LOCAL TEST CABINET NO. 1
OPERATING AND TESTING METHODS

CONTENTS PAGE

1. GENERAL

1.01 This section describes the method of operation of the local test cabinet No. 1 (J94708) for making tests of the subscriber line and trunk plant.

1.02 This section has been reissued to include testing in panel offices through B switchboard incoming selectors, testing for

capacitance using the RCCI key and further information on testing tube type subscriber sets as well as to bring it up to date generally.

1.03 The various locations of the cabinet and the arrangements of the keys and jacks in the cabinet are covered in Section 662-200-100, "Local Test Cabinet No. 1, Description of Equipment."

2. METHOD OF CONNECTING BATTERY, RINGING AND COIN CONTROL SUPPLY TO LOCAL TEST CABINET

2.01 When Test Cabinet Is Permanently Located: Permanent wiring is installed for supplying test battery, central office battery, coin control current and ringing current. The talking lines and test lines are also permanently wired in.

2.02 When Test Cabinet Is Portable: Make connections using patching cords from the jacks in the cabinet to the supply jacks. Use the binding posts where cords or jacks are not available.

Connection of Jacks and Associated Binding Posts

2.03 Connect the cabinet jacks or binding posts as follows:

Jacks	Binding Post	Connect to
T BAT	100 V + 20 V +	Test battery supply.
BAT G	CO BAT GRD	Central office battery and ground supply. (See Note 1.)
R R-	± or ± - GEN G	Ringing current and generator ground supply in a.c. or a.c.-d.c. offices, negative superimposed ringing current and generator ground supply in 4-party full selective offices or hand generator in magneto offices not equipped with ringing machines. (See Note 2.)
R+	± +	Positive superimposed ringing current supply in 4-party full selective offices.
CT	CC CR	Coin collect and coin return current supply.
	4 V -	Dry cell battery for transmitter supply in magneto offices. Connect the positive to GRD binding post.
	R R1	When provided for rheostat, must be strapped if rheostat is not used.

Note 1: In magneto offices ground supply only is required. Connect it to the GRD binding post.

Note 2: When the hand generator is used, strap GEN G post to the GRD post.

2.04 Check the sleeve and ground binding post strapping to see that proper connections are made for the various conditions as shown in Figs. 1, 2, 3 and 4. No strapping between these binding posts is required in non-multiple type magneto offices. The strap connecting binding posts S-1 and SB-1, Figs. 2 and 3 or S and S-1, Fig. 4, is required only to test for crosses between lines. When the local test cabinet is permanently located, straps may be soldered to the binding post terminals underneath the panel.

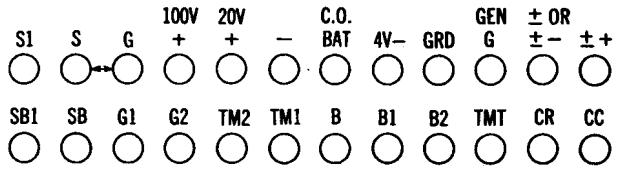

Fig. 1 - Step-by-Step Offices

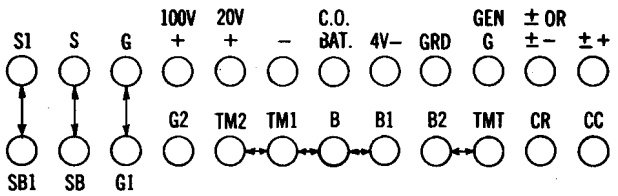

Fig. 2 - Panel and 24-Volt Manual Offices

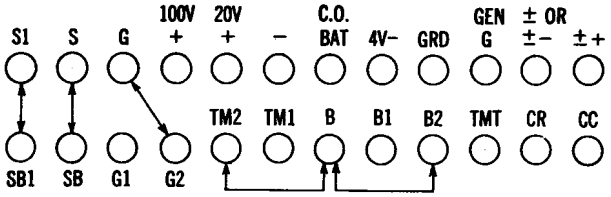

Fig. 3 - 9-C (38-Volt) Offices

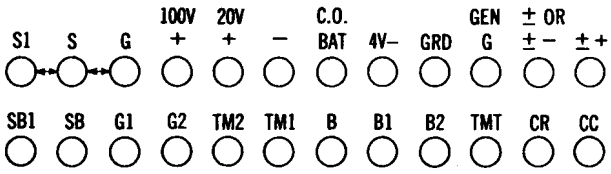

Fig. 4 - Multiple Magneto Offices

3. METHOD OF ESTABLISHING TEST CONNECTIONS

When the Test Cabinet Is Portable

3.01 Make connections from the jacks in the cabinet with patching cords to the subscriber line at the distributing frame protectors, to terminal strip lugs at the distributing frame, to a test connector or to a switchboard jack according to the following paragraphs.

3.02 LINE Jack. Connect to the test connector jack with the test connector cord. Use cord with red plug. See Fig. 5.

3.03 M.D.F. (two jacks). Connect to the line at the protector with the frame test cord equipped with two No. 252-type plugs. Use a cord with No. 50 cord tips when the line is not to be opened. Insert the No. 289A plug with the clamping bar to the left (or the No. 152 plug with the ridged side to the left).

3.04 T Jack. Connect to a jack of the line or trunk at the switchboard with a P3E or a P3F cord. Connect to the test connector jack with the test connector cord with the black plug. See Fig. 5.

3.05 G Jack. Connect to the line or trunk to test for cross with the circuit connected to T jack. Use a P3E or a P3F cord.

3.06 TM and GM Jacks. Connect to the lines in non-multiple magneto offices for the same tests as with the T and G jacks. Use P2A cords.

3.07 I.D.F. (two jacks). Connect to a subscriber line on the distributing frame terminal strip with a standard service observing cord. Insert the No. 289A plug with the clamping bar to the left (or the No. 152 plug with the ridged side to the left).

Note: Do not use this connection in panel offices as the sleeve condition of the test circuit is not suitable.

When the Test Cabinet Is Permanently Located at the Distributing Frame

3.08 Make connections from the line protector to the cabinet as explained in 3.03 when the cord will reach the cabinet. If the cabinet is too far from the protector, plug into the test jacks provided at the frame. Insert the No. 289A plug with the clamping bar to the left (or the No. 152 plug with the ridged side to the left). To connect to a line or trunk at the switchboard, use the call circuit to the switchboard operator to order up the test cords at the switchboard.

When the Test Cabinet Is Located on the Cable Turning Section of Switchboard

3.09 Make connections to the line or trunk jack by patching directly to the switchboard jack with a P3E or a P3F cord. Use the test trunk to distributing frame for testing through the protectors.

In Step-by-Step Offices without Test Connectors

3.10 Make connections to the terminal strip at the distributing frame in small step-by-step offices or in community dial offices where test connectors are not provided.

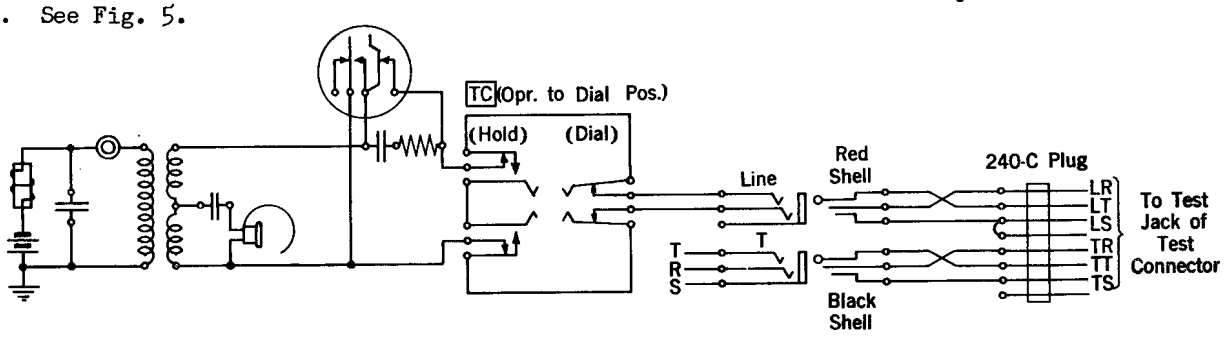

Fig. 5 - Connection to Test Connector

In Step-by-Step Offices with Test Connectors

3.11 When the test connector is used, plug the No. 240C plug into the jack of the test connector. Plug the cord with the red plug into the LINE jack and the cord with black plug into the T jack of the cabinet. Operate the TC key to the dial position and dial the tens' and units' digits thus causing the test connector to select the line. Hold the test connector on the line by operating the TC key to the hold position. This also releases the telephone for use with the test circuit. See Fig. 5.

3.12 To advance the test connector to another line on the same level operate the TC key to the dial position and dial one digit for the number of steps the test connector is to be advanced.

Note: A 10-party terminal per line divided code ringing connector cannot be advanced by the above method. Release the connection by restoring key TC to normal for a few seconds. Then operate the key to the dial position and dial the desired number.

In Step-by-Step Offices with Test Distributors

3.13 When the test cabinet is permanently located it will be wired directly to the test distributor if only one test distributor is used. If more than one test distributor is associated with the test cabinet, use the two patching cords to connect the jacks wired to the cabinet to the proper test distributor jacks. Obtain connection to the desired line the same as when using a test connector except that four digits must be dialed instead of two. Voltmeter tests cannot be made on the third wire as it is not connected through when the test distributor is used.

In Panel Offices through B Switchboard Incoming Selectors

3.14 When the test cabinet is permanently located in a panel office it may be arranged for connection by means of a jack circuit to a B switchboard incoming selector. Plug one end of a patching cord into the jack associated with the incoming test selector and the other end into the T jack of the test cabinet. Operate the T key. This establishes a talking connection with the B operator on a straightforward trunking basis. When the trunk order tone is heard, give the number of the desired line. During selection continuous dial tone is audible. When the selection is completed, dial tone is discontinued. The dial tone changes to interrupted tone in case an overflow condition is encountered. When the subscriber line is busy, the busy tone will be heard if the test selector is not equipped with the no-test feature.

4. METHOD OF USING THE TALKING LINE AND CALL CIRCUIT

4.01 To answer an incoming call or to make an outgoing call, operate the trunk key TRK to the talking position to connect the telephone and dial to the talking line. When answering an incoming machine ringing call, operate the TRK key to the hold position to trip the ringing, then restore to the talking position. See Fig. 6. To hold the talking line and release the telephone circuit for use with the test circuit operate the TRK key to the hold position.

4.02 To order up test cords at the switchboard, depress the call circuit key C CKT to talk with the operator.

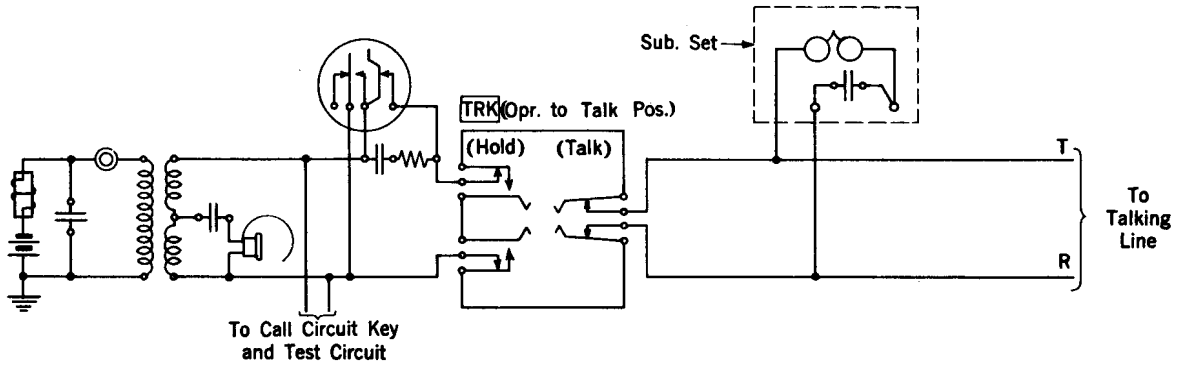

Fig. 6 - Telephone, Talking Line and Call Circuit

5. METHOD OF PERFORMING TESTS

Checking the Test Battery Voltages

5.01 To check the 100-volt test battery operate the VM REV key. See Fig. 8. The meter should indicate a voltage between 99 and 101 volts. If only five batteries are in use, add the sixth when required. To check the 20-volt tap operate the 20,000 and the VM REV key. The voltage should not be greater than 21 volts. Restore the 20,000 key and operate the 1000 key. The voltage should not be less than 19 volts after 10 seconds drain. Make adjustments as required with the taps on the battery.

5.02 To check the voltage of the test batteries associated with the +STA and -STA keys, operate the VM REV key and the +STA or -STA key to check the associated positive or negative battery, respectively. The battery voltages should be within the limits shown on the test set circuit drawing.

Voltmeter Test

5.03 Set up the connection to the subscriber line. Fig. 7 shows the connection for the voltmeter test. (In case the subscriber line is equipped with one or more tube type subscriber sets, operate the 20,000 key as the presence of the tube on the line will probably affect the results if the 100-volt test battery is used.) No test should be made until the needle of the instrument comes to rest. To make a voltmeter test, proceed as follows:

(a) Operate the G Key - Disregard any throw (ballistic deflection) of the voltmeter needle. Also, disregard any steady deflection within the prescribed limits.

(b) Operate the REV Key - Observe the throw and the steady deflection (if any). The steady deflection indicates the insulation resistance of the tip side of the line and should be within the limits prescribed locally. The insulation resistance may be obtained from Table 1 or 2.

(c) Restore the REV Key - Observe the throw and the steady deflection (if any). The steady deflection indicates the insulation resistance of the ring side of the line and should be within the limits prescribed locally. The insulation resistance may be obtained from Table 1 or 2.

(d) Restore the G Key - When the proper throw is obtained and the steady deflection is within the limits prescribed locally, the line is O.K. Table 7 shows the amount of ballistie deflection for various line conditions and subscriber set types and combinations. It should be noted in this connection that the ballistic deflection is dependent upon the insulation resistance of the line.

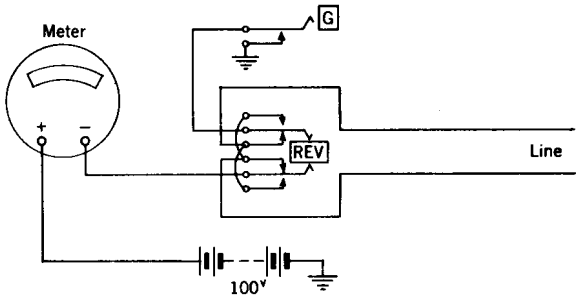

Fig. 7 - Operation of G and REV Keys

5.04 The throw associated with the operation and restoration of the REV key depends upon the type of circuit under test. The following is a description of the action which should take place under various circuit conditions.

(a) Condenser across Tip and Ring: See Fig. 7. The operation of the G key connects ground to the tip side of the line and allows current to flow from the test battery through the winding of the voltmeter to charge the condenser. The momentary flow of current causes a momentary deflection, or "throw" of the voltmeter needle. The operation of the REV key reverses the line causing the condenser to discharge in series with the test battery and voltmeter, and immediately recharge with a polarity opposite to the original charge. This operation causes a "throw" of the needle approximately twice as great as when the G key was operated at the beginning of the test. The increased "throw" is due to the combined effect of the test battery and the charged condenser. The restoration or any subsequent operation of the REV key results in like manner in the same increased deflection. The extent of the "throw" is proportional to the capacity of the condenser. Table 7 at the end of the section shows the approximate "throw" (ballistic deflection) for various station connections and for different gauges and lengths of cable and for various values of line insulation resistance. The values given on the table are approximate only and are to be used as a guide for the results that may be obtained from various

voltmeters and line conditions. The capacity of the subscriber line is not considered in these figures. The values given for cables are for cable pairs that are open at the distant end.

(b) Condenser Connected between the Ring Side of the Line and Ground: See Fig. 7. When the test circuit is connected to the line, current flows through the winding of the volt-milliammeter and charges the condenser. As previously stated, however, no attention should be paid to any deflection of the volt-milliammeter incident to establishing the testing connection. The operation of the G key has no effect on the circuit. The operation of the REV key with the G key operated, connects ground to the ring side of the line and discharges the condenser. This action is not indicated by the volt-milliammeter. The restoration of the REV key causes current to again flow through the winding of the volt-milliammeter and recharge the condenser. The recharge of the condenser is indicated by a momentary deflection of the voltmeter needle. The extent of the deflection is proportional to the capacity connected between the ring side of the line and ground. The ballistic deflection, Table 7, includes values for station connections with a condenser from one side of the line to ground. In testing a condenser connected between the ring side of the line and ground, the important operation is the restoration of the REV key.

(c) Condenser Connected between the Tip Side of the Line and Ground: The action is the same as when the condenser is connected between the ring side of the line and ground except that the condenser is charged through the meter when the REV key is operated and discharged to ground when the REV key is restored.

5.05 Test of One Side of the Line to Ground Using the RCCI Key:

(a) Condenser Connected between the Ring Side of the Line and Ground: A condenser connected between the ring side of the line and ground may, in addition to the method outlined in 5.04(b), also be tested by the RCCI method. This method is particularly useful in determining the degree of capacity unbalance to ground on a cable pair since it gives relatively large ballistic indications and since the effect of the mutual capacity between conductors is minimized. Operate the RCCI key, thereby permitting a current flow from the central office 24 (or 38)-volt negative battery through the winding of the milliammeter to the ring side of the line charging the condenser to a negative potential of 24 (or 38) volts. Restore the RCCI key. This operation connects 100-volt positive battery to the condenser in series with the 100,000-ohm winding of the voltmeter, discharging the condenser and immediately recharging it to a potential of 100 volts. The extent of the voltmeter throw is proportional to the capacity of the condenser. This method results in a larger deflection than the method outlined in 5.04(b) because of the combined action of the 24 (or 38)-volt negative charge in the condenser and the 100-volt positive potential of the test battery. In testing a condenser between one side of the line to ground, the important operation is the restoration of the RCCI key.

(b) Condenser Connected between the Tip Side of the Line and Ground: The action is the same as when the condenser is connected between the ring side of the line and ground except that the REV key should first be operated and the condenser is charged through the meter when the RCCI key is operated and discharged to ground when the RCCI key is restored.

5.06 If during operations (a) to (d) in 5.03, the steady deflection of the voltmeter needle does not come within the prescribed limits, proceed as follows:

(a) Restore all keys to normal - See Fig. 7. If a steady deflection is obtained with all keys normal, a ring ground is indicated. Current flows through the winding of the volt-milliammeter to the ring side of the line to ground.

(b) Operate the REV key - See Fig. 7. If a steady deflection is obtained, a tip ground is indicated. Current flows through the winding of the volt-milliammeter to the tip side of the line to ground.

(c) Operate the G key - See Fig. 7. If a steady deflection is obtained, a tip and ring cross is indicated. Current flows through the winding of the volt-milliammeter to the tip side of the line, through the cross to the ring side of the line to ground at the G key.

Resistance Measurements with Volt-Milliammeter

5.07 Connect the circuit under test to the T jack in the cabinet. With no keys operated, 100-volt battery through 100,000 ohms and the meter is connected to the ring side of the test circuit. See Fig. 8. Operate the REV key to connect to the tip side.

5.08 Measurements with Voltmeter: Resistance measurements with the voltmeter are most accurate when the resistance of the meter is equal to the unknown resistance. In that case, the meter reads half the test battery voltage. Note the reading with all keys normal. Operate and restore in succession the 20,000 key and the 1000 key, noting the readings, to find the connection that gives nearest to half the test battery voltage. The conditions of the test circuit are as follows:

Key Operated	Meter Scale	Meter Resistance	Battery Voltage
None	0-150	100,000 ohms	100 volts
20,000	0-30	20,000 ohms	20 volts
1000	0-30	1000 ohms	20 volts

From the meter reading determine the resistance as given in Table 1, 2 or 3 at the end of this section. See Fig. 8. For the method of calculating the resistance refer to Section F54.121.

5.09 Resistance measurements with the voltmeter are affected by foreign potentials, especially when the 20-volt test battery is used. To obtain an accurate reading if there is any potential on the conductor, note the first reading with the voltmeter as E_1. Then operate the FEMF key (also the VM REV key if the needle moves to the left). If the VM REV key is normal, note the second reading as $-E_2$, if the key is operated, as $+E_2$. (All readings to be on same scale.) Then $E_1 \pm E_2$ is the value of "Meter Reading" to be used for determining the resistance from the tables.

5.10 When making resistance measurements using the 100-volt test battery on lines having tube type subsets connected, readings of less than 45 volts should not be considered as they may be affected by current flowing through the tube. Ordinarily, satisfactory measurements can be made using the 20-volt test battery and the 20,000-ohm winding.

5.11 Measurements with Milliammeter: For resistances of 200 ohms or less use the milliammeter. See Fig. 8. Operate the RCCI key to connect the central office battery through the meter to the ring side of the test circuit. Operate REV key to connect to the tip side. From the meter reading determine the resistance as given in Table 4, 5 or 6 at the end of this section according to the voltage of the office battery. To check the central office battery voltage to determine which column is to be used on the resistance tables, patch the T jack to the BAT G jack when the cabinet is permanently located or to the battery supply jack when the cabinet is not permanently wired to the central office battery. Operate the REV and FEMF keys to read the voltage on the voltmeter. In a 24-volt office, also operate the 1000 key.

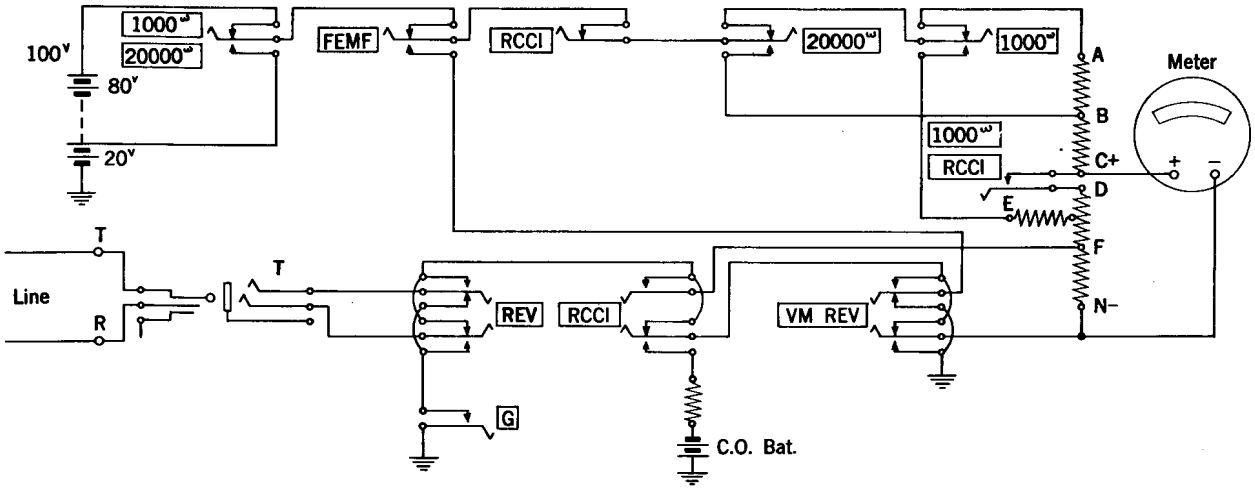

Fig. 8 - Test Connections with Volt-Milliammeter

Cross with Central Office Battery, Foreign Potential or Earth Potential

5.12 If during the operations outlined in 5.06 a voltmeter reading in excess of the test battery voltage is obtained, a cross with central office battery, foreign potential or earth potential is indicated. A deflection of less than the test battery voltage may also indicate a cross with foreign potential but usually it indicates a leakage to ground or between conductors.

5.13 To determine whether a potential exists on a circuit, operate the FEMF key, which connects the test circuit through the meter to ground instead of to the test battery. See Fig. 8. If the foreign potential is negative the voltmeter needle will be deflected to the right. If it is positive, the needle will tend to deflect to the left of zero. In this case, operate the VM REV key to reverse the connections of the voltmeter to obtain a reading to the right of zero. The 20,000 and 1000 keys can also be used with the FEMF key for foreign potentials of less than 30 volts.

Test for Cross between Lines

5.14 To test for a cross between two lines establish a test connection to the first line through jack T, and to the second line through jack G. A deflection indicates that the ring of the first line is crossed with the tip or ring of the second line. Operate the REV key to check the tip side of the first line. See Fig. 9. This test is effective only when each line is free from grounds.

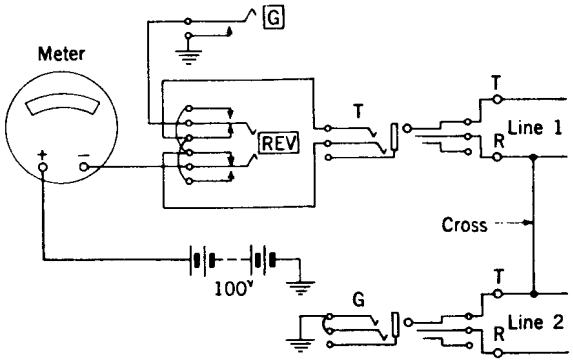

Fig. 9 - Test for Cross between Lines

Third Wire Test

5.15 To test the sleeve of a subscriber line for a cross with another line or for a cross with battery or ground operate the 3WT key. See Fig. 10. This disconnects the central office battery or ground from the test circuit sleeve and connects the voltmeter circuit to the sleeve for making the desired test. The 20,000, 1000 and VM REV keys can be used in this test. Central office battery through the milliammeter cannot be connected to the sleeve.

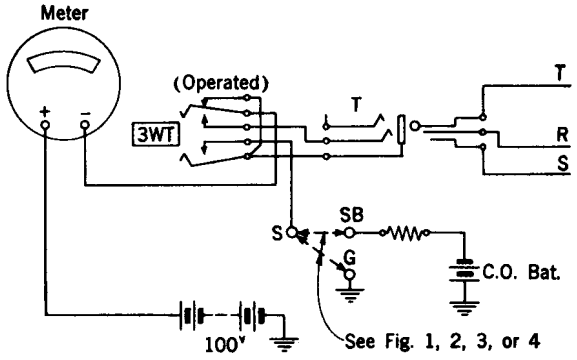

Fig. 10 - Third Wire Test

Check of Central Office Subscriber Line Circuit

5.16 Line with Battery on Ring, Ground on Tip: The check for the proper operation of the line circuit in a manual or a step-by-step office is made with the line connected to test jack T. This test does not apply in a panel office. See Note in 3.07. After connection to the subscriber line is established, operate the third wire open key 3WO to cause the release of the cutoff relay and the connection of the line relay to the line. Make a voltmeter test to determine the proper electrical condition on the tip and ring of a line with the line relay connected to the line.

5.17 Operate the T key to connect the telephone induction coil in series with a resistance across the tip and ring of the test circuit through the T and 3WO keys. See Fig. 11. When the line is thus bridged the line relay should operate and be indicated by the answering of the switchboard operator or by reception of dial tone.

5.18 Restore the T key to release the line relay and the 3WO key to operate the cutoff relay.

5.19 Line with Battery on Tip, No Ground on Ring: The check of this type of line is the same as described in 5.16 to 5.18 except that the LRP key is also operated. The operation of the LRP key connects ground through a resistance to the tip of the circuit causing the operation of the line relay.

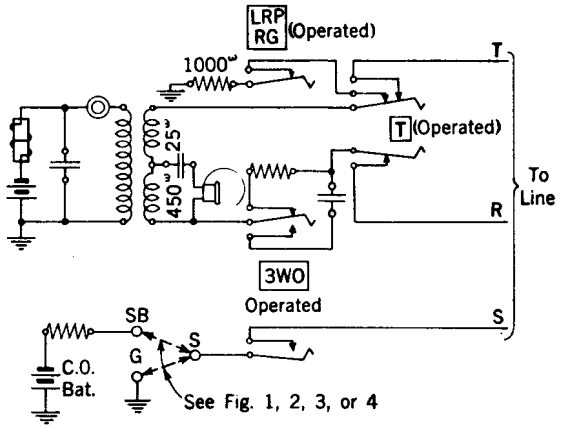

Fig. 11 - Check of Central Office Subscriber Line Circuit

5.20 Line with Battery on Ring, No Ground on Tip: The check of this type of line is the same as described in 5.19 except that the REV key is also operated to connect the ground through the LRP key to the ring side of the line.

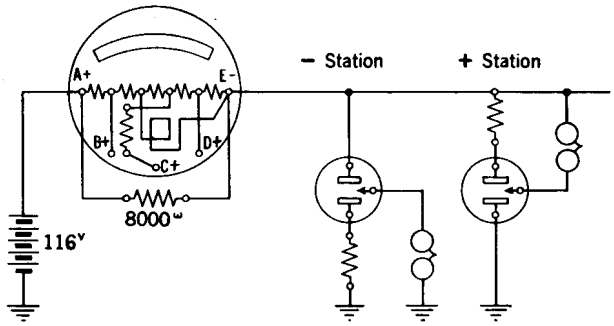

Fig. 12 - Test for Positive Tube Type Station

Tube Type Subscriber Set Test

5.21 Test on Ring Side of Line: With all keys normal, observe the reading of the voltmeter. If the reading is 67 volts or more, the test cannot be made due to the low insulation resistance (50,000 ohms or less).

5.22 Note whether the voltmeter reading is over or under 45 volts (125,000 ohms line insulation resistance).

5.23 To test for a positive station, operate the +STA key; for a negative station, operate the -STA key. See Fig. 12 for a schematic of the connections with the +STA key operated. Note the reading of the meter.

5.24 A reading of less than 17 volts (120-volt scale) indicates that a station of the polarity tested for is not connected to the side of the line being checked. A reading of 24 volts or more indicates the station checked for is connected.

5.25 A reading between 17 and 24 volts indicates that the station tested for is connected if the initial reading was less than 45 volts. In case the initial reading was over 45 volts, only readings of 24 volts or more are an indication of the station.

5.26 Test on Tip Side of Line: To test for stations on the tip side of the line, operate the REV key and follow the same procedure as outlined for the ring side.

Note: If, as on an 8-party line, two stations of the same polarity are connected to the same side of the line, it will be necessary to ring each of them and check with the subscriber. The voltmeter test indicates that at least one station of the polarity tested for is connected, but does not distinguish between one and two stations.

Cold Cathode Tube Visual Indicators

5.27 General: If the test desk is equipped with the tube type subscriber set testing feature, it shall be used to check for the presence of such equipment (103A key equipment, 21-type indicators or similar equipment). Use the +STA key when testing for 21-type indicators and the -STA key for 103A key equipment. The same voltmeter deflection limits apply as for any 4-party tube test except that a reading of 17 volts or more always indicates the presence of a tube regardless of the leak resistance, provided that the initial reading on the 100,000w scale was not more than 67 volts.

5.28 If a ballistic test is made the throw of the voltmeter needle will be approximately the same as would be obtained if the steady deflection were caused by a leak resistance with no discharge tube on the line. This throw of the needle due to station capacity will indicate continuity to the station (the first station in the case of party lines).

5.29 In making the test for 103A key equipment, with the G key operated and all other test keys normal, the discharge tube will operate and cause a steady deflection of approximately 12.5 to 25 volts if there is no appreciable leak on the line. If there is a leak on the line in the range of 150,000 to 300,000

ohms, the steady deflection may be as high as 45 volts. Readings above 45 volts are due entirely to leak as the tube will not be operated. Satisfactory measurements of leak resistances can generally be made using the 20-volt test battery and 20,000-ohm winding.

5.30 In making the test for the 21-type indicator on

(a) an individual line or a P.B.X. extension (with the G key operated and all other test keys normal),

(b) the ring station of a 2-party line (with no test keys operated),

(c) the tip station of a 2-party line (REV key operated if line under test is the ring party),

the discharge tube in the 21-type indicator will operate and cause a steady deflection of between 25 and 45 volts. Readings below 25 volts or above 45 volts are due entirely to leak as the tube will not be operated. Satisfactory measurements of leak resistance can generally be made using the 20-volt test battery and 20,000-ohm winding.

Supplying Talking Battery and Talking on Test Circuit

5.31 When it is necessary to supply talking battery through the test circuit, operate the T and RCCI keys. This supplies central office battery through the repeating coil and milliammeter to the ring side and ground through the repeating coil to the tip side of the line. Observe the meter for supervision on the line. See Fig. 13.

Transmission Tests

5.32 To make a transmission test with a repairman or a subscriber at a station, operate the RCCI and TMT keys. The former key supplies battery and ground to the line and the latter cuts in a network consisting of series resistances and a bridged condenser between the repeating coil and the induction coil to increase the transmission loss so that the transmission level is about equal to that received by the subscriber on a toll connection. See Fig. 14.

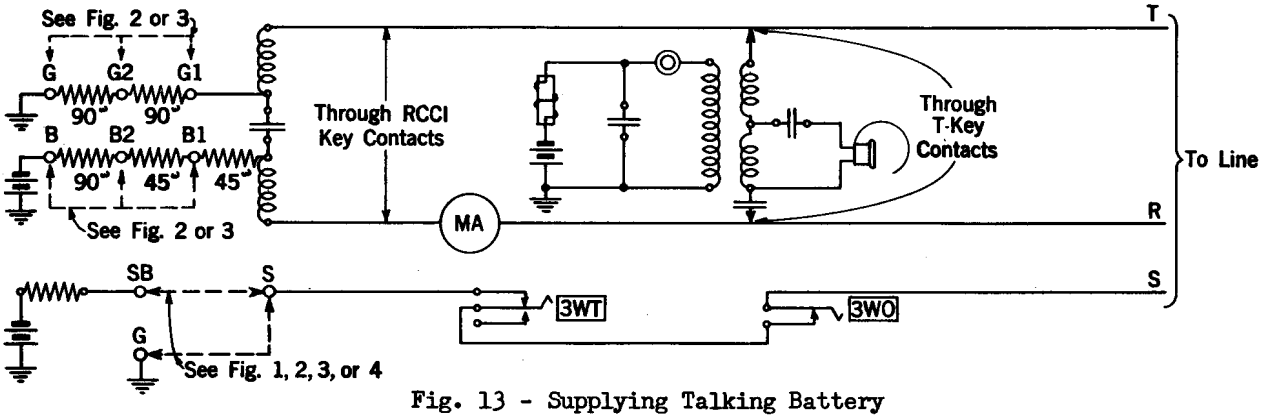

Fig. 13 - Supplying Talking Battery

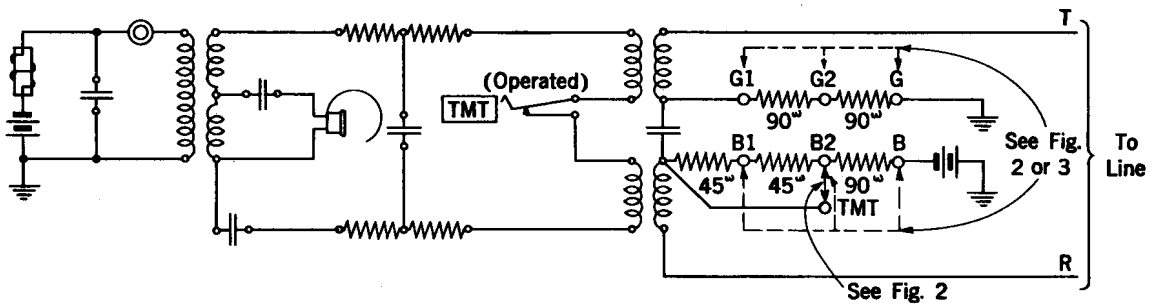

Fig. 14 - Transmission Test

5.33 Proceed with the test by talking to the person at the station and observe the following:

(a) Talk directly into the transmitter and not across or around it.

(b) The lips should almost touch the mouthpiece.

(c) The tone of voice should be a natural conversational tone, neither too low nor too soft, and therefore one that can be maintained during the course of the day. Supervision should be given to the person at the station to insure his talking directly into the transmitter at all times.

In judging the conversation, consider the following:

(a) Necessity for repetition.

(b) Volume.

(c) Quality, that is, the distinctness or clarity of the conversation. Quality may be poor on transmitters even though the volume is good or vice versa.

Note: When the cabinet is strapped for a 24-volt office the resistance in series with the repeating coil winding is reduced and if there is a ground on the ring side of the circuit at the central office, the current might be sufficient to damage the milliammeter. The tester should, therefore, take precautions against operating the TMT key unless the line tests clear of ground.

5.34 To Test the Station Transmitter and Cords for Burning: Restore the TMT key and operate the T key. Request the craftsman at the station to listen for burning noises while he shakes the cords and checks the transmitter by blowing gently into it. The test deskman should also listen.

Coin Collector Relay Test

5.35 Operate the CC (coin collect) or the CR (coin return) key to operate the coin relay at a coin collector station. Make a voltmeter test of the tip side of the line. If the tip side tests clear of ground, the proper operation of the coin relay is indicated.

IN and OUT Testing

5.36 When test connections are established to a line with the four-conductor cord at the distributing frame, operate the IN key to connect the test circuit to the central office side of the circuit and the OUT key to connect to the conductors outside the office. When the line is not to be opened, connect with a two-conductor cord and operate the OUT key.

Ringing Features

5.37 The ringing current is normally supplied to the ring side of the line when the ringing key is operated. By operating the REV key and then the ringing key, ringing current is supplied to the tip side of the line.

To Ring Bells on a Party Line Having a Receiver Off the Hook

5.38 Use the remove-ground key RG LRP to disconnect the ringing ground from the line in order to ring the bells on a party line on which the ringers are connected to ground. Operate the RG LRP key, then the ringing key to attract the attention of a subscriber who has left his receiver off the hook. This applies whether the ringers are connected through condensers or through cold cathode tubes but does not apply to lines equipped with relay type subscriber sets.

TABLE 1

100,000-OHM WINDING - 150 VOLT SCALE

Meter Reading (Volts)	Resistance Test Battery Voltage 99	100	101	Meter Reading (Volts)	Resistance Test Battery Voltage 99	100	101
100		0	1,000	50	98,000	100,000	102,000
98	1,020	2,040	3,061	48	106,200	108,300	110,400
96	3,125	4,166	5,208	46	115,200	117,400	119,600
94	5,319	6,382	7,446	44	125,000	127,300	129,500
92	7,608	8,695	9,782	42	135,700	138,100	140,500
90	10,000	11,110	12,220	40	147,500	150,000	152,500
88	12,500	13,640	14,770	38	160,500	163,200	165,800
86	15,120	16,280	17,440	36	175,000	177,800	180,600
84	17,860	19,050	20,240	34	191,200	194,100	197,100
82	20,730	21,950	23,170	32	209,400	212,500	215,600
80	23,750	25,000	26,250	30	230,000	233,300	236,700
78	26,920	28,200	29,490	28	253,600	257,100	260,700
76	30,260	31,580	32,890	26	280,800	284,600	288,500
74	33,780	35,130	36,490	24	312,500	316,700	320,800
72	37,500	38,890	40,280	22	350,000	354,500	359,100
70	41,430	42,860	44,280	20	395,000	400,000	405,000
68	45,590	47,060	48,530	18	450,000	455,600	461,100
66	50,000	51,510	53,030	16	518,700	525,000	531,300
64	54,690	56,250	57,810	14	607,100	614,300	621,400
62	59,680	61,290	62,900	12	725,000	733,300	741,700
60	65,000	66,670	68,330	10	890,000	900,000	910,000
58	70,690	72,410	74,140	8	1,137,000	1,150,000	1,162,000
56	76,780	78,570	80,360	6	1,550,000	1,367,000	1,583,000
54	83,330	85,180	87,040	4	2,375,000	2,400,000	2,425,000
52	90,380	92,310	94,230	2	4,850,000	4,900,000	4,950,000

Note: On subscriber lines with tube type subsets, readings of less than 45 volts should not be considered. See 5.10.

TABLE 2

20,000-OHM WINDING - 30 VOLT SCALE

Meter Reading (Volts)	Resistance Test 19.4	Resistance Battery 20	Resistance Voltage 20.6	Meter Reading (Volts)	Resistance Test 19.4	Resistance Battery 20	Resistance Voltage 20.6
20		0	600	10.0	18,800	20,000	21,200
19.6		408	1,020	9.6	20,420	21,670	22,920
19.2	208	833	1,458	9.2	22,170	23,480	24,780
18.8	638	1,276	1,914	8.8	24,090	25,450	26,820
18.4	1,086	1,739	2,392	8.4	26,190	27,620	29,050
18.0	1,556	2,222	2,888	8.0	28,500	30,000	31,500
17.6	2,046	2,727	3,410	7.6	31,050	32,630	34,210
17.2	2,558	3,255	3,954	7.2	33,890	35,560	37,220
16.8	3,096	3,809	4,524	6.8	37,060	38,820	40,590
16.4	3,658	4,390	5,122	6.4	40,620	42,500	44,380
16.0	4,250	5,000	5,750	6.0	44,670	46,670	48,670
15.6	4,872	5,641	6,410	5.6	49,290	51,430	53,570
15.2	5,526	6,315	7,106	5.2	54,620	56,920	59,230
14.8	6,236	7,027	7,838	4.8	60,830	63,330	65,830
14.4	6,944	7,777	8,612	4.4	68,180	70,910	73,640
14.0	7,714	8,571	9,428	4.0	77,000	80,000	83,000
13.6	8,530	9,411	10,290	3.6	87,780	91,110	94,450
13.2	9,394	10,300	11,210	3.2	101,200	105,000	108,800
12.8	10,310	11,250	12,260	2.8	118,600	122,900	127,100
12.4	11,290	12,260	13,230	2.4	141,700	146,700	151,700
12.0	12,330	13,330	14,330	2.0	174,000	180,000	186,000
11.6	13,450	14,480	15,520	1.6	222,500	230,000	237,500
11.2	14,640	15,710	16,790	1.2	303,300	313,300	323,300
10.8	15,930	17,040	18,150	.8	465,000	480,000	495,000
10.4	17,310	18,460	19,620	.4	950,000	980,000	1,010,000

TABLE 3

1,000-OHM WINDING 30 VOLT SCALE

20.0		0	30	10.0	940	1,000	1,060
19.6		20	51	9.6	1,021	1,083	1,146
19.2	10	42	73	9.2	1,109	1,174	1,239
18.8	32	63	96	8.8	1,205	1,273	1,341
18.4	54	87	120	8.4	1,310	1,381	1,452
18.0	78	111	144	8.0	1,425	1,500	1,575
17.6	102	136	171	7.6	1,553	1,632	1,711
17.2	128	163	198	7.2	1,694	1,778	1,861
16.8	155	190	226	6.8	1,853	1,941	2,029
16.4	183	220	256	6.4	2,031	2,125	2,219
16.0	213	250	288	6.0	2,233	2,333	2,433
15.6	244	282	321	5.6	2,464	2,571	2,679
15.2	276	316	355	5.2	2,731	2,846	2,962
14.8	312	351	392	4.8	3,042	3,167	3,292
14.4	347	389	431	4.4	3,409	3,545	3,682
14.0	386	428	471	4.0	3,850	4,000	4,150
13.6	427	471	515	3.6	4,389	4,556	4,722
13.2	470	515	561	3.2	5,062	5,250	5,438
12.8	516	563	613	2.8	5,929	6,143	6,357
12.4	565	613	661	2.4	7,083	7,333	7,583
12.0	617	667	717	2.0	8,700	9,000	9,300
11.6	672	724	776	1.6	11,130	11,500	11,880
11.2	732	786	839	1.2	15,170	15,670	16,170
10.8	796	852	907	.8	23,250	24,000	24,750
10.4	865	925	981	.4	47,500	49,000	50,500

TABLE 4

MILLIAMMETER SCALE

24 VOLT OFFICE BATTERY

(65 Ohms Circuit Resistance)

Meter Reading (Milamperes)	Resistance Central Office Battery Voltage 21.6	24.0	26.4	Meter Reading (Milamperes)	Resistance Central Office Battery Voltage 21.6	24.0	26.4
375			5.4	185	51.7	64.7	77.7
370		0	6.3	180	55.0	68.2	81.7
365		.7	7.3	175	58.3	72.1	85.8
360		1.7	8.3	170	62.0	76.1	90.2
355		2.6	9.3	165	65.9	80.4	95.0
350		3.6	10.4	160	70.0	85.0	100.0
345		4.6	11.5	155	74.3	89.7	105.3
340		5.7	12.7	150	79.0	95.0	111.0
335	0	6.7	13.8	145	84.0	100.5	117.1
330	.5	7.7	15.0	140	89.3	106.4	123.6
325	1.4	8.8	16.2	135	95.0	112.8	130.6
320	2.5	10.0	17.5	130	101.2	119.6	138.1
315	3.6	11.2	18.8	125	107.8	127.0	146.2
310	4.7	12.4	20.2	120	115.0	135.0	155.0
305	5.8	13.7	21.6	115	122.8	143.7	164.6
300	7.0	15.0	23.0	110	131.4	153.2	175.0
295	8.2	16.3	24.4	105	140.7	163.6	186.4
290	9.5	17.8	26.1	100	151.0	175.0	199.0
285	10.8	19.2	27.7	95	162.4	187.6	212.9
280	12.2	20.7	29.3	90	175.0	201.7	228.3
275	13.6	22.3	31.0	85	189.1	217.4	245.6
270	15.0	23.9	32.8	80	205.0	235.0	265.0
265	16.5	25.6	34.6	75	223.0	255.0	287.0
260	18.1	27.3	36.4	70	243.6	277.9	312.1
255	19.7	29.2	38.4	65	267.3	304.2	341.2
250	21.4	31.0	40.5	60	295.0	335.0	375.1
245	23.2	33.0	42.7	55	327.7	371.4	415.0
240	25.0	35.0	45.0	50	367.0	415.0	463.0
235	26.8	37.0	47.2	45	415.0	468.3	521.7
230	28.8	39.3	49.7	40	475.0	535.0	595.0
225	30.9	41.7	52.2	35	552.1	620.7	689.3
220	33.2	44.0	55.0	30	655.0	735.0	815.0
215	35.3	46.6	57.7	25	799.0	895.0	991.0
210	37.7	49.3	60.7	20	1015.	1135.	1255.
205	40.2	52.0	63.7	15	1375.	1535.	1695.
200	43.0	55.0	67.0	10	2095.	2335.	2575.
195	45.8	58.1	70.3	5	4255.	4735.	5215.
190	48.7	61.3	73.9	0			

TABLE 5

MILLIAMMETER SCALE

38 VOLT OFFICE BATTERY

(110 Ohms Circuit Resistance)

Meter Reading (Milamperes)	Resistance Central Office Battery Voltage 34.2	38	41.8	Meter Reading (Milamperes)	Resistance Central Office Battery Voltage 34.2	38	41.8
375			1.5	185	74.9	95.4	115.9
370			3.0	180	80.0	101.1	122.2
365			4.5	175	85.4	107.1	128.9
360			6.1	170	91.2	113.5	135.9
355			7.7	165	97.3	120.3	143.3
350			9.4	160	103.8	127.5	151.3
345		0	11.2	155	110.6	135.2	159.7
340		1.8	12.9	150	118.0	143.3	168.7
335		3.4	14.8	145	125.9	152.1	178.3
330		5.2	16.7	140	134.3	161.4	188.6
325		6.9	18.6	135	143.3	171.5	199.6
320		8.7	20.6	130	153.1	182.3	211.5
315		10.6	22.7	125	163.6	194.0	224.4
310	0	12.6	24.8	120	175.0	206.7	238.3
305	2.1	14.6	27.1	115	187.4	220.4	253.5
300	4.0	16.7	29.3	110	200.9	235.5	270.0
295	5.9	18.8	31.7	105	215.7	251.9	288.1
290	7.9	21.0	34.1	100	232.0	270.0	308.0
285	10.0	23.3	36.7	95	250.0	290.0	330.0
280	12.1	25.7	39.3	90	270.0	312.2	354.5
275	14.4	28.2	42.0	85	292.4	337.1	381.8
270	16.7	30.7	44.8	80	317.5	365.0	412.5
265	19.1	33.4	47.7	75	346.0	396.7	447.3
260	21.5	36.2	50.8	70	378.6	432.9	487.1
255	24.1	39.0	53.9	65	416.2	474.6	533.1
250	26.8	42.0	57.2	60	460.0	523.3	586.7
245	29.6	45.1	60.6	55	511.8	580.9	650.0
240	32.5	48.3	64.2	50	574.0	650.0	726.0
235	35.5	51.7	67.9	45	650.0	734.4	818.9
230	38.7	55.2	71.7	40	745.0	840.0	935.
225	42.0	58.9	75.8	35	867.2	976.	1084.
220	45.5	62.7	80.0	30	1030.	1157.	1283.
215	49.1	66.7	84.4	25	1258.	1410.	1562.
210	52.9	71.0	89.1	20	1600.	1790.	1980.
205	56.8	75.4	93.9	15	2170.	2423.	2677.
200	61.0	80.0	99.0	10	3310.	3690.	4070.
195	65.4	84.9	104.4	5	6730.	7490.	8250.
190	70.0	90.0	110.0	0			

TABLE 6

MILLIAMMETER SCALE

48 VOLT OFFICE BATTERY

(200 Ohms Circuit Resistance)

Meter Reading (Milamperes)	Resistance Central Office Battery Voltage 47	48.5	50
250			0
245			4.1
240		2.1	8.3
235	0	6.4	12.8
230	4.3	10.9	17.4
225	8.9	15.6	22.2
220	13.6	20.5	27.3
215	18.6	25.6	32.6
210	23.8	31.0	38.1
205	29.3	36.6	43.9
200	35.0	42.5	50.0
195	41.0	48.7	56.4
190	47.4	55.1	63.2
185	54.1	62.2	70.3
180	61.1	69.4	77.8
175	68.6	77.1	85.7
170	76.5	85.3	94.1
165	84.9	93.9	103.0
160	93.8	103.1	112.5
155	103.2	112.9	122.6
150	113.3	123.3	133.3
145	124.1	134.5	144.8
140	135.7	146.4	157.1
135	148.2	159.3	170.4
130	161.5	173.1	184.6
125	176.0	188.0	200.0
120	191.7	204.2	216.7
115	208.7	221.7	234.8
110	227.3	240.9	254.6
105	247.6	261.8	276.2
100	270.0	285.0	300.0
95	294.7	310.5	326.3
90	322.2	338.9	355.6
85	352.9	370.6	388.2
80	387.5	406.2	425.0
75	426.7	446.7	466.7
70	471.4	492.9	514.3
65	523.1	546.2	569.2
60	588.3	608.3	633.3
55	654.6	681.8	709.1
50	740.0	770.0	800.0
45	844.	878.	911.
40	975.	1013.	1050.
35	1143.	1186.	1229.
30	1367.	1417.	1467.
25	1680.	1740.	1800.
20	2150.	2225.	2300.
15	2933.	3033.	3133.
10	4500.	4650.	4800.
5	9200.	9500.	9800.
0			

TABLE 7

BALLISTIC DEFLECTIONS

USING THE 100,000 OHM VOLTMETER

These values are approximate only and are based on zero subscriber loop.

Type of Line	Equipment on Line		Ballistic Deflection of Needle Insulation Resistance of Line: Infinite Ohms	500,000 Ohms	200,000 Ohms	100,000 Ohms	50,000 Ohms
Individual line	No. 68-A (1,400 ohms) ringer with 1-mf. condenser bridged across line.		50	52	57	63	72
Individual line	No. 8-AA (1,000 ohms) ringer with 2-mf. condenser bridged across line.		76	73	72	74	78
Two-party Message Rate, or Two-party Flat Rate	No. 68-AA (1,000 ohms) or No. 68-A (1,400 ohms) ringer in series with 1-mf. condenser legged from one side of line to ground.		25	35	45	56	70
Two-party	No. 8-AA (1,000 ohms) ringer in series with 2-mf. condenser legged from one side of line to ground.		38	45	53	62	72
Four-party Semi-Selective	No. 68-A (1,400 ohms) ringer in series with 1-mf. condenser, two stations legged from one side of line to ground.		39	46	53	62	72
Four-party Semi-Selective	No. 8-AA (1,000 ohms) ringer in series with 2-mf. condenser, two stations legged from one side of line to ground.		53	57	62	68	75
Four-party Full-Selective	No. 85 Type relay in series with .5-mf. condenser bridged across line.	1 Station	31	38	47	57	70
		2 Stations	52	54	58	65	73
		3 Stations	66	66	67	70	76
		4 Stations	77	75	74	75	79
Four-party Full-Selective	No. 85 Type relay in series with 1-mf. condenser bridged across line.	1 Station	50	52	57	63	72
		2 Stations	76	74	73	74	78
		3 Stations	93	88	84	82	83
		4 Stations	106	98	92	88	86
Four-party Full-Selective	No. 85 Type relay in series with 2-mf. condenser bridged across line.	1 Station	75	73	72	74	78
		2 Stations	103	96	91	87	86
		3 Stations	120	110	103	96	91
		4 Stations	132	120	110	102	95
Cable Values are for open loops							
No. 19 and 22-Gauge Cable		5 Miles	23	32	42	55	68
		10 Miles	38	44	51	60	71
		15 Miles	48	52	57	64	73
		20 Miles	56	58	62	68	75
		25 Miles	62	63	66	71	77
		30 Miles	66	68	70	73	78
No. 24-Gauge Cable		5 Miles	22	31	42	55	68
		10 Miles	35	42	50	59	71
		15 Miles	45	50	56	63	73
		20 Miles	52	56	60	66	75
		25 Miles	58	60	64	70	76
		30 Miles	62	64	67	71	77