# DROP AND BLOCK WIRING
## TESTING AND FAULT LOCATING

CONTENTS



### 1. GENERAL

**1.01** This section is reissued to revise reference section numbers.

**1.02** In locating trouble in the drop and block wire plant, much time and effort can be saved by careful analysis and systematic procedure by the workmen. Certain types of trouble are readily apparent and can be detected by a visual inspection while other types present very little external evidence of their existence and require electrical tests to locate them.

**1.03** A thorough knowledge of plant conditions throughout the territory involved greatly assists a workman in locating trouble. Frequently the knowledge of an unsatisfactory plant condition for example, unsatisfactory tree conditions, etc., which has not as yet been corrected suggests the first point to examine for the trouble.

**1.04** Alertness is noting foreign construction operations that might interfere with the telephone plant will assist, in many instances, in quickly locating the cause of the trouble. Consultation with the party in charge of the operations, before they have progressed to a point where the telephone plant is endangered, will frequently prevent any interference with the telephone service. When it is noted that the telephone plant will interfere with the progress of building operations or other construction work, the condition should be corrected or reported in accordance with local instructions.

**1.05** In order that the workman may proceed intelligently and efficiently to locate the cause of the trouble, he should have the following information:

(a) Telephone number.

(b) Name and address of subscriber, given in sufficient detail to permit ready identification of the premises of the subscriber (such as apartment number, floor, room number, etc.).

(c) Cable numbers, pair numbers and terminals. Where terminals are not stenciled or otherwise marked, binding post identification.

(d) Number of pole on which drop or drops terminate (on other than cable lines), if available.

(e) Transmission zone.

(f) Nature of trouble as diagnosed by test or from report.

(g) Whether or not station is out of service.

(h) Other items of special information as:

1. Any indication (such as the operation of protective equipment) that there may be foreign current upon the line.
2. That special effort is necessary to restore service quickly as to hospitals or doctor's offices, etc.

3. That trouble of similar nature has recently occurred on the same line.

4. That trouble is of such a nature that the entire line from the terminal to the station should be inspected.

**1.06** If, after securing the above information, the workman is aware of conditions in the outside plant which might have caused the trouble, his investigation should be begun by a visit to the points where these conditions are known to exist. If nothing is found at these points and then appropriate tests are made which determine that the trouble is in drop or block wire, the investigation should be continued in accordance with the methods given in detail for specific types of faults. (See parts 2, 3, 4, and 5.)

**1.07** Hand test sets can ordinarily be used on common battery circuits and magneto test sets on magneto or local battery circuits, to make the necessary electrical tests on the line to locate faults. These sets should be so employed that a trouble may be located quickly without making unnecessary tests. Proper utilization of the test set will enable the repairman to locate many troubles without enlisting the aid of the test deskman or the operator. Test sets employed should be provided with leads ending in approved clips equipped with test points so that contacts may be made with conductors by piercing the insulation with these points. No other method of establishing contacts with conductors through the insulation of the wires should be used. When tests are being made which depend upon a click being heard in the receiver of the test set be sure that the click is heard both upon the make and the break of the contact.

**1.08** When it is necessary, in locating a fault in drop or block wire, to open the line at various points for the purpose of making a test, first select points where disconnections can readily be made such as binding posts, bridging connectors, etc. In general, no wires shall be cut until tests have isolated the fault between two adjacent such points. Then after an inspection has been made if further tests are required to locate the fault, one conductor of the wire may be cut to make the test.

**1.09** Before leaving a line upon which work has been done or repairs have been made, suitable tests should be made in accordance with local instructions to determine that the line is in good working condition.

**1.10** Whenever there is any indication (such as the operation of protective equipment) of the presence of foreign current upon a line, suitable precautions shall be taken to prevent the possibility of electric shock being sustained by the workmen.

**1.11** The detailed procedures to be employed to locate the various types of faults in the drop and block wire plant are outlined in the following parts of this section. All repairs should be made in accordance with the provisions of Section 462-800-305CA.

## 2. GROUNDS

**2.01** Two types of grounds are commonly encountered in the drop and block wire plant, namely,

(a) ***Low Resistance Ground.*** This type of ground is usually the result of a complete breakdown of the insulation on a conductor due to deterioration or abrasion and contact with grounded objects such as guys, suspension strand, ground wires, rain spouts, conduit, etc., establishing a low resistance path to ground.

(b) ***High Resistance Ground.*** This type of ground may be caused by complete or partial breakdown of the insulation on a conductor and the establishment of a poor contact with grounded objects so that the path to ground is of high resistance, except in wet weather. It may also be caused by complete breakdown of the insulation on a conductor and contact with objects such as wood poles, trees, buildings, etc., that do not afford a low resistance path to ground. Troubles of the latter class are frequently of varying intensity, appearing usually during wet weather and usually must be located either under wet weather conditions or by a visual inspection for the point where the insulation is faulty.

**Common Battery Circuits—Locating Grounds in the Drop and Block Wire Plant**

**Low Resistance Grounds**

**2.02** Information as to which side of the line is grounded is important. This is especially true if the cause of the fault is not found by visual inspection and tests must be resorted to, to more accurately determine its location. This information, if it is available, should be obtained when the trouble is referred for clearing. If it is not available the side that is grounded should be determined during the tests that are necessary to isolate the trouble to a drop or block wire.

**2.03** The drop or block wire in which the fault is located should be found by the following test. Disconnect all drop, block or bridle wires bridged to the grounded line from the binding posts in the cable terminal, so placing the wires that they may be reconnected in their original position upon completion of the test. (If it is known which side of the line is grounded it is necessary to disconnect only the wires on the grounded side of the line.) Connect one clip of the test set to a suitable ground such as the metal terminal case or suspension strand and touch the other clip to the binding post on which battery normally should be found. (See fig. 1). If no battery click is heard in the receiver, touch the other binding post. (If still no battery click is heard there is other trouble on the line which must be cared for before proceeding with the locating of the trouble in the drop or block wire.)

TEST TO DETERMINE BATTERY SIDE OF LINE

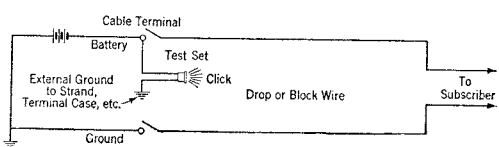



**Fig. 1**

When a battery click is heard connect the clip to the binding post carrying battery and remove the other clip from the external ground. Touch this clip to the conductors of the drop wire. A battery click will be heard in the receiver when the grounded wire is touched. (See figures 2 and 3.)

GROUND SIDE GROUNDED

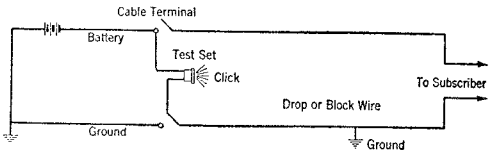



**Fig. 2**

BATTERY SIDE GROUNDED

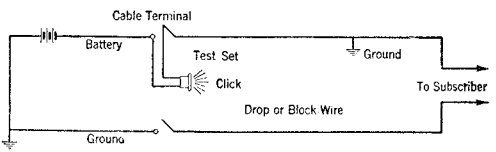



**Fig. 3**

Note whether or not the insulation upon the grounded wire carries a tracer. This knowledge will be helpful if subsequent tests at other points are necessary (unless an intervening splice has been made in a non-standard manner and the tracer reversed). Before reconnecting the wires disconnected to make this test, be sure to test every wire separately to determine whether or not it is clear.

**2.04** After the fault has been isolated to a particular drop or block wire, a careful inspection for the conditions causing the ground should be made before testing at other points to further isolate the fault. This is desirable as low resistance grounds in the drop and block wire plant are usually caused by conditions that are readily discovered by visual inspection.

**2.05** If a visual inspection of the wire that is grounded does not disclose the fault, further tests are necessary to definitely locate the source of the trouble. In making these tests, if the ground is on the battery side of the line:

(a) Open that side of the line.

(b) Then attach one clip of the test set to the binding post or wire end on the central office side of the open.

(c) Touch the end of the wire that leads away from the central office with the other clip. (See Figure 4.)

BATTERY SIDE GROUNDED

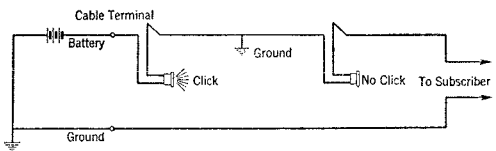



**Fig. 4**

However, if the external ground is on the ground side of the line:

(a) Open that side.

(b) Establish a contact with the battery side of the line by attaching a clip of the test set to a binding post or if the test is at a point in the wire by piercing the insulation of the conductor carrying battery with the point of the test set clip.

(c) Touch the exposed end of the wire that leads away from the central office with the other clip. (See Figure 5.)

GROUND SIDE GROUNDED

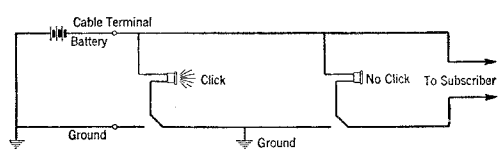



**Fig. 5**

The test, if on an individual line, will indicate by a click in the receiver that the ground is located toward the station or by absence of a click that it is located in the direction of the central office. On a party line the click indicates that the ground is located in the portion of the wire that is directly affected by the test and absence of the click indicates that the ground is either toward the central office or in a portion of the wire which is not affected by the test at that particular point.

**2.06** In locating grounds on party lines it is desirable, when possible, to start at a point where the circuits to all parties are common and are carried on a single pair of conductors. Then test the wires to each individual party until the wire that is in trouble is found.

**High Resistance Grounds**

**2.07** Trouble of this type is frequently of varying intensity and in some instances appears only under severe moisture conditions. Often the trouble is caused by the cumulative effects of lowered insulation at several entirely different points in the drop or block wire plant and this condition is frequently found on party lines. If the resistance of the contact to ground is high, it frequently is difficult, if not impossible, to obtain a positive indication by testing with the hand test set as outlined under low resistance grounds. In this case it is advisable to first determine that the fault is not located toward the central office by disconnecting the drop or block wire at the cable terminals and having the circuit tested from the central office when testing facilities are available. On a party line if this disconnection reduces the leak to ground but does not entirely clear the line, leave the wires disconnected until after similar tests have been made where other wires are bridged to the line so that all the conditions contributing to the leak may be isolated and cleared. On party lines where the disconnection has either cleared the fault or has had no effect on the leak to ground or on individual lines, reconnect the wires immediately after the test has been concluded and the result reported. After the wire or wires which cause or contribute to the leak are determined, the fault usually may be found by making a careful visual inspection. If the points of faulty insulation are not found it is necessary to further isolate them by opening the faulty conductor at various points and having the circuit tested from the central office when testing facilities are available.

*Note:* Where leaks to ground exist at several points due to faulty insulation on different sides of the line the trouble may be referred to the workman as a short and a ground. This possibility should be understood when starting to clear a trouble so referred.

**Magneto or Local Battery Circuits—Clearing Grounds in the Drop and Block Wire Plant**

**2.08** A high resistance ground on a magneto circuit usually does not have as serious an effect on service as would a similar ground on a common battery circuit. For this reason the existence of high resistance grounds on magneto lines frequently is not detected until the fault has developed so that the resistance of the path to ground has become low. Therefore, the methods outlined in the following paragraphs pertain mainly to locating low resistance grounds. When a high resistance ground does interfere with the proper operation of a line it may be necessary in order to locate the fault to disconnect the wires and have the circuit tested from the central office when testing facilities are available. (See Paragraph 2.07.)

**2.09** Two of the more commonly used tests with the magneto test set that are employed in magneto areas to locate grounds in the drop and block wiring are usually termed "Grounding Test" and "Listening Test." Their application is described in the following paragraphs.

**2.10** Where it is possible to ground one lead of the test set on a metal terminal case, messenger strand, anchor guy, etc., the grounding test is usually effective in isolating the fault to a particular portion of the drop or block wire. (See Figure 6.)

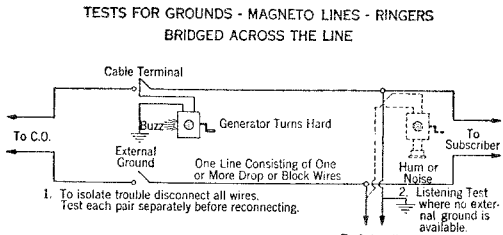



**Fig. 6**

To make this test:

(a) Disconnect the drop or block wire at a convenient point.

(b) Connect one clip of the test set to a suitable ground such as the metal terminal case, suspension strand or strand of an uninsulated anchor guy and connect the other test clip to one of the disconnected wires.

(c) Turn the handle of the generator.

If the generator turns hard and the buzzer operates, the trouble is in the portion of the wire tested. In areas where the ringers are not grounded, if the generator turns freely and the buzzer does not operate, the wire tested is clear of ground. In selective ringing areas where the ringers are grounded, if the generator turns normally and the buzzer operates as on a clear line, the wire tested is clear. If the fault is not indicated, repeat this test with the test clip connected to the other disconnected wire. If these tests do not indicate that the trouble in the portion of the wire tested the test should be repeated in any other portion of the drop or block wire which was not affected by the test at this point.

**2.11** Except in areas where selective ringing is used, when the ground has been isolated to a particular portion of the drop or block wire, before reconnecting the wires connect one lead of the test set to each wire and closely observe the sound in the receiver. This will be helpful in estimating the type and severity of the faults and will assist when subsequent tests are necessary at points where no external ground is available and the listening test must be entirely depended upon.

**2.12** Grounds affecting the telephone circuit vary considerably in resistance, depending upon the extent of the breakdown of the insulation and the nature of the contact that causes the external ground. The sounds produced in the receiver vary according to the nature of the contact. Solid grounds usually are indicated by a steady hum. Grounds caused by moisture intensifying what would normally be a light leak generally produce rasping or fluttering noises. Lines grounded by contact with guys, cable sheath, suspension strand, rain spouts, etc., are frequently very noisy due to the imperfect contact afforded by dirty or corroded surfaces. Therefore, when applying the listening test this factor should be given careful consideration.

**2.13** To make the listening test (see Figure 6) disconnect both conductors of the drop or block wire at a point where the disconnection can conveniently be made. Connect the leads of the test set to the two conductors on the station side of the disconnection and listen for noise in the receiver. If the line is noisy, a ground is located in the portion of the circuit tested. If no noise is detected the disconnected wires should be reconnected and the

same test repeated in the other portions of the circuit that were not affected by the test at this point. When the portion of the wire that the trouble is in is found, make a careful inspection to determine the cause. If the cause is not found by inspection continue to isolate the fault until its possible location is limited to such a small portion of the wire that finding the exact location is less economical than replacing the section of the wire.

**2.14** In areas where selective ringing is employed and the station ringers are connected to ground the listening test must be applied in the following manner: (See Figure 7.)

TESTS FOR GROUNDS - MAGNETO LINES - RINGERS GROUNDED

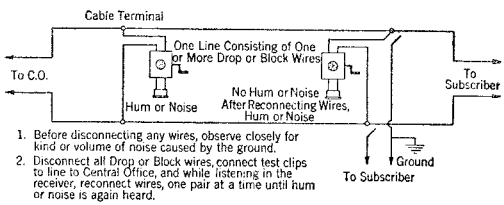



**Fig. 7**

(a) Disconnect both conductors of the drop or block wire or wires at a point where the disconnection can be conveniently made.

(b) Connect the two leads of the test set to the two conductors on the office side of the disconnection and listen in the receiver for noise.

(c) If no noise is detected reconnect the disconnected wires, one pair at a time, and listen in after each reconnection. When the grounded pair is reconnected this will be indicated by the consequent noise on the line and a further investigation should be made of the wire in this portion of the circuit to locate the trouble by inspection and if necessary by further tests of the same nature.

## 3. OPENS

**3.01** Opens in the drop and block wire plant are of three classes, namely:

(a) ***Opens.*** A complete open in a line is usually due to a break in one or both conductors of a drop or block wire, to a wire disconnected from a binding post or bridging connector or to an improper or split pair connection at a cable terminal.

(b) ***Intermittent Opens.*** The common causes of an open of this type are loose connections at binding posts or bridging connectors, improperly made splices, wires corroded through, kinks, etc.

(c) ***High Resistance Connections.*** High Resistance connections are ordinarily caused by improper cleaning of wires before attaching them to binding posts, or bridging connectors, or by the formation of corrosion on wires, binding posts, nuts and washers.

Opens of the first class are ordinarily easily recognized and are usually referred to the workman as such. High resistance connections causing only poor transmission and noise and not causing cutouts are often not identified as opens and therefore are not referred to the workman as such.

### Common Battery Circuits—Locating Opens in the Drop and Block Wire Plant

#### Opens

**3.02** To locate an open in the drop or block wire plant, isolate the fault by making successive tests at different points in the line with the hand test set. (See Figure 8.)

TEST FOR LOCATING AN OPEN

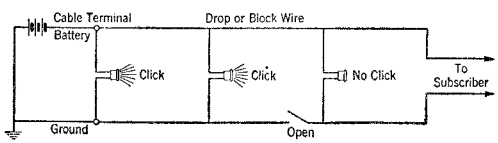



**Fig. 8**

To make the test, bridge the test set across the line. If a battery click is heard in the receiver on the make and on the break of the contact the open is away from the central office. If these clicks are not heard it is situated toward the central office. When clicks are heard on one test and on the test at the next point in the line no clicks are heard the fault is located between the points at which these two tests were made. After the fault has ben isolated to one span or section, the wire in this span or section should be carefully examined, if necessary lowering the wire to do so.

Then if the fault cannot be found it should be eliminated by replacing the wire in that span or section. When locating an open the test set should be bridged across the line on the far side of any wire support on every test. If the trouble is at a wire support, adherence to this instruction will result in the direction in which the fault is situated changing on the test that is close to the support where the wire is in trouble. Then the verification that the fault is at the support consists of repeating the test on the near side of the support. During the tests, wires should be shaken as described in paragraph 3.03.

#### Intermittent Opens

**3.03** Intermittent opens in the drop and block wire are frequently difficult to locate and generally require a close inspection. If it is not detected by the inspection, resort to tests to locate the fault. When making a test on the line the wires toward the central office should be moved at knobs or other supporting fixtures and the wire in the span or section toward the central office should be shaken. A succession of battery clicks or a fluttering noise in the receiver indicates that the open is near to the point of movement and it ordinarily can then be found by a careful inspection. Check all connections at binding posts, bridging connectors, etc., to be sure that they are tight.

#### High Resistance Connections

**3.04** High resistance connections are generally indicated by noise and occasionally by cutouts. Connections may appear tight and in good condition on visual inspection and yet the contact afforded may be so poor that noise is introduced into the circuit. The cause of this type of trouble ordinarily can be located by bridging the test set across the line near the various connections on the side away from the source of battery and listening for noise. Moving the wires at connections or tightening screws or locknuts may clear the trouble but to prevent its recurrence all wires should be removed at the connecting point found faulty and thoroughly cleaned before replacing. Where the trouble is not definitely found at any connection, the wires should be removed, cleaned and replaced at all binding posts or bridging connectors, etc. When the trouble is at the binding posts of a cable terminal and the nuts and washers are found dirty and corroded, the spinning should be removed from the top of the binding post with the binding post cutter and the nuts and washers should be replaced with new ones before reestablishing the connection.

### Magneto or Local Battery Circuits—Locating Opens in the Drop and Block Wire Plant

#### Opens

**3.05** When testing to locate an open in the drop or block wiring in areas where the ringing is selective and the ringers are not bridged across the line, the magneto test set should be bridged across the affected line by placing one test clip on one conductor and the other test clip on the other conductor of the pair. Place the test set switch in the proper position for calling and spin the handle of the generator. If the generator turns as it normally would on a clear line and the buzzer operates the open is not between the central office and the point at which the test is being made. If the generator turns freely and the buzzer does not operate the open is toward the central office. (See Figure 9.) By properly repeating this test at suitably selected points, the open may be definitely located. (Follow the principles that are outlined in paragraph 3.02.)

TESTS FOR OPENS - MAGNETO LINES - RINGERS GROUNDED

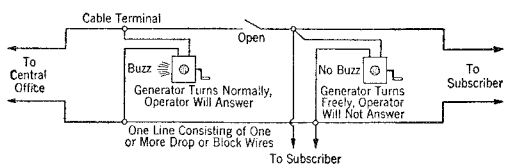



**Fig. 9**

**3.06** In areas where the ringers are bridged across the line it usually is advisable to disconnect one side of the line at a binding post or bridging connector and in order to avoid calling the operator unnecessarily, test away from the central office. Place one clip of the test set on the end of the disconnected wire and connect the other clip to the other side of the line. With the test set switch in the proper position for calling, spin the handle of the generator. If the generator turns as it normally would on a line in good working condition and the buzzer operates it indicates:

(a) On an individual line that the circuit to the subscriber's station is not open.

(b) On a party line that a circuit is closed to at least one subscriber's station.

If the generator turns freely and the buzzer does not operate it indicates:

(c) On an individual line that the open is located between the point at which the test was made and the subscriber's station.

(d) On a party line (if only one open exists) that the open is located between the point at which the test was made and the point where the first party is bridged to the line.

In order to determine the condition of the line between the point of the test and the central office, remove the clip from the end of the disconnected wire and place it upon the binding post or bridging connector from which the wire was disconnected and repeat the test. If the generator turns normally, the buzzer operates and the operator answers, the circuit to the central office is closed. If the operator fails to answer even though the generator and buzzer operate normally, the open is located between the point of the test and the central office. (This latter condition would obtain if a party whose circuit was intact was bridged to the line between the point of the test and the central office.) The open may be definitely located by repeating this test at properly selected points. (See Figure 10.)

TESTS FOR OPENS - MAGNETO LINES - RINGERS BRIDGED ACROSS THE LINE

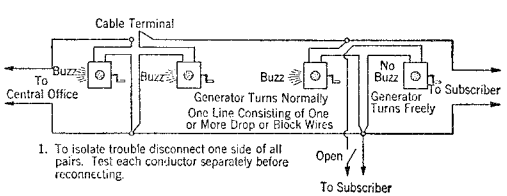



Fig. 10

**Intermittent Opens**

**3.07** In the case of intermittent opens a test similar to that described in paragraph 3.02 can often be used to advantage. As it involves depending upon the test set battery and receiver, these equipment items must be in first class condition. In selective ringing areas the connection should be established as in paragraph 3.05. A battery click on the make and on the break of the circuit indicates that the line to the central office is closed. Rasping or fluttering noises in the receiver or the absence of a click indicates that the trouble is between the testing point and the central office. While making this test, move or shake the wire in the manner that is outlined in paragraph 3.03. In areas where the ringers are bridged across the line the connections should be established as in paragraph 3.06 and the direction of the open can be determined by listening in the receiver at each test. Under certain conditions, such as where the line is very long or where the circuit remains open for a reasonably long period, it may be found desirable to test with the hand generator as for dead opens.

**3.08** When the intermittent open cannot be located by the use of the test set and testing facilities are available in the central office, call the office on the affected line and request that the circuit be tested. The condition of the circuit to the point at which the test set is bridged to the line should indicate whether the trouble is located between that point and the central office. Repetition of this procedure at suitably selected points should result in the determination of two points in the line between which the conditions change and indicate that the fault is located between these two points. After this has been done make a careful visual inspection, if necessary with the wire lowered, which usually will result in finding the fault. If the fault is not found replace the wire in this section.

## 4. SHORT CIRCUITS

**4.01** Short circuits in drop and block wiring are of two general classes as follows:

(a) Low resistance short circuits. These are due to a complete breakdown of the insulation between the two wires and the establishment of a low resistance path from one wire to the other. Frequent causes are injury to or deterioration of insulation at supporting fixtures, abrasion at knobs, at rings and at contacts with poles, trees, buildings, etc., and injury due to interference by foreign workmen, building operations, etc.

(b) High resistance short circuits. These are due to the establishment of a high resistance path between the two wires, caused by either a partial breakdown of the insulation or a complete breakdown of the insulation which has resulted in only a poor or high resistance contact between the wires. The usual causes for this type of short circuit are similar to those given for the first type, differing only in that the deterioration of or injury to the insulation is less severe.

### Common Battery Circuits—Locating Short Circuits in the Drop and Block Wire Plant

#### Low Resistance Short Circuits

**4.02** In locating a low resistance short circuit in the drop or block wire plant first isolate the fault to a particular portion of the wire. To do this disconnect one side of the line at various convenient points such as at binding posts, bridging connectors or protectors and connect the test set in the line. (See Figure 11.)

TESTS TO LOCATE SHORT CIRCUITS

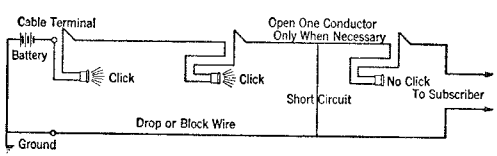



**Fig. 11**

If a battery click is heard on the make and on the break of the connection the short circuit is located away from the central office. If no click is heard it is in the portion of the circuit toward the central office. When the clicks are heard at the point one test is made and are not heard at the point the next test is made, the fault is located between these two points.

**4.03** After the fault has been isolated to a particular portion of the wire, make an inspection of this section, noting especially the condition at each wire support. Location of the fault is facilitated if, while making this inspection, the test set is bridged across the line near each wire support and the wire is moved at the support and in the adjacent spans. If this disturbance of the wire causes the short circuit to shake out even momentarily, this will be indicated by a fluttering noise or a series of clicks in the receiver. Then, by making a careful inspection of the wire near the point it was moved, the fault can usually be found.

**4.04** If the short circuit cannot be located by the inspection, it becomes necessary to further isolate it to a particular span or section by repeating at various points, the test outlined in paragraph 4.02, cutting one conductor of the wire, when necessary, to permit making the test. After the fault has been isolated to a particular section or span, make a careful inspection of the wire in that section or span, if possible with the wire lowered, and when, if the fault is not found, cut out and replace the wire.

#### High Resistance Short Circuits

**4.05** High resistance short circuits often cannot be located by the tests described for low resistance short circuits. In this event it becomes necessary to obtain assistance by having the condition of the circuit observed at the testing equipment in the central office while one side of the line is opened at various points. When a disconnection at one point causes the fault to disappear and a disconnection at an adjacent point does not, the fault is located between the two points at which these tests were made. After the fault has been isolated in this manner to a particular section or span, make a careful inspection of the wire in that section or span, if possible with the wire lowered, and then, if the fault is not found, cut out and replace the wire.

### Magneto or Local Battery Circuits—Locating Short Circuits in the Drop and Block Wire Plant

**4.06** To locate a short circuit in the drop or block wire plant in a magneto area it is usually advisable to first isolate the fault to a

particular portion of the drop or block wire. The following test can be used for this purpose. (See Figure 12.)

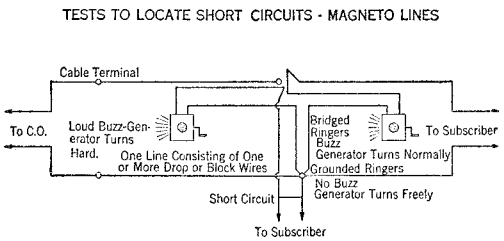



**Fig. 12**

Disconnect one side of the drop or block wire or wires (if more than one party is bridged at the point of test). Attach one clip of the test set to the end of the disconnected wire and connect the other clip to the other side of the line. If more than one wire was disconnected test each wire separately. With the switch of the test set in proper position for calling, spin the handle of the generator. If the handle of the generator turns harder than is normal on a clear line and the buzzer is louder than usual, the short is in the portion of the circuit under test and should be located by visual inspection or if necessary by further similar tests. Before reconnecting the wires transfer the test set clip from the end of the disconnected wire to the central office end of the circuit and repeat the test to be sure that this portion of the circuit is clear.

## 5. CROSSES

**5.01** Crosses in the drop and block wire plant result from the establishment of an electrical contact between one conductor of a drop or block wire and one conductor or binding post of another line. Troubles of this nature are therefore less common than grounds, opens or short circuits and are to a large extent limited to localities where two or more working block or drop wires are in close proximity.

**5.02** Common causes of crosses in drop and block wiring are:

(a) Breakdown of the insulation on wires in ring runs on poles or buildings due to deterioration, abrasion on rings or injury from external sources.

(b) Breakdown of insulation on wires in close proximity in building or pole runs due to deterioration, abrasion or other injury.

(c) Improper dressing and connecting of wires at cable terminals so that wires or ends of wires touch adjacent binding posts of other lines.

**5.03** When the trouble to be located is a cross, the work is greatly facilitated if certain items of information have been obtained. These items are as follows:

(a) The line number of each of the lines that are crossed together.

(b) The cable number and pair number that each of the crossed lines takes.

(c) Cable terminal locations — all terminals where drops terminate on either of the crossed lines.

(d) Number of each pole on which drops of either line terminate (on other than cable lines), if available.

### Common Battery Circuits—Locating Crosses in the Drop and Block Wire Plant

**5.04** In isolating a cross to a portion of the plant, such as to the drop or block wire plant or to a portion of a drop or block wire make the following test. (See Figure 13.)

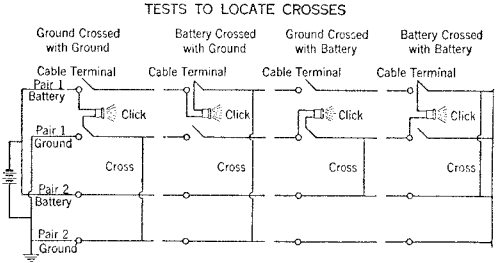



**Fig. 13**

(a) Disconnect all wires of one of the crossed lines from the binding posts or bridging connectors, using care to so place the wires that they may be properly reconnected in their original position upon completion of the test.

(b) Attach one clip of the test set to one of the pair of binding posts or bridging connectors from which the wires were disconnected and with the other clip touch in turn each of the wires just disconnected.

(c) If no battery click is heard on the make and break of any of the contacts, transfer the clip on the binding post or bridging connector to the other binding post or bridging connector of the same pair and repeat the test.

If clicks are heard the wire causing the clicks when touched is crossed with another line and the cross is in the portion of the wire that is affected by the tests at this point. If no clicks are heard on either test the cross is not located in the portion of the circuit which is affected by the tests at this point. On party lines this test should be made at every point at which a drop or block wire is bridged to the circuit until the fault is isolated to the line of a particular party. After it has been determined that the fault locates on the station side of a cable terminal, there is still the possibility that the inside wiring of the station is crossed with another line. Therefore, to determine that the cross is located in the drop or block wire, the above test should be repeated at the protector or connecting block at the subscriber's premises.

**5.05** After the fault has been isolated in a drop or block wire, it usually can be found by carefully inspecting the wire throughout its entire length. If it cannot be found by inpection, it must be further isolated by repeating the tests at suitable points, if necessary cutting a conductor to permit making the test. If it is necessary to cut a conductor, repairs should be made on completion of the tests.

**High Resistance Crosses**

**5.06** When the cross is of high resistance so that the test set cannot successfully be used to locate the fault, request that the condition of the line be observed at the testing equipment in the central office while disconnections are made at various points in the circuit. The fault can in this manner be isolated to a particular portion of the drop or block wire and can then be discovered by visual inspection. In areas where testing equipment suitable for this test is not available at the central office, the operator may be called and requested to talk or ring on one of the crossed lines while the test set is bridged to a suitable disconnected portion of the other circuit. If the ring or the operator's voice is heard in the test set the cross is in the portion of the circuit under observation and when by suitable repetition of this test the fault is isolated to a sufficiently small section of the drop or block wire it can be found by visual inspection.

**Magneto or Local Battery Circuits—Locating Crosses in the Drop and Block Wire Plant**

**5.07** When one of the crossed lines is unknown and no test deskman is on duty, the following test can be applied to identify the unknown line with which the known line is crossed. (See Figure 14.)

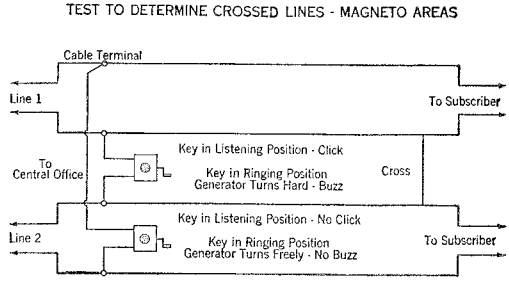



**Fig. 14**

At a cable terminal where drop or block wires of the known line terminate, or at the main frame, attach one clip of the magneto test set to one side of the known line. Place the test set switch in the listening position. While listening in the receiver, explore both sides of the other pairs with the free test set clip. If contact is made with the conductor which is crossed with the wire to which the other test clip is attached, a click will be heard in the receiver. If no click is heard after making contact with all the other wires, transfer the clip to the other side of the known line and repeat the same procedure. After the crossed wires have been indicated by the above test, this indication may be verified by ringing on the two wires. If the two wires are crossed the hand generator will turn hard as in the case of a short circuit.

**5.08** To isolate a cross to a particular portion of a drop or block wire where it can usually be found by a visual inspection, make the following test at points where one or more drop or block wires are bridged to each of the lines affected. (See Figure 15.)

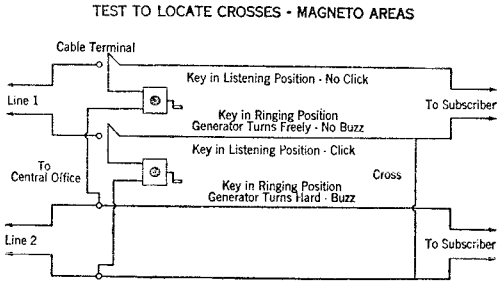


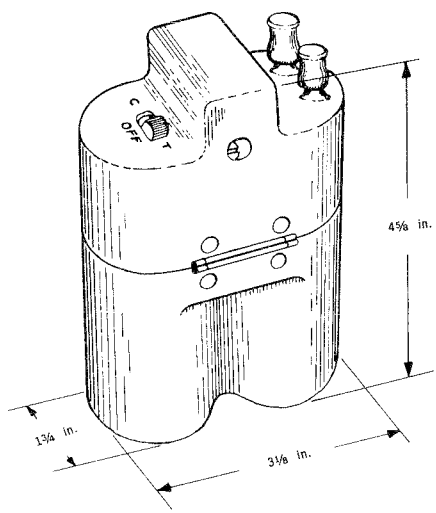

**Fig. 15**

Disconnect all drop or block wires that are bridged to one of the crossed lines at a cable terminal or other connecting point, so placing or identifying the wires that they may be properly reconnected in their original position. Connect one clip of the magneto test set to one of the disconnected conductors. With the test set switch in the listening position, touch with the other test clip first one and then the other wire of the other crossed line which was not disconnected. If no clicks are heard in the receiver of the test set upon the establishment of either of the above contacts, transfer the test clip to the other conductor of the disconnected pair and repeat the test. If no clicks are heard this time the portion of the circuit from the point of disconnection to the subscriber's station is clear. If a click is heard the cross is located in the wire tested, and an inspection of that wire should be made. If any other wires were disconnected they should be tested individually before they are reconnected. As outlined in paragraph 5.05, a check test can be made by ringing on the wires that the above test indicates are crossed. Further tests necessary to locate the fault may be made by testing as one pair the two wires that are crossed and proceeding as for a short circuit. In making any subsequent tests that are necessary, if the wires that are crossed can be identified by the tracer, it is not necessary to disconnect both wires. If it becomes necessary to make further tests at other than connecting points, it usually will be necessary to cut only one of the wires that is known to be crossed.

## 6. 81A TEST SET

**6.01** The 81A Test Set, as shown below, consists of a buzzer, capacitor and switch which are contained in a case made of insulating material. The case is equipped with two spring-type binding posts to which W2AK Test Set Cords or the wire itself may be connected. Space is provided within the case for two KS14711 (standard flashlight) dry cells in series which are required for the operation of the test set.

**6.02** The switch has 3 positions: OFF, C for dc continuity test, and T which furnishes buzzer tone.




## 7. USE OF 81A TEST SET

**7.01** The 81A test set may be used on non-working inside wiring cable and drop, block, and inside wire to trace non-working conductor pairs which cannot be readily traced by sight or to make continuity tests on non-working conductor pairs.

**7.02** The 81A test set should ***not*** be used on working lines because the buzzer tone will interfere with the customer's use of these lines and may result in a customer trouble report.

**7.03** When tracing conductors or testing for open conductors it is necessary to use a hand test set in conjunction with the 81A test set. To detect shorted conductors or low resistance grounded conductors the 81A test set alone is sufficient.

## 8. TESTING FOR SHORTED (Crossed, Shunted) CONDUCTORS

**8.01** Connect 81A test set across the pair of non-working conductors to be tested, with the switch in the OFF position.

**8.02** Push switch to C position

- If the buzzer does not buzz, the pair is not shorted.
- If the buzzer buzzes, there is a short across the pair.

## 9. TESTING FOR OPEN CONDUCTORS

**9.01** After testing for a short circuit, push switch to the T position to start buzzer.

**9.02** Assuming the location of both ends of the pair is known, go to one end with a hand test set and connect it across the pair.

- If the buzzer is heard, the pair is not open.
- If the buzzer is not heard, the pair is open on one side or both.

**9.03** Each side can be checked if a spare conductor (known to be good), is available between the two points, or if there is a good ground connection available at both ends, by connecting the 81A test set between one conductor and the spare or ground at one location and connecting the hand test set at the other location between the spare or ground, as the case may be, and the conductor being tested.

- The buzzer tone indicates that side is not open.
- No buzzer tone is an indication that the side is open.

## 10. TESTING FOR LOW RESISTANCE GROUNDED CONDUCTORS

**10.01** At a location where there is a good ground, connect one side of the 81A test set to the ground connection and the other side to one conductor of the wire being tested.

**10.02** Push switch to C position.

- If the buzzer is heard, the conductor is grounded.
- If the buzzer is not heard, the conductor does not have a low resistance ground.

**10.03** Repeat this operation on the other conductor of the wire involved.

**10.04** The consideration involved in testing for high resistance grounds is covered in part 2 of this section.

## 11. TRACING NON-WORKING CONDUCTORS

**11.01** Connect the 81A test set across the pair of the non-working conductors to be traced and test to be sure there is not a short circuit. Switch to the T position to start buzzer and go to the location at which it is desired to identify the wire. Using a hand test set, bridge it across each pair of wires until tone is heard. If tone cannot be heard on any pair, either the pair does not appear at that particular point or one or both sides of the pair is open.