June 22, 1926. 1,589,699

L. F. HUNT

GROUND DETECTOR

Filed August 22, 1923. 2 Sheets-Sheet 1

Fig. 1.

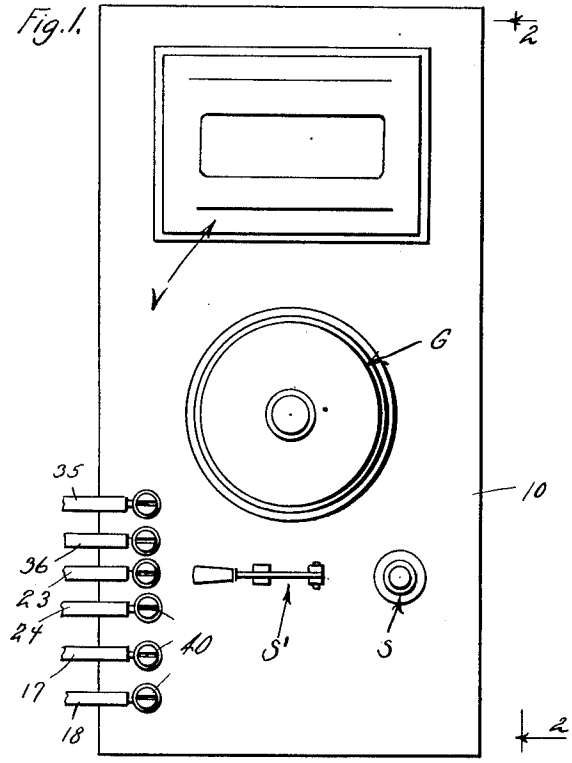


Fig. 2.

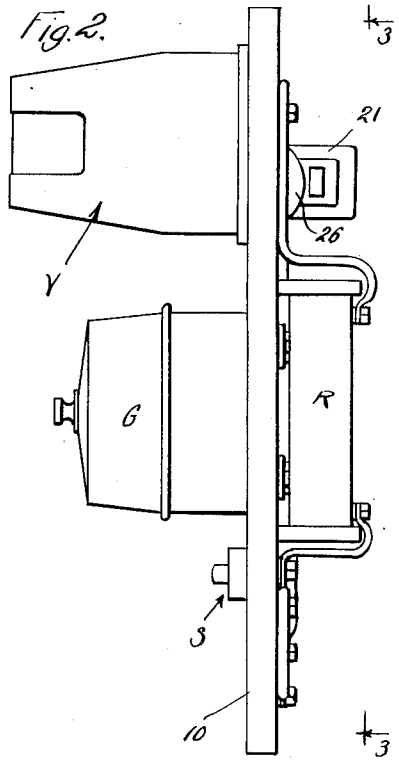
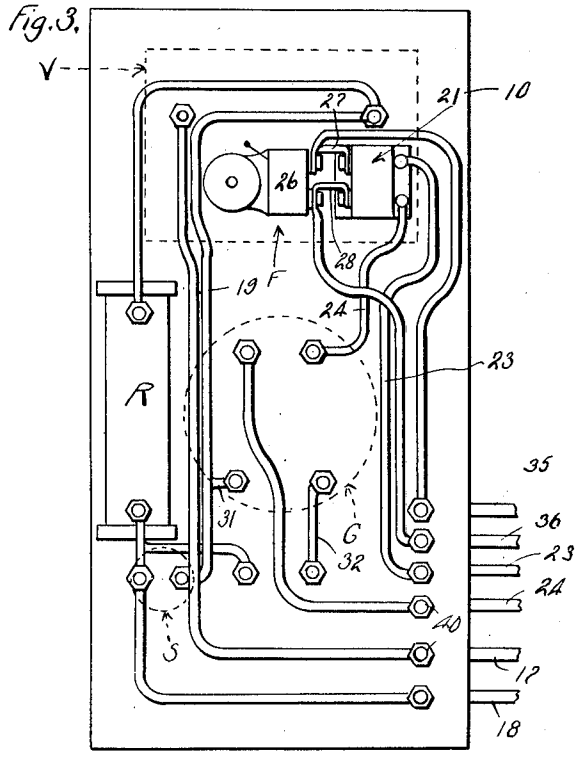


Fig. 3.



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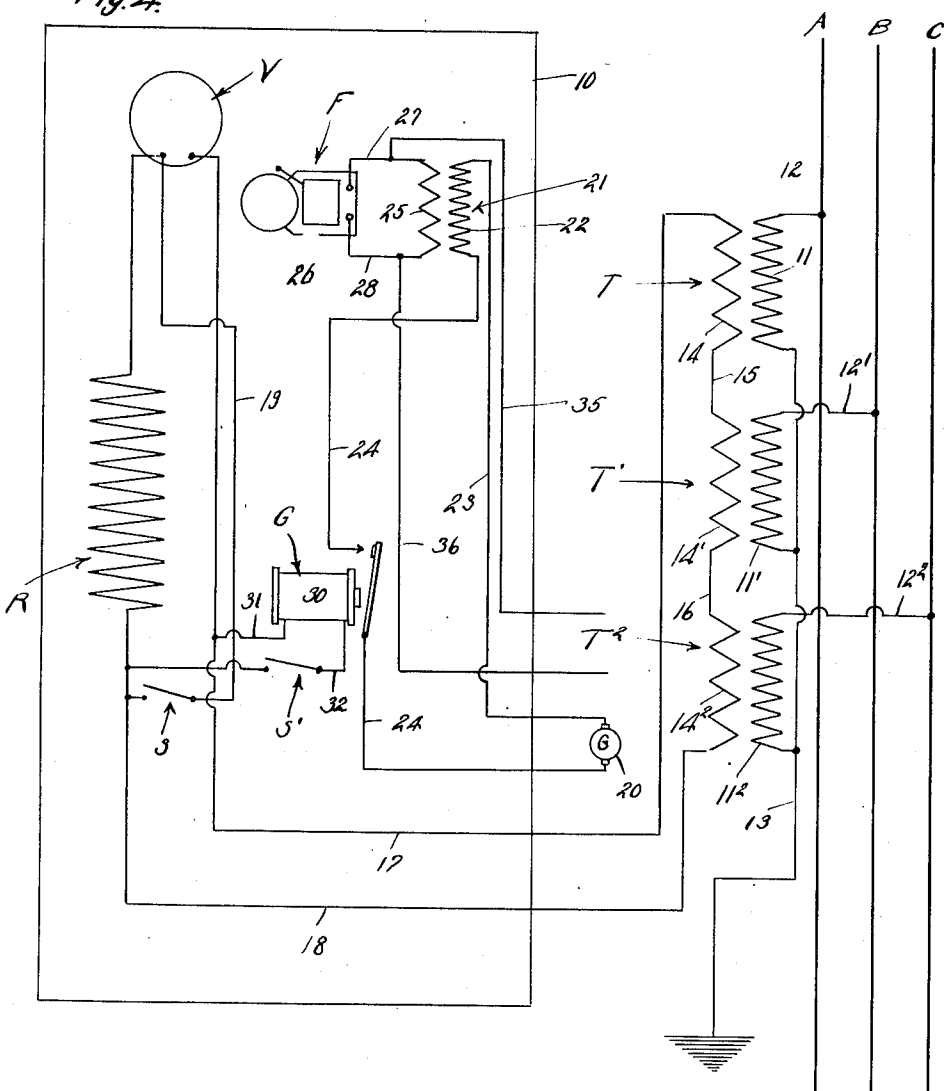
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Filed August 22, 1923 2 Sheets-Sheet 2

Fig. 4.



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Patented June 22, 1926. 1,589,699

UNITED STATES PATENT OFFICE.

LLOYD F. HUNT, OF LOS ANGELES, CALIFORNIA.

GROUND DETECTOR.

Application filed August 22, 1923. Serial No. 658,749.

This invention has to do with a ground detector useful for detecting grounds in transmission or distributing lines, or the like, and it is an object of the invention to provide a device of this character which is simple, effective and reliable.

Grounds, for instance, in power transmission and distributing lines, are undesirable and wasteful and are often dangerous. It is, therefore, desirable to provide means for detecting grounds on such lines so that they can be investigated and remedied as quickly as possible. Devices for this purpose have been devised and used, some of them being more or less successful.

It is a general object of this invention to provide a practical and improved device of the character above specified.

The various objects and features of my invention will be best and more fully understood from the following detailed description of a typical preferred form and carrying out of the invention, throughout which description reference is had to the accompanying drawings, in which—

Fig. 1 is a face view of the instrument board provided by this invention;

Fig. 2 is a side elevation of the parts shown in Fig. 1, being a view taken as indicated by the line 2—2 on Fig. 1;

Fig. 3 is a rear view of the instrument board, being a view taken as indicated by the line 3—3 on Fig. 2; and

Fig. 4 is a diagram illustrating the invention.

The present invention is suitable for use in detecting grounds in transmission or distributing lines of various types. For the purpose of facilitating a clear understanding of the invention I have disclosed it in a typical form and as applied to a three-wire three-phase A-C power transmission line, it being understood, of course, that the invention is not to be considered limited to this specific form or application.

In the apparatus provided by my present invention there are three principal potential transformers T, T^1, and T^2, connected in Y with the three high tension power lines A, B, and C; a voltmeter V, connected with the secondaries of the principal transformers; resistance R in the connection between the transformers and voltmeter; a switch S for controlling a connection to the voltmeter around the resistance R; an alarm F, having an independent operating circuit; a relay G, for controlling the alarm circuit; and a control switch S^1 for the relay G.

All of the above named parts, except the transformers T, T^1 and T^2, may be advantageously mounted on a single instrument board 10, so that they form a unit that can be conveniently mounted in a suitable location. In the particular arrangement that I have illustrated in the drawings, the voltmeter V, relay G, and control switches S and S^1 are mounted on the face or front side of the instrument board 10, while the other parts are mounted on the back of the instrument board. The various connections between the parts on the instrument board are preferably arranged at the rear of the board, as I have illustrated in Figs. 2 and 3 of the drawings.

The primary winding 11 of the transformer T has one side connected with the line A by a connection 12, and the other side connected to ground through grounding connection 13. The primary winding 11^1 of the transformer T^1 has one side connected with the line B by a connection 12^1 and the other side connected with ground through the connection 13. The secondary windings 14, 14^1 and 14^2 of the transformers T, T^1 and T^2, respectively, are connected in series by connections 15 and 16, one end of the series being connected with one terminal of the voltmeter B by a connection 17, the other end of the series being connected with the other terminal of the voltmeter by a connection 18. The resistance R is located in the connection 18. There is a connection 19 between the connection 18 and the last mentioned terminal of the voltmeter around the resistance R whereby the resistance R can be cut out. The switch S is arranged in the connection 19 so that it controls the cutting out of the resistance R.

The signal F is preferably an audible signal, for instance, a bell. In the particular apparatus illustrated in the drawings, the bell F is adapted to be operated from an independent circuit, for instance, by a 110 volt circuit, from a generator 20, or other suitable source of energy, through a suitable transformer 21. One side of the primary winding 22 of the transformer 21 is connected with the generator 20 by a connection 23, while the other side is connected with the generator through a connection 24. The relay G is arranged in the connection 24 to control the energization of the transformer

21. The two sides of the secondary winding 25 of the transformer 21 are connected with the terminals of the bell 26 by suitable connections 27 and 28.

The winding 30 of the relay G is connected with the connections 17 and 18 by connections 31 and 32, respectively, so that it is energized when there is flow through the connections 17 and 18 to the voltmeter V. The switch S^1 for controlling the relay G is arranged in one of the connections to the winding 30, for instance, connection 32, as I have illustrated in the diagram Fig. 4. The relay G is such that when the winding 30 is energized a predetermined amount it closes the connection 24 so that the primary winding of the transformer 21 is energized.

In the particular apparatus illustrated in the drawings, I have provided extension lines 35 and 36 connected with the connections 27 and 28, respectively, for the purpose of operating a second signal at a point removed from the instrument board 10, if so desired.

In a form of the invention where the transformers T, T^1 and T^2, and the generator 20 are separated from the parts carried by the instrument board, the connections between the first mentioned parts and those carried by the instrument board may be made through suitable binding posts 40 provided on the instrument board, as I have clearly illustrated in Figs. 1 and 3 of the drawings.

Under normal operating conditions the switch S is left open and the switch S^1 is closed. Therefore, in practical construction the switch S is preferably a button switch, adapted to be actuated through a suitable push button, whereas, the switch S^1 is preferably an ordinary knife switch. When the high voltage lines A, B, and C are operating without leakage to ground there is a balanced flow between the lines A, B, and C through the primary windings of the transformers T, T^1 and T^2. The primaries of the transformers being connected in Y there is no flow through the secondary windings of the transformers or in the circuit to the voltmeter V through the connections 17 and 18. The primaries being connected so that they are balanced the vector sum of the potentials of the secondaries is zero, so, therefore, there is no flow in the circuit to the voltmeter V. However, the moment a ground occurs on any one of the main lines A, B, or C, the balance of the primaries of the transformers is disturbed causing a corresponding disturbance in the secondaries, and, therefore, flow in the circuit to the voltmeter through resistance R. The voltmeter V, of course, indicates the extent of the flow, and, therefore, the extent of the ground. Where there is a slight ground on one of the main lines A, B, or C, the voltmeter V, due to the resistance R, will be only slightly effected. I preferably construct the voltmeter so that it will indicate from zero to full ground when the resistance R is in and will indicate from zero to about ten percent ground when the resistance is cut out. When the ground is only slight and it is desired to obtain an accurate reading the switch S is closed, cutting out the resistance R, giving a direct reading on the voltmeter V.

The relay G is such that it is actuated to close the connection 24 when the ground is of a certain predetermined amount, for instance, ten percent. When the relay G is actuated the connection 24 is closed thereby causing energization of the transformer 21 so that the bell 26 operates. In practice it is desirable to connect the primary winding of the transformer 21 in a circuit of, say, 110 volts, and to proportion the transformer to suit such circuit and the bell 26.

In the apparatus I have provided an attendant can tell at any time, by examining the voltmeter V, whether or not there is a ground on any of the main lines A, B, or C, and if there is an indication of a slight ground, say, less then ten percent, he can obtain a very accurate reading by actuating the switch S to cut out the resistance R. At any time when the ground gets sufficient to operate the relay G the attendant's attention is called by the operation of the alarm F. After the attendant's attention has been called he can, of course, cut off the alarm by opening the switch S^1. It is to be noted that the alarm is operated directly from the circuit of the secondaries of the transformers through the relay and that it is not dependent upon operation of the voltmeter or any other like device or instrument. The primaries of the transformers are all permanently connected with the main lines so that there are no high voltage switches that require operation. The transformers being connected in the manner herein provided the voltmeter is not energized unless there is a ground on one of the main lines and voltage variations in the main lines are balanced out so that they do not cause actuation of the voltmeter.

Having described only a typical preferred form of my invention I do not wish to limit myself of the specific details hereinabove set forth but wish to reserve to myself any changes or variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. In a ground detector for a three-wire system, a voltage indicator, and means connecting the voltage indicator with the three wires, said means including three transformers having their primary windings con-

nected in Y with the wires and their secondary windings connected in series and with the voltage indicator.

2. In a ground detector for a three-wire system, a voltage indicator, and means connecting the voltage indicator with the three wires, said means including three transformers each having one side of its primary winding connected with one of the wires and the other side connected with ground, the secondary windings of the transformers being connected in series and with the voltage indicator.

3. In a ground detector for a three-wire system, a voltage indicator, three transformers each having one side of its primary winding connected with a wire and the other side connected with ground the secondary windings being connected in series, a circuit connecting the series of secondary windings with the voltage indicator, and audible signal, an operating circuit for the signal, a relay in the first mentioned circuit to control the operating circuit of the signal, and variable resistance in the first mentioned circuit.

In witness that claim the foregoing I have hereunto subscribed my name this 9th day of August, 1923.

LLOYD F. HUNT.