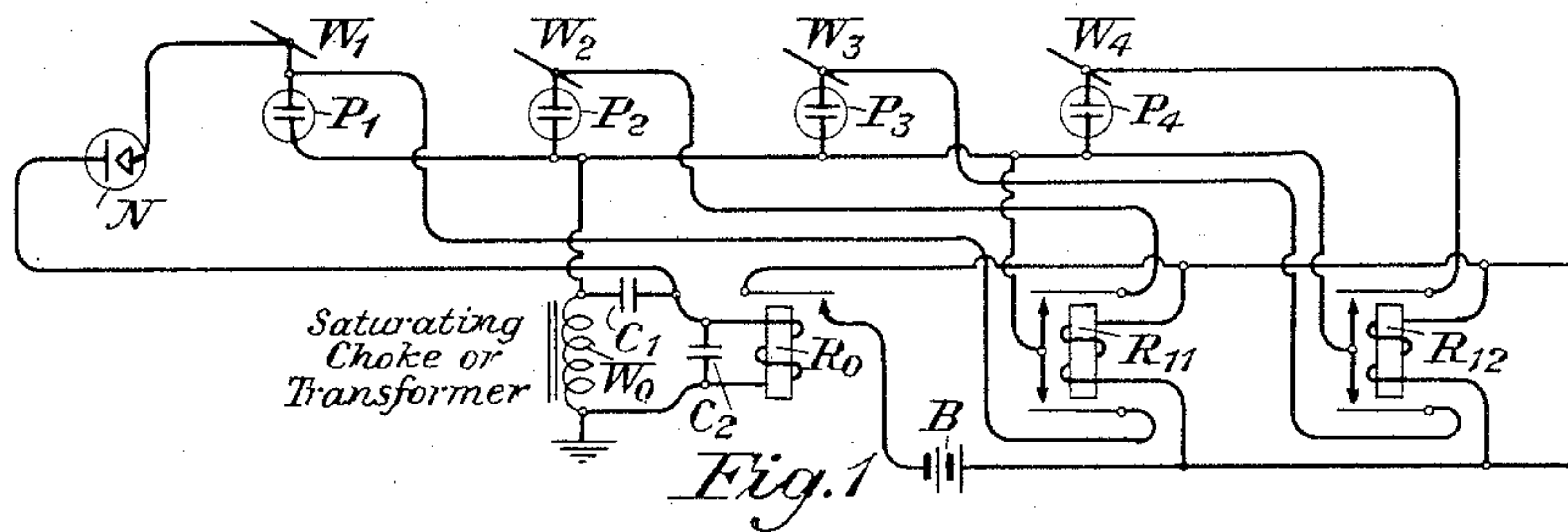
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ELECTRICAL PROTECTIVE SYSTEM

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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 above a fixed and predetermined value become impressed thereon. Still more particularly, this invention relates to arrangements for testing the apparatus employed in carrying out the principles of this invention.

10 Pairs of protector blocks each having an air gap which breaks down at a predetermined potential, have 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 saturating reactor is interposed in the ground connection of each pair of protector blocks or in the common ground connection of all the protector blocks. This resistor or reactor, as the case may be, is designed to carry all of the operating current flowing through all of the protector blocks associated therewith.

25 In these arrangements apparatus is connected or otherwise coupled to the resistor or saturating reactor, and this apparatus is caused to operate in response to the potential which exists between the terminals of the resistor or saturating reactor. Upon the operation of the aforementioned apparatus, circuits are established for simultaneously grounding all of the protector blocks, the grounding circuit including the resistor or saturating reactor.

35 This invention employs one or more cold cathode gas filled tubes in order to improve the operation of the circuits which have heretofore been used for simultaneously grounding a plurality of exposed conductors. The cold cathode tube employed in this invention may, if desired, be of a two, three or multi-electrode type, one or more of said electrodes preferably being activated. The envelope of said tube encloses a rare gas of any well known type, the electrodes being so constructed and spaced from each other that the tube is enabled to rectify alternating currents which are impressed across its terminals. The spacing of the electrodes and the pressure of the gas included within the tube are such that the passage of current through the tube may take place only when the voltage impressed across its terminals exceeds a predetermined value.

50 This invention will be better understood from the detailed description hereinafter following when considered in connection with the accompanying drawing in which Figure 1 shows a

multi-grounding arrangement employing apparatus including a gas-filled tube of the rectifying type, as just described; Fig. 2 shows a modification of the arrangement illustrated in Fig. 1 in which the relay operated by the potential across the resistor or saturating reactor may have two windings, one of which is connected in the circuit of the protector block and the other in the circuit of the gas-filled tube, and Figs. 3 and 4 show apparatus including a plurality of gas-filled tubes arranged for full wave rectification.

Referring to Fig. 1 of the drawing, the conductors W_1 , W_2 , W_3 and W_4 represent four of a plurality of lines or conductors which may become exposed to inductive effects. The conductors W_1 , W_2 , W_3 and W_4 are connected, respectively, to the upper terminals of a plurality of protector blocks P_1 , P_2 , P_3 and P_4 , each of which may include a pair of electrodes so mounted and so constructed that these electrodes are normally spaced from each other by a predetermined distance. The lower terminals of all of these protector blocks P_1 , P_2 , P_3 and P_4 are connected to ground through a common saturating choke coil or transformer designated W_0 .

The saturating choke coil or transformer W_0 is connected to the winding of an alternating current relay designated R_0 . This interconnected circuit may include a condenser C_1 . A condenser C_2 may be connected in shunt with the winding of relay R_0 . A gas-filled tube is also connected between the conductor W_1 and the terminal common to the condensers C_1 and C_2 .

The armature and contact of the relay R_0 are connected in a circuit which includes a source of potential B such as a battery of the dry cell type, this circuit including the windings of a plurality of relays designated R_{11} and R_{12} which are connected in parallel relationship as shown, or in series parallel relationship, if so desired. The operation of the relay R_0 will complete a circuit from the source B and simultaneously operate both of the relays R_{11} and R_{12} , and such other relays as may be similarly connected to this circuit. The lower armature and contact of the relay R_{11} will then provide a circuit of negligible impedance in shunt with the protector block P_1 , and the upper armature and contact of the same relay R_{11} will provide a similar circuit in shunt with the protector block P_2 . Likewise, the lower and upper armatures and contacts of the relay R_{12} will simultaneously provide similar paths of negligible impedances which shunt the protector blocks P_3 and P_4 , respectively.

When a voltage impressed upon the conductor

W₁ is sufficient to cause the tube N to act as a rectifier of that voltage, a current will flow from the conductor W₁, through the tube N and through the winding of the relay R₀, to ground. This current will flow only during half of the cycle of the impressed voltage. The condenser C₂, which shunts the winding of the relay R₀, will tend to discharge a current through the relay during the remaining half of the cycle in order that the relay R₀ may remain operated throughout the entire period during which the extraneous voltage maintains its effect upon the conductor W₁. The operation of the relay R₀ will operate the relays R₁₁ and R₁₂ and these will cause the protector blocks P₁, P₂, P₃ and P₄ to be shunted by circuits established through the armatures and contacts of these relays, as already described.

If for any reason the tube N fails to discharge from the voltage impressed upon the conductor W₁, to cause the operation of the relay R₀, the voltage impressed upon the conductor W₁ may be sufficient in magnitude to break down the circuit of the protector block P₁. In that event current will be discharged through the protector block P₁ and through the saturating choke or transformer W₀, to ground. The potential across the terminals of the saturating choke W₀ will then be sufficient to transmit a current through the condenser C₁ to the winding of the relay R₀, and the latter relay will then become operated. Its operation will then cause the operation of relays R₁₁ and R₁₂, and all of the protector blocks will then be short-circuited, as already described.

Similarly, a sufficiently high voltage induced in any one of the conductors W₁, W₂, W₃ and W₄, etc., will cause the protector block associated with the conductor so impressed with abnormal voltage, to break down and, therefore, cause a large current to flow through the saturating choke or transformer W₀. In any one of these cases the relay R₀ will become operated, and then provide the necessary shunt circuits around all of the protector blocks, as already described.

It will be understood that the relays R₁₁ and R₁₂ may be entirely dispensed with and that the relay R₀ may be of the multi-contact type, including an armature which simultaneously closes a plurality of contacts each of which controls a circuit employed for providing a shunt path around one of the protector blocks. This will be apparent to those skilled in this art.

In the arrangement shown in Fig. 2 the relay R₀ includes two windings, the upper of which is directly connected across the saturating choke or transformer W₀, while the lower winding is connected in a circuit in series with the conductor W₁, the tube N, and ground. The condenser C₁ is employed to shunt the latter winding of the relay R₀.

In the arrangement of Fig. 2 two separate paths are provided between the conductor W₁ and ground. One of these paths includes the protector block P₁ and the saturating choke or transformer W₀ across which the upper winding of the relay R₀ is connected. The other path includes the tube N and the lower winding of the relay R₀ across which the condenser C₁ is connected. As both of the windings of the relay R₀ are part of a composite structure, the armature of this relay will close its contact when a sufficient current flows through either of these windings.

As in the case of Fig. 1, the tube N rectifies one half of the impressed alternating voltage appearing at conductor W₁, and during that half of the

cycle when rectification occurs, the condenser C₁ will become charged and the flow of current through the lower winding of the relay R₀ will cause the armature of the relay R₀ to close its contact. During each remaining half cycle, the condenser C₁ will discharge through the lower winding of the relay R₀ and therefore aid in maintaining the relay R₀ operated. It seems hardly necessary to repeat that when the relay R₀ becomes operated, the relays R₁₁ and R₁₂ become simultaneously operated and these provide short-circuiting paths around the protector blocks P₁, P₂, P₃ and P₄. Moreover, the relays R₁₁ and R₁₂ may be eliminated, if so desired, in which case the relay R₀ may be one of the multi-contact type, providing a plurality of contacts each of which, when closed by the armature of the relay, controls a circuit for shunting one of the protector blocks.

In the arrangement of Fig. 2 the impression of a high potential upon any one of the conductors W₁, W₂, W₃ and W₄ may cause the breakdown of any one or all of the corresponding protector blocks which are connected to these conductors so that current may flow through the saturating choke or transformer W₀. When this current flows through the upper winding of the relay R₀ which is connected to the winding W₀ the relay R₀ will then operate.

Fig. 3 shows an arrangement including four cold cathode gas-filled tubes arranged for full wave rectification of any sufficient voltage impressed upon the conductor W₁ to discharge across the tube elements. The conductor W₁ is connected to the upper terminal of the winding of the relay R₀ through the tube N₁. It is also connected to the lower terminal of the winding of the relay R₀ through the oppositely poled tube N₂. The upper terminal of the coil W₀ is connected to the upper terminal of the winding of the relay R₀ through the tube N₃, and this same upper terminal of the winding of relay W₀ is connected to the lower terminal of the winding of the relay R₀ through the oppositely poled tube N₄. The winding of the relay R₀ is also connected across the winding W₀, the interconnecting circuit including a pair of condensers designated C₁ which may, if desired, be of the same capacity.

Resistors Z₁, Z₂, Z₃ and Z₄ respectively shunt the tubes N₁, N₂, N₃ and N₄. These resistors may be of substantially equal magnitudes and they are employed to equalize the break-down voltages of the various tubes.

When sufficient alternating potential becomes impressed upon the conductor W₁, two of the gas-filled tubes will transmit current during one half of the cycle through the winding of the relay R₀, and the other two of the gas-filled tubes will transmit current through the winding of the relay R₀ during the remaining half of the cycle. Thus during the positive half of the cycle, current will flow from conductor W₁ through the tube N₁, then through the winding of the relay R₀, through the tube N₄ and over the winding W₀ to ground. During the negative half of the cycle, current will flow from ground over the winding W₀, through the tube N₃, through the winding of the relay R₀, then through tube N₂ and thence to conductor W₁. Thus, current is continuously supplied to the winding of the relay R₀ during both halves of each alternating potential impressed upon the conductor W₁. This insures the continuous operation of the relay R₀ while such a voltage remains impressed upon the conductor W₀.

If the voltage impressed upon the conductor W_1 fails to be of an amplitude sufficient to operate tubes N_1 , N_2 , N_3 and N_4 , the relay R_0 may still be operated if the voltage is sufficient to break down the gap between the electrodes of the protector blocks connected to conductors W_1 , W_2 , W_3 , W_4 , etc. Thus, if the protector block P_1 , for example, breaks down by virtue of the existence of a sufficiently high potential upon the conductor W_1 , current will flow from the conductor W_1 , through the protector block P_1 and through the saturating choke or transformer W_0 , to ground. This will cause current to flow through the condenser C_1 to the winding of the relay R_0 and operate the latter relay. This will, of course, simultaneously operate the relays R_{11} and R_{12} and instantly shunt all of the protector blocks P_1 , P_2 , P_3 and P_4 which are connected to the various conductors W_1 , W_2 , W_3 and W_4 .

Fig. 4 illustrates the conductor W_1 connected to ground through one path which includes the protector block P_1 and the saturating choke or transformer W_0 , across which the upper winding of the relay R_0 is directly connected. It also illustrates a second path to ground which includes the various rectifying tubes N_1 , N_2 , N_3 and N_4 , the lower winding of the relay R_0 , across which a condenser C_1 may, if desired, be connected, and the saturating choke or transformer W_0 . The various tubes N_1 , N_2 , N_3 and N_4 are respectively shunted by resistors Z_1 , Z_2 , Z_3 and Z_4 , as in Fig. 3.

During the positive half of the impressed alternating cycle, current will flow through the tube N_1 , the lower winding of the relay R_0 , the tube N_4 , and the saturating choke or transformer W_0 , to ground. During the negative half of the cycle, current will flow from ground through the winding W_0 , through tube N_3 , through the lower winding of relay R_0 , then through tube N_2 to the conductor W_1 . The energization of the lower winding of the relay R_0 will be sufficient to operate the relay R_0 but, it will be noted when current flows through the winding W_0 current will also flow through the upper winding of the relay R_0 , and the latter winding will aid in maintaining the relay R_0 operated.

However, if any or all of the tubes N_1 , N_2 , N_3 and N_4 fail to operate, a sufficient voltage impressed upon any one or all of the conductors W_1 , W_2 , W_3 or W_4 may cause the gap of a corresponding protector block to be broken down and produce a flow of current through the upper winding of the relay R_0 . This current may be sufficient to cause its armature to close its associated contact and thereby simultaneously operate the relays R_{11} and R_{12} .

In each of the arrangements of Figs. 1 to 4, the relays R_{11} and R_{12} may be omitted and a multi-contact relay may be substituted for the relay R_0 . The relay R_0 , however, may be of the single contact type as shown, and only one relay such as R_{11} may be provided, the winding of which will be connected to the armature and contact of the relay R_0 . The relay R_{11} may be of the multi-contact type including a plurality of contacts each of which may be connected to a circuit employed for shunting any one of the protector blocks. This will be understood by those skilled in the 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 used in many and widely varied

forms, without departing from the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A protector system for a conductor exposed to inductive interference comprising a protector block, a saturating reactor connected in series with said protector block between said conductor and ground, a gas filled rectifier tube connected from said conductor in parallel with said protector block, and an alternating current relay, the winding of which is connected across said saturating reactor, the armature and contact of said relay completing a circuit in shunt around said protector block.

2. The combination of a plurality of exposed conductors, a plurality of protector blocks, one terminal of each of which is connected to one of said conductors, a saturating reactor connected between the other terminal of each of said protector blocks and ground, an alternating current relay, a condenser interconnecting the winding of the alternating current relay with the saturating reactor, and a cold cathode gas filled rectifier tube having a pair of terminals which are connected between one of said conductors and the ungrounded side of the winding of said relay, and means responsive to the operation of said relay for simultaneously grounding all of said conductors.

3. A protection system for an exposed conductor comprising a protector block, a saturating reactor connected in series with the protector block between the exposed conductor and ground, a cold cathode gas filled rectifier tube having two terminals, and a relay having two windings one of which is connected in series with the tube between the exposed conductor and ground and the other of which is connected in shunt with the saturating reactor, the armature and contact of said relay forming a circuit which shunts said protector block.

4. A protection system for an exposed conductor comprising a protector block, cold cathode gas filled rectifying means, and means responsive either to the break-down of the gap of the protector block or to the operation of the rectifying means for providing a conductive path in shunt with the protector block, said responsive means consisting of a relay, the winding of which is energized either when the gap of the protector block becomes discharged or when the rectifying means operates.

5. A protection system for a plurality of exposed conductors comprising a plurality of protector blocks, one terminal of each of which is connected to one of the exposed conductors, a saturating reactor connected between the other terminal of each of said protector blocks and ground, an alternating current relay, a pair of condensers each of which interconnects one terminal of the saturating reactor with one terminal of the winding of the alternating current relay, and a full wave cold cathode gas filled rectifying apparatus connected from one of said conductors to said saturating reactor and the winding of the alternating current relay so that both halves of each alternating current cycle of voltage transmitted through said apparatus will produce current in the winding of the relay, and means responsive to the operation of said relay for simultaneously grounding all of the exposed conductors.

6. In a protection system for a plurality of exposed conductors, the combination of a plurality of protector blocks, one terminal of each of which is connected to each of the exposed conductors, a common saturating reactor connected to the

other terminal of each of said protector blocks and ground, cold cathode gas filled rectifying apparatus, a relay having two windings one of which is connected in shunt with the common reactor
5 and the other of which is connected in series with the gas tube rectifying apparatus between

one of said exposed conductors and ground, a condenser connected in shunt with the latter winding of said relay, and means responsive to the operation of said relay for simultaneously shunting all of said protector blocks.

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