

## **LINE CONCENTRATOR NO. 1A**

### **SYSTEMS TESTS**

#### **1.00 INTRODUCTION**

**1.01** This is one of a group of sections pertaining to line concentrator No. 1A. This section contains tests to be made on concentrator systems after cutover when the system is in service.

**1.02** This section is reissued to include 50-line remote unit testing, to correct and revise the test methods previously shown, and to include additional tests.

**1.03** Due to extensive changes, marginal arrows have been omitted.

**1.04** The tests covered in this section are as follows:

#### **Maintenance Tests**

- A. Measuring Remote Unit Battery Voltage from Control Unit under Charging Condition
- B. Measuring Battery Voltage at Remote Unit under No Charging Conditions
- C. Battery Replacement at Remote Unit
- D. Ground Return Resistance
- E. Charging Current at Remote Unit
- F. Insulation Resistance of Signaling Leads
- G. Interference on Signaling Leads
- H. Line Insulation Tests
- I. Service Denial Call

J. Service Denial under Permanent Signal Conditions

K. Alarm Circuits

L. Dial Tone Speed Register

M. Trunk Group Usage Recorder

#### **Operational Tests**

A. General

B. Selection of Service Test Calls

1. General

2. Originating Denied Service

3. Terminating Denied Service

4. Double Connections

5. Telephone Circuit Between Control and Remote Units

C. Use of Test Lines

1. Terminating Call

2. Service Request Call

D. Service Request Call

E. Terminating Call

F. Disconnect Call

G. Trunk Tests

H. Releasing Double Connections

**SECTION C85.020.03**

**2.00 REFERENCE MATERIALS AND APPARATUS REQUIRED**

**2.01** The following reference material must be used with this section:

CD- and SD-96536-01, Common Systems, Line Concentrator No. 1A, Control Unit, 100-Line Capacity

CD- and SD-96537-01, Common Systems, Line Concentrator No. 1A, Remote Unit, 100-Line Capacity

CD- and SD-95957-01, Common Systems, Line Concentrator No. 1A, Remote Unit, 500-Line Capacity

A304.544/C85.020.04, Line Concentrator No. 1A, Trouble Analysis

A301.025/C70.027, Line Concentrator No. 1A, KS-15917, List 3 Battery Supply

**2.02** Apparatus (See Table A)

**3.00 PREPARATION AND PRECAUTIONS**

**3.01** A portion of the tests in this section will require testing at both the control unit and the remote unit simultaneously.

**3.02** A talking circuit will be required between units to coordinate testing. If possible, the talking circuit should use facilities other than those assigned for concentrator use.

**Precautions**

**3.03** The line concentrator No. 1A contains neutral and magnetic latching dry-reed relays, mercury relays, diodes, and magnetic latching crossbar switches in both the remote and control units.

**General**

**3.04** When working at the remote unit in temperatures below freezing, use a handkerchief or other form of face mask to prevent breath from condensing on any portion of the equipment. Condensation on the equipment may cause malfunctions.

**TABLE A  
APPARATUS**

Apparatus	Maintenance Test													Needed At	
	A	B	C	D	E	F	G	H	I	J	K	L	M	Remote Unit	Control Unit
KS-14510 Volt-Ohm-Milliammeter or Equivalent 20,000 Ohms per Volt	X	X		X	X	X	X	X						X	X
High-Impedance Test Receiver or Hand Test Set									X	X	X				X
Dummy Fuse Prepared with Meter Connections. (See Fig. 1 for local preparation.)					X									X	
1015A Spare Parts and Tool Kit	*	*	*	*	*	*	*	*	*	*	*	*	*	X	

\* The 1015A spare parts and tool kit are required only if replacement of parts is required.

**3.05** Do not make any adjustments to relays or crossbar switches without consulting the appropriate requirement and adjusting procedure section for the particular relay or switch.

#### Dry-Reed Relays

**3.06** The cutoff *CO*- relays in the control unit and the line *L*- and cutoff *CO*- relays in the remote unit are of the 302 dry-reed type. Before testing on contacts of those relays or the circuits containing them, refer to Section A304.545/C16.031 entitled Dry-Reed-Type Relays, Precautions To Be Observed When Testing.

**3.07** Contacts of reed relays may be damaged if test connections are made which cause these contacts to make or break 1/2 ampere or more of current. A high-impedance telephone test set or headset should be used at the control unit when testing reed relay contacts and the circuits containing them. A 500-ohm resistor has been connected in series with the resistance battery test terminal in the remote unit; a low-impedance test set, such as the 1011B telephone hand test set, may be used for testing these contacts at the remote unit when this resistance battery test terminal is used.

#### Mercury Relays

**3.08** The relays in series with the signaling leads in both the remote and control units are of the 303 mercury contact type. Before testing these relays or the circuits containing them, refer to Section A460.055, Relays 275, 276, 291, 292, 301, and 303 Types Using Test Sets SD-95439-01 (J94725A).

**3.09** These signaling relays may be permanently damaged if more than 60 ma of current is caused to flow through their windings. A high-impedance telephone set should be used at the control unit when making tests on the signaling leads. At the remote unit, a low-impedance test set, such as the 1011B telephone hand test set, may be used when testing signaling leads when the resistance battery test terminal is used.

#### Magnetic Latching Crossbar Switches and Reed Relays

**3.10** The hold magnets and cutoff relays in both units are magnetic latching. These switches or relays should not be operated or released electrically or manually during testing except by normal circuit operation or in strict accordance with approved procedures. Indiscriminate operation or release of these switches and relays will cause malfunctions of the system.

#### Diodes

**3.11** Before testing diodes or the circuits containing them, refer to Section A304.455/C16.030 entitled Procedures To Be Followed When Working on Circuits Containing Diodes, Varistors, or Transistors.

**3.12** The battery in the remote unit does not have sufficient capacity to allow blocking a major portion of the apparatus used in making a call, or blocking the timing circuit. The proper procedure is:

1. Make repeated tests, observing relay operation.
2. Determine condition of *W* and *Z* relays when operation stops.
3. Determine condition of *RK2* and *CCK* relays when operation stops.
4. Using SCs, localize trouble to the area limited by *W*, *Z*, *RK2*, and *CCK* operation.
5. Using FSs, pinpoint possible troubles.
6. Check equipment for troubles pinpointed above.

**Note:** Section A304.544/C85.020.04, Line Concentrator No. 1A, Trouble Analysis may be used to assist in locating trouble experienced during application of this section.

**3.13** Additional precautions should be taken to ensure that concentrator tests do not interfere with the normal progress of concentrator calls whenever possible.

## 4. MAINTENANCE TESTS

## A. Measuring Remote Unit Battery Voltage from Control Unit under Charging Condition

A.1 100-Line Remote Unit Using Both Groups or Group 0 Only, or  
50-Line Remote Unit Associated with Group 0 of Control Unit

STEP	ACTION	VERIFICATION
1	When hold magnets 07 are released, proceed to Step 3. When hold magnets 07 are operated, determine if TB07 relay is released. When TB07 relay is released, proceed to Step 2. When TB07 relay is operated, it will be necessary to wait for completion of call on trunk 07.	
2	Operate DP0 relay to cause hold magnets 07 to release.  <i>Caution: Trunks having higher preference that are waiting for disconnection will release first.</i>	
3	Block A07 and C07 hold magnets operated. Measure the voltage across tip and ring of trunk 07 with a voltmeter.	Limits are between 25 and 34 volts.
4	Remove blocking tools from A07 and C07 hold magnets.	

A.2 100-Line Remote Unit Using Group 1 Only or 50-Line Remote Unit  
Associated with Group 1 of Control Unit

1	When hold magnets 17 are released, proceed to Step 3. When hold magnets 17 are operated, determine if TB17 released. When TB17 is released, proceed to Step 2. When TB17 is operated, it will be necessary to wait for completion of call on trunk 17.	
2	Operate DP1 relay to cause hold magnets 17 to release.  <i>Caution: Trunks of higher preference waiting for disconnection will release first.</i>	
3	Block A17 and C17 hold magnets operated. Measure the voltage across tip and ring of trunk 17 with a voltmeter.	Limits are between 25 and 34 volts.
4	Remove blocking tools from A17 and C17 hold magnets.	

STEP	ACTION	VERIFICATION
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**B. Measuring Battery Voltage at Remote Unit under No Charging Conditions**

- |   |  |                   |
|---|--|-------------------|
| 1 | Remove CHG fuse.                                       |                   |
| 2 | Place volt-ohm-milliammeter across battery terminals.* | Minimum 23 volts. |
| 3 | After verification replace CHG fuse.                   |                   |

**C. Battery Replacement at Remote Unit**

- |    |  |  |
|----|--|--|
| 1  | Tie replacement battery temporarily to equipment in a position to allow removal of existing battery and transfer of leads. |  |
| 2  | Block <i>RL2</i> relay operated in control unit.   |  |
| 3. | Transfer battery leads from existing battery to replacement.†  |  |
| 4  | Release <i>RL2</i> relay.  |  |
| 5  | Remove existing battery and install replacement.   |  |

**D. Ground Return Resistance**

- |   |   |   |
|---|---|---|
| 1 | Follow procedure specified in Fig. 2. (Fig. 2 is located at end of this section.) | Ground return resistance not more than 23 ohms. |
|---|---|---|

**Caution:** *The battery at the remote unit will not obtain a charge while charge fuse is removed; therefore, make this test during light load periods when possible.*

**E. Charging Current at Remote Unit**

This test should be made during light load, if possible, to facilitate keeping four trunks in each group busy when measuring current at a 100-line remote unit using both groups, or four trunks busy in the appropriate group when measuring current at a 100-line remote unit using one group only, or a 50-line remote unit.

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\* Test during the interval of a call to obtain maximum load, if possible.

† See Section A301.025/C70.027, Line Concentrator No. 1A, Battery Supply.

STEP	ACTION	VERIFICATION
	<i>Caution: The battery of the remote unit will not obtain a charge while the charge (CHG) or dummy fuse is out of the fuse holder. (The dummy fuse will not provide a charging path if a meter is not connected to it.)</i>	
1	Block operated <i>A</i> and <i>C</i> hold magnets or release trunks (operation of <i>DP0</i> for Group 0 or <i>DP1</i> for Group 1) to allow charging over six or twelve trunks when remote unit is associated with one or two groups of the control unit.	
2	Remove charge CHG fuse and insert dummy fuse (Fig. 1) in fuse holder. (Fig. 1 is located at end of this section.) Measure charging current.	Charging current near but not exceeding 140 ma when charge is obtained from two groups or as near as possible to 80 ma when charge is obtained from one group.
3	When charging current does not meet the requirement, refer to SD-96536-01, Note 304 for strapping instructions.	
4	Remove dummy fuse and insert charge CHG fuse. Remove any blocking tools used.	

#### F. Insulation Resistance of Signaling Leads

*Caution: This test will make the concentrator inoperative, therefore close cooperation between personnel is necessary to keep the out-of-service time to a minimum when this test is performed. It is preferable that this be done during light traffic conditions.*

1	Measure insulation resistance of signaling leads following procedure specified in Fig. 3. (Fig. 3 is located at end of this Section.)	Minimum insulation resistance of 30,000 ohms to ground or other conductor of pair.
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#### G. Interference on Signaling Leads (See Note)

1	When hold magnets <i>07*</i> are released, proceed to Step 3. When hold magnets <i>07*</i> are operated, determine if <i>TB07*</i> relay is released. When <i>TB07*</i> relay is released, proceed to Step 2. When <i>TB07*</i> relay is operated, it will be necessary to wait for completion of call on trunk <i>07*</i> .	
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\* When 100-line remote unit using Group 1 only or 50-line remote unit associated with Group 1 of control unit is tested, use hold magnets *17*, *TB17* relay, and *DP1* relay in Steps 1 through 5.

STEP	ACTION	VERIFICATION
2	Operate <i>DP0*</i> relay to cause hold magnets <i>07*</i> to release.	
	<b>Caution:</b> <i>Trunks of higher preference waiting for disconnection will release first.</i>	
3	Block <i>A07*</i> and <i>C07*</i> hold magnets operated.	
4	Measure ac interference as shown in Fig. 4.	
5	Remove blocking tools from the <i>A07*</i> and <i>C07*</i> hold magnets.	
	<b>Note:</b> The ac interference should be below the limits at all times. Therefore, sufficient tests should be made to ensure that the limits are met during all intervals of the day if troubles occurring appear to be due to ac interference (signaling troubles during certain intervals of the day). If random troubles are occurring which might be due to ac interference, a recording voltmeter can be used to determine whether ac interference is exceeding the limits during random intervals.	
6	Determine total interference (ac plus dc) on signaling leads following procedure specified in example shown below.	The maximum interference voltage of 10 volts dc, 5 volts ac, or 10 volts for the sum of the dc and peak ac voltages providing ac voltage component does not exceed 5 volts rms (7.07 volts peak.)
	<p><b>Example:</b></p> <p>Maximum dc charging current (obtained in Test D) = 0.140 amp</p> <p>Signaling current = assume 0.100 amp (for all cases)</p> <p>Ground return resistance (obtained in Test E) = 20 ohms</p> <p>DC voltage = <math>(0.140 + 0.100) \times 20 = 4.8</math> volts</p> <p>AC voltage (obtained from Test G) = 3 volts rms</p> <p>Peak ac voltage = <math>1.414 \times 3 = 4.242</math> volts</p> <p>Total interference (peak ac plus dc) = <math>4.242 + 4.8 = 9.042</math> volts</p>	

\* When 100-line remote unit using Group 1 only, or 50-line remote unit associated with Group 1 of control unit is tested, use hold magnets 17, *TB17* relay, and *DP1* relay in Steps 1 through 5.

**TABLE B**  
**SIGNALING LEAD RESISTANCE**

Lead Desig	Number of Leads Required for Following Ohm Ranges (See Note 2)			
	0-575*	576-765†	766-860†	861-1000†
T22 or T12	1	1	1	1
R22 or R12	1	1	1	1
T23 or T13	1	2	3	4
R23 or R13	1	2	3	4

\* The sum of the loop resistance and the compensating resistance (CO-C15 Control Circuit) adjusted as near as possible to but not less than 750 ohms at 72 F.

† Strap all compensating resistance (CO-C15 Control Circuit) out.

**Note 1:** The ac voltage component must be 5 volts rms or less. If the ac limits are exceeded, it will be necessary to supply battery and ground to the remote signal circuit to obtain a metallic circuit. This information supersedes information shown on Issue 5 of SD-96536-01. SD-96556-01 contains a method to provide -24 volt battery in a central office that does not have a -24 volt battery power supply. SD-96537-01 and SD-95957-01 contain cross connection information for the use of T22,R22, T23,R23 punchings or T12, R12, T13, R13 punchings, respectively, which will be used when a metallic circuit is desired. The number of leads required is shown in Table B.

**Note 2:** Determine cable resistance at 72 F based on cable pair make-up. Use of the following equation determines the predicted maximum cable resistance, based on the maximum temperature, the various lengths of cable, whether underground or aerial, and the type and gauge of cable.

$$R_c = \frac{395 + T_m}{463} \cdot R_{72 \text{ F}} \text{ ohms}$$

$R_c$  = Maximum cable resistance.

$T_m$  = Maximum predicted pair temperature and

$R_{72 \text{ F}}$  = Pair resistance at 72 F

Required artificial resistance equals:

$$R_a = 800 - R_c$$

Insert resistance to come as close to this value without exceeding it as the strapping arrangement will allow.

STEP	ACTION	VERIFICATION
<b>H. Line Insulation Tests</b>		
1	Line insulation tests may be performed with an ohmmeter or in regular manner with either the automatic line insulation test frame or the line insulation test set.	Minimum insulation resistance is 15,000 ohms.
<b>I. Service Denial Call</b>		
1	In control unit, connect terminal A69 of the control unit terminal block to terminal 3 of the <i>CO</i> relay associated with the line to be denied service.	
2	When a line is to be denied in a crossbar office, insulate the contact on <i>D1S</i> relays associated with the line (SD-96536-01, Sheet B2, Table A). In step-by-step areas, proceed to Step 3.	
3	Block normal the <i>SRP0</i> , <i>DP0</i> , <i>DP1</i> , and <i>SRP1</i> relays.	
4	Operate and hold <i>T0</i> or <i>T1</i> key depending on the group the line is in.  <b>Caution: Do not operate the <i>T0</i> or <i>T1</i> key while a call is in progress.</b>	Observe the <i>SL</i> relay of the line to be denied service to ensure that it operates and releases and the <i>COK</i> lamp lights. If the <i>SL</i> relay does not release, observe which <i>A</i> and <i>B</i> relays are operated and determine from the chart on Sheet B2 of SD-96536-01 which line attempted to place a terminating call and was denied service. In most cases when the <i>T0</i> or <i>T1</i> key is released, the terminating call will complete since ringing is not tripped, and when the call is disconnected the service denied condition will be removed. However, if a terminating call is not completed (observation of cross points will determine if a call is completed), it will be necessary to remove the wrong service denied condition.
5	Release <i>T0</i> or <i>T1</i> key.	
6	Remove blocking tool from the <i>SRP0</i> and <i>SRP1</i> relays.	
7	Open the sleeve lead between the control unit and the central office equipment.	
8	Remove the insulation on the <i>D1S</i> relay and the cross connection between terminal A69 and the <i>CO</i> relay.	

STEP	ACTION	VERIFICATION
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- |   |   |  |
|---|---|--|
| 9 | When service is to be restored, close the sleeve lead between the control unit and the central office and then make a terminating call to the customer. |  |
|---|---|--|

**J. Service Denial under Permanent Signal Conditions**

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|---|--|--|
| 1 | Repeat Steps 1 through 3 in Section I.   |  |
| 2 | Manually release <i>TB</i> relay for trunk connected to the line to be denied service and remove blocking tool from appropriate <i>DP</i> relay. |  |
| 3 | If trunk did not release in Step 2, operate appropriate <i>DP0</i> or <i>DP1</i> relay.  |  |
| 4 | Block the <i>DP</i> relay used in Step 3.  |  |
| 5 | Repeat Steps 4 through 8 in Section I.   |  |
| 6 | Repeat Step 9 in Section I when service is to be restored.   |  |

**K. Alarm Circuits**

**Caution:** *These tests should be performed during light traffic conditions, since any call attempting to complete while relays are operated or fuse removed will fail.*

- |   |  |  |
|---|--|--|
| 1 | Test uncompleted call alarm; at control unit, block <i>CCK</i> relay nonoperated. Initiate call from remote control. | Alarm relay <i>CAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate. |
| 2 | Remove blocking tool from <i>CCK</i> relay. Operate alarm release <i>AR</i> key.                                     | Relay <i>CAL</i> releases. <i>AL</i> lamp extinguished. Central office alarms retired. |
| 3 | Block <i>RK2</i> relay nonoperated. Initiate call.   | Alarm relay <i>RAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate. |
| 4 | Remove blocking tool from <i>RK2</i> relay. Operate alarm release <i>AR</i> key.                                     | Relay <i>RAL</i> releases. <i>AL</i> lamp extinguished. Central office alarms retired. |
| 5 | Block both <i>CCK</i> and <i>RK2</i> relays nonoperated. Initiate call.  | Alarm relay <i>SAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate. |
| 6 | Remove blocking tools from <i>CCK</i> and <i>RK2</i> relays. Operate alarm release <i>AR</i> key.                    | Relay <i>SAL</i> releases. <i>AL</i> lamp extinguished. Central office alarms retired. |
| 7 | Block both <i>CCK</i> and <i>RK2</i> relays operated. Initiate call.   | Alarm relay <i>SAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate. |

STEP	ACTION	VERIFICATION
8	Remove blocking tools from <i>CCK</i> and <i>RK2</i> relays. Operate alarm release <i>AR</i> key.	Relay <i>SAL</i> releases. <i>AL</i> lamp extinguishes. Central office alarms retire.
9	Block <i>S2A</i> relay released. Initiate call.	Alarm relay <i>SAL</i> operates. <i>AL</i> lamp lights. Central office alarms operate.
10	Remove blocking tool from <i>S2A</i> relay. Operate alarm release <i>AR</i> key.	Relay <i>SAL</i> releases. <i>AL</i> lamp extinguished. Central office alarms retire.
11	Repeat Steps 9 and 10 for <i>S2A</i> relay.	
12	Test control unit fuse alarm. Insert an operated fuse in each fuse location, one at a time.	Alarm relay <i>FA</i> operates. <i>FA</i> lamp lights. Central office alarms operate.
13	Test charging circuit alarm. Insert an operated fuse into <i>CHG</i> fuse holder at remote unit. Trunk 00 must be idle and released.	Alarm relay <i>RAL</i> operates, <i>CF</i> relay operates. <i>AL</i> lamp lights. Central office alarms operate.
	<b>Note 1:</b> When this test is made on a 50-line remote unit or on 1/2 of a 100-line remote unit, used as Group 1, trunk 10 must be idle.	
	<b>Note 2:</b> To release a trunk, operate <i>DP0</i> or <i>DP1</i> relay until trunk releases.	

#### L. Dial Tone Speed Register

**Note:** The dial tone speed register circuit must be started when this test is performed. Also, since one terminal on an arc of the dial tone speed register is assigned to each group of trunks of the control circuit, and the dial tone register circuit will test many terminals not associated with the concentrator and other arcs during one cycle of testing, it will be necessary to cause the dial tone speed register circuit to make a cycle for each step shown below.

1	Insulate 8B of the <i>TGB0</i> relay in control unit.	One registration on the dial tone delay and dial tone attempt register associated with Group 0 when dial tone speed register circuit is testing the associated arc and terminal.
2	Remove the insulation from <i>TGB0</i> relay. (The <i>TGB0</i> relay should not be operated.)	One registration on the dial tone attempt register associated with Group 0 when dial tone speed register circuit is testing the associated arc and terminal.

STEP	ACTION	VERIFICATION
3	Insulate 8B of the <i>TGB1</i> relay in control circuit.	Verification will be same as Step 1 except the registers, arc, and terminal will be associated with Group 1.
4	Remove the insulation from <i>TGB1</i> relay. (The <i>TGB1</i> relay should not be operated.)	Verification will be same as Step 2; however, the register, arc, and terminal will be associated with Group 1.

#### M. Trunk Group Usage Recorder

**Note:** For procedures to follow when performing Test M, refer to Section A204.539, Concentrator Trunk Usage Recorder SD-96549-01, Tests.

### 5. OPERATIONAL TESTS

#### A. General

**5.01** The following tests describe the action required to make operational tests. When trouble is experienced, it will be necessary to analyze the trouble to determine which tests to perform and what equipment should be tested to minimize testing effort. It is imperative that a thorough knowledge of the circuit functions, the results of wrong signaling, and the effects of latching equipment by magnetic circuits be known.

**5.02** The line concentrator 1A uses ground return signaling employing marginal relays, and will perform satisfactorily if the voltage and range limits stated on the schematic drawings are met. If these conditions are not met during the signaling operation, wrong signals may result and noncorresponding information may be registered in the remote and control circuits. Temporary cable trouble, due to outside plant operations or momentary high ac voltages, may cause wrong signaling. In addition, correct signaling with circuit troubles such as crossed or open contacts will cause the signal to be registered incorrectly.

**5.03** The line concentrator circuit causes apparatus (hold magnets and cutoff relays) to be operated and electrically latched in this condition magnetically until the magnetic circuit is changed. This is done to conserve power requirements of the remote unit while the connection is used for

transmission. For example, hold magnets are operated and cutoff relays are released on any service request call, and the equipment will remain in this condition until the subscriber returns the line to an on-hook condition and a disconnect call is made. (Previous telephone systems allowed the equipment to return to normal by an on-hook signal.) Therefore, after an on-hook signal, a disconnect call is made to reverse the direction of current flow through the hold magnets and cutoff relays used in the service request call. This allows the hold magnets to release and the cutoff relays to reoperate.

**5.04** Troubles occurring in circuits which use magnetically latched apparatus may result in lines being locked out, or in double connections. This occurs when a line is identified in the remote unit on a service request call, and wrong signaling or registration (in the control unit) causes cross points associated with different line equipment to be used in the control circuit. As previously stated, a disconnect call identifies in the control circuit which equipment must be returned to a normal condition. Assuming no circuit irregularities or signaling errors on a disconnect call, the magnetic field of the identified equipment in both the control and remote circuit will be returned to the normal condition (hold magnet released and cutoff relay operated). This action will leave the cutoff relay in remote circuit used on the service request call in a cutoff condition. To illustrate this, assume that line 10 initiates a service request call which causes line 10 to be connected to trunk 00 in the

remote circuit, and wrong signaling or registration causes line 20 to be connected to trunk 00 in the control circuit. If line 20 was not in use, the subscriber would receive dial tone and complete his call. Line 10 would be cut off (*CO-* relay released) in the remote circuit and line 20 would be cut off in the control circuit. When an on-hook condition occurs, the concentrator will disconnect this call; however, the control circuit will identify the line as line 20 and if correct signaling and registration occurs, the *CO-* relay of line 20 in both the control and remote circuits will operate to remove the cutoff condition. However, this will leave line 10 in a cutoff condition thus denying service to the customer on line 10.

**5.05** Another cause of trouble is wrong identification of the line or trunk requesting service, whether it is a service request, terminating, or disconnect call. One example of this is: line 10 requests service and the call completes satisfactorily; however, when the disconnect call is made to release the connection, the wrong *LB-* relay operates and the line is identified as line 11. The connection will be released (hold magnets released); however, line 10 will still be left in a cutoff condition, thus denying service to the customer.

**5.06** Another effect of wrong identification, signaling, or registration is a double connection. Some of the troubles caused by double connections are listed in Section A304.544/C85.020.04, Trouble Analysis. In order to test the right equipment and minimize testing effort when locating a trouble causing double connections, a thorough knowledge of the cause and the results of double connections is necessary. Table C contains some of the troubles that can occur due to wrong signaling, incorrect registration, or crosses, and the results of various calls following the first call. Cases 1 through 9 assume correct signaling and registration on calls listed in the "Action That Follows" column.

**5.07** Double connections (two trunks connected to one line) may cause the concentrator to cycle until released as explained in Section F. This occurs when the first trunk of the double connection releases and the cutoff relay (*CO-*) in the remote circuit is returned to a normal condition (operated). This causes -24 volts through the line relay of the remote circuit to be connected through the remaining trunk of the double connection and

the central office line relay to -48 volts which causes the line relay in the remote circuit to be operated. A service request call will be originated by the line and another double connection will occur. This cycling may continue until the double connection is released.

**5.08** For the above reasons, it may be necessary to observe both the remote and control circuits when double connections, no dial tone reports, ringing cannot be tripped, and wrong-subscriber-reached reports keep occurring, and there appears to be no trouble associated with one line or the control circuit. Table C shows some of the combinations of troubles and succeeding calls that can cause these trouble reports. A single test that appears to complete may be the cause of future trouble reports. An example of this is Case 2 where a single test may obtain dial tone and the call would complete satisfactorily; however, a disconnect call following the test call will deny the customer service. In this example, the trouble would have been found if the crosspoints in the remote and control circuits had been checked on the service request call to determine if the remote and control circuit line appearances agreed.

**5.09** Since common control circuits are used, blocking or operating relays may affect all lines. Therefore, a thorough knowledge of the circuit is important to prevent service interruptions.

**5.10** All lines of one group have access to all trunks of the group. Therefore, a line may fail only when connected to a particular trunk. Analysis of the troubles may indicate that the troubles are occurring on one line or one trunk, in a certain *LA-* or *LB-* group, or in one group of trunks. Therefore, it would be helpful to keep a record of trouble reports to determine if the troubles occur in a particular portion of the circuit.

**5.11** In summary, trouble reports should be analyzed to determine what portion of the circuit is in trouble and which tests should be made. Even numerous operational tests will not locate the trouble unless the condition that caused the trouble is duplicated. Table C shows some of the troubles caused by wrong identification, signaling, or registration; however, all the possibilities are not listed since the troubles depend on the duration and location of wrong identification, signal-

ing, or registration and the sequence of succeeding calls. If the trouble appears to be due to signaling troubles, a check of the ac voltage on the signaling pairs should be made. When ac voltage exceeds the limits shown on the schematic drawing when measuring according to Test G of the previous section of this practice, provide a metallic circuit for signaling as indicated in Test G.

**Caution:** *The ac voltage must be within limits at all times.*

**Note:** Read Section A304.544/C85.020.04, Trouble Analysis for method of locating trouble and causes of troubles.

## B. Selection of Service Test Calls

### 1. General

**5.12** Basically there are three different types of test calls that can be made: service request, terminating, and disconnect calls. The type of call used to locate a trouble would depend on the trouble report received. Most trouble reports can be classified as originating or terminating service denials, double connections, and showering reports. Originating service denial classification would include no dial tone, cannot call out, cannot break dial tone, denied service, or other similar reports. Terminating service denial classification would include reached wrong party, cannot trip ringing, cannot reach party, and other similar reports. A disconnect test call should be made after a service request or terminating test call and, due to the trunk load control feature, it may be necessary to operate the *DP0* or *DP1* relays to cause a disconnect test call to be made.

**5.13** When alarms are being received, consult Section A304.544/C85.020.04, Trouble Analysis for the method of determining whether the trouble is in the control or remote circuit. If the trouble is in the control circuit, the trouble can be cleared and service restored without the aid of personnel at the remote location. When service denial reports, double trunking, or showering occurs, terminating service test calls and test calls (both terminating and service request) on lines 49 and 99 can be made from the central office before dispatching personnel to the remote location. If the cause of trouble cannot be found or several reports have been received with no trouble found,

it may be necessary to have personnel at the remote location to observe that the remote circuit functions correctly and to place service request calls. This would be necessary when wrong signaling is suspected. An example of when to dispatch personnel to the remote location occurs when reached wrong party reports are received and terminating service test calls have been made but the subscriber does not answer. Testing could show that the call is terminating to a subscriber set but would not verify that it was the right subscriber's line. Personnel at the remote location could verify that the correct crosspoints were closed and ringing was present on the subscriber's line.

### 2. Originating Denied Service

**5.14** A service request call should be used to verify the ability of the concentrator to complete a call when these troubles occur. A service request call on lines other than the test lines can only be originated by personnel at the remote location or by the subscriber. Since originating a service request call at the remote unit requires personnel to be dispatched to the remote location which causes testing to be delayed, it appears feasible that a terminating call should be made from the test desk to test the subscriber end of the line and then request him to make an originating call. However, the terminating call would connect a trunk to the subscriber, and the disconnect call following the terminating call should operate the cutoff relay in the remote unit associated with the subscriber. Thus a condition (released *CO*-relay) that may have caused the trouble report would be removed, and the results would indicate there was no trouble on the subscriber's line. Therefore, it may be necessary to verify the condition of the *CO*- relay at the remote unit when an originating service denied report is received associated with a subscriber line that has had a number of reports of no dial tone or originating service denials. It must also be remembered that a subscriber could have an originating service denied condition, and a subsequent terminating call would remove the trouble condition. In addition, if the *CO*- relay failed to operate on the disconnect call, the customer would again be cut off until another terminating call is made which would connect the subscriber to a trunk, and the subscriber would again have service until the terminating connection was disconnected.

**5.15** One test call may not be sufficient to find the trouble, as the failure of contact closure of one set of crosspoints would be found only when this trunk was selected. In the latter case, originating or terminating denied service reports should be received from all subscribers in the group.

**5.16** Table C contains conditions that will deny service due to calls on another line than the subscriber reporting trouble. Therefore, it may be necessary to originate various types of test calls on other lines and check the condition of the CO-relay associated with the subscriber reporting the trouble.

**3. Terminating Denied Service**

**5.17** Terminating calls will normally be made to test lines on which trouble reports are received. The method of testing will be the same as discussed under 2. Originating Denied Service Reports with the exception that the CO-relay will be located in the control circuit and the cutoff condition could be removed if a service request call is made before the terminating test call.

**4. Double Connections**

**5.18** Table C describes certain combinations of calls and troubles which can cause double connections. It may be necessary to place both service request and terminating calls on all lines to duplicate conditions shown in Table C. In most cases it will not be necessary to place test calls shown in the "Action That Follows" column if the correct condition (operated or released) of the cutoff relay and the correct crosspoint required for the call is checked in both circuits plus determining whether the condition of any other cutoff relay was changed. In addition a pattern of trouble may be determined if records of the troubles are kept. An example of this is when double connections occur only on lines of two LB groups. The lines in these groups should be tested.

**5. Telephone Circuit Between Control and Remote Units**

**5.19** To facilitate testing, an unassigned directory number may be assigned to the spare jack circuit of the control frame and connected at the distributing frame. A plug-ended telephone subscriber set can then be connected to the spare jack circuit which can be used to originate terminating calls to subscribers associated with the line concentrator. Also, this telephone will provide a path of communication between the remote and control units. Personnel at the remote location can call the personnel at the control unit location by using a hand test set on subscriber lines that are not connected to the concentrator or by using a spare cable pair that has been assigned to spare line equipment. This path of communication will not be affected by concentrator troubles.

**C. Use of Test Lines**



*These tests indicate that the concentrator is capable of completing a call on one line only in each group of the control circuit and can be used to test that a connection can be made on each trunk to the test line by selecting each trunk as shown below. It must be remembered that other lines may fail due to circuit troubles or apparatus failures when connected to these trunks. The circuit may identify the test line correctly, but may fail to identify lines in another group due to a dirty contact of the LA-relay. The test line may complete a call to a particular trunk and another line may fail due to bent select fingers. Therefore, test lines may be used to determine if the concentrator system is operative. However, if trouble continues or analysis shows the trouble is associated with certain lines, it will be necessary to make the associated service test calls.*

*Caution: It is preferable to test all trunks during light load period.*

STEP	ACTION	VERIFICATION
<b>1. Terminating Call</b>		
1	Dial directory number assigned to concentra-	Ohmmeter or Wheatstone Bridge measure-

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<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
	tor line terminal 49 from test desk or subscriber set. (A subscriber set may be connected to the spare jack which is cabled to the distributing frame where a cross connection to an unassigned line can be made. This arrangement will facilitate observation of the control unit during testing.)	ment will show 33,000 ohms plus trunk loop resistance across tip and ring of line 49.
2	Remove on-hook condition.  <i>Note:</i> It may be necessary to operate the associated <i>DP-</i> relay to cause disconnection.	Observe that a disconnect call is made and the hold magnet and crosspoints associated with line 49 release.
3	Block operated the <i>A</i> and <i>C</i> hold magnets used on previous call or calls.	
4	Repeat Step 1.	Same as Step 1.
5	Repeat Step 2.	Same as Step 2.
6	Repeat Step 3.	
7	Repeat Steps 3, 4, 5, and 6 until calls are made on all trunks of Group 0. Remove all blocking tools.  <i>Caution: Trunks should be available for service calls; therefore, remove blocking tools if all trunks become busy.</i>  <i>Note:</i> It may be necessary to operate the associated <i>DPO</i> relay to cause unused trunks to release due to trunk load control feature.	Same as Steps 4 and 5.
8	Repeat Steps 1 through 7 using number assigned to line terminal 99, trunks in group 1, and <i>DP1</i> relay.	Same as Steps 1 through 5.
<b>2. Service Request Call</b>		
1	When hold magnets <i>09</i> are released, proceed to Step 3. When hold magnets <i>09</i> are operated, determine whether <i>TB09</i> relay is released. When <i>TB09</i> relay is operated, it will be necessary to wait for completion of call on trunk <i>09</i> .	
2	Operate <i>DPO</i> relay to cause hold magnets <i>09</i> to release.	

STEP	ACTION	VERIFICATION
	<i>Caution: Trunks having higher preference that are waiting for disconnection will release first.</i>	
3	Block A09 and C09 hold magnets operated.	
4	Ground tip lead of trunk 09 and measure the resistance between the tip and ring of line 49.	A service request call will be originated on line 49 and an ohmmeter or Wheatstone Bridge measurement will show 33,000 ohms plus trunk loop resistance across tip and ring.
5	Remove ground from tip lead of trunk 09. If a disconnect call is not initiated on line 49, operate DP0 relay. Hold magnets of the trunk associated with line 49 will release.	
6	Block the A and C hold magnets used on previous call or calls.	
7	Repeat Step 4.	Same as Step 4.
8	Repeat Step 5.	
9	Repeat Step 6.	
10	Repeat Steps 7, 8, and 9 until calls are made on all trunks in Group 0 except trunk 9. Remove all blocking tools.	
	<i>Caution: Trunks should be available for service calls; therefore, remove blocking tools if all trunks become busy.</i>	
11	Repeat Tests 1 through 10 using trunk 08 or 19 in Steps 1, 2, and 3 when option Y or Z respectively, is provided on SD-96537-01. The DP1 relay will be used instead of the DP0 relay and the trunks in Group 1 will be tested.	

#### D. Service Request Call

1	Place an off-hook signal on line to be tested.	Dial tone should be heard.
2	Measure voltage drop across 2 and 3, 4 and 5 contacts of associated CO- relays in both the control and remote circuits. When double connections or denied service reports have been received, it may be necessary to check other CO- relays.	A voltage drop across these contacts indicate that they are open.

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STEP	ACTION	VERIFICATION
3	Determine that correct crosspoints have closed.	Observe that the line used on test call is connected to same trunk in remote and control circuits.
4	Break dial tone (dial a digit).	Call should remain connected with <i>TB</i> - relay operated.
5	Replace the off-hook signal with an on-hook signal.	<i>TB</i> - relay should release and call should disconnect within 6 to 8 seconds.  <i>Note:</i> It may be necessary to operate the associated <i>DP</i> - relay due to the trunk load control feature.
6	Check that correct crosspoints release.	
7	Measure voltage drop across 2 and 3, 4 and 5 of associated <i>CO</i> - relays in the remote and control circuits.  <i>Note 1:</i> When double connections or denied service reports have been received, it may be necessary to check other <i>CO</i> - relays.  <i>Note 2:</i> No alarms should be received during test.	No voltage drop across these contacts indicates that they are closed.

E. Terminating Call

1	Ground sleeve lead on frame terminal strip.  <i>Caution:</i> In crossbar offices it will be necessary to dial the associated directory number, since ground on the sleeve lead will operate hold magnets on link frames and could cause double connections on these frames.	
2	Measure voltage drop across 2 and 3, 4 and 5 contacts of the associated <i>CO</i> - relays in both the remote and control circuits.  <i>Note:</i> When double connections or denied service reports have been received, it may be necessary to check other <i>CO</i> - relays.	A voltage drop across these contacts indicates that they are open.
3	Determine that correct crosspoints have closed.	Observe that the line used on test call is connected to same trunk in remote and control circuits.
4	Remove ground from sleeve lead.	<i>TB</i> - relay should release and call should disconnect within 6 to 8 seconds.

STEP	ACTION	VERIFICATION
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*Note:* It may be necessary to operate the associated *DP-* relay due to the trunk load control feature.

- |   |  |  |
|---|--|--|
| 5 | Check that correct crosspoints release.  |  |
| 6 | Measure voltage drop across 2 and 3, 4 and 5 of associated <i>CO-</i> relays in remote and control circuits. |  |

*Note:* When double connection or denied service reports have been received, it may be necessary to check other *CO-* relays.

*Caution: This test does not check the leads from central office equipment to the line concentrator. Also, it does not check the ability of the subscriber to receive and trip ringing. It will be necessary to dial the subscriber's number on another central office line to test these features. Remember: if the subscriber does not answer, ringing may be occurring on the wrong subscriber line.*

#### F. Disconnect Call

- |   |  |  |
|---|--|--|
| 1 | Place either a service request or terminating call and follow procedures shown in these test calls for the disconnect portion of the call. |  |
|---|--|--|

#### G. Trunk Tests

- |   |  |  |
|---|--|--|
| 1 | Place a service request or terminating call and observe which trunk is used on the call.         | Same as service request or terminating call. |
| 2 | When the call releases, block the <i>A</i> and <i>C</i> hold magnets operated of the trunk used. |  |
| 3 | Repeat Steps 1 and 2 until all trunks are used.  |  |

*Caution: It is preferable that this test be done during light traffic conditions. If necessary to perform this test during heavy traffic, unblock trunks during calls to allow service traffic to complete calls.*

STEP	ACTION	VERIFICATION
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### H. Releasing Double Connections

- 1 Block *SPR*- relay of group containing double connections nonoperated.
- 2 Determine if ground is present on sleeve lead of trunks on double connection. If ground is present, block associated *TP*- relay nonoperated. If no ground is present proceed to Step 3.
- 3 Block the *TB*- relays associated with the double connection nonoperated.
- 4 Operate associated *DP*- relay and observe that the double connection releases.
- 5 Release *DP*- relay when double connection has released.

**Caution:** Operation of *DP*- relay beyond the required time to release the trunks waiting for disconnection and the double connected trunks will cause a time-out alarm or cycling.

- 6 Remove blocking tools.

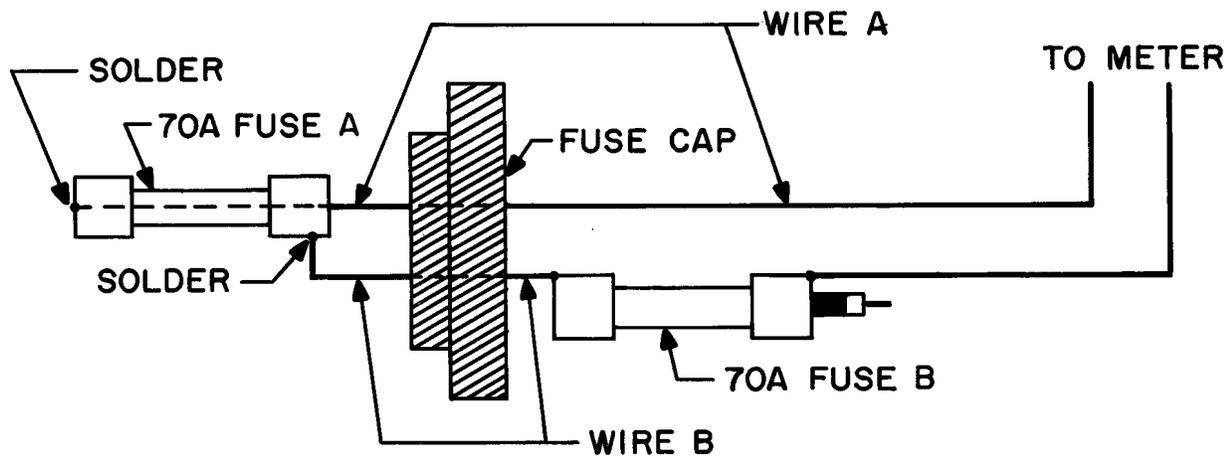


Fig. 1 — Construction of Dummy Fuse for Charge Current Measurements

#### Steps in Construction

1. Unsolder fuse element of 70A fuse A. Remove element, spring, cap, plastic tip, etc.
2. Replace fuse element with wire connections as shown.
3. Thread wire through fuse cap.
4. Solder 70A fuse B into circuit with wire B.
5. Tape bare parts of fuse B.

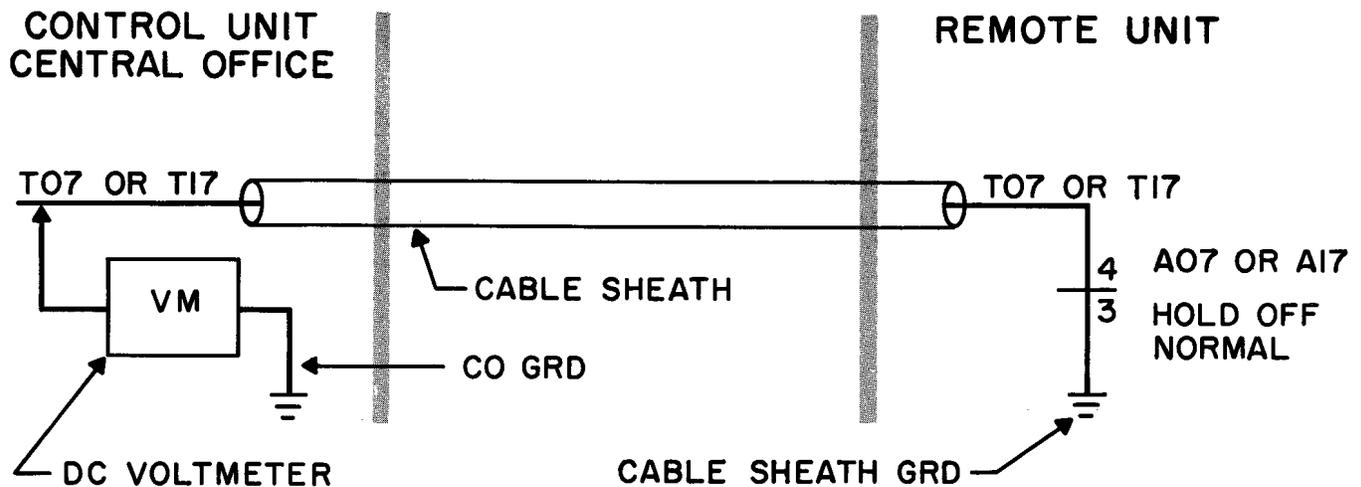


Fig. 2 — Measurement of Ground Return Resistance

**Procedure:**

1. When hold magnets 07\* are released, proceed to Step 3. When hold magnets 07\* are operated, determine if TB07\* relay is released. When TB07\* relay is released, proceed to Step 2. When TB07\* relay is operated, it will be necessary to wait for completion of call on trunk 07\*.
2. Operate DP0† relay to cause hold magnets 07\* to release.

**Caution:** Trunks of higher preference waiting for disconnection will release first.

3. Block A07\* hold magnets operated.
4. Remove charge (CHG) fuse in remote unit. Measure voltage as shown and determine polarity of voltage relative to ground. Plus (+)

for positive, minus (–) for negative. This voltage is E1.

5. Insert dummy fuse (Fig. 1) in charge CHG fuse holder and measure charging current (I) to remote unit (should be approximately 140 ma).
6. Remove dummy fuse and replace charge CHG fuse to allow charging current to flow. Measure voltage as shown. This voltage is E2.
7. Remove blocking tools from A07\* and C07\* hold magnets.

8. Ground return resistance ( $R_G$ ) can be obtained from the following formula:

$$\text{(approximate) } R_G = \frac{E_2 \pm E_1}{I}$$

\* Hold magnet 07 will be used when a 100-line remote unit is used with both groups or Group 0 only, or 50-line remote unit associated with Group 0 of control unit. Hold magnet 17 will be used when 100-line remote unit is used with Group 1 only or 50-line remote unit associated with Group 1 of control unit.

† DP0 or DP1 relay will be used for trunk 07 or 17, respectively.

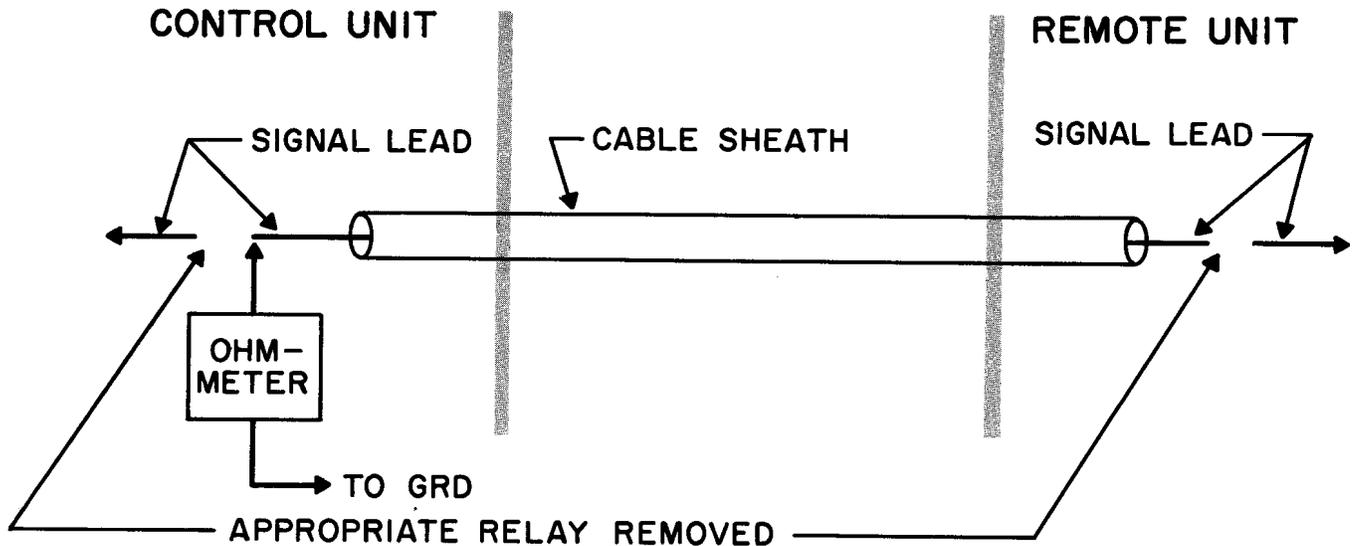


Fig. 3 – Measurement of Signal Lead Insulation Resistance

**Procedure:**

**100-Line Remote Unit Using Both Groups or Group 0 Only, or 50-Line Remote Unit Associated with Group 0 of Control Unit.**

1. Block operated *RL2* relay in control unit.
2. Remove *S1* relays in control and remote unit.
3. Measure leakage of *TS0* at terminal strip A, terminal 70 (CAD 6).
4. Replace *S1* relays in both units.
5. If calls are waiting (operated preference relays), remove blocking tool from the *RL2* relay and allow calls to complete. After calls complete, block *RL2* relay operated.
6. Remove *S3* relay in control and remote unit.
7. Measure leakage of *RS0* lead at terminal strip A, terminal 60 (CAD 6).
8. Replace *S3* relays in both units.
9. Repeat Step 5.
10. Remove *M* relay in remote unit.

11. Measure leakage of *TS1* lead at terminal strip A, terminal 71 (CAD 6).
12. Replace *M* relay in remote unit.
13. Repeat Step 5.
14. Remove *RS1* lead at remote unit.
15. Measure leakage of *RS1* lead at terminal strip A, terminal 61 (CAD 6).
16. Replace *RS1* lead at remote unit.
17. Remove blocking tool from *RL2* relay.

**100-Line Remote Unit Using Group 1 Only or 50-Line Remote Unit Associated with Group 1 of Control Unit.**

18. Repeat Steps 1 through 17 substituting the following terminals for *TS0*, *RS0*, *TS1*, and *RS1* leads:

<i>TS0</i>	Terminal Strip A	Terminal 72
<i>RS0</i>	A	62
<i>TS1</i>	A	73
<i>RS1</i>	A	63

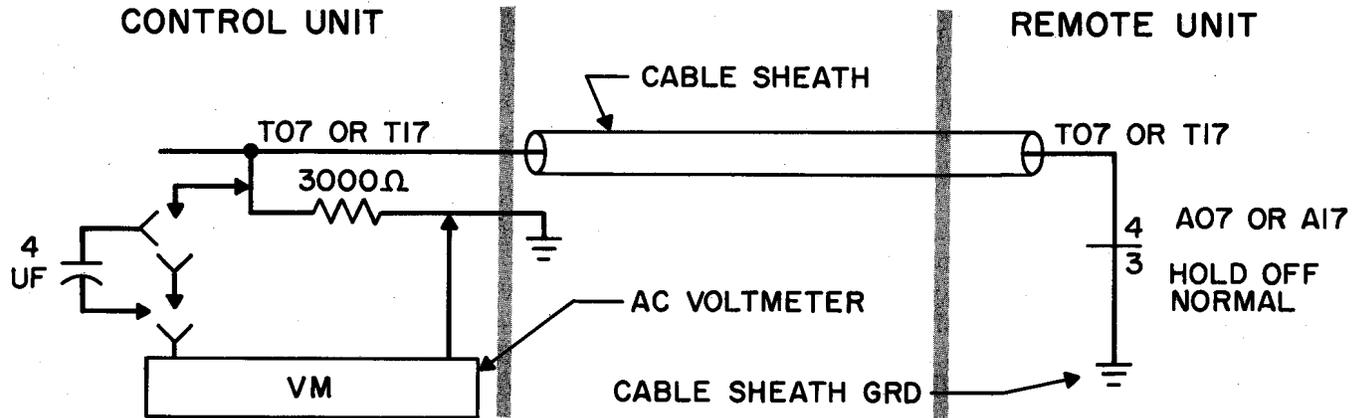


Fig. 4 — Measurement of AC Interference on Signal Leads

**Procedure:**

1. Terminate tip of trunk 07 or 17 to ground through 3000 ohms as shown.
2. Measure ac voltage across 3000 ohms.

**Note:** If an ac voltmeter is used, the 4-mf capacitor is not required; if a dc voltmeter is used, use the 4-mf capacitor as shown.

**6. Analysis of Trouble Conditions.**

**6.01** This table lists some of the effects which may result when calls do not complete satisfactorily. Case 2 will be explained in detail to provide an understanding of Table C.

**6.02** In Case 2, a service request call is originated from the remote circuit, and crosspoints are closed to the line originating the call in the remote circuit and to a different line terminal in the control circuit as shown in the "Line Terminal Connected" column. Also, the same trunk is used in both units on the call as shown in the "Trunk Connected" column. This trouble would occur when the customer on line 10 originates a service request call and crosspoints are closed for both line terminal 10 in the remote circuit and line terminal 20 in the control circuit. The column designated "Conditions" indicates that the call is made when both line terminals have no previous connection (closed crosspoints) and both are working lines (assigned). Since line 20 is a working line and

does not have a previous crosspoint closed, the customer will obtain dial tone and will complete his call. The "Action That Follows" column indicates the type of call that follows, and the results of such calls are shown in the "Results" column. It is further assumed that the call completes satisfactorily in the "Action That Follows" column.

**6.03** A service request call from the line connected at the control unit will cause a double connection at the control end. In the above example, the customer associated with line 20 can originate a service request call, since the cutoff relay associated with the line terminal at the remote end is normal. This call will select another trunk, and it is assumed that this call will complete satisfactorily. This call would close crosspoints in both the remote and control circuit to line 20. When this occurs, lines 10 and 20 will each be connected to one set of crosspoints in the remote circuit, but line 20 will be closed to two sets of crosspoints in the control circuit, thus causing two trunks to be connected to one line terminal in the control circuit.

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**6.04** When a terminating call to line 10 is made after the original call, the call will complete, since the cutoff relay in the control circuit of line 10 remained normal on the original call. This will cause two trunks to be connected to line 10 in the remote unit and one trunk to lines 10 and 20 in the control unit.

**6.05** A disconnect call following the original call will identify the line desiring disconnection as line 20. Therefore, the cutoff relay for line 10 in the remote unit will remain in the cutoff condition which will deny originating service for line 10.

**6.06** The "Results" column shows the results of subsequent calls but may not be the observed results when a subscriber reports trouble. An example of this follows:

(a) As previously shown, line 10 could be double connected at the remote end when a terminating call follows the original call. When the subscribers return their switchhooks to the normal condition (on-hook), a disconnect call will be made. If the trunk that has line 10 connected in the remote unit and line 20 in the control unit disconnects first, the trunk will disconnect. Since line identification is made in the

control unit, line 20 will be identified and the cutoff relay will be returned to normal in both units. Since it was assumed that line 20 was idle in the remote unit, the cutoff relay for line 20 will be normal; and when the disconnect call is made, the condition of the cutoff relay will remain the same. The second trunk with line 10 connected in both units will now disconnect.

(b) However, if the trunk that has line 10 connected in both units disconnects first, the cutoff relay for line 10 in the remote unit will be returned to normal. This will originate a service request call caused by the connection of the -48 volt battery of the central office through the remaining crosspoints of the cutoff relay and the line relay (line 10) to -24 volt battery. This cycle would continue as long as the trunk with line 10 connected at both ends is disconnected first. Thus, in one case, the double connection could be observed while the other case would show no double connection.

**6.07** An analysis of each case and the results of double connections in Table C can be made to determine the results of a mismatch of information between the remote and control units and the condition that will be left in the line concentrator when a double connection occurs.

TABLE C — TYPICAL TROUBLE CASES

Case	Type of Call	Conditions	Line Terminal Connected on Call		Trunk Connected		Results	Action That Follows	Results
			Remote	Control	Remote	Control			
1	SR	Remote and control line terminals used on call not connected on previous call and line terminal of control circuit not assigned (see Fig. 5).	Line terminal originating call	Different	Same		Call will cycle as long as an off-hook signal is present due to no trunk closure to central office.		
2	SR	Remote and control line terminals used on call not connected to previous call (see Fig. 5).	Line terminal originating call	Different	Same		Call will complete.	SR call from line terminal connected in control circuit (see Fig. 6).  Terminating call to line terminal originating SR call (see Fig. 7).  Disconnect call.	Two trunks connected in the control unit to line terminal used in control unit.  Two trunks connected in the remote unit to line terminal originating service request call.  Line terminal originating call will be left in a cutoff condition.
3	SR	Remote line terminal used on call not connected to previous call; however, control line terminal connected on previous call (see Fig. 8).	Line terminal originating call	Different	Same		Double connection of two trunks to line terminal of control circuit.	First disconnect call on trunk connected to line terminal originating call.  First disconnect call on trunk used on previous call.  Terminating call to terminal originating call (see Fig. 9).	Line terminal originating call will be left in a cutoff condition and a service request call will be originated by the other line terminal causing two trunks in both the remote and control circuit to be connected.  Both trunks will disconnect, but line terminal originating call will be left in cutoff condition.  Two trunks on each line terminal. Three trunks involved with one trunk shared.

TABLE C - TYPICAL TROUBLE CASES (Cont)

Case	Type of Call	Conditions	Line Terminal Connected on Call		Trunk Connected		Results	Action That Follows	Results
			Remote	Control	Remote	Control			
4	SR	Trunks used on call did not have previous connection (see Fig. 10).	Same as line terminal originating call	Line terminal originating call	Different	Trunk selected by control unit	No dial tone. Both trunks will remain held operated. The trunk connected in the remote unit will not be identified by the control unit for disconnection. The trunk connected in the control unit will remain busy due to central office -48 volt battery through the TS-relay to -24 volt battery through remote unit off normal contact.	Terminating call using trunk connected in remote unit.  Service request call using trunk connected in remote unit.	Will be connected to wrong line terminal.  No dial tone.
5	SR	Connection on trunk used in remote unit.	Same as line terminal originating call	Line terminal originating call	Different	Trunk selected by control unit	No dial tone. Trunk selected by control unit will remain busy (see Case 4). Line terminal will be cut off but no line closure in remote unit.		
6	Term.	Remote and control line terminals not used on previous call (see Fig. 5).	Different	Line terminal originating call	Same		Wrong customer will be reached.	SR call from line terminal originating call (see Fig. 6).  Terminating call to line terminal of remote unit (see Fig. 7).  Disconnect call.	Double connection in control unit.  Double connection in remote unit.  Line terminal in remote unit left in cutoff.

TABLE C—TYPICAL TROUBLE CASES (Cont)

Case	Type of Call	Conditions	Line Terminal Connected on Call		Trunk Connected		Results	Action That Follows	Results
			Remote	Control	Remote	Control			
7	Term.	Connection on remote unit line terminal used on call (see Fig. 11).	Different	Line terminal originating call	Same		Wrong customer reached and double connection in remote circuit.	<p>First disconnect call on trunk connected to line terminal originating call.</p> <p>First disconnect call on trunk used on previous call.</p> <p>SR call from line terminal originating the call (see Fig. 12).</p>	<p>Both trunks will disconnect.</p> <p>When line terminal in remote unit is returned to normal, a service request call will be made due to central office battery through the other trunk. This cycle will continue.</p> <p>Two trunks on each line terminal with three trunks involved and one trunk shared by each line terminal.</p>
8	Term.	Trunks used on call did not have previous connections (see Fig. 10).	Same as line originating call	Line terminal originating call	Different	Trunk selected by control circuit	Customer will not be reached and ringing may not be tripped. The trunk connected in the remote unit will not be identified by the control unit for disconnections. The trunk connected in the control unit will remain busy due to central office -48 volt battery through the TS-relay to -24 volt battery through remote unit off normal contact.	Same as Case 4.	
9	Term.	Connection on trunk used in remote unit.	Same as line originating call	Line terminal originating call	Different	Trunk selected by control circuit	Customer will not be reached and ringing may not be tripped. Trunk selected by control unit will remain busy (see Case 8). Line terminal will be cut off, but no line closure in remote circuit.		

TABLE C—TYPICAL TROUBLE CASES (Cont)

Case	Type of Call	Conditions	Line Terminal Connected on Call		Trunk Connected		Results	Action That Follows	Results
			Remote	Control	Remote	Control			
10	SR or Term.	No connection on line terminals used on call in remote or control units.	Other than line originating call		Trunk selected by control circuit		All trunks would be connected to wrong line and concentrator would connect trunks as they disconnect.		
11	SR		Different	Line terminal originating call	Same		All trunks would be set up since line requesting service would not be cut off and trunks would be set up as disconnect calls are made.		
12	Term.		Line terminal originating call	Different	Same		All trunks would be set up since line requesting service would not be cut off. Also trunks would be set up as disconnect calls are made.		
13	Dis-connect	No connection on line terminal of remote unit used on call.	Different	Line terminal requiring disconnection	Same		Line terminal requiring disconnection is left in cutoff condition in remote circuit.		
14	Dis-connect	Connection on line terminal of remote unit used on call.	Different	Line terminal requiring disconnection	Same		Line terminal requiring disconnection is left in cutoff condition in remote circuit. Line terminal in remote circuit used on call will be returned to a cut-through condition, thus causing a service request call and a double connection of this line in both the remote and control units (see Fig. 12).		

TROUBLE CONDITIONS (Fig. 5 through 12)

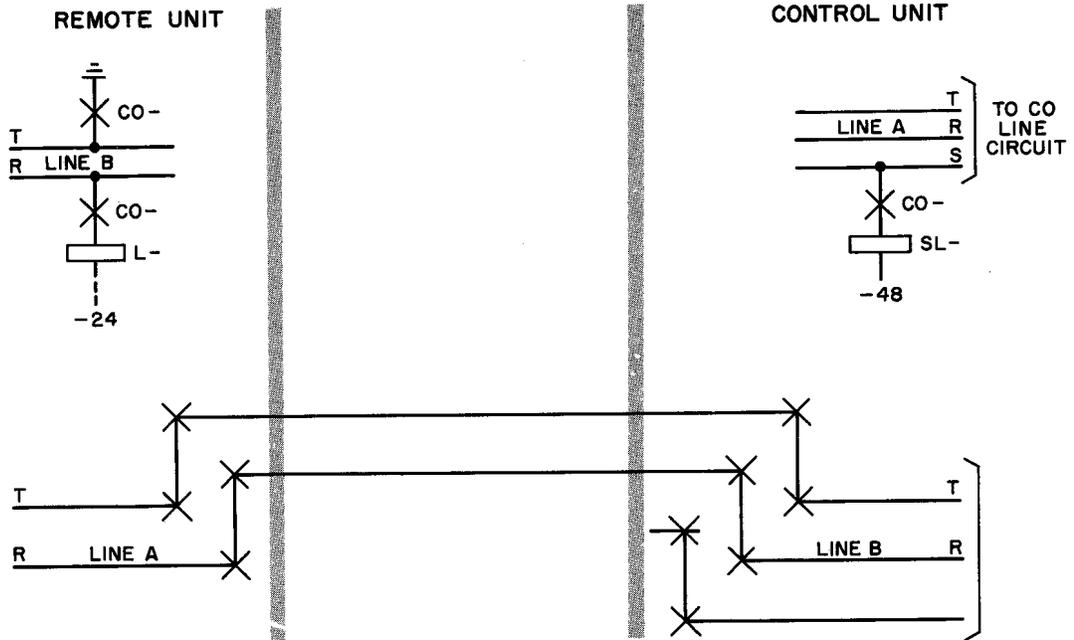


Fig. 5

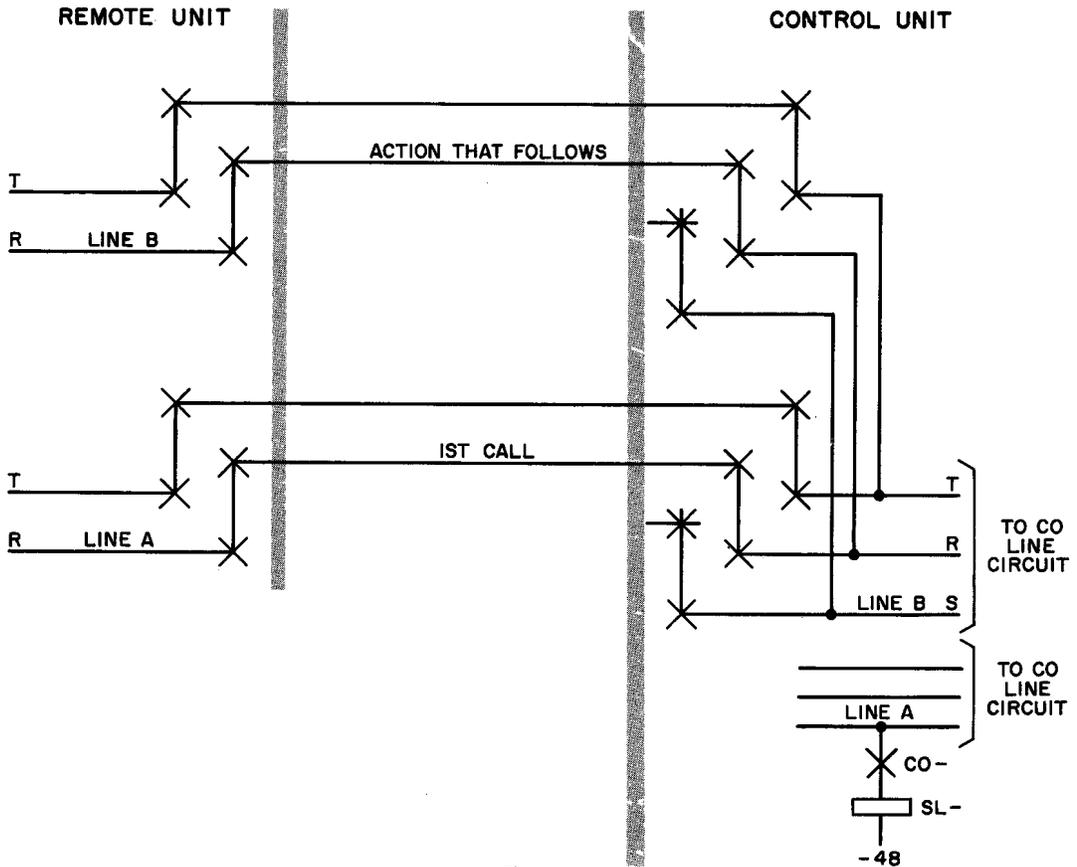


Fig. 6

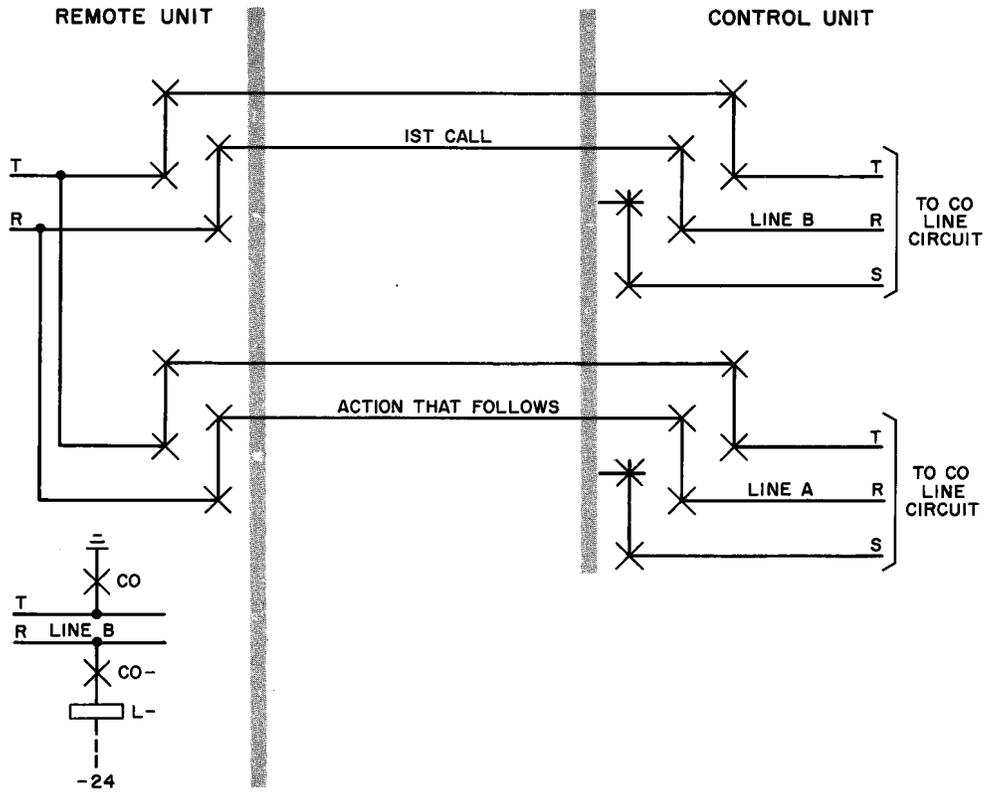


Fig. 7

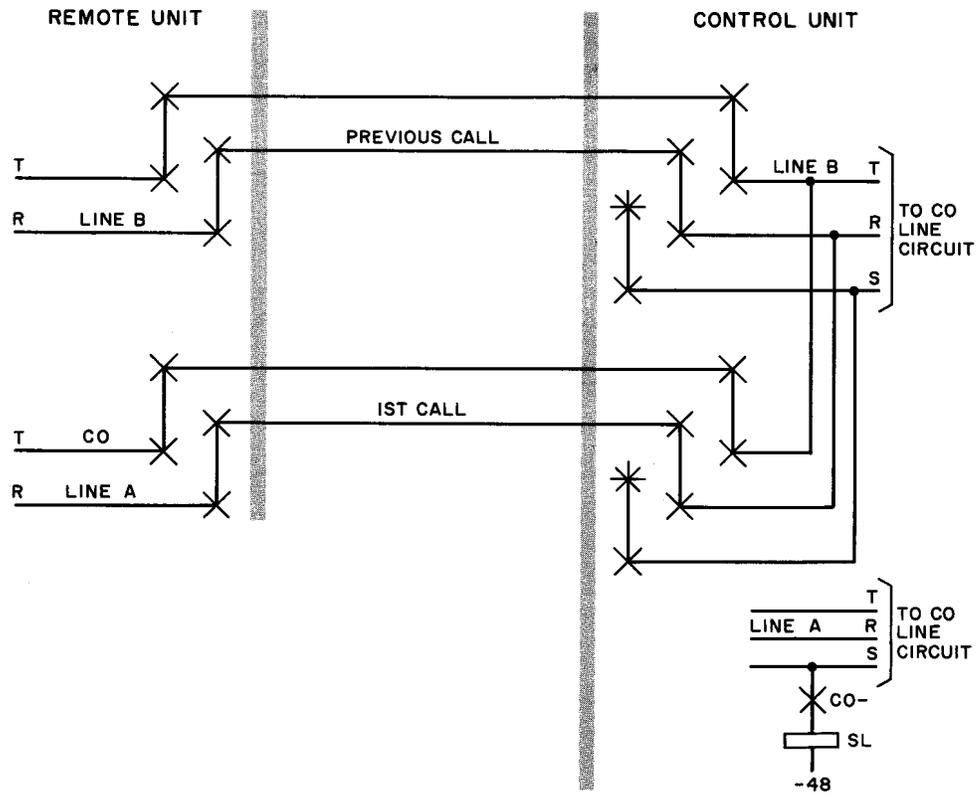


Fig. 8

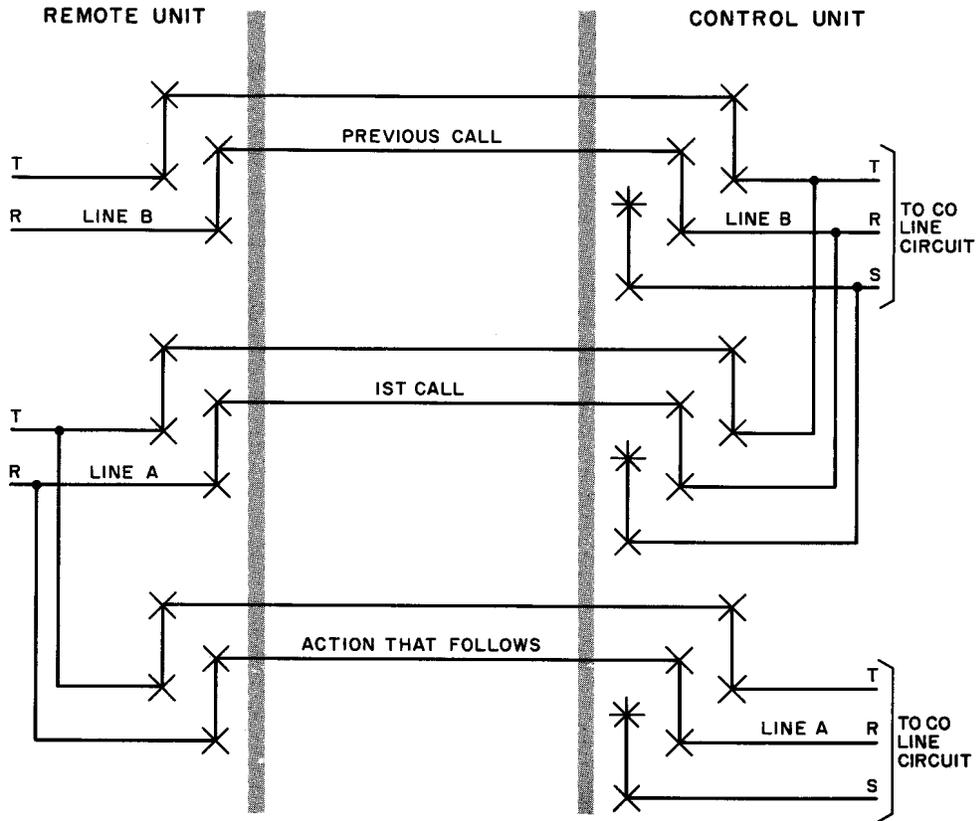


Fig. 9

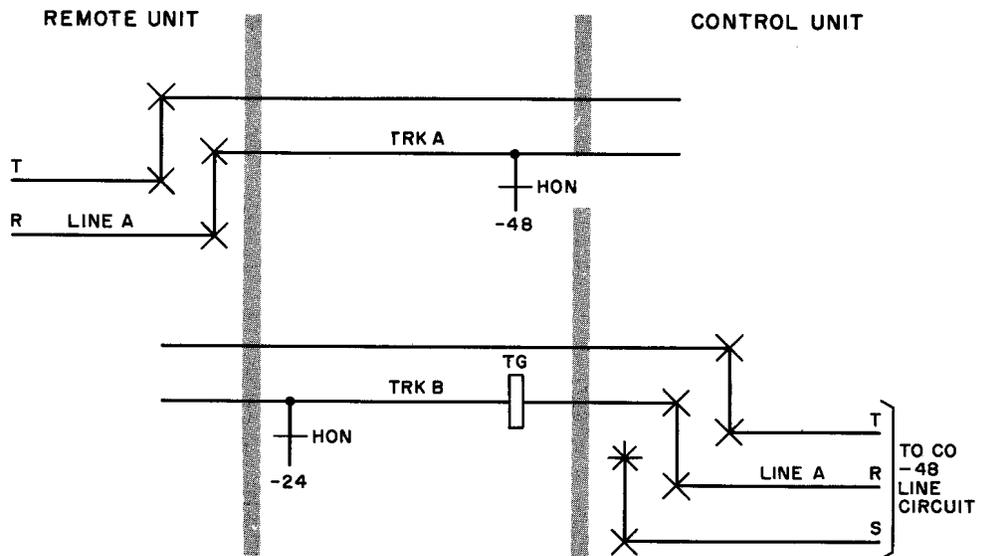


Fig. 10

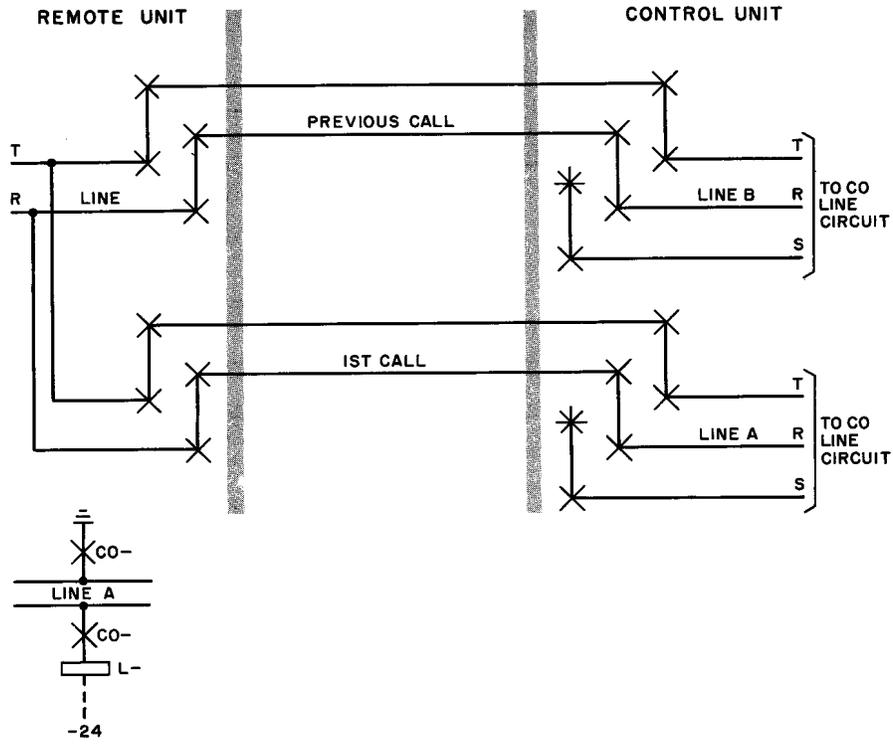


Fig. 11

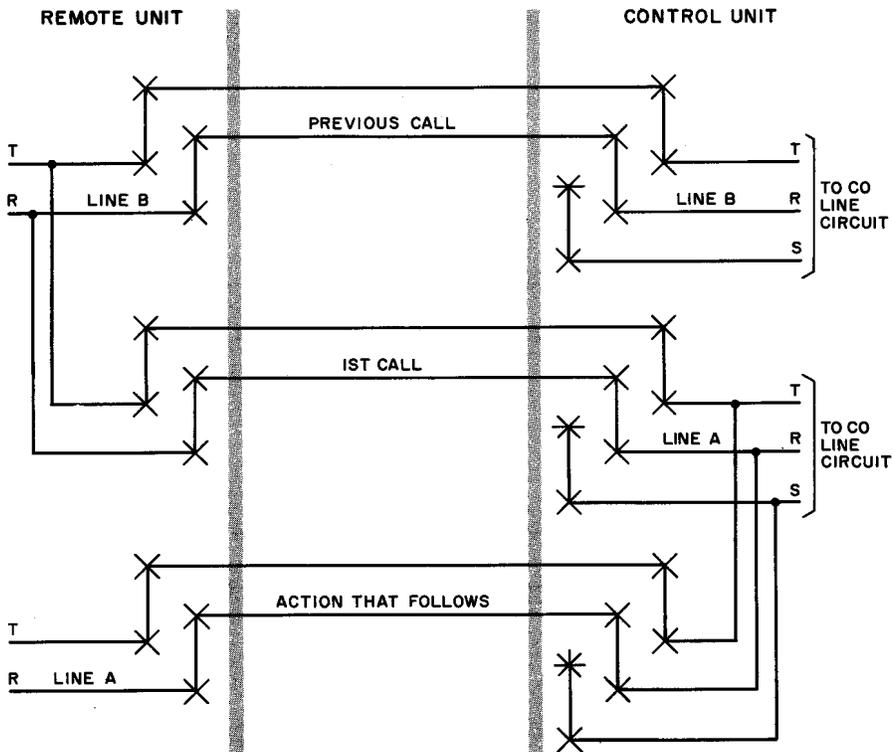


Fig. 12