LOCATION OF CROSSES AND GROUNDS IN SWITCHBOARD MULTIPLE

1. GENERAL

1.01 This section covers procedures for locating grounds and crosses in the jacks and multiple wiring of local and toll switchboards having No. 49, No. 92 or equivalent type jacks by means of the drop in potential method and using a 54 type test set, or equivalent.

1.02 The method covered in this section presupposes that the nature of the trouble, i.e., whether it is a cross with battery, with ground or with another conductor, and which conductor or conductors (tip, ring or sleeve) are affected is first determined by suitable tests. Also that the particular line of switchboard or multiple in which the trouble exists has been determined, in so far as possible, by opening cross-connections, and that the cross-connections to the line of switchboard in which the trouble exists are left open until the trouble is located and cleared. In the case of local offices where only one line of switchboard is involved so that it is not necessary to open cross-connections in order to isolate the trouble, the circuit should be left open at the distributing frame until the trouble is located and cleared.

1.03 While conducting tests in accordance with this section, arrangements should be made to maintain, whenever possible, a busy condition on the sleeve of the circuit under test. Incoming or two-way trunks should also be made busy at the distant end.

1.04 In certain cases where induction from a-c. idle or busy indicating circuits is sufficient to render the use of a test receiver impracticable for the location of troubles, a galvanometer may be substituted for the receiver. Although the method of test as covered herein refers throughout to the use of a test receiver, it will be understood that in cases where a galvanometer is used, a deflection will be the equivalent of "a click in the test receiver."

2. APPARATUS

Local and Toll Switchboards

2.01 No. 54-A Test Set, or equivalent, for use with No. 92 jack switchboards. No. 54-B Test Set, or equivalent, for use with No. 49 jack switchboards. The circuit arrangement of these test sets is shown in Fig. 1. (Cords and plugs are included with the test sets.)

2.02 No. 528 Receiver, with head band, connected to the test set; or any suitable Galvanometer, if required, such as the Weston Model No. 375.

2.03 One No. P3D Cord equipped at each end with a No. 109 Plug for No. 92 jack switchboards. One No. P3E Cord equipped at each end with a No. 110 Plug for No. 49 jack switchboards.

Local Common Battery Switchboards

2.04 No. 58-A Test Set and one additional No. P3D or No. P3E Cord for use with the test set.

Note: If a No. 58-A Test Set is not available, a common battery cord with the tip and ring conductors temporarily transposed at the cord shelf may be used instead.

Toll Switchboards

2.05 One or two No. W3A Cords each equipped with one No. 110 Plug.

3. PREPARATION

3.01 Before attempting to locate the fault, take down any cords which are connected to the multiple jack circuit under test. Exercise care, however, to preserve whenever possible, the busy condition.

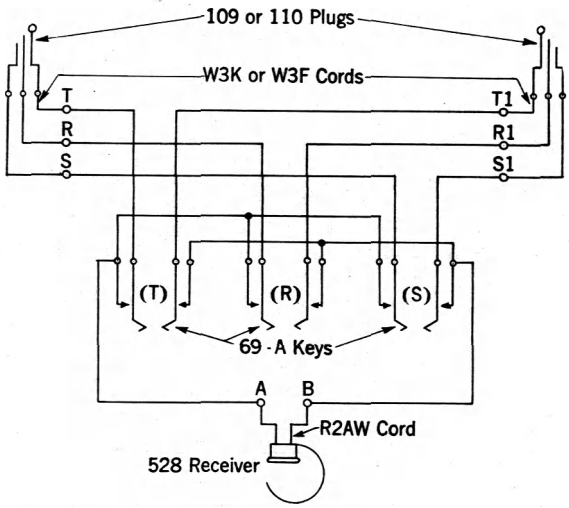

Fig. 1 - 54 Type Test Set with No. 528 Receiver.

3.02 Establish the necessary circuit condition to cause current to flow through the fault as covered in the following paragraphs. Cords used for the current flow connection should be connected to the first multiple jack appearance of the circuit or circuits in trouble. Where the multiple is extended without cross-connection through more than one line of switchboard, the current flow connection should usually be made, at first, at the head of the line of board having the largest number of multiple appearances.

Local Common Battery Switchboards

3.03 Except in the case of a sleeve crossed with battery, for which no external current flow connection is required, the necessary circuit condition to provide current flow for the test may be obtained by connecting an "A" cord or a trunk cord to the circuit in trouble, either directly or through a No. 58-A Test Set and patching cord. The function of the No. 58-A Test Set is to transpose battery from the ring to the tip and ground from the tip to the ring. To locate a cross with battery or ground, the current flow connection should be made in accordance with Table 1.

TABLE 1

Crosses with Battery or Ground

Nature of Trouble	Current Flow Connection
Ground on tip or Battery on ring	Common battery cord through No. 58-A test set and patching cord (or common battery cord with T and R transposed, see 2.04).
Ground on ring or Battery on tip	Common battery cord direct. (T and R not transposed.)
Ground on sleeve	Common battery cord direct. (T and R not transposed.)
Battery on sleeve	No external connection is required if there is a path to ground through the cutoff relay, or equivalent.

3.04 To provide the necessary current flow for locating crosses between the conductors of one circuit, set up current flow connections in accordance with Table 2.

TABLE 2

Crosses Between the Conductors of One Line or Trunk

Nature of Trouble	Current Flow Connection
Tip to ring or Ring to sleeve	Common battery cord direct. (T and R not transposed.)
Tip to sleeve	Common battery cord through No. 58-A test set and patching cord (or common battery cord with T and R transposed, see 2.04).

3.05 When two circuits are crossed, one common battery cord is put up to supply battery to one of the circuits. A second common battery cord is employed when it is necessary to supply ground to the tip or ring of the second circuit. In these cases current flow connections are set up in accordance with Table 3.

TABLE 3

Crosses Between Two Circuits

Nature of Trouble	Current Flow Connection
Tip to tip or Ring to ring	Common battery cord direct (T and R not transposed) in one circuit and a common battery cord through No. 58-A test set and patching cord (or common battery cord with T and R transposed, see 2.04) in the other circuit.
Tip to ring	Common battery cord direct (T and R not transposed) in each circuit.
Tip to sleeve	Common battery cord through No. 58-A test set and patching cord (or common battery cord with T and R transposed, see 2.04) in the circuit with the tip in trouble.
Ring to sleeve	Common battery cord direct (T and R not transposed) in the circuit with the ring in trouble.
Sleeve to sleeve	Common battery cord in either circuit.

Toll Switchboards

3.06 Except in cases where a sleeve is crossed with battery so that an external current flow connection is not necessary, current flow connections may be conveniently made by using a No. W3A cord which is plugged into the first multiple jack of the circuit in trouble. The clip at the end of the sleeve conductor of the No. W3A cord should be connected to a plug sleeve of one of the idle cords on the position in order to provide a busy test condition on the sleeve of the circuit under test. Battery and ground for the current flow through the fault may be obtained, as required, by fastening the clips at the ends of the free conductors of the No. W3A cord to the plug sleeves of idle cords for a source of battery, or for ground, to any convenient ground on the position.

3.07 In the case of a cross between two circuits, it will ordinarily be necessary to employ two No. W3A cords, one cord being used to supply battery to the conductor in trouble in the first circuit and the other cord to provide a ground connection for the conductor in trouble in the second circuit. If, however, the latter conductor already has a connection to ground through a sufficiently low resistance to permit enough current flow for the test, the additional ground connection is unnecessary.

4. METHOD

4.01 After the proper current flow condition has been established, connect one of the cords of the No. 54-A or No. 54-B test set to the first multiple jack appearance unless this is the jack to which the current flow connection has been made, in which case the next appearance should be used, and connect the other cord of the test set to the succeeding appearance of the multiple.

4.02 Operate and release the T, R or S key of the test set, according to whether the trouble is on the tip, ring or sleeve of the circuit under test, and listen for a click in the test receiver (or, if a galvanometer is being used in place of a test receiver, observe whether there is a deflection.)

Note: When the trouble is due to a grounded sleeve conductor and no click is heard, it is necessary that the sleeve cross-connection be opened at the I.D.F. and this test repeated.

4.03 If a click is heard in the receiver, it is an indication that the trouble is in or beyond the jack to which is connected the 54 type test set plug farthest from the current flow connection. Disconnect the cord of the test set from the jack nearest the head of the switchboard and plug it into the jack succeeding that to which the other cord of the test set is connected.

4.04 Again operate the T, R or S key of the test set and listen for a click in the receiver as before. If a click is heard in the receiver, proceed to the jack succeeding that to which the test cord farthest from the head of the switchboard is connected. Again operate the proper key and listen for a click in the receiver.

4.05 Proceed in this manner along the multiple until no click is heard in the receiver when the key is operated. Of the two jacks to which the test set is connected, the trouble is then indicated to be in or close to the one which is nearest to the current flow connection. See Figs. 2 and 3.

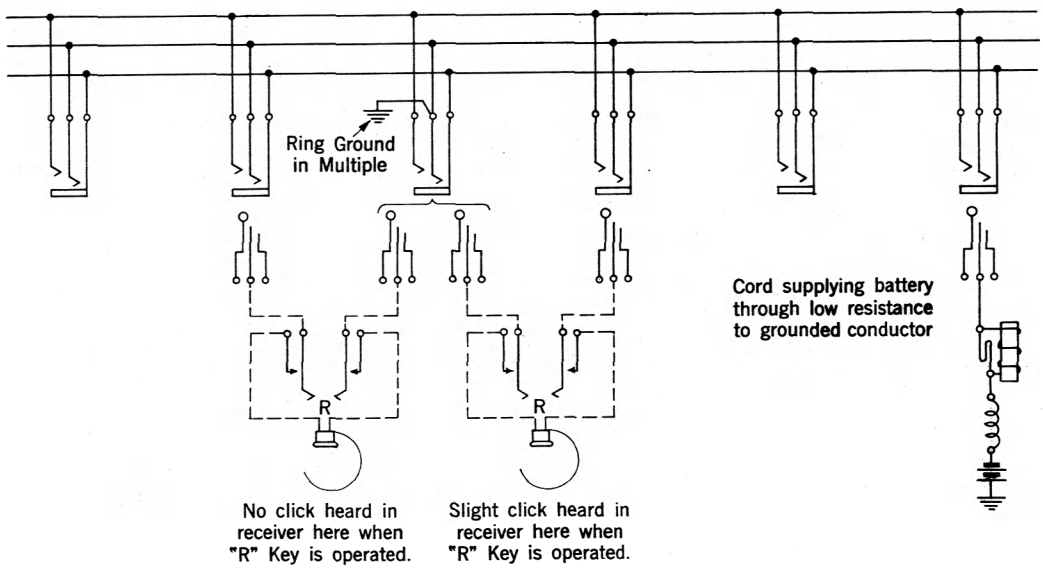

Fig. 2 - Method of Locating a Ring Ground.

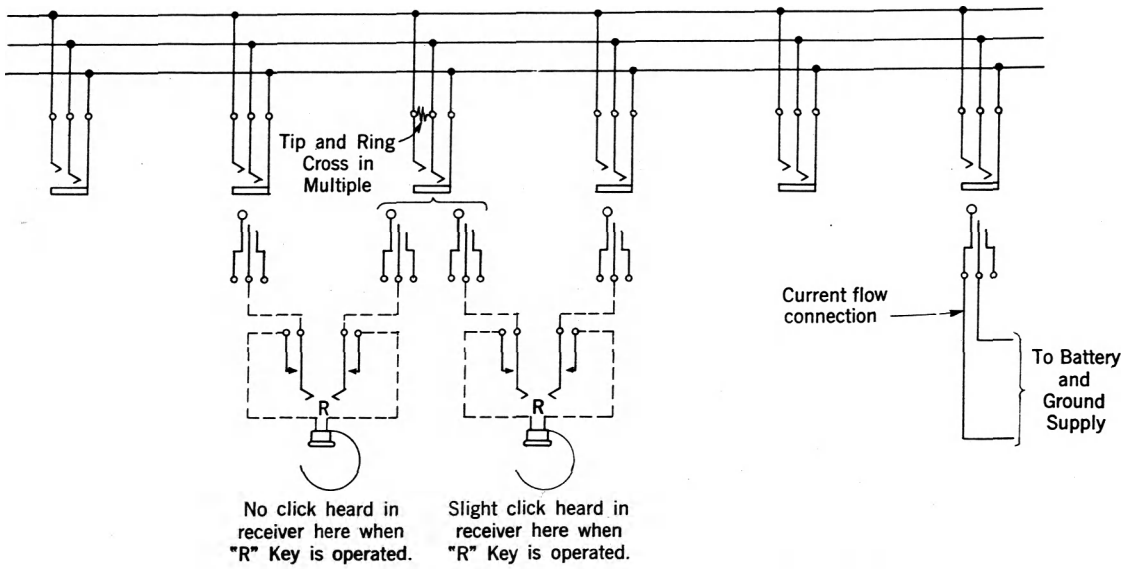

Fig. 3 - Method of Locating a Tip and Ring Cross.

4.06 Should clicks be heard throughout the entire length of the multiple, it is an indication that the fault is at or near the last jack.

4.07 In cases where a sleeve conductor and another conductor are crossed so that tests may be made either along the sleeve or along the other conductor, use the other conductor since false indications may be obtained from tests along the sleeve due to operators making tests for the busy condition. In instances where the current flow connection is not at the first multiple jack appearance, there may be current flowing in the sleeve conductor on both sides of the fault.

4.08 In the absence of a click in the test receiver under the tests of 4.02, move the current flow connection to the fourth multiple jack appearance.

4.09 Make a test between the third and second jack appearances. Absence of clicks indicates that there is insufficient current flow for the test or that the trouble has come clear. Clicks indicate that the trouble is in the second or first jack appearances or outside of the switchboard.

4.10 Make a test between the second and first jack appearances. No click indicates that the trouble is in or near the second multiple jack. Clicks indicate the trouble to be in or near the first multiple jack or outside of the switchboard lineup.

4.11 If clicks are received and the multiple is extended through another line of switchboard which cannot be isolated by opening cross-connections, repeat the tests of 4.01 to 4.10, inclusive, in the other line of board.

4.12 If the tests of 4.11 show that the trouble is not in or beyond the second multiple jack appearance in the second line of switchboard, proceed as covered in the following paragraphs to determine whether the trouble is in the first multiple jack appearance of either line of board or outside of the sections.

4.13 At the head position in one line of switchboard connect the 54 type test set between the first multiple jack of the circuit under test and a multiple jack of a spare circuit which is free from trouble and has no equipment connected to it. Set up the current flow connection at another multiple jack of the circuit under test. At the other board connect a patching cord between a jack of the circuit under test and a jack of the spare circuit as shown in Fig. 4.

4.14 Make a test on the conductor in trouble. No click indicates that the trouble is in the first multiple jack ap-

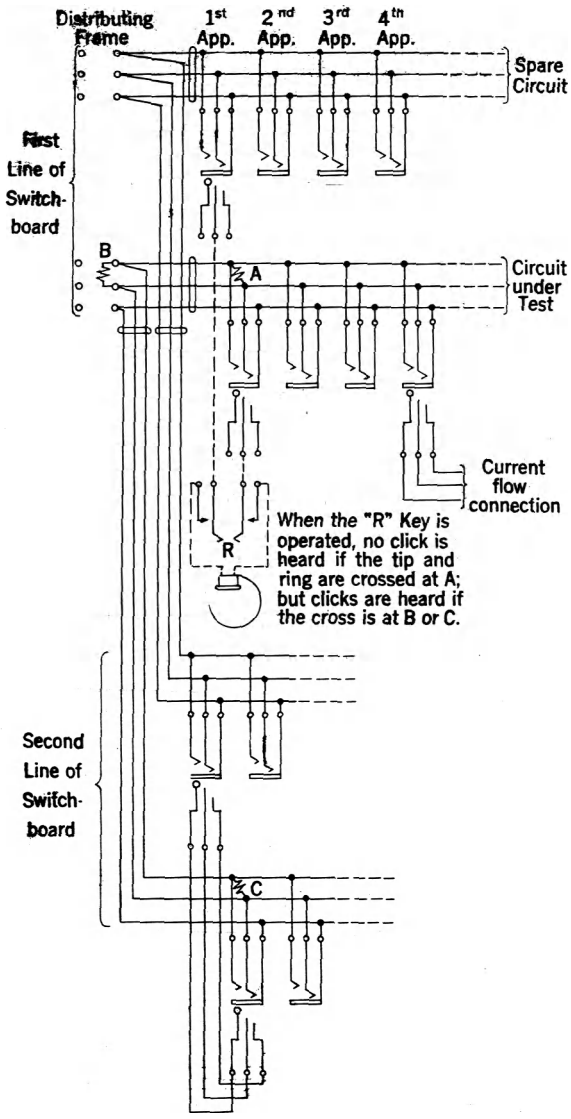

Fig. 4 - Method of Determining if Trouble is in a First Multiple Jack or Outside of the Sections of Two Switchboards Permanently Cabled Together.

pearance of the switchboard in which the current flow connection is made. Clicks indicate that the trouble is not in the first multiple jack.

4.15 If a click is heard in 4.14 transfer the current flow connection and the test set to the second line of board and the patching cord to the first line of board.

4.16 Make the test of 4.14 for the multiple of the second line of switchboard. No click indicates that the trouble is in the first multiple jack appearance of the second line of board. Clicks indicate that the trouble is outside of the sections of both lines of switchboard.

4.17 After troubles have been found and corrected, remove all testing equipment and close all cross-connections.