Oct. 14, 1930. C. A. ANDERSON 1,778,207

TEST SET

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Fig. 5

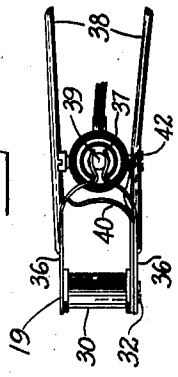


Fig. 6

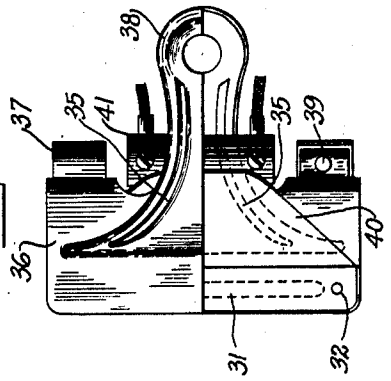


Fig. 7

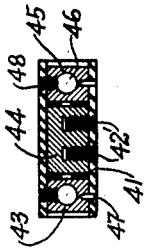
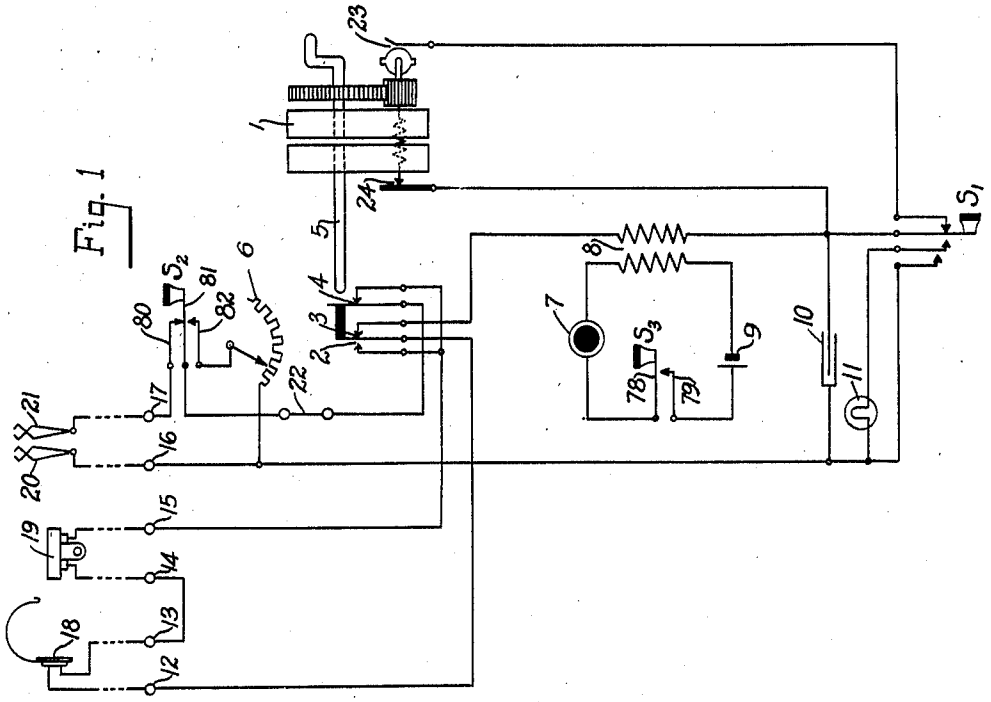


Fig. 1



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TEST SET

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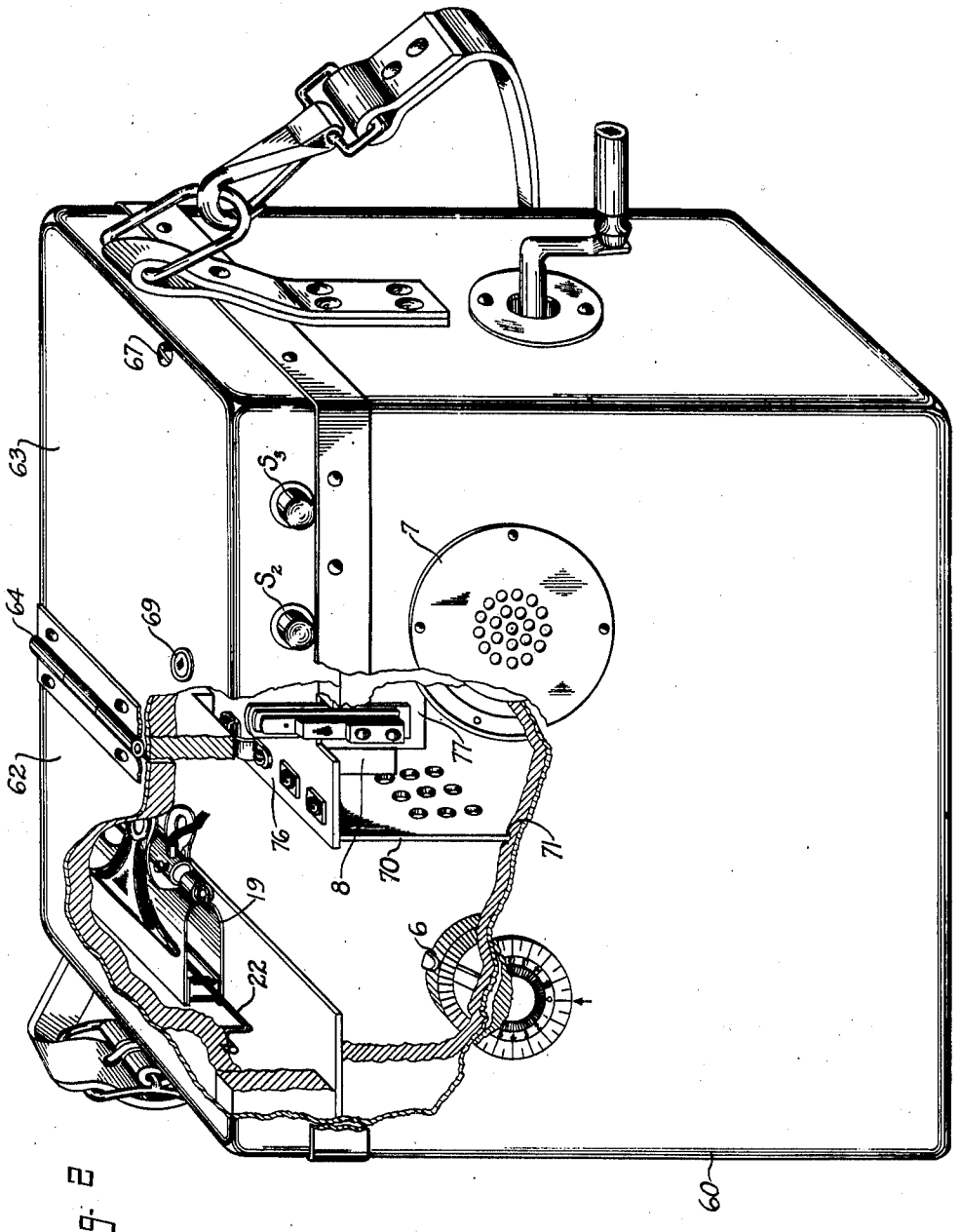

Fig. 2

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TEST SET

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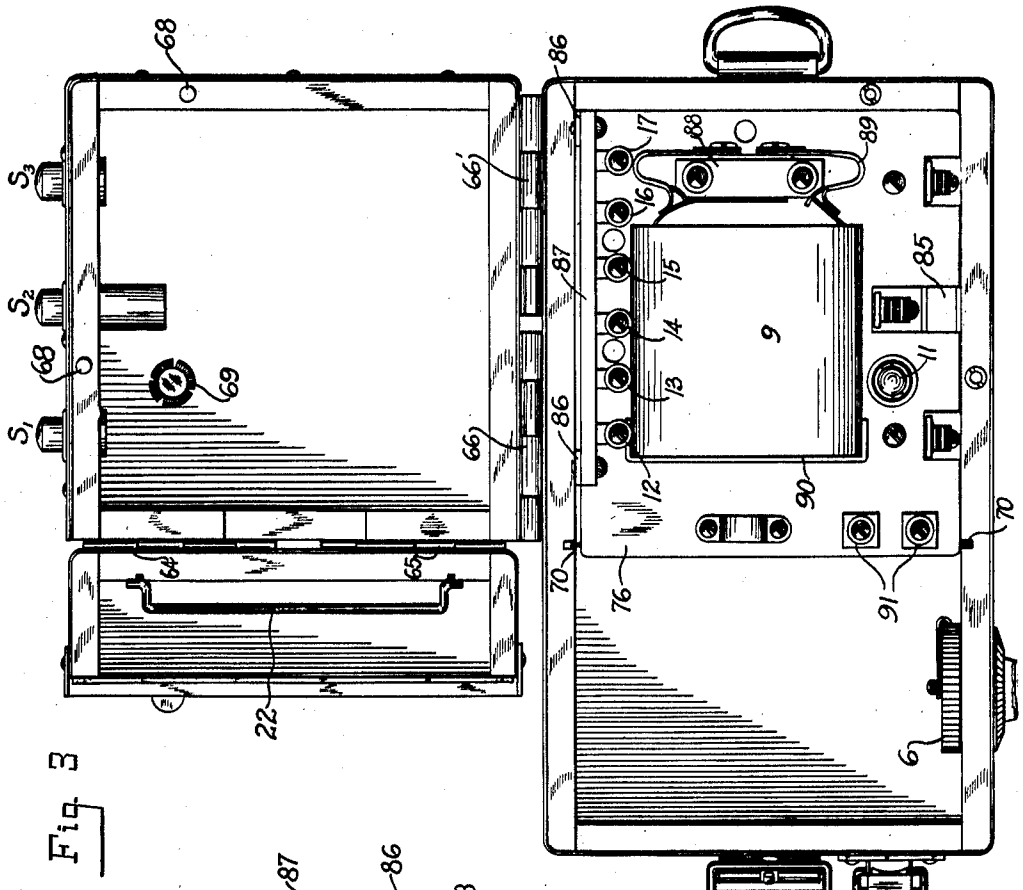

Fig. 3

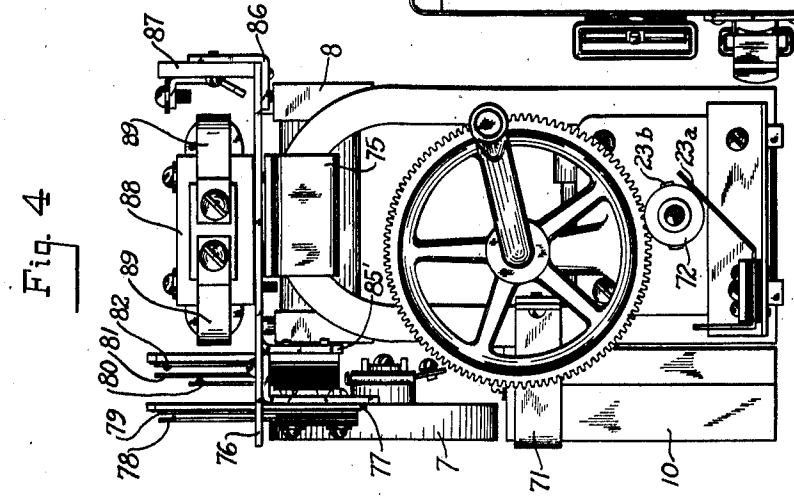

Fig. 4

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UNITED STATES PATENT OFFICE

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TEST SET

Application filed July 5, 1927. Serial No. 203,654.

This invention relates to test sets for use in locating faults in transmission lines, especially telephone and telegraph transmission lines, and it is an object of this invention to produce a portable test set which shall be reliable in action, simple and rugged in construction, and which shall be economical of manufacture.

A feature of the invention consists in the novel circuit arrangement whereby a more reliable action is obtained. Another feature of the invention consists in the compact and expedient arrangement of the various parts whereby the test set is rendered more convenient to use. Additional features will be evident from the detailed description.

Referring now to the drawings wherein there is illustrated an embodiment of my invention, Figure 1 is a diagram of the electrical circuit; Figure 2 is a perspective view of the set with a portion of the box broken away to show the arrangement on the inside thereof; Figure 3 is a top view of the complete box with the cover open; Figure 4 is a side view of the generator unit with the various parts mounted thereon; Figure 5 is a side view of the finder coil; Figure 6 is a front view partly in section of the finder coil; and Figure 7 is a section along the terminal clip of Fig. 6.

Referring, now, to Fig. 1 of the drawings, 1 indicates a magneto generator of the standard well known type, having contacts such as 2, 3 and 4, arranged to be automatically operated in the well known manner upon the operation of the generator. In the present case upon operating the generator the contacts 3 and 4 open and the contact 2 closes. Under those conditions the shaft 5 which is in electrical contact with one of the terminals of the generator winding comes into electrical contact with left hand spring of contact 4. The generator is provided with a pair of interrupter contacts 23, arranged to close a moment after the voltage wave passes its peak during each half of the cycle. There is also provided a number of switches S_1, S_2, and S_3, for establishing various circuits for a purpose to be more fully described later. There is also provided an adjustable calibrated non-inductive resistance or rheostat 6, a telephone transmitter 7, an induction coil 8, battery 9, condenser 10, and signal lamp 11. To the terminals 12 and 13 there is connected a telephone receiver 18; to the terminals 14 and 15 there is connected a finder or inductance coil 19; and to the terminals 16 and 17 there are connected two line clips 20 and 21. The receiver, finder and line clips are connected to the respective terminals by means of flexible leads of suitable length. In the circuit there is provided a link 22 for a purpose to be more fully explained hereafter.

An explanation will now be given of the construction of the finder coil 19, shown in Figs. 5, 6 and 7. The finder consists of an oblong coil 30 having a core 31, and upper and lower iron pole pieces 32 at the two ends of the coil, respectively. The coil 30 is fastened to the lower jaw of a spring clip by means of two screws which pass through the lower jaw of the clip and both pole pieces, the upper of which is threaded to receive the screws. The spring clip is of a standard type in which the jaws 36 are held together by the tension of clamping springs 37 placed at each end of the clip. Portions of the jaws 36 are extended at the rear to form handles 38, whereby the jaws may be forced open by pivoting about the ball bearings 39 against the tension of springs 37. There is formed on each side of the center line of the handle a groove 35 formed by depressing the metal of which the handle is made. This gives the handle rigidity against bending. The terminal leads from the coil 30 are placed one in each groove, on the lower handle portion, and extend to the cylindrical insulated terminal block 41. The spring clip is made of magnetic material and acts as a path for any flux that passes through the coil 30. On the lower jaw of the clip there is provided a shield 40 which covers the lead wires from the coil 30 and protects them against damage. The shield 40 is made of magnetic material and also improves the magnetic circuit at the meeting point of the upper and lower jaws of the clip. The terminal block 41 preferably comprises a tube of insulating material with the necessary fittings and is secured to the lower handle 38

by means of two screws, one of which is shown at 42 in Fig. 5. On the inside of the block 41 are placed three circular brass slugs 43, 44, and 45, spaced apart by insulating disks. The slugs are slightly larger than the tube (inside diameter) and are forced in place. Small brass nails are driven into slightly smaller holes 47 drilled in the slugs 43 and 45, and to these nails are soldered the lead wires from the coil 30. In each of the slugs 43 and 45 there is drilled a hole 46 into which may be placed the conducting tip of a standard cord, the same being then held in position by a screw which is passed through the threaded hole 48. The other ends of the cord tip are connected to the binding posts 14 and 15 shown in Fig. 1. The screws 42, for securing the terminal block to the clip, pass through the tapped holes 42'. It may be mentioned that the insulating tube and the three slugs 43, 44 and 45, together with the separating washers are preferably assembled before any holes are drilled, the drilling and tapping operations being performed on the assembled unit.

To use the finder 19, the upper jaw 36 is opened outwardly from the coil 30 by forcing the handles 38 together and the clip is passed over a wire which is to be tested. The handles are then released and the clip encircles the wire, assuming a position with respect to the wire that is being tested similar to the position of the clip shown in Fig. 2, with respect to the wire 22 shown in that figure. If alternating current is passing through the wire encircled by the clip, the alternating field produced by the current will pass through the core 31 of coil 30, and induce a voltage in the coil. It is to be noted that the clip provides a magnetic circuit for that field.

In making a test for ground on a metallic circuit, the finder coil is left in its normal position encircling the conductor link 22 shown in Fig. 1, and one of the test clips, for example clip 21, is connected to a ground wire or other good ground connection and the other clip connected first to one line and then to the other. With each of the two latter connections the lineman operates the generator. Upon operating the generator the contacts 3 and 4 open, the contact 2 closes, and a connection is established between the left hand spring of the contact 4 and the shaft 5 of the generator. If the clip 20 happens to be connected to the line which is grounded, a circuit is completed from ground at the far end of the line, over the line, to the clip 20, binding post 16, condenser 10, terminal 24 of the generator, through the generator winding to the frame of the generator, thence by way of the shaft 5 and left hand spring of contact 4, through the link 22, back contact controlled by the switch S_2, binding post 17, to ground at the terminal clip 21. Alternating current from the generator, flowing through the link 22 will produce an alternating flux, and this alternating flux will induce an alternating voltage in the coil 30 of the finder 19. The finder 19 and the telephone receiver 18 being connected in a loop which is closed at the contact 2 controlled by the generator shaft, an alternating current will flow in that loop and produce an audible sound in the telephone receiver. When, however, the line clip 20 is connected to the ungrounded line wire, then the previously traced circuit from the generator through the link 22 is open at the clip 20, and since no current is flowing through the link 22, no voltage is induced in the coil of the finder 19 and no sound is heard in the telephone receiver. From the above it may be seen that the presence or absence of a tone in the receiver indicates whether the line conductor connected with is or is not grounded.

As stated before, the intermittent closure of the contacts 23 occurs twice per cycle, a moment after the peak of the output wave of the generator is reached. The closure of the contacts 23 results in the short circuiting of the generator 1 by way of the back contact of the switch S_2. As a result of the short circuiting of the generator, there is provided a discharge path for the condenser 10 through the line that is being tested, said path extending from ground at the remote end of the line, through the line to the clip 20, left hand terminal of the condenser 10, back contact of the switch S_1, closed interrupter contacts 23, to the frame of the generator 1, left hand spring of contact 4, link 22, back contact controlled by the switch S_2, to ground at the terminal clip 21. This sudden discharge of the condenser produces a sharp peak in the current wave, which makes for maximum efficiency in the inductance effect of the test current upon the finder coil 19.

The line man having determined on which one of the lines the ground exists will now determine the approximate distance to the ground. To do this the line man operates the generator 1 and also the switch S_2. The switch S_2 in its operated position substitutes the variable calibrated resistance 6 for the grounded line in a manner which is apparent from the circuit shown in Fig. 1. The line man observes the intensity of the sound in the receiver, and if the sound is greater than what it was before the switch S_2 was operated he increases the resistance 6, whereas, if it is less than it was before, he reduces the resistance. The switch S_2 is thrown from one position to the other and the variable resistance 6 varied until the intensity of the sound produced when the current is flowing through the resistance 6 is substantially the same as that produced when the current is flowing through the grounded line. When this result is obtained the line man knows

that the resistance of the line is approximately equal to that of the resistance 6. Since the size of the line wire is known, the length of wire to the fault can be readily calculated.

If the line extends in both directions from the point where the test was made, it is now necessary to determine the direction to the trouble. To do this, the clip 20 is kept on the grounded line and the coil 19 is removed from around the conductor link 22 and is placed around the grounded line wire, so that it encircles the line wire in the same manner as it previously encircled the link 22. The finder coil is placed around the line wire first on one side of the clip 20 and then on the other side of the clip. Since the current is flowing along the line from the clip 20 to ground, a current will be induced in the coil 19 when the coil is on the line between the clip 20 and the grounded point, whereas if the coil 19 is on the other side of the clip, that is the ungrounded side, there will be no current flowing from the generator through the portion of the line embraced by the clip, hence no current will be induced in the coil 30. When current is induced in the coil of the finder, a sound is heard in the telephone receiver. The presence or absence of sound in the telephone receiver will be an indication of whether the finder coil is on the side of the line between the clip 20 and ground or whether the finder coil is on the side of the clip away from the ground.

If the line trouble is due not to a grounded line but rather to a short across the line then the two line clips 20—21 are connected one to each line, instead of one to one line and the other to ground. The test for distance to the short is then performed in the same manner as before. The resistance 6 is varied until the intensity of the current induced in the coil of the finder as measured by the intensity of the sound in the receiver, is substantially unchanged when the resistance 6 is substituted for the line resistance by depressing the switch S_2. It should be remembered that now the rheostat reading represents the combined resistance of the two line conductors, and this fact should be taken into account in calculating the distance to the fault. The test for direction to the short in the case of a short circuited line is the same as that in the case of a grounded line. The finder coil is placed around one of the lines, first on one side of the clip and then on the other. In one case a sound will be heard in the receiver and in the other case no sound will be heard. It follows, from what has been said before, that the fault is along the line in the direction from the clip towards the finder coil when the finder is on the side of the clip from which the sound is heard.

In testing to determine which one of two line conductors is grounded the telephone receiver may be dispensed with and the lamp 11 used as an indicator. The test is performed in the same manner as was previously described except the switch S_1 is partially operated so that it closes its first front contact but not its second front contact. Under those conditions, the lamp 11 is connected across the condensor 10 and the interrupter contacts 23 are disconnected at the switch S_1. With the clip 21 connected to ground and the clip 20 connected to the grounded line, a circuit is established from ground at the remote end of the grounded line, over the line to clip 20, thence by way of the condenser 10 and lamp 11 in parallel to the terminal 24 of the generator, through the winding of the generator to the frame, thence by way of the shaft 5, left hand spring of contact 4, link 22 and back contact of the switch S_2 to ground at the clip 21. If the clip 20 is connected to the ungrounded line, so such circuit is established. The establishment of this circuit is indicated by the lighted condition of the lamp which is in parallel with the condenser. When using the lamp, it is desirable to get the maximum current flow, and the shape of the current wave is not very material. At such times the generator is not short circuited at contacts 23, the shunting circuit being open at the front contact of switch S_1, and the full output of the generator flows through the lamp 11 and condenser 10 in parallel.

High resistance shorts such as result when two line wires cross or touch one another very lightly have been a source of great trouble. In such cases, it is generally difficult to determine the line resistance to the fault since the resistance of the fault itself is unknown. This trouble is overcome by providing the outermost left hand contact of the switch S_1. When the switch S_1 is operated to its extreme left hand position, the condenser 10 and the lamp 11 are short circuited and the interrupter contacts 23 are open circuited. Under those conditions the generator is connected directly to the line clips 20, 21 and the full output of the generator may be projected over the line. The large current output from the generator breaks down the resistance at the fault and causes the two line conductors to practically stick together, reducing the resistance to a minimum. The test for distance to the fault may then be performed in the manner previously explained.

The line man having determined the direction of the fault and having calculated that the fault is, let us assume about 20 miles distant, drives out 19 miles instead of 20, just for certainty, and upon making another test finds that the trouble is still ahead of him. He can tell however, that the trouble is closer at hand by the increased volume of the sound in the receiver. The test now indicates that the fault is, say, one and one-tenth miles further ahead. He then pro-

ceeds to the fault and repairs the same, making further tests if the actual trouble is not readily seen on approaching its vicinity.

To call the test board man at the telephone exchange and notify him that the trouble has been cleared and the line is now ready for further use, the clips 20—21 are clamped one to each line, and if the distance to the exchange is not too great, the generator is operated without operating the switch S_1, thereby projecting ringing current over the line through the condenser 10. If the distance to the exchange is too great to ring through the condenser 10, the switch S_1 is operated to its extreme left hand position, short-circuiting the lamp 11 and the condenser 10 and placing the entire generator output across the line. Having projected ringing current over the line, the line man stops rotating the generator 1 and closes the switch S_3. He is now placed in talking relation with the line, the circuit extending from the clip 20, through the condenser 10, right hand winding of the coil 8, back contact 3, receiver 18, coil of the finder 19, back contact 4, link 22, to the line clip 21 by way of the back contact of the switch S_2. The battery 9 furnishes talking current to the transmitter 7.

If desired, the variable resistance 6 may be replaced by a fixed resistance. Under those conditions the resistance to the fault may be roughly approximated by operating the switch S_2 as before. Since the size of the line conductors are known, calculation will readily show how many miles of line wire correspond in resistance to the value of the resistance 6. In testing for distance if the intensity of sound in the receiver is increased when the resistance 6 is substituted for the line resistance this indicates that the distance to the fault is greater than the number of miles of line wire that correspond to the resistance 6. If the intensity of sound in the receiver is less when the current is flowing through the resistance than when it is flowing through the line this indicates that the fault is at a lesser distance than is the number of miles that correspond to the resistance 6. The different intensity in the sound indicates the approximate difference in the distance.

Reference may be now had to Figures 2, 3, and 4 wherein there is illustrated the physical arrangement of the various parts constituting the test set. The box 60 is made of wood, and is covered with a fibrous protective coating. The box is provided with a cover formed in two sections 62, and 63. The cover section 62, is hinged to the section 63 by the hinges 64 and 65, while the section 63 is hinged to the box by the hinge 66, and is further secured to the box by means of screws 67 passed through the holes 68. By this arangement the section 62 may be opened at will, while the section 63, which is to be opened only when repairs or replacements are to be made, is normally held locked by the screws 67. The top 62 may be held closed by an ordinary hasp. The cover section 63 is provided with a celluloid window 69 placed opposite the lamp 11, whereby the condition of the lamp may be observed.

To the inside of the cover portion 62 there is secured a metal rod 22 about which the finder coil 19 may be clasped. The rod is connected to the two insulated conducting hinges 64 and 65, by two conductors placed in grooves on the inner side of the cover. Through the hinges the rod 22 is connected to the other parts shown in Figures 1, 2, 3, and 4. It may thus be seen that the test to determine which one of two lines is grounded, and also the test for the distance to a fault, may be made without removing the finder 19 from the case.

The box 60 is divided into two sections by the plate 70 which is held in two grooves 71, one on each side of the box. The telephone receiver, the line clips 21, and the removable handle for turning the generator are carried in the chamber to the left of the plate, whereas the generator 1, the transmitter 7, induction coil 8, battery 9 and the switch contacts S_1, S_2 and S_3 are mounted as a unitary structure in the chamber to the right of the plate 70.

The magneto generator 1 is of standard construction and consists of a number of inverted, U-shaped, permanent magnets between the ends of which a coil carrying armature is arranged to be rotated. There is provided a set of contacts 2, 3, and 4, (Fig. 1) arranged to be operated by the outward movement of the shaft 5, which shaft is moved outwardly in the well known manner upon being rotated. In addition to the contacts 2, 3, and 4, there is provided a set of contacts 23 consisting of a spring member 23^a (Fig. 4) normally pressing against the insulating disk 72 upon the shaft that carries the armature, but twice per revolution making contact with conducting projections 23^b on the same shaft. The generator unit is secured to the case by two screws (not shown) passed thru the bottom of the case into corresponding holes drilled in the bottom of the generator unit.

The condenser 10 is secured to the magneto by means of a clamp 71. To the top of the magneto there is fastened a cover plate 76 by means of a bracket 75. An inverted L-shaped plate 77 is secured to the lower side of the cover plate. The plate 77 acts as a support for the contacts controlled by the switches S_1, and S_3, and for the transmitter 7. The springs 78 and 79 are insulated from each other and are fastened to the plate 77 by means of screws, as may be seen in Figure 4. The springs controlled by the switch

S_1, are secured to the plate 77 in a similar manner, as shown in Figure 2. A section 85 is punched in the cover plate and the metal is bent down at 85′ to form a support for the springs 80, 81, and 82 of the switch S_2. The induction coil 8 is mounted on the lower side of the cover plate 76 in a position shown in Figures 2 and 4. Two L-shaped metal strips 86, secured to the cover plate, support the insulating terminal block 87, on which are mounted the terminals 12 to 17. The screws passing thru the insulating block 88, secure it and the bracket 75 to the cover plate. The spring terminal clips 89, maintain the the battery 9 against the bracket 90, the bracket being secured to the cover plate. The lamp 11 is mounted on the cover plate in any well known manner. There is also provided two binding posts 91, insulated from the cover plate, to which are connected leads from the rheostat 6. When the push button S_1, shown in Figure 4 is pushed with the flat portion of the thumb until the thumb encounters the box, the right hand back contact shown in Figure 1 will be opened and the middle front contact will be closed, but the outer left front contact will still be open. If the push button S_1, is pushed in further, for instance with the tip of the thumb, the outer left front contact will also be closed.

When it is desired to use the transmitter 7, the lineman may find it rather inconvenient to hold the box with the transmitter 7 (Fig. 2) before him. Under such conditions it is frequently quite convenient to talk directly into the left hand chamber of the box, the cover 62 being open. To facilitate this, the plate 70 is provided with a number of small holes through which sound may pass. It is found that the transmitter 7, when mounted as shown in Figure 2, responds very satisfactorily to sound waves reaching it by way of the holes in the plate 70.

What is claimed is:

1. A line test set wherein a telephone receiver and a finder coil are connected in series across two line clips, a generator, a switch, and connections controlled by the switch for connecting the generator in place of the telephone and finder coil and for connecting the telephone and the finder coil in a closed loop.

2. A line test set wherein a telephone receiver and a finder coil are connected in series across two line clips, a generator, a switch operated upon the operation of the generator for connecting the generator across the line clips in place of the telephone and finder coil and for connecting the telephone and the finder coil in a closed loop.

3. In a line test set, a pair of line clips, a telephone receiver normally connected across said line clips, a generator normally disconnected from one of the line clips, a finder coil, and means controlled by the generator for disconnecting the receiver from the line clips and connecting it instead across the finder, and for connecting the generator across the line clips.

4. A line test set mounted in a case and including means for connecting the set to a line to be tested, an inductance coil, a conducting link permanently mounted within the case and connected in series with said means, said coil being normally inductively coupled with said link.

5. A line test set mounted in a case and including a pair of line clips to be connected to line to be tested, an inductance coil removably held in said case and connected with the rest of the set by flexible leads, a conducting link within the case connected in series with said clips, said coil being normally inductively coupled with said link, a testing circuit including said link and said coil in normally coupled condition, and a test circuit including said coil and excluding said link.

6. A line test set mounted in a case, a conducting link within the case, an artificial line, means for connecting the link to the line to be tested or to the artificial line, means for comparing the current flow in the two lines, said means including a coil inductively coupled with said link.

7. A line test set mounted in a case and including means for connecting the set to a line to be tested, a variable artificial line within the case, means for establishing a circuit either to the line to be tested or to the artificial line, and induction means for comparing the current flow in the two lines.

8. A line test set including means for connecting the set to a line to be tested, a conducting link and a variable calibrated resistor, means for connecting the conducting link in series with the line to be tested or with said resistor, and an inductance coil adapted to be mounted in inductive relationship with said conducting link.

9. A line test set mounted in a case and including a pair of line clips to be connected to a line to be tested, an inductance coil, a conducting link within the case connected in series with said clips, said coil being normally inductively coupled with said link, a resistor, and means for connecting said resistor in said series circuit in place of said clips.

10. A line test set mounted in a case and including means for connecting the set to a line to be tested, a resistor, a conducting link within the case normally connected in series with said means, means for substituting the resistor for said first means in said series circuit, and an inductance coil removably held in said case and connected with the rest of the set by flexible leads, said coil being normally inductively coupled with said link.

11. A line test set mounted in a case and

including means for connecting the set to a line to be tested, a resistor, a conducting link within the case connected in series with said means, means for substituting the resistor for the clip in said series circuit, an inductance coil normally inductively coupled with said link, and a telephone receiver connected to detect current flow in said inductance coil.

12. A line test set including a magneto generator having mounted thereon to form an integral unit, a switch, a condenser, a battery, and a telephone transmitter, a box divided into two compartments in one of which the unit is mounted, and a telephone receiver, an inductance coil and a line clip electrically connected with said unit carried in the other compartment.

13. A test set case having mounted therein a generator to which is secured a telephone transmitter, said case having a plurality of small holes formed therein opposite the transmitter through which sound may pass to the transmitter, a partition dividing the case into two compartments, said partition having formed therein a number of small holes through which sound may pass to the transmitter.

14. A finder having an iron core and a winding therefor mounted between two spring pressed jaws of magnetic material, one of said jaws having a groove therein in which groove is placed one of the incoming conductors to the coil, a protecting sheet of magnetic material extending along the jaw from the coil to the point where the two jaws are pressed together, said sheet covering the groove containing the wire.

15. A finder consisting of a clip having two pivoted jaws of magnetic material pressed against each other by a spring, an oblong coil having an iron core mounted between said jaws, said core being secured to one of said jaws so as to be included in a series magnetic circuit with both of said jaws and spaced from the pivot point of the jaws, so that the clip may be placed around a wire to be tested by opening the jaws and slipping the clip over the wire until the wire is in the space between the coil and pivot point, and upon closing the jaws the clip is retained around the wire.

16. A finder consisting of a pair of pivoted jaws, a coil mounted between said jaws, said jaws being extended to form two handles for opening the jaws, a terminal block consisting of a cylindrical insulating casing containing three metal slugs insulated from each other; said terminal block being secured to one handle by means of a screw passed through the handle and one slug, the other two slugs each having two holes drilled through the casing into the slug, one of said two holes being adapted to receive a permanent connection to the coil, and the other adapted to receive an incoming lead, and screws in the terminal block for holding the incoming leads in place.

17. In a line test set, a pair of line clips, a receiver and a condenser normally connected to said line clips, a generator, means effective upon the operation of the generator for disconnecting the receiver from the line clips and for connecting the generator to the line clips in series with the condenser, a lamp, and means for bridging the lamp across the condenser.

18. In a line test set, a pair of line clips, a receiver and a condenser normally connected to said line clips, a generator, means effective upon the operation of the generator for disconnecting the receiver from the line clips and for connecting the generator to the line clips in series with the condenser, and means for shunting the condenser.

19. In a line test set, a pair of line clips, a receiver and a condenser normally connected to said line clips, a generator, means effective upon the operation of the generator for disconnecting the receiver from the line clips and for connecting the generator to the line clips in series with the condenser, means for periodically short-circuiting the generator, and means for preventing the last named means from being effective and for shunting the condenser.

20. In a line test set, a pair of line clips, a receiver and a condenser normally connected to said line clips, a generator, means effective upon the operation of the generator for disconnecting the receiver from the line clips and for connecting the generator to the line clips in series with the condenser, a lamp, and a two-position key for bridging the lamp across the condenser when operated to its first position and for shunting the lamp and the condenser when operated to its second position.

21. A line test set mounted in a case, an artificial line within the case, means for alternatively establishing a flow of current in the artificial line and in the line to be tested, and induction means for comparing the current in the two lines.

22. A line test set comprising a generator, a transmitter mounted on the generator, and a case having a partition dividing the case into two compartments, the first compartment being adapted to house the generator and transmitter unit, said partition having holes through which sound directed into the second compartment may pass to the transmitter.

23. A line test set case comprising two compartments, the first compartment adapted to house the generator of a test set, and the second compartment adapted to serve as a space for the receiver of the test set, a cover for the first compartment hinged to the case, and a second cover for the second compartment hinged to the first cover.

24. A case for a line test set comprising a generator, a receiver, and a finder coil, said case comprising two compartments, the first compartment adapted to house the generator, and the second compartment adapted to serve as a space for the receiver, a cover for the first compartment hinged to said case, and a second cover for the second compartment hinged to said first cover, said second cover having a pocket adapted to serve as a space for the finder coil.

25. A line test set mounted in a case, a finder coil, a cover hinged to the case by means of two electrically insulated hinges, a conducting link mounted in said cover and adapted to support said finder coil, said conductor link being electrically connected to the test set through said hinges.

26. A finder consisting of a clip having two spring jaws pivoted at one end, a coil having an iron core, one end of said core being secured to the free end of one of said jaws, the other end of said core being adapted to engage the free end of the other of said jaws, and a magnetic circuit closed by said jaws including said core and the sections of said jaws between the respective points of contact with said core and the pivoted end.

27. In a line test set, a pair of line clips, a condenser, a receiver normally connected across said line clips in series with said condenser, a generator, a finder coil, and means controlled by the generator for disconnecting said receiver from said line clips and connecting it across said finder coil and for connecting said generator across said line clips in series with said condenser.

28. In a line test set, a pair of line clips, a condenser, an induction coil, a receiver normally bridged across said line clips in series with said line clips and a winding of said induction coil, a generator, a finder coil, and means controlled by said generator for disconnecting said receiver from said line clips, said condenser and said induction coil winding and for connecting it across said finder coil, and for bridging said generator across said line clips in series with said condenser.

29. In a test set including means for connecting the set to outside conductors to be tested, a conducting link connected in series with said means, an inductance coil normally inductively coupled with said link, and means for testing conductors with said inductance coil in either its normal position or inductively coupled with one of the conductors under test.

30. In a test set including means for connecting the set to line conductors to be tested, a conducting link connected in series with said means, an inductance coil normally inductively coupled with said link, means for performing certain tests on the line conductors with said inductance coil in normal position, and means for performing certain other tests on the line with said inductance coil inductively coupled with one of the conductors under test.

31. A line test set mounted in a case and including means for connecting the set to the line conductors to be tested, a conducting link within the case connected in series with said means, an inductance coil adapted to be inductively coupled with a line conductor under test but normally carried in the case in inductive relation with said link, and means for testing a line without removing said inductance coil from the case.

32. In a line test set, an induction coil, a primary winding for said coil permanently mounted in said set, a secondary winding normally associated with said primary winding, arrangements whereby said secondary winding may be readily removed from the set and placed in inductive relation to outside conductors, and a receiver connected to said secondary winding when the same is in use in either case.

33. In a line test set, a finder coil for use outside the set and connected to the same by flexible conductors, a compartment inside the set for storing said coil, and a conductor in said compartment with which the coil is inductively coupled when stored in the compartment.

34. A line test set including a magneto generator having mounted thereon to form an integral unit, a switch, a condenser, a battery, and a telephone transmitter, a box divided into two compartments in one of which the unit is mounted, and a conducting link comprising a rigid conductor electrically connected with said unit mounted in the other compartment.

In witness whereof, I hereunto subscribe my name this 2d day of July, A. D. 1927.

CLARENCE A. ANDERSON.