STROMBERG-CARLSON

TYPE E LOCAL & TOLL TEST PANEL

operation manual

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS CORPORATION

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STROMBERG-CARLSON

TYPE "B" LOCAL AND TOLL TEST PANEL

OPERATION MANUAL

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STROMBERG-CARLSON

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Section I. GENERAL

1. INTRODUCTION

The Stromberg-Carlson Type "E" Local and Toll Test Panel (further referred to as "test panel") is designed to facilitate testing of local and toll lines and trunks and miscellaneous equipment. The types of tests which can be made with the test panel are listed below.

a. Resistance tests.

b. Capacitance tests.

c. Foreign battery tests.

d. Transmission tests.

e. Coin control.

f. Pulse speed and percent make tests.

g. Toll signaling tests (dial leg).

h. AC voltages measurements.

i. Current measurements.

The test panel also provides facilities to aid in clearing line faults. These facilities consist of the howler circuit, sounder circuit and connections for the Wheatstone Bridge. Tests can be made over the following paths:

a. Inspector's trunks.

b. Order wire trunks.

c. Test switch train.

d. Test shoe.

e. Test cord through jack field section.

f. Binding posts.

This bulletin discusses all equipment which may be found on the test panel. The reader should refer only to that equipment which is supplied with his own particular test panel. Figures 1, 2, 3 and 4 illustrate the test panel. The circled numbers on the illustrations are used to associate the control or instrument to the paragraph number in this bulletin which discusses the use of the particular control or instrument.

2. DESCRIPTION (Fig. 1)

The Type "E" Local and Toll Test Panel mounts on an 8- or 9-foot frame which includes the test desk portion of the test panel and the jack field section. Both the 8- and 9-foot test panels can be increased to reach a total height of 11 foot 6 inches (by the use of a special addition) where ceiling height permits. Figure 1 illustrates a typical Type "E" Test Panel without the addition.

3. FACE EQUIPMENT (Fig. 2)

Across the top of the face equipment is a space for miscellaneous equipment, the sounder, and the fuse panel. Below these are two panels A and B. Each panel contains part of the jack field section on the upper portion and the trunk switches on the lower portion. Below the two panels, mounted on the piling rail, are the coin collect (CC) and coin return (CR) lamps, the night alarm (NA) switch, the howler (HLR) lamp; positive-negative (P-N), hi-low (H-L), differential duplex (DIFF DUP), coin current (COIN CUR), polar leg (POL LEG), and polar balance (POL BAL), rheostats, the sounder lamp, sounder jack, the SDR SW (sounder switching) key, and the SDR REV (sounder reverse) key. The jack field section is described below.

4. JACK FIELD SECTION

The jack field section terminates the test jacks of toll trunks. Because of the unlimited possible combinations which may appear in the jack field, only the four common appearances will be discussed in this paragraph. These four appearances are the basic test terminations from which deviations are made to meet local requirements. Since changes are common, consult your Stromberg-Carlson representative for operating instructions on jacks not covered in this manual. The four combinations explained below are: Phantom Group Operation; Simplex Operation; Carrier Operation; and Interoffice, Tandem, and Loop trunks.

a. Phantom Groups. The phantom group consists of three sets of jacks; Side 1, Phantom, and Side 2. The two side circuits have eight jacks which are used to test from different points in the toll trunk. The phantom circuit has only four jacks. The jacks and their purposes are listed below.

(1) LINE. The LINE jack (PH LINE jack on phantom circuit) provides access to the outside line. When a test cord is inserted into this jack, the local trunk equipment is disconnected to permit testing the outside plant. In the case of the phantom group however, the line jack will only allow testing to the simplex connection of both side circuits. The line jack of the side circuits permits testing the outside plant.

(2) LEQ. The LEQ (line equipment) jack is used to test inside the office and disconnects the outside plant. This provides a test point facing into the composite and the repeaters.

(3) DEQ. The DEQ (drop equipment) jack is used to test out (through a voice repeater when used). This jack disconnects the terminating trunk circuit.

(4) DROP. The DROP jack (phantom drop jack on phantom circuit) is used to test into the trunk circuit. This jack disconnects the outside plant from the trunk circuit.

(5) DSD-DSL. The DSD (Dial Signal Drop) and DSL (Dial Signal Line) jacks

(SX SGL Simplex Signal Leg) provide a means of testing the signal circuits. The DSD jack is used to test in towards the trunk circuit and disconnects the signaling circuit. The DSL jack is used to test through the signaling circuit and disconnects the local trunk circuit.

(6) LIST. The LIST (listen) jack provides a means to listen on the trunk circuit to determine if the line is in use. The LIST jack bridges across the voice path between the outside line and the trunk circuit.

(7) BUSY. The BUSY jack marks the trunk circuit busy to outgoing calls and provides a connection to the tip and ring for transmission. When it is desired only to busy out the trunk, a dummy plug is used to leave the testing cords free for testing.

b. Simplex Operation. Simplex operation is used when a signaling circuit other than loop pulsing is required. In this case the trunk is simplexed and the simplex circuit is used for the signaling circuit. When this type of a trunk appears on the test panel jack field, it requires eight jacks. These jacks are the LINE, LEQ, DEQ, DROP, DSD-DSL, LIST, and BUSY. The purpose of these jacks is the same as that described in a(1) through (7) with the exception of a(5) above. With simplex operation, the DSD-DSL jacks are connected in a different part of the dial leg circuit. The DSD-DSL jacks (SX SGL (Simplex Signal Leg)) provide a means for testing the signal leg. When the test cord is inserted into the DSL jack, the signal circuit to the line can be tested and the circuit to the local signal circuit is opened. When the test cord is inserted into the DSD jack, the signal circuit is opened towards the distant office and the circuit to the local signal circuit is completed for testing.

c. Carrier Operation. Carrier trunks may have six or eight test jacks. When only six jacks are provided, the LEQ and DEQ jacks are left off. The jacks and their purposes are the same as those described in a(1) through (7) above with the exception of a(5). With carrier operation, the signal circuit jacks are the CX1 (composite 1) - CX2 (composite 2) jacks. The CX1-CX2 jacks provide a means for testing the E and M signaling circuit. These jacks are used in the same manner as those described for the DSL-DSD jacks in a(5) above.

d. Interoffice, Tandem, and Loop Trunks. These types of trunks are generally tie trunks which connect two offices together. When these trunks appear in the jack field section, they generally terminate in four jacks; LINE, DROP, LIST, and BUSY. The purposes of these jacks are the same as those described in a(1), (4), (6) and (7) above.

5. METER PANEL (Fig. 3)

The meter panel is mounted at the base of the face equipment and is tilted backwards for ease of viewing from a standing or sitting position. The meter panel mounts the following components: On the left are the SET 100, PRESET, RING PAD, TRANS (transmission), TEST, AC ZERO, and DC ZERO rheostats; in the center is the Volt-ohm-milliammeter; on the right are the SET 100 key, the DC lamp, the MR (meter reverse) key and the dial.

6. KEYSHELF (Fig. 4)

The keyshelf contains all the testing and ringing keys. Behind the keys on the left are the PT (primary tip) and PR (primary ring) binding posts; in the center are the GR, X1, and X2 terminals for the Wheatstone Bridge; on the right are the AT (auxiliary tip) and AR (auxiliary ring) binding posts and the test cords. On the front of the keyshelf are two operator's jacks for the operator's headset.

Section II. TEST PANEL CALIBRATIONS

7. GENERAL

The purpose of this section is to provide the test desk operator with the proper operating procedures for making required calibrations before the test panel is put into use. These calibrations are usually made by the installation personnel at the time of installation. However, in some cases these calibrations may have been tampered with after installation. Therefore, recheck all of the following calibrations before the test panel is put into operation.

8. CALIBRATING METER TO INDICATE CORRECT DC VOLTAGE

The purpose of this calibration is to make sure that the meter indicates the proper DC voltage when a voltage source is being tested.

a. Set all test keys in their nonoperated position.

b. Connect the positive side of a DC (fully charged 48-volt battery) source to the PT binding post (fig. 4), and the negative side of the DC source through a fuse to the PR binding post.

c. Adjust RH7 (fig. 5) until the meter needle indicates (on the lower scale) the voltage of the voltage source connected to the PT and PR binding posts.

d. Disconnect the voltage source from the PT and PR binding posts.

9. CALIBRATING METER TO INDICATE CORRECT AC VOLTAGE

The purpose of this calibration is to make sure that the meter indicates the proper AC voltage when a voltage source is being tested.

a. Set all test keys in their nonoperated position.

b. Connect a 150-volt AC voltmeter across the PT and PR binding posts (fig. 4). (To prevent damage to this meter, be sure to use the high measuring range.)

c. Turn the RING PAD control (fig. 3) to the full clockwise position.

d. Operate the RING ON TIP-RING ON RING key to either position.

e. Adjust the selector switch on the AC voltmeter connected to the PT-PR binding posts to measure the applied voltage.

f. Adjust rheostat RH8 (fig. 5) until the test panel meter indicates the same voltage (ringing voltage) as the AC voltmeter. (The RING PAD rheostat can be regulated to increase or decrease the ringing voltage output.)

g. Restore all keys and disconnect the voltmeter when this adjustment is completed.

Note. In subparagraphs h through p below, a voltage source of 150 volts AC and 15 volts AC should be used. If these voltages are not available, use a voltage source which is as close to this value as possible, but does not exceed 150 volts or 15 volts.

h. Connect a 150-volt AC source to the PT-PR binding posts.

i. Operate the INCOMING AC HIGH-INCOMING AC LOW key to the INCOMING AC HIGH position.

j. Observe the meter, the meter needle should indicate 150 volts on the lower scale.

k. Remove the 150-volt AC source from the PT and PR binding posts.

l. Connect a 15-volt AC source to the PT-PR binding posts.

m. Observe the meter, the meter needle should indicate 15 volts on the lower scale.

n. Operate the INCOMING AC LOW-INCOMING AC HIGH key to the INCOMING AC LOW position.

o. Adjust rheostat RH1 (fig. 5) until the meter needle indicates 150 on the lower scale.

p. Disconnect the 15-volt AC source from the PT and PR binding posts.

q. Restore all keys to normal.

10. CALIBRATING METER TO INDICATE ACTUAL RESISTANCE

This calibration is made to make sure that the meter indicates proper resistance measurements. When resistances are required, use a decade box or a resistor with a tolerence of not more than 2%.

a. Set all keys to their unoperated position.

b. Adjust the DC ZERO rheostat to the center of its movement.

c. Disconnect the operator's telephone set from the operator's jack.

d. Connect a strap across the PT-PR binding posts.

e. Operate the LOOP LOW-LOOP key to the LOOP position.

f. Adjust rheostat RH6 (fig. 5) until the meter indicates "0" on the upper scale.

g. Remove the strap from the PT-PR binding posts.

h. Connect a 50,000-ohm resistor across the PT-PR binding posts.

i. Adjust rheostat RH4 (fig. 5) until the meter indicates 50,000 on the upper scale.

j. Repeat steps d through i above until the meter is accurate.

k. Remove the 50,000-ohm resistor from across the PT-PR binding posts.

l. Connect a strap across the PT-PR binding posts.

m. Operate the LOOP LOW-LOOP key to the LOOP LOW position.

n. Adjust rheostat RH5 (fig. 5) until the meter needle indicates "0" on the upper scale.

o. Remove the strap from across the PT-PR binding posts.

p. Connect a 500-ohm resistor across the PT-PR binding posts.

q. Adjust rheostat RH3 until the meter needle indicates a mid-scale reading on the upper scale.

r. Repeat steps l through q above until the meter is accurate.

s. Remove the 500-ohm resistor from across the PT-PR binding posts.

t. Insert the operator's headset into the headset jacks.

u. Connect a strap across the PT-PR binding posts.

v. Adjust the AC ZERO control until the meter indicates "0".

w. Restore the LOOP LOW-LOOP key to normal.

x. Operate the MONITOR-ZERO ADJUST key to the ZERO ADJUST position.

y. The meter should indicate "0".

z. Remove the operator's headset, the meter should indicate "0".

11. PRELIMINARY CAPACITANCE TEST

This test is made to assure that the meter circuit functions properly when making capacitance readings. To prepare the test panel for this test, connect a 15-UF capacitor across the PT and PR binding posts and operate the DIRECT MAKE-LOOP CAPACITY key to the LOOP CAPACITY position. Adjust rheostat RH11 (fig. 5) until a full scale (150) reading is obtained on the lower scale.

With this adjustment made, prepare a capacitance conversion chart. This chart will be required to convert voltage readings to capacitance in UF when making capacitance tests. To prepare this chart, obtain two 1-UF capacitors, two 2-UF capacitors, and one 4-UF capacitor and connect them as indicated in the Connection column of the chart on page 12. When the capacitors are connected properly, connect them across the PT and PR binding posts of the test panel and operate the DIRECT MAKE-LOOP CAPACITY key to the LOOP CAPACITY position. Record the maximum reading indicated on the lower scale of the meter in the Actual voltage column of the chart. The readings indicated in the Approximate voltage column of the chart on page 12 are approximate.

Actual voltage	Approximate voltage	Capacitance	Connection
	10	0.5 UF	1-UF and 1-UF capacitors in series
	20	1.0 UF	1-UF capacitor
	38	2.0 UF	2-UF capacitor
	55	3.0 UF	1-UF and 2-UF capacitors in parallel
	68	4.0 UF	4-UF capacitor
	80	5.0 UF	4-UF and 1-UF capacitors in parallel
	95	6.0 UF	4-UF and 2-UF capacitors in parallel
	108	7.0 UF	4-UF, 2-UF, and 1-UF capacitors in parallel
	116	8.0 UF	4-UF, 2-UF, and 2-UF capacitors in parallel
	125	9.0 UF	4-UF, 2-UF, 2-UF, and 1-UF capacitors in parallel
	132	10.0 UF	4-UF, 2-UF, 2-UF, 1-UF, and 1-UF capacitors in parallel

12. CALIBRATING THE TRANSMISSION TEST CIRCUIT

The purpose of this calibration is to make sure that the transmission test circuit is calibrated accurately.

a. Adjust resistor R1 (fig. 5) to 750 ohms and proceed as follows.

b. Connect a milliammeter (0-300 MA) across the PT-PR binding posts.

c. Operate the TRANSMISSION TEST-TEST CURRENT key to the TRANSMISSION TEST position.

d. Turn the TRANS TEST rheostat until the milliammeter connected to the binding posts indicates 100 milliamperes.

e. Adjust rheostat RH9 (fig. 5) until the test panel meter indicates 100 milliamperes.

f. Vary the position of the TRANS TEST rheostat, both meters should indicate the same current flow reading.

g. Restore all keys to normal.

h. Disconnect the meter from the binding posts.

13. CALIBRATING CURRENT ON TEST LEADS CIRCUIT

The purpose of this calibration is to assure accurate current measurement.

a. Connect a decade box (with maximum resistance in) and a milliammeter in series between the PR binding posts and negative battery.

b. Connect ground to the PT binding post.

c. Operate the TRANSMISSION TEST-TEST CURRENT key to the TEST CURRENT position.

d. Adjust the resistance of the decade box until the meter connected to the binding posts indicates 100 milliamperes.

e. Adjust resistor R28 (fig. 5) until the test panel meter indicates 100 milliamperes.

f. Tighten resistor R28 in place.

g. Restore all keys to normal.

h. Remove all connections to the binding posts.

14. CALIBRATING PULSE SPEED AND PERCENT MAKE CIRCUIT

a. Connect a 10 impulses per second (IPS) ground to the PR binding post.

b. Operate the SPEED-TIP CAPACITY key to the SPEED position.

c. Turn the SET 100 rheostat to the center of its movement.

d. Adjust resistor R1 (fig. 5) until the test panel meter indicates 100 on the lower scale.

e. Fasten resistor R1 in place.

f. Restore all keys to normal.

g. Remove the connection from the PR binding posts.

h. Operate the WB LOOP-SET 100 key to the SET 100 position.

i. Adjust resistor R3 (fig. 5) until the test panel meter indicates 100 on the lower scale.

j. Fasten resistor R3 in place.

k. Restore all keys to normal.

Section III. TEST PANEL OPERATING PROCEDURES

Note. This section provides detailed procedures for operating the test panel. It includes the procedures for answering incoming calls to the test panel, originating calls from the test panel, adjustments and calibrations, and the major tests that can be performed with the test panel.

15. GENERAL

a. With all keys at normal, the volt-ohm-milliammeter (meter) and the operator's talking and dialing circuit are connected across the test circuit. The meter is connected as a 0- to 150-volt voltmeter.

b. When the test panel is not being used, all keys should be in their normal unoperated positions, and the operator's headset plug should be removed from the headset jacks. Tests can be performed with the test panel even though the operator's headset plug is not inserted in the headset jacks. However, the recommended operating procedure is to insert the operator's headset plug into either set of headset jacks whenever the test panel is being used and to disconnect the operator's headset plug when it is anticipated that the test panel will not be used for long periods of time (30 minutes or more) or when the test panel is left unattended.

16. METER ADJUSTMENT FOR RESISTANCE MEASUREMENTS

a. General. When the operator's headset plug is inserted into the headset jacks the DC testing battery for the meter is rectified AC. The AC is supplied by commercial power lines. When the headset plug is removed, or when the AC supply fails, the central office battery supplies power to the meter. If the AC supply fails with the headset plug inserted into the headset jack, the DC lamp will light. Subparagraphs b and c below describe the meter adjustments to be made under both of these conditions.

b. Headset Plugged in (AC ZERO Adjustments). When the operator's headset plug is inserted into the headset jack, make the meter adjustment as described below. When the headset plug is not inserted into the headset jack and/or the DC lamp (fig. 3) is lighted, make the adjustment described in c below.

(1) Operate the MONITOR-ZERO ADJUST key to the ZERO ADJUST position.

(2) Adjust the AC ZERO rheostat until the meter needle indicates zero ohms on the upper scale (full-scale deflection).

(3) Restore the MONITOR-ZERO ADJUST key to normal after this adjustment is completed.

(4) Make this adjustment prior to each resistance measurement to insure accurate meter readings.

c. Headset Not Plugged in (DC ZERO Adjustment).

(1) Operate the MONITOR-ZERO ADJUST key to the ZERO ADJUST position.

(2) Adjust the DC ZERO rheostat until the meter needle indicates zero ohms on the upper scale (full-scale deflection).

(3) Restore the MONITOR-ZERO ADJUST key to normal after this adjustment is completed.

(4) Make this adjustment prior to each resistance measurement.

17. INSPECTOR'S TRUNKS (S-50368 OR EQUIVALENT)

The inspector trunks are used by repairmen to gain access to the test desk through the XY Dial* Equipment. The following subparagraphs describe the procedure to be followed when an inspector's trunk is being used.

a. Incoming Call Indication. The test panel operator is notified of an incoming call when the supervisory lamp associated with the inspector's trunk in use lights, and by the sounding of the night alarm buzzer (when the NA switch is operated (counterclockwise position)).

b. Answering Call.

(1) Operate the INSPECTOR'S TRK key associated with the lighted supervisory lamp to the PRIMARY TEST position or to the AUXILIARY TEST position. If the AUXILIARY TEST position is used, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(2) Conversation can take place as soon as this is done.

(3) During transmission, the supervisory lamp is not lighted and the busy lamp is lighted.

c. Holding After Call is Answered. If, after answering the call, it is desired to disconnect the testing leads from the trunk but to hold the established path, follow the procedure described below.

(1) Inform the repairman of the approximate length of time the trunk will be in the hold condition.

(2) Operate the hold key associated with the trunk in use and restore the INSPECTOR'S TRK key to normal. This holds the trunk operated and permits the test panel operator to answer or originate other calls or perform other operations until such time that it is convenient to reconnect the testing leads to the inspector's trunk.

(3) During the hold process, the supervisory lamp associated with the trunk is not lighted and the busy lamp is lighted.

(4) If, during the holding process the supervisory lamp flashes, it is an indication that the repairman is recalling the test panel operator. When this condition exists, proceed as described in (5) below. (If the supervisory lamp lights, it is an indication that the repairman has disconnected. When this condition exists, proceed as described in f(1) below.)

(5) To re-establish the transmission path, the INSPECTOR'S TRK key is operated to the same position as described in b(1) above. Restore the associated hold key to normal. Transmission can now take place.

d. Testing. Before tests can be made, other keys must be operated. Refer to (1) and (2) on page 16 for the applicable condition.

*T.M. Reg. U.S. Pat. Off.

(1) Tests over primary testing leads. If tests are to be made and the INSPECTOR'S TRK key is in the PRIMARY TEST position, operate the CO CONTROL-CONNECTOR RELEASE key to the CO CONTROL position (to provide a metallic testing circuit). Then proceed with the desired test.

(2) Tests over auxiliary testing leads. If tests are to be made over this trunk and the key is in the AUXILIARY TEST position, provide a metallic testing circuit by operating the CO CONTROL-CONNECTOR RELEASE key to the CO CONTROL position and the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position. Then proceed with the desired test.

e. Holding During Testing Procedure. If, during the testing procedure, it is desired to disconnect the testing leads from the trunk but hold the established testing path, follow the procedure described below.

(1) Operate the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to the required position (depending on whether the primary or auxiliary testing leads are being used).

(2) Inform the repairman of the approximate length of time the trunk will be in the hold condition.

(3) Operate the hold key associated with the trunk in use and restore the INSPECTOR'S TRK key to normal. This holds the trunk operated and permits the test panel operator to answer or originate other calls or perform other operations until such time that it is convenient to reconnect the testing leads to the inspector's trunk.

(4) Restore all other test keys to normal.

(5) During the hold process the supervisory lamp associated with the trunk is not lighted and the busy lamp is lighted.

(6) If, during the holding process the supervisory lamp flashes, it is an indication that the repairman is recalling the test panel operator. If this condition occurs, proceed as described in (7) below. (If the supervisory lamp lights, it is an indication that the repairman has disconnected. When this condition exists, proceed as described in f(1), below.)

(7) To re-establish the testing circuit, operate the INSPECTOR'S TRK key associated with the trunk in use to the same position as in b(1) above. Reoperate the CO CONTROL-CONNECTOR RELEASE key to the CO CONTROL position. Restore the associated hold key to normal. Testing can now take place.

(8) To perform tests over the trunk, perform the operations described in d(1) or (2) above.

f. Disconnect.

(1) Calling party disconnects first. If the repairman disconnects first, the supervisory lamp associated with the trunk in use lights. The supervisory lamp and the busy lamp remain lighted until the test panel operator disconnects. To disconnect, restore all keys associated with the trunk in use to normal. The supervisory lamp and the busy lamp go out. At this point the trunk is restored to normal and is again available for use.

(2) Test panel operator disconnects first. To disconnect, restore all keys

associated with the trunk in use to normal. The busy lamp goes out, but the supervisory lamp remains lighted. When the calling party disconnects, the supervisory lamp goes out. At this point the trunk is restored to normal and is again available for use.

18. SELECTOR LEVEL TRUNKS (INTER TOLL) (S-50314 OR EQUIVALENT)

Inter-toll selector level trunks are provided in the larger toll offices. These trunks provide a transmission circuit for testing inter-toll trunks. Normally these trunks are provided for national code tests 101, 102, and 103. The operation of this circuit is described below.

a. Incoming Call Indication. The test panel operator is notified of an incoming call by the lighting of the supervisory lamp associated with a SELECTOR LEVEL key.

b. Answering Call.

(1) Operate the SELECTOR LEVEL key associated with the lighted supervisory lamp to the PRIMARY TEST or AUXILIARY TEST position. If the key is operated to the AUXILIARY TEST position, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(2) Conversation can take place as soon as this is done.

(3) During transmission, the busy lamp is lighted and the supervisory lamp is out.

c. Holding After Call is Answered. If, after answering the call, it is desired to disconnect the testing leads from the trunk but to hold the established path, follow the procedure described below.

(1) Inform the testman at the distant end of the approximate length of time the trunk will be in the hold condition.

(2) Operate the hold key associated with the trunk in use.

(3) Restore the SELECTOR LEVEL PRIMARY TEST-SELECTOR LEVEL AUXILIARY TEST key to normal.

(4) During the hold condition, the busy lamp is lighted and the supervisory lamp is out.

(5) No recall is possible at this time.

(6) To re-establish the transmission path, the SELECTOR LEVEL key is operated to the position it was in as described in b(1) above. Restore the associated hold key to normal. Transmission can now take place.

d. Release. Upon completion of tests, restore all keys to normal.

19. TWO-WAY TO LINE TRUNK CIRCUIT (S-50306 OR EQUIVALENT)

The two-way to line trunk from the test panel can be terminated at a magneto telephone or a dial telephone. This trunk is used for transmission purposes only. No provision is made for making tests over this trunk. The procedure to be followed when a two-way to line trunk is being used is as follows:

a. Incoming Call. The test desk operator is notified of an incoming call on the two-way to line trunk from either a magneto telephone or a dial telephone by the intermittent lighting of the supervisory lamp associated with the trunk, and by the intermittent sounding of the night alarm buzzer (when the NA switch is operated (counterclockwise position)).

b. Answering Call.

(1) Operate the 2-WAY TO LINE TRK key. Use the PRIMARY TEST position if the transmission path is to be established over the primary testing leads, or the AUXILIARY TEST position if the transmission path is to be established over the auxiliary testing leads.

(2) Conversation can take place as soon as this key is operated. (If the AUXILIARY TEST position is used, the TEST AUXILIARY-CO AUXILIARY key must be operated to the TEST AUXILIARY position.)

(3) During transmission, the supervisory lamp and the test busy lamp remain lighted if the trunk is connected to a dial line. Only the busy lamp is lighted if the trunk is connected to a magneto telephone.

c. Holding After Call is Answered. If, after answering the call, it is desired to disconnect the testing leads from the trunk but to hold the established path, follow the procedure described below.

(1) Inform the party on the trunk of the approximate length of time the trunk will be in the hold position.

(2) Operate the hold key associated with the two-way to line trunk and restore the 2-WAY TO LINE TRK key to normal. This holds the trunk operated and permits the test panel operator to answer or originate other calls or perform other operations until such time that it is convenient to reconnect the testing leads to the two-way to line trunk.

(3) During the hold process the supervisory lamp associated with the trunk is lighted and the busy lamp may or may not be lighted depending on the wiring option. (This condition is the same regardless of whether the trunk is connected to a magneto telephone or a dial telephone.)

(4) No recall supervision is provided.

(5) To re-establish the transmission circuit, operate the key or keys to the same position as in b above. Restore the associated hold key to normal. Transmission can now take place.

d. Disconnect on Incoming Calls.

(1) Trunk connected to magneto telephone.

(a) Calling party disconnects first. If the trunk is connected to a magneto telephone, and the party desires to disconnect, he must ring-off. The busy lamp remains lighted and the supervisory lamp lights during the ringing period. (If the party does not ring-off, the supervisory lamp does not light.) The busy lamp will remain lighted until the test panel operator disconnects. To disconnect, restore the 2-WAY TO LINE TRK key to normal. The busy lamp goes out. At this point the trunk is again available for use.

(b) Test panel operator disconnects first. To disconnect, restore the 2-WAY TO LINE TRK key associated with the trunk to normal. The busy lamp goes out. When the calling party rings-off, the supervisory lamp lights during the ringing period. (If the calling party does not ring-off, the supervisory lamp does not light.) At this point the trunk is again available for use.

(2) Trunk connected to dial line.

(a) Calling party disconnects first. If the calling party disconnects first, the supervisory lamp and the busy lamp remain lighted until the test panel operator disconnects. To disconnect, restore all keys associated with the trunk to normal. The supervisory lamp and the busy lamp go out. At this point the trunk is restored to normal and is again available for use.

(b) Test panel operator disconnects first. To disconnect, restore all keys associated with the trunk to normal. This causes the busy lamp and the supervisory lamp to go out. However, the trunk cannot be used until the calling party disconnects. No supervision is given at the test panel when the calling party disconnects.

e. Outgoing Call to Magneto Telephone.

(1) Connecting to line. To establish a connection to the line, operate the 2-WAY TO LINE TRK key to the PRIMARY TEST position if the primary testing leads are to be used or to the AUXILIARY TEST position if the auxiliary testing leads are to be used. This causes the busy lamp associated with the trunk to light.

(2) Ringing.

(a) If the 2-WAY TO LINE TRK key is in the PRIMARY TEST position, ring the magneto telephone by intermittently operating the RING ON TIP-RING ON RING key to either position. Adjust the Ringing Voltage with the RING PAD rheostat. Each time ringing current is supplied, the supervisory lamp associated with the trunk lights. When the called party answers, restore the RING ON TIP-RING ON RING key to normal.

(b) If the 2-WAY TO LINE TRK key is in the AUXILIARY TEST position, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position. Then, intermittently operate the RING ON TIP-RING ON RING key from the normal position to either operated position. Each time ringing current is supplied, the supervisory lamp associated with the trunk lights. When the called party answers, restore the TEST AUXILIARY-CO AUXILIARY key and the RING ON TIP-RING ON RING key to normal.

(3) Called party answers. When the called party answers, the transmission circuit is completed and conversation can take place. During transmission the busy lamp remains lighted and the supervisory lamp is extinguished.

(4) Holding after call is answered. The operational procedure for holding the trunk operated after the called party answers is the same as that described in c on page 18. After reconnecting to the trunk, the busy lamp lights and the supervisory lamp goes out.

(5) Disconnect. The disconnect procedure on outgoing calls is the same as that described in d(1) on page 18.

f. Outgoing Call to Dial Line.

(1) Connecting to dial line equipment. Operate the 2-WAY TO LINE TRK key to the PRIMARY TEST position or to the AUXILIARY TEST position. This causes the supervisory lamp and the busy lamp associated with the trunk to light. Dial tone is heard in the receiver of the operator's headset.

(2) Dialing.

(a) If the 2-WAY TO LINE TRK key is in the PRIMARY TEST position, dial the number to be called. Each time the dial is turned off-normal the supervisory lamp associated with the trunk goes out (busy lamp remains lighted). This lamp relights after each digit is dialed. Dial tone is not heard in the operator's receiver after the first digit has been dialed.

(b) If the 2-WAY TO LINE TRK key is in the AUXILIARY TEST position, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position. Then, dial the number to be called. Each time the dial is turned off-normal the supervisory lamp is affected ((a) above). After all digits have been dialed, restore the TEST AUXILIARY-CO AUXILIARY key to normal.

(3) Dialing completed. After all of the digits have been dialed, the supervisory lamp lights and remains lighted.

(4) Called party answers. When the called party answers, the supervisory lamp associated with the trunk goes out, and ringback tone is disconnected. Conversation between the test panel operator and the called party can take place at this time. During transmission, the busy lamp remains lighted.

(5) Holding after called party answers. The operational procedure for holding the trunk operated after the called party answers is the same as that described in c on page 18.

(6) Disconnect on outgoing dial line calls.

(a) Called party disconnects first. If the called party disconnects first, the supervisory lamp lights. The busy lamp remains lighted. To disconnect, restore all keys associated with the trunk to normal. The busy lamp and the supervisory lamp go out. At this time the trunk is restored to normal and is again available for use.

(b) Test panel operator disconnects first. To disconnect, restore all keys associated with the trunk to normal. The busy lamp goes out. At this time the trunk is restored to normal and is again available for use even if the called party has not disconnected.

20. TWO WAY TRUNK BETWEEN POSITIONS (ORDER WIRE) (S-50304 OR EQUIVALENT)

The ORDER WIRE key or jack provides a metallic path (T and R) between test panel position 1, another test panel position, or other equipment. The following subparagraph describes the procedures to be followed when the order wire is being used.

a. Incoming Call. The test panel operator is notified of an incoming call when the order wire supervisory lamp lights and by the sounding of the night alarm buzzer (when the NA switch is operated (counterclockwise position)).

b. Answering Call.

(1) Operate the ORDER WIRE key to the PRIMARY TEST or AUXILIARY TEST position or insert a test cord into the ORDER WIRE jack. If the AUXILIARY TEST position or AUX test cord is used operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(2) Transmission can take place as soon as this is done.

(3) During transmission, the supervisory lamp is not lighted.

(4) On circuits containing a busy lamp, the busy lamp remains lighted.

c. Holding After Call is Answered. If, after answering the call, it is desired to disconnect the testing leads from the trunk, but to hold the established path, proceed as follows:

(1) Inform the party at the distant end of how long you will be disconnected.

(2) Restore the ORDER WIRE key to its normal position or remove the test cord. The busy lamp will go out.

(3) If after disconnecting, the supervisory lamp flashes, it is an indication that the party at the other end of the trunk is recalling the test panel operator. (If the supervisory lamp goes out, proceed as described in e below.)

(4) To re-establish the transmission or testing circuit between the local test panel position and the distant position, operate the ORDER WIRE key to the same position as b(1) above or insert the test cord into the ORDER WIRE jack. Transmission can now take place.

d. Testing. Before tests can be made, it is necessary for the equipment to be tested to be connected to the distant end of the trunk. When this is done, proceed as described below.

(1) If the ORDER WIRE key is in the PRIMARY TEST position or if the PRIM test cord is used, proceed with the desired tests.

(2) If the ORDER WIRE key is in the AUXILIARY TEST position or if the AUX test cord is being used, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position. Then proceed with the desired test.

e. Disconnect. Since there is no disconnect supervision provided at the distant end, the disconnect time must be understood by both parties. However, to disconnect, restore the ORDER WIRE key to normal or remove the test cord from the ORDER WIRE jack. When this is done, both the busy lamp and the supervisory lamp will go out.

f. Originating Call.

(1) Operate the ORDER WIRE key to the PRIMARY TEST or AUXILIARY TEST position (or insert the PRIM or AUX test cord into the ORDER WIRE jack).

(2) If the AUXILIARY TEST position or AUX cord is used, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(3) The busy lamp will light.

g. Called Party Answers.

(1) When the called party answers, the supervisory lamp flashes on and then goes off.

(2) Transmission and testing can take place at this time.

h. Holding After Call is Answered. To hold this connection, proceed as described in c on page 21.

i. Disconnect. To disconnect, proceed as described in e on page 21.

21. TWO WAY TO COMMON BATTERY TRUNK (S-50305 OR EQUIVALENT)

The two-way to common battery trunk circuit provides a transmission path between the test desk and a distant common battery telephone.

a. Incoming Call Indication. The test desk operator is notified of an incoming call when the supervisory lamp associated with the two-way to common battery trunk in use lights, and by the sounding of the night alarm buzzer. (when the NA switch is operated (counterclockwise position)).

b. Answering Call.

(1) Operate the 2-WAY TO CB TRK key associated with the lighted supervisory lamp, to the PRIMARY TEST or AUXILIARY TEST position. If the AUXILIARY TEST position is used, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(2) Conversation can now take place.

(3) During transmission, the supervisory lamp is out and the busy lamp is lighted.

c. Disconnect. After the conversation is completed, disconnect by restoring all keys to normal. The busy lamp will go out.

d. Originating a Call.

(1) Operate the 2-WAY TO CB TRK key to the AUXILIARY or PRIMARY TEST position. If the AUXILIARY TEST position is used, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position. Ringback tone will be heard and the busy lamp will light.

(2) When the called party answers, ringback tone will cease and the supervisory lamp will flash on and then go out.

(3) Conversation can now take place.

e. Disconnect. After the conversation is completed, disconnect by restoring all keys to normal. The busy lamp will go out.

22. MDF TRUNKS (S-50007 OR EQUIVALENT)

Each of the two MDF trunks are used by the test panel operator to make tests on the outside lines or the inside central office equipment. These tests can be made over the primary or the auxiliary testing leads. The MDF trunks also are used for

making three-wire Wheatstone Bridge tests by the use of the WH BG TIP-WH BG RING key. If desired, these trunks can also be used to make calls to subscribers served by the exchange. Before performing any of the operations described below over an MDF trunk, be sure the test shoe associated with the MDF trunk to be used is properly inserted into the protector terminals associated with the desired line. Upon completion of the tests, be sure the test shoe is removed from the line under test.

a. Testing Outside Plant Lines.

(1) Operate the MDF OUT key associated with the inserted test shoe to the PRIMARY TEST position or to the AUXILIARY TEST position. If this key is operated to the AUXILIARY TEST position, the TEST AUXILIARY-CO AUXILIARY key must be operated to the TEST AUXILIARY position.

(2) Perform the desired tests.

(3) When testing is completed, restore all keys to normal and remove the test shoe.

b. Testing Inside Central Office Equipment, By-passing Heat Coils.

(1) Operate the MDF IN key to the PRIMARY TEST position or to the AUXILIARY TEST position. If this key is operated to the AUXILIARY TEST position, the TEST AUXILIARY-CO AUXILIARY key must be operated to the TEST AUXILIARY position.

(2) Perform the desired tests.

(3) When testing is completed, restore all keys to normal and remove the test shoe.

c. Testing Inside Central Office Equipment Through Heat Coils.

(1) Operate the HEAT COIL key to the PRIMARY TEST position or to the AUXILIARY TEST position. If this key is operated to the AUXILIARY TEST position, the TEST AUXILIARY-CO AUXILIARY key must be operated to the TEST AUXILIARY position.

(2) Perform the desired tests.

(3) When testing is completed, restore all keys to normal and remove the test shoe.

d. Outgoing Call Without Using XY Dial Equipment.

(1) Connecting to line or trunk. Operate the MDF OUT key to the PRIMARY TEST or AUXILIARY TEST position.

(2) Ringing.

(a) If the MDF OUT key is in the PRIMARY TEST position, ring the telephone or equipment on the line under test by intermittently operating the RING ON TIP-RING ON RING key to the required position. The meter will indicate the ringing voltage being supplied. Adjust the ringing voltage with the RING PAD rheostat. When the called party or switchboard operator answers, restore the RING ON TIP-RING ON RING key to normal.

(b) If the MDF OUT key is in the AUXILIARY TEST position, operate the TEST

AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position. Then, intermittently operate the RING ON TIP-RING ON RING key to the required position. The meter will indicate the ringing voltage being supplied. When the called party or switchboard operator answers, restore the TEST AUXILIARY-CO AUXILIARY key and the RING ON TIP-RING ON RING key to normal.

(3) Called party answers. When the called party answers, supply transmission battery by operating the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to the TALK BATTERY PRIMARY position if the MDF OUT key is in the PRIMARY TEST position, or to the TALK BATTERY AUXILIARY position if the MDF OUT key is in the AUXILIARY TEST position. Transmission can take place as soon as this key is operated.

(4) Disconnect. To disconnect, restore the MDF OUT key associated with the trunk in use to normal.

e. Outgoing Call Using XY Dial Equipment.

(1) Connecting to line or trunk. Operate the MDF IN key or the HEAT COIL key to the PRIMARY TEST position or to the AUXILIARY TEST position. If the key being used is operated to the AUXILIARY TEST position, the TEST AUXILIARY-CO AUXILIARY key must be operated to the TEST AUXILIARY position.

(2) Dial loop. Operate the DIAL LOOP-RELEASE PERM key to the DIAL LOOP position to establish a dial loop. Dial tone is heard in the operator's receiver.

(3) Dialing. Dial the digits of the telephone being called. Dial tone is not heard after the first digit is dialed.

(4) Dialing completed. After all of the digits have been dialed, ringback tone is heard in the operator's receiver.

(5) Called party answers. When the called party answers, ringback tone is no longer heard in the operator's receiver. Conversation between the test panel operator and the called party can take place at this time.

(6) Disconnect. To disconnect, restore all keys that were used to make this call to normal and remove the test shoe.

f. Wheatstone Bridge Tests. To make Wheatstone Bridge tests over an MDF trunk, refer to paragraph 27.

g. Testing Trunks.

(1) Dialing out on trunks. On trunks to another central office which terminate in automatic equipment (loop pulsing) connect to the trunk by inserting the test shoe into the proper protector on the MDF.

(a) Seizing equipment. To seize the automatic equipment at the distant end of the trunk, operate the MDF OUT key (a(1) on page 23) to the PRIMARY TEST or AUXILIARY TEST position and operate the DIAL LOOP-RELEASE PERM key to the DIAL LOOP position.

(b) Dialing. Dial the desired number in the distant exchange.

(c) Dialing completed. After all the digits of the desired number are dialed, ringback tone is heard.

(d) Called party answers. When the called party answers, ringback tone is no longer heard in the operator's receiver. Conversation between the test panel operator and the called party can take place at this time.

(e) Disconnect. To disconnect, restore all keys that were used to make this call to normal and remove the test shoe.

(2) Ringing in on trunk. On ring-down trunks entering the local office, connect to the trunk by inserting the test shoe into the proper protector block on the MDF.

(a) Connecting to trunk equipment. When the test shoe is inserted into the proper pair, operate the MDF IN key to the PRIMARY TEST or AUXILIARY TEST position.

(b) Ringing. (If the MDF IN key is in the AUXILIARY TEST position, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.) In either case, operate the RING ON TIP-RING ON RING key to the required position. The meter will indicate the ringing voltage supplied. Adjust the ringing voltage with the RING PAD rheostat. When the attendant's switchboard operator answers the call, restore the RING ON TIP-RING ON RING key to normal.

(c) Attendant's switchboard operator answers. When the attendant's switchboard operator answers, conversation can take place between the attendant's switchboard operator and the test panel operator.

(d) Disconnect. To disconnect, restore all keys that were used to establish this call to normal and remove the test shoe.

23. TEST BINDING POSTS (S-50290)

The PT and PR and AT and AR binding posts provide an alternate means for the test panel operator to connect the test desk testing leads to the equipment to be tested. Follow the procedure below when it is desired to use the test binding posts.

a. Primary Binding Posts.

(1) Connect the equipment to be tested to the PT and PR binding posts.

(2) Perform the desired tests.

b. Auxiliary Binding Posts.

(1) Connect the equipment to be tested to the AT and AR binding posts.

(2) Operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(3) Perform the desired tests.

c. Transmission Battery. If transmission battery is required by the equipment under test, operate the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to the TALK BATTERY PRIMARY position if the primary testing leads are being used, or to the TALK BATTERY AUXILIARY position if the auxiliary testing leads are being used.

d. Testing Completed. When testing is completed, restore all of the keys to normal and disconnect the equipment under test from the test binding posts.

24. TRANSFER CIRCUIT (S-11856 OR EQUIVALENT)

The transfer circuit provides a means by which the supervisory lamp leads of certain circuits can be transferred from the toll test panel to the toll board. The circuits which may be provided with this feature are the inspector's trunks, Inter-toll, and repair trunks, etc. This circuit is used whenever the test panel is to be left unattended (15 minutes or more). To transfer the lamp leads to the toll board, operate the TRANSFER key to the PRIMARY TEST position. To transfer the lamp leads back to the test panel, restore the TRANSFER key.

25. TEST CORDS (S-50294 OR S-50134)

The test cords consist of a PRIM and AUX cord. The test cords are used to extend the provisions of the test panel to the jacks mounted in the jack field section.

a. Testing. To test with the test cords, insert the test cords into the jack to be tested and perform the desired tests. When the AUX test cord is used, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

b. Disconnect. When testing is completed, remove the test cord from the jack being tested and restore all keys to normal.

26. TEST SELECTOR TRUNKS (S-50302 OR EQUIVALENT)

Test selector trunks provide access from the test panel to any one of the lines served by the connectors of an XY Dial central office. No provision is made for incoming calls over these trunks. These trunks are primarily used to connect to station lines for testing purposes. Subparagraphs a and b below describe the procedure to be followed when a test selector trunk is to be used.

a. Testing.

(1) Connecting to line. Operate a TEST SELECTOR TRK key to the PRIMARY TEST or AUXILIARY TEST position. If the key is operated to the AUXILIARY TEST position, the TEST AUXILIARY-CO AUXILIARY key must be operated to the TEST AUXILIARY position. When the test selector is seized, the test selector supervisory lamp lights. Dial the numbers of the telephone to be tested. After the last digit is dialed, the testing leads of the test panel are connected to the tip and ring of the called line and the test selector supervisory lamp goes out. If the test selector supervisory lamp is flashing, the line under test is busy ((2)(b) below), but a transmission path is extended across the tip and ring of the line under test.

(2) Holding after connection to line is established.

(a) If connection to an idle line is established and it is desired to disconnect from the trunk but hold the trunk operated, operate the hold key associated with the trunk in use and restore the TEST SELECTOR TRK key to normal. This operation holds the trunk operated and permits the test panel operator to answer or originate other calls or perform other operations until such time that it is convenient to reconnect to the test selector trunk. When the test selector trunk is in the hold condition, the busy lamp is lighted. To re-establish the connection between the test panel and the line to be tested, operate the TEST

SELECTOR TRK key associated with the trunk in the hold condition to the same condition as in subparagraph (1) on page 26 and restore the associated hold key to normal.

(b) If connection to the line is established, and the line is busy (permanent indication), the supervisory lamp flashes at the rate of 120 flashes per minute. If desired, the trunk can be put in the hold condition in the same manner as described in (a) on page 26, or monitored as described in b(2) below. When the line becomes idle, the supervisory lamp stops flashing. Connection to the line is re-established in the same manner as described in a(1) on page 26.

(3) Testing. After connection to the line is established, the desired tests can be performed.

Note. When the test selector associated with the test selector trunk circuit in use is in a distant exchange, two resistors (R1 and R2) are in the test loop circuit. When making resistance measurements, the meter reading includes the combined resistance of resistors R1, R2, the loop resistance to the test selector, and the circuit under test. The resistance of resistors R1, R2, and the loop to the test selector must be subtracted from the meter indication in order to obtain an accurate reading. This is especially important when low resistance measurements are being made. Since the distance between offices will vary, then the resistance to be subtracted will also vary. Check with the wire chief for local values.

(4) Disconnect. To disconnect from a test selector trunk, restore all keys associated with the trunk to normal. Restore all keys to normal.

b. Outgoing Call.

(1) Connecting to line. Connection to the line is established in the same manner as described in a(1) on page 26.

(2) Monitoring. If the called station is busy, a transmission path is extended to the line under test. The test panel operator can monitor the call but should operate the MONITOR-ZERO ADJUST key to the MONITOR position. If there is no one talking on the line, the line has a permanent condition. If the called line is not busy follow the procedure described below.

(3) Ringing. To ring the called telephone, intermittently operate the RING ON TIP-RING ON RING key to the required position. The meter indicates the ringing voltage being supplied. This voltage is regulated by adjusting the RING PAD rheostat. When the called party answers, restore the RING ON TIP-RING ON RING key to normal.

(4) Called party answers. When the called party answers, supply transmission battery by operating the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to the TALK BATTERY PRIMARY position if the TEST SELECTOR TRK key is in the PRIMARY TEST position, or to the TALK BATTERY AUXILIARY position if the TEST SELECTOR key is in the AUXILIARY TEST position. Transmission can take place as soon as this key is operated.

(5) Disconnect. To disconnect, restore all keys to normal.

27. WHEATSTONE BRIDGE (S-50296 OR EQUIVALENT)

The Wheatstone Bridge circuit provides a means for making precise resistance measurements on outside plant lines. In order to use the Wheatstone Bridge feature of this test panel, it is necessary to strap the X1, X2, and GR terminals of a Wheatstone Bridge to the X1, X2, and GR terminals on the keyshelf of the test panel. Connection can be made to the line to be tested through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), and the test switch train. It is suggested that the MDF trunks be used. Subparagraphs a through c below describe the tests that can be made after the Wheatstone Bridge testing terminals are extended to the line under test. Subparagraph d describes the method of performing three-wire Wheatstone Bridge tests.

a. Loop Resistance. To make loop resistance measurements, operate the WB LOOP-SET 100 key to the WB LOOP position. Make the measurement by operating the controls on the Wheatstone Bridge as described in the Leeds Northrup bulletin supplied with the Wheatstone Bridge. Restore all keys to normal after testing is completed.

b. Tip to Ground Resistance. To make tip to ground resistance measurements, operate the WB T-G - WB R-G key to the WB T-G position. Make the measurement by operating the controls on the Wheatstone Bridge as described in the Leeds Northrup bulletin supplied with the Wheatstone Bridge. Restore all keys to normal after testing is completed.

c. Ring to Ground Resistance. To make ring to ground resistance measurements, operate the WB T-G - WB R-G key to the WB R-G position. Make the measurement by operating the controls on the Wheatstone Bridge as described in the Leeds Northrup bulletin supplied with the Wheatstone Bridge. Restore all keys to normal after testing is completed.

d. Three-wire Wheatstone Bridge Tests. Three-wire Wheatstone Bridge tests are necessary when line faults cannot be found with the two-wire Wheatstone Bridge tests.

(1) Connecting to faulty line. The Wheatstone Bridge is connected to the faulty line by direct connection to the primary or auxiliary binding posts, over the inspector's trunk or test selector trunks, or over the MDF trunks. When connection to the faulty line is established, operate the WB LOOP-SET 100 key to the WB LOOP position. Connect the third wire to the Wheatstone Bridge as described in (2) below.

(2) Connecting third wire to Wheatstone Bridge. The third wire is connected to the Wheatstone Bridge over either of the MDF trunks.

(a) Make this connection by inserting a second test shoe into a protector terminal which terminates a cable pair that is known to be good.

(b) Operate the WH BG TIP-WH BG RING key associated with the inserted test shoe to the WH BG TIP position to connect the tip conductor of the spare cable pair to the Wheatstone Bridge or to the WH BG RING position to connect the ring conductor of the spare cable pair to the Wheatstone Bridge.

(3) Resistance test. With the two faulty conductors ((1) above) and the third wire ((2) above) connected to the Wheatstone Bridge, three-wire resistance measurements can be made. Refer to the bulletin supplied with the Wheatstone Bridge for the proper operation of the Wheatstone Bridge. Restore all keys when testing is completed.

28. LOOP BATTERY MEASUREMENT (S-50290)

This test is performed to determine if a source of battery voltage is connected to the tip and ring of an outside plant line and to determine the potential of this voltage. The only keys that are to be operated at this time are those that are needed to establish connection to the line to be tested. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). Subparagraphs a through c below describe the observations to be made as soon as the connection to the line under test is established. As soon as connection to the line is established, the meter indicates if a source of battery voltage is connected to the tip and ring of the line under test.

a. Meter Needle Deflects to Left. If the meter needle deflects to the left, it indicates that the negative side of a battery source is connected to the tip conductor and the positive side of this battery source is connected to the ring conductor of the line under test. When this condition exists, immediately operate the MR (meter reverse) key (or the SLEEVE TEST-REVERSE key to the REVERSE position) to prevent damage to the meter. This causes the meter needle to deflect to the right. Read the indication on the lower scale of the meter to determine the potential of the battery voltage.

b. Meter Needle Deflects to Right. If the meter needle deflects to the right, it indicates that the negative side of a battery source is connected to the ring conductor and the positive side of this battery source is connected to the tip conductor of the line under test. Read the lower scale of the meter to determine the potential of the battery voltage.

c. Meter Needle Does Not Deflect. If the meter needle does not deflect, it is an indication that a source of battery voltage is not connected between the tip and ring of the line under test. However, a source of battery voltage could be connected between either the tip or ring of the line under test and ground. This condition is determined by making the test for battery on tip or ring (par. 29).

d. Restore Keys. Upon completion of the test restore all keys to normal.

29. TESTING FOR BATTERY ON TIP OR RING (S-50290)

This test is performed to determine if a source of battery voltage is connected between the tip or ring of an outside plant line and ground (the earth), and to determine the potential of this voltage. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). The following subparagraphs describe the procedure to be followed when making battery on tip or ring measurements after connection to the line is established.

a. Testing for Battery on Tip. Operate the TOLL RING-TIP BATTERY key to the TIP BATTERY position. Make the observations described in (1) through (3) below.

(1) Meter needle deflects to left. If the meter needle deflects to the left, it indicates that a positive battery source (whose negative side is connected to ground) is connected to the conductor under test. When this condition exists, immediately restore the TOLL RING-TIP BATTERY key to normal to prevent damage to the meter. Then operate the meter reverse key (or the SLEEVE TEST-REVERSE key

to the REVERSE position) and the TOLL RING-TIP BATTERY key to the TIP BATTERY position. The meter needle should deflect to the right. Read the lower scale of the meter to determine the potential of the battery voltage.

(2) Meter needle deflects to right. If the meter needle deflects to the right, it indicates that a negative battery source (whose positive side is connected to ground) is connected to the conductor under test. Read the lower scale of the meter to determine the potential of the battery voltage.

(3) Meter needle does not deflect.

(a) If the meter needle does not deflect, it indicates that a battery source is not connected between the conductor under test and ground. However, a battery source may still be present on the conductor under test, but will not cause the conductor under test to be faulty. An example of this condition would be if one side of a battery source was connected to the conductor under test, but the other side of the battery source was not connected to ground.

(b) Another example of when the meter needle would not deflect would be if a battery source was connected across the tip and ring of the line under test. However, this condition would be determined by the battery loop measurement (par. 28).

(4) Restore keys. After determining the condition of the conductor under test, restore all keys to normal.

b. Testing for Battery on Ring. The test for battery on the ring side of the line is the same as that described in a on page 29 with the following exception: The 135∿ -RING BATTERY key is operated to the RING BATTERY position instead of the TOLL RING-TIP BATTERY key being operated to the TIP BATTERY position.

30. MEASURING LOOP RESISTANCE (S-50290)

The purpose of this test is to determine whether the loop (tip and ring) of the line under test is completed (shorted), and to determine the loop resistance of the line under test. To test a loop terminated by a telephone, the handset of that telephone must be removed before the test can be performed. To test a loop which is not connected to any equipment, the tip and ring lead must be connected together at the distant end to complete the loop. Before making the loop resistance measurement, zero adjust the meter. Then, make the loop resistance measurement by operating the LOOP LOW-LOOP key to the LOOP position. Subparagraphs a through c below describe the observations to be made as soon as this key is operated. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26).

a. Meter Needle Does Not Deflect. If the meter needle does not deflect, it indicates that the loop of the line under test is open (or of infinite resistance). In this case, the line is faulty. If this condition exists, restore all keys to normal and proceed with other desired tests.

b. Meter Needle Indicates More Than 5,000 Ohms. If the meter needle indicates more than 5,000 ohms (on the upper scale), record the reading observed. Compare this reading with the resistance reading on the line record card for the line under test. The indication of the condition of the line are described in (1) through (3) on page 31.

(1) If the loop resistance is much higher than it should be, it is an indication that equipment other than that assigned to the line under test is connected to the loop, or that the line is faulty.

(2) If the loop resistance is much lower than it should be, it is an indication that equipment other than that assigned to the line under test is connected to the loop, or that the line is shorted, and therefore is faulty.

(3) If the loop resistance is approximately the same as it should be, it is an indication that the loop of the line under test is not faulty. However, it is possible to have a source of battery or ground connected to either the tip or ring of the line loop under test. This condition can be determined by making the tests described in paragraphs 29 and 33.

c. Meter Needle Indicates 5,000 Ohms or Less. If the meter needle indicates 5,000 ohms or less (on the upper scale), restore the LOOP LOW-LOOP key to normal and then operate it to the LOOP LOW position. (This changes the meter circuit so that the actual resistance is one-one hundredth of the value indicated on the upper meter scale.) Record the reading indicated by the meter needle and divide this reading by 100. The result (quotient) obtained is the loop resistance of the line under test. Compare this reading with the resistance reading on the line record card for the line under test. The indications of the condition of the line are the same as that described in b(1) through (3) above.

31. MEASURING AC VOLTAGES (S-50142 OR EQUIVALENT)

This test is performed to measure AC voltages of less than 150 volts. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). When connection is made to the equipment to be tested, operate the INCOMING AC LOW-INCOMING AC HIGH key to the INCOMING AC HIGH position.

a. Meter Does Not Deflect. If the meter needle does not deflect, it indicates that an AC voltage is not present.

b. Meter Needle Indicates 15 Volts or More. If the meter needle indicates more than 15 volts (on the lower scale), record this voltage as the applied voltage.

c. Meter Needle Indicates Less Than 15 Volts. If the meter needle indicates less than 15 volts, obtain a more accurate reading by operating the INCOMING AC LOW-INCOMING AC HIGH key to the INCOMING AC LOW position. This changes the meter circuit to indicate 10 times the actual voltage. Record the reading indicated by the meter needle on the lower scale of the meter and divide this reading by 10. The result (quotient) is the actual voltage of the equipment being tested.

d. Testing Completed. Upon completion of the test, restore all keys to normal and proceed with other tests.

32. TESTING FOR GROUND ON TIP OR RING (S-50290 OR EQUIVALENT)

This test is performed to determine if the tip or ring of an outside plant line is connected to ground (the earth), and to determine the value of the resistance to ground. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts

(par. 23), test cords (par. 25), or the test selector (par. 26). After connection is made to the line to be tested, make a ground on tip or ring measurement. Before making these measurements, zero adjust the meter.

a. Testing for Ground on Tip. Operate the TIP GROUND LOW-TIP GROUND key to the TIP GROUND position. Make the observations described in (1) through (3) below.

(1) Meter needle does not deflect. If the meter needle does not deflect, it is an indication that the conductor under test is not grounded, or is grounded through an infinite resistance. In either case, the conductor can be considered as not being grounded. If this condition exists, restore all keys to normal and perform other desired tests.

(2) Meter needle indicates more than 5,000 ohms. If the meter needle indicates more than 5,000 ohms (on the upper scale), it is an indication that the conductor under test is connected to ground (the earth). Record the reading observed. This reading indicates the resistance in ohms from the test desk to ground over the conductor under test. Unless this condition is desired, the line is considered to be faulty. Restore all keys to normal when the test is completed, and proceed with other desired tests.

(3) Meter needle indicates 5,000 ohms or less. If the meter needle indicates 5,000 ohms or less (on the upper scale) it is an indication that the conductor under test is connected to ground (the earth). Operate the TIP GROUND LOW-TIP GROUND key to the TIP GROUND LOW position. (This changes the meter circuit so that the actual resistance is one-one hundredth of the value indicated on the upper scale.) Record the reading indicated by the meter needle and divide by 100. The result (quotient) obtained is the resistance in ohms from the test desk to ground over the conductor under test. Restore all keys when the test is completed, and proceed with other desired tests.

b. Testing for Ground on Ring. The test for ground on the ring side of the line is the same as that described in a above with the following exception: The RING GROUND LOW-RING GROUND key is used instead of the TIP GROUND LOW-TIP GROUND key.

33. MEASURING LOOP CAPACITANCE (S-50290)

This test is performed to determine the capacitance between the tip and ring of the line under test. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). After connection to the line is established, make the loop capacitance test as described below.

a. Operate the DIRECT MAKE-LOOP CAPACITY key to the LOOP CAPACITY position.

b. Record the maximum reading observed on the lower scale of the meter.

c. Make the corrected capacitance reading by comparing the reading indicated by the meter to the actual voltage column in the prepared chart (par. 11).

d. Restore all keys to normal after making the test.

34. TESTING FOR TIP OR RING TO GROUND CAPACITANCE (S-50290)

This test is performed to measure the capacitance between the tip or ring, of

an outside plant line and ground. Before making this test, be sure that the preliminary capacitance test (par. 11) has been made. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). Subparagraphs a and b below describe the procedure to be followed when making tip or ring to ground capacitance tests.

a. Tip to Ground Capacitance Test.

(1) Operate the SPEED-TIP CAPACITY key to the TIP CAPACITY position.

(2) Record the maximum reading observed on the lower scale of the meter.

(3) Determine the capacitance by comparing the reading obtained, to the actual reading column in the chart prepared in paragraph 11. The chart indicates the approximate capacitance between the tip conductor of the line under test and ground.

b. Ring to Ground Capacitance Test.

(1) Operate the PERCENT MAKE-RING CAPACITY key to the RING CAPACITY position.

(2) Record the maximum reading observed on the lower scale of the meter.

(3) Determine the capacitance by comparing the reading obtained to the actual voltage column in the prepared chart (par. 11).

c. Restore Keys to Normal. Restore all keys to normal after testing is completed.

35. APPLICATION OF RINGING VOLTAGE (S-50290)

Ringing voltage can be applied to any line served by the central office. Subparagraph a below describes the method of applying ringing voltage to local (dial, common battery, and local battery) lines or trunks served by the exchange. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). Subparagraph c below describes the method of applying ringing voltage to toll lines.

a. Ringing Local Lines. When connection is made to the line, apply ringing current. Use the ring on loop method ((1) below) when the ringer of the equipment to be rung is connected across the tip and ring of the line. Use the ring on tip method or the ring on ring method ((2) below) when one side of the ringer on the equipment to be rung is connected to ground.

(1) Ring on loop. To supply ringing current to a line over the tip and ring conductors (metallic ringing), operate the RING ON TIP-RING ON RING switch to either position (for about 1 second). Read the lower scale of the meter to determine the ringing voltage being supplied. If necessary, increase or decrease this voltage by adjusting the RING PAD control. Ringing voltage of 70 volts should be applied about every 5 seconds until the called party answers.

(2) Ring on tip, or ring on ring. To supply ringing current over the tip side of a line (tip to ground ringing), operate the RING ON TIP-RING ON RING switch to the RING ON TIP position (for about 1 second). To supply ringing

current over the ring side of a line (ring to ground ringing), operate the RING ON TIP-RING ON RING key to the RING ON RING position (for about 1 second). Read the lower scale of the meter to determine the ringing voltage being supplied. If necessary, increase or decrease this voltage by adjusting the RING PAD control. Ringing voltage of 70 volts should be applied for 1 second every 6 seconds, until the called party answers.

b. Frequency Ringing. On lines requiring frequency ringing, use the RING ON TIP-RING ON RING key that provides the proper frequency for the phone being tested.

c. Ringing Toll Lines. To supply ringing to lines served by the exchange which require that DC not be superimposed with the ringing circuit, make the connection to the line to be rung, then operate the TOLL RING-TIP BATTERY key to the TOLL RING position (for about 2 seconds). Read the lower scale of the meter to determine the ringing voltage being applied. If necessary, increase or decrease this voltage by adjusting the RING PAD control. Ringing voltage of 70 volts should be applied about every 6 seconds, until the distant operator answers.

36. TRANSMISSION TEST (S-50139)

This test is performed to determine the transmission quality of the transmitter in a telephone. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). If an MDF trunk is being used, restore the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to normal after connection to the line is established. Make the transmission test as described below.

a. Operate the TRANSMISSION TEST-TEST CURRENT key to the TRANSMISSION TEST position.

b. Adjust the TRANS TEST rheostat (fig. 3) until the meter needle indicates 40 (40 milliamperes) on the lower scale.

c. Instruct the repairman at the telephone under test to talk into the transmitter. By listening, the experienced test panel operator can determine whether or not the transmitter of the telephone under test is of proper quality. (If the test desk operator does not have sufficient experience in making this type of test, it is recommended that the tests be performed on transmitters which are known to be of good quality before transmission tests are performed.)

d. Restore all keys to normal when testing is completed.

37. LOOP CURRENT TEST (S-50141)

This test is performed to measure the current flow in a DC circuit such as a teletype line. This test is not to be made on alternating current circuits or on direct current circuits which are expected to indicate more than 150 milliamperes of current flow. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). After the connection to the line is established, make the loop current test as described below.

a. Operate the TRANSMISSION TEST-TEST CURRENT key to the TEST CURRENT position.

b. Record the reading indicated by the meter needle (on the lower scale). This reading is the current flow, in millaimperes, in the loop under test.

c. Restore all keys to normal after this test is completed.

38. TESTING TRUNKS TERMINATING AT TOLL SWITCHBOARD (S-50294 OR EQUIVALENT)

Toll Switchboard trunks which appear at the test panel can be tested for dialing, ringing, and supervision. To make these tests, the No. 3 SWBD key is used when the test cord is inserted into the LIST jack (multipled to operator's appearance) of the trunk to be tested. When the test cord is inserted, proceed as follows:

a. Dialing.

(1) Operate the No. 3 SWBD key to either position. If the key is operated to the AUXILIARY TEST position, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(2) The supervisory lamp lights.

(3) Dial the required digit (or digits).

(4) When connection is made, ringback tone will be heard.

b. Supervision.

(1) When the called party answers, ringback tone will no longer be heard and the supervisory lamp will go out.

(2) When the called party hangs up, the supervisory lamp lights.

c. Disconnect. To disconnect, restore all keys to normal and disconnect the test cord. The supervisory lamp goes out.

d. Ringing. On ringdown trunks, follow the procedures outlined above with the exception that in step a(3), do not dial. Ring on the trunk using the No. 3 SWBD RING key.

39. COIN CONTROL (S-50138)

The purpose of this circuit is to provide a required amount of current to a pay station telephone for the purpose of adjusting the coin return or coin collect relay. Connection to the pay station can be made over the inspector's trunk, the MDF trunk or the test switch train. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26). When connection is made and transmission is established, proceed as follows:

a. Coin Collect. When it is desired to adjust the coin collect portion of the pay station telephone inform the installer repairman at the pay station of your intentions.

(1) Operate the COIN RETURN-COIN COLLECT key to the COIN COLLECT position.

(2) Adjust the COIN CUR rheostat (fig. 3) until the meter needle indicates the prescribed current (generally 65 MA) for the type of equipment at the pay station.

(3) Inform the repairman that this condition exists and that the coin return relay should be operated.

(4) Inform the repairman to adjust the collect relay to operate on the applied current.

(5) When the relay is adjusted, restore the COIN RETURN-COIN COLLECT key to normal, wait 5 seconds and reoperate the key to the COIN COLLECT position.

(6) Ask the repairman if the coin collect relay is functioning properly.

(7) If the coin collect relay is not functioning properly, repeat the steps in (4) through (6) above.

(8) When the coin collect relay is functioning properly, adjust the coin return relay (b below).

b. Coin Return. When it is desired to adjust the coin return portion of a pay station telephone, proceed as described in a(1) through (8) above with the exception that the COIN RETURN portion of the COIN RETURN-COIN COLLECT key is used.

40. PREPAY PAYSTATION CONTROL AND PBX LINE TEST (S-50421)

The PAY STA & PBX key is used to test Prepay Paystation adapters within the central office and is also used to test PBX line circuits.

a. Pre-pay Paystation Adapter Test.

(1) Test the coin return and stuck coin features as follows:

(a) Connect to the paystation telephone using the test switch train (par. 26).

(b) When connection is made, operate the CO CONTROL-CONNECTOR RELEASE key to the CO CONTROL position.

(c) Operate the DIAL LOOP-RELEASE PERM key to the DIAL LOOP position.

(d) Simulate a deposited coin by operating the PAY STA & PBX key.

(e) Dial a digit of any level that does not appear at the operator's board.

(f) Restore the DIAL LOOP-RELEASE PERM key.

(g) Observe the coin return (CR) lamp (fig. 2). The lamp should flash at the rate of 60 times per minute. Failure of the lamp to flash indicates a defective prepay paystation adapter circuit.

(h) Restore the PAY STA & PBX key.

(2) Test the coin collect feature as follows:

(a) Reoperate the DIAL LOOP-RELEASE PERM key to the DIAL LOOP position.

(b) Reoperate the PAY STA & PBX key.

(c) Dial a test number in the telephone exchange.

(d) Answer the call at the test telephone and then restore the handset.

(e) Restore the DIAL LOOP-RELEASE PERM key to normal.

(f) Observe the coin collect (CC) lamp (fig. 2). The lamp will flash at the rate of 60 times per minute. Failure of the lamp to flash indicates a faulty prepay paystation adapter.

(g) Upon completion of the test, restore all keys to normal.

b. PBX Line Test. To test a PBX line circuit, connect to the line using the test switch train, and proceed as follows:

(1) Operate the CO CONTROL-CONNECTOR RELEASE key to the CO CONTROL position.

(2) Operate the DIAL LOOP-RELEASE PERM key to the DIAL LOOP position.

(3) Operate the PAY STA & PBX key. Dial tone should be heard in the operator's headset. If dial tone is not heard, it indicates a faulty PBX line circuit.

(4) Upon completion of the test, restore all keys to normal.

41. PULSE SPEED AND PERCENT MAKE TESTS, LOCAL LINES (S-50291 OR EQUIVALENT)

The pulse speed test is performed to determine the number of pulses per second received from the impulse springs at the telephone dial. The percent make test is performed to determine the length of time pulsing contacts are closed. Connection to the line to be tested can be made through the inspector's trunks (par. 17), order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25), or the test selector (par. 26).

a. Pulse Speed Tests.

(1) Inform the telephone user not to disconnect, and then place the line under test in the hold position or disconnect the line from the binding posts. On the inspector's trunk circuit, restore the CO CONTROL-CONNECTOR RELEASE key.

(2) Restore all test keys to normal.

(3) Make the SET 100 adjustment in the following manner:

(a) Operate the SET 100 key.

(b) Operate the SPEED-TIP CAPACITY key to the SPEED position.

(c) Adjust the SET 100 rheostat until the meter needle indicates 100 on the lower scale.

(4) Restore the SET 100 key to normal.

(5) Reconnect to the line under test. On inspector's trunks, operate the CO CONTROL-CONNECTOR RELEASE key to the CO CONTROL position.

(6) Adjust the PRESET rheostat until the meter needle indicates 10 times the expected reading on the lower scale.

(7) Restore the SPEED-TIP CAPACITY key to normal.

(8) Operate the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to the TALK BATTERY AUXILIARY position if the auxiliary testing leads are connected to the line under test; or, to the TALK BATTERY PRIMARY position if the primary testing leads are connected to the line under test.

(9) Instruct the person at the telephone under test to dial the digit "0" but not to release the dial for 3 or 4 seconds. As soon as this instruction is given, restore the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to normal, and operate the SPEED-TIP CAPACITY key to the SPEED position. The meter needle indicates the preset value on the lower scale.

(10) When the party at the telephone under test releases the dial, the meter needle moves, indicating the actual speed of the impulses received. For example, if the dial under test has a pulse speed of 12 pulses per second, the meter needle will move slowly toward 120 and become steady at 120 by the time the last pulse is received. After the last pulse of the digit dialed is received, the meter needle will again indicate the preset value.

(11) To obtain a more accurate dial speed reading, readjust the PRESET rheostat until the meter needle indicates the value nearest to the steady value indicated by the meter needle in (10) above.

(12) Make another speed test following the procedure described in (9) through (11) above.

(13) Continue to make speed tests until the meter needle remains steady throughout the entire series of pulses. When this condition exists, record the reading observed on the lower scale of the meter, and divide by 10. The result (quotient) is the pulse speed of the dial in pulses per second. The dial speed should be 10 pulses per second, plus or minus 2 pulses per second.

(14) To re-establish a transmission circuit when testing is completed, restore the SPEED-TIP CAPACITY key to normal, and operate the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to the desired position.

(15) Restore all keys to normal when testing is completed. Disconnect the line from the binding posts if they were used.

b. Percent Make Tests. The percent make reading does not indicate the actual percent make of the pulsing contacts in the dial. This reading is actually an indication of the result of the percent make of the dial, line resistance, inductance, and capacitance, and the capacitance of the ringers across the line. This reading may also vary with the exchange voltage. Normally it is not necessary to make percent make tests over a telephone user's line. However, if it is done, an abnormal percent make reading usually is an indication of faulty line conditions, rather than dial adjustment. This abnormal percent make reading is desirable since it is an indication of how the pulses on the line under test affect the XY dial automatic equipment. Establish the connection to the line and proceed as described below.

(1) Perform the instructions described in a(1) through (5) on page 37 with the following exceptions: Operate the PERCENT MAKE-RING CAPACITY key to the PERCENT MAKE position where the SPEED-TIP CAPACITY key was operated to the SPEED position.

(2) Adjust the PRESET rheostat until the meter needle indicates 40 on the lower scale.

(3) Restore the PERCENT MAKE-RING CAPACITY key to normal.

(4) Perform the instructions described in a(8) and (9) on page 38 with the following exceptions: Operate the PERCENT MAKE-RING CAPACITY key to the PERCENT MAKE position where the SPEED-TIP CAPACITY key was operated to the SPEED position.

(5) When the party at the telephone under test releases the dial, the meter needle will move slowly in the direction of the actual percent make of the pulsing contacts. For example, if the dial under test has a percent make of 50, the meter needle will move slowly toward 50 (lower scale) and become steady at this reading by the time the last pulse is received. When the last pulse of the digit dialed is received, the meter needle again indicates the preset value.

(6) To obtain a more accurate percent make reading, readjust the PRESET rheostat until the meter needle indicates the value nearest to the steady value indicated by the meter needle in (5) above.

(7) Make another percent make test following the procedure described in (4) through (6) above.

(8) Continue to make percent make tests until the meter needle remains steady throughout the entire series of pulses. When this condition exists, record the reading observed on the lower scale of the meter.

(9) To re-establish a transmission circuit when testing is completed, restore the PERCENT MAKE-RING CAPACITY key to normal, and operate the TALK BATTERY AUXILIARY-TALK BATTERY PRIMARY key to the required position.

(10) Restore all keys to normal when testing is completed. Disconnect the line from the binding posts if used.

42. TESTING TEST PANEL DIAL AND LOOSE DIALS

The test panel operator may desire to make pulse speed and percent make tests on the test panel dial or on loose dials. Subparagraphs a and b below describe the method of performing these tests on loose dials; subparagraphs c and d below describe the method of performing these tests on the test panel dial. If desired, the test panel dial can be removed and tested as a loose dial (a and b below) or the test panel dial can be removed, and loose dials put in its place, and the tests performed as described in c and d below.

a. Pulse Speed Tests on Loose Dials.

(1) Perform the operations described in paragraph 41a(3) and (4).

(2) Connect the impulse springs of the dial under test to the primary or auxiliary binding posts. If this connection is made to the auxiliary binding posts, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(3) Adjust the PRESET rheostat until the meter needle indicates 10 times the expected reading on the lower scale.

(4) Dial the digit "0".

(5) Perform the operations described in paragraph 41a(10) and (11).

(6) Make another speed test following the procedure described in (4) and (5) above.

(7) Perform the operation described in paragraph 41a(13).

(8) Restore all keys when testing is completed and disconnect the dial from the binding posts.

b. Percent Make Tests on Loose Dials.

(1) Perform the operations described in paragraph 41a(3) and (4) with the following exception: Operate the PERCENT MAKE-RING CAPACITY key to the PERCENT MAKE position wherever the SPEED-TIP CAPACITY key was operated to the SPEED position.

(2) Perform the operation described in a(2) on page 39.

(3) Adjust the PRESET rheostat until the meter needle indicates 40 on the lower scale.

(4) Dial the digit "0".

(5) Perform the operations described in paragraph 41b(5) and (6).

(6) Make another percent make test following the procedure described in (4) and (5) above.

(7) Perform the operations described in paragraph 41b(8).

(8) Restore all keys when testing is completed and disconnect the dial from the binding posts.

c. Pulse Speed Test on Test Panel Dial.

(1) Perform the operations described in paragraph 41a(3) and (4).

(2) If the test is to be performed over the auxiliary testing leads, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position. If the primary testing leads are being used, leave this key unoperated.

(3) Operate the DIAL LOOP-RELEASE PERM key to the DIAL LOOP position.

(4) Adjust the PRESET rheostat until the meter needle indicates 10 times the expected reading on the lower scale.

(5) Dial the digit "0".

(6) Perform the operations described in paragraph 41a(10) and (11).

(7) Make another speed test following the procedure described in (5) and (6) above.

(8) Perform the operations described in paragraph 41a(13).

(9) Restore all keys when testing is completed.

d. Percent Make Test Panel Dial. To make percent make tests on the test panel dial, follow the procedures described below.

(1) Perform the operations described in paragraph 41a(3) and (4) on page 40 with the following exception: Operate the PERCENT MAKE-RING CAPACITY key to the PERCENT MAKE position wherever the SPEED-TIP CAPACITY key was operated to the SPEED position.

(2) Perform the operations described in c(2) and (3) on page 40.

(3) Adjust the PRESET rheostat until the meter needle indicates 40 on the lower scale.

(4) Dial the digit "0".

(5) Perform the operations described in paragraph 41b(5) and (6).

(6) Make another percent make test following the procedure described in (4) and (5) above.

(7) Perform the operations described in paragraph 41b(8).

(8) Restore all keys when testing is completed.

43. DIRECT MAKE TESTS (S-50291)

The purpose of the direct make test is to determine the length of time that pulsing contacts from a pulsing source are closed. When this test is made the pulsing source is connected directly to the meter and the pulses are not repeated by a pulsing relay. Connection to the equipment supplying the pulses can be established by direct connection to the primary or auxiliary binding posts (par. 23) or over the MDF trunks (par. 22). Subparagraphs a and b below describe the method of performing direct make tests over each of the above methods of establishing a connection to the pulsing source. To perform direct make tests, refer to the applicable condition described below.

a. Direct Make Test Over Primary or Auxiliary Binding Posts.

Do not connect the pulsing source to the binding posts until instructed to do so.

(1) Restore all test keys to normal.

(2) Make the SET 100 adjustment in the following manner.

(a) Operate the WB LOOP-SET 100 key to the SET 100 position.

(b) Operate the DIRECT MAKE-LOOP CAPACITY key to the DIRECT MAKE position.

(c) Adjust the SET 100 rheostat until the meter needle indicates 10 times the expected reading on the lower scale.

(3) Restore the WB LOOP-SET 100 key and the DIRECT MAKE-LOOP CAPACITY key to normal.

(4) Connect the pulsing source to the binding posts. If the auxiliary binding posts are being used, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.

(5) Operate the DIRECT MAKE-LOOP CAPACITY key to the DIRECT MAKE position.

(6) Record the reading observed on the lower scale of the meter. This reading is the percent make of the pulsing contacts of the pulsing source.

(7) Restore all keys to normal when testing is completed, and disconnect the pulsing source from the binding posts.

b. Direct Make Tests Over MDF Trunks.

(1) Restore all keys associated with the trunk in use to normal.

(2) Perform the operations described in a(2) and (3) on page 41.

(3) Insert the test shoe into the protector block and perform the operations described in paragraph 22a(1) and (2).

(4) Operate the DIRECT MAKE-LOOP CAPACITY key to the DIRECT MAKE position.

(5) Record the reading observed on the lower scale of the meter. This reading is the percent make of the pulsing contacts of the pulsing source.

(6) Restore all keys to normal when testing is completed.

44. HOWLER (S-50136 OR EQUIVALENT)

a. The howler circuit provides a graduated howler tone to a subscriber's telephone to attract the attention of the telephone user. This tone is supplied when it has been determined that the subscriber has forgotton to replace, or has improperly replaced, the handset on the cradle of the telephone. The test desk operator can usually determine that this condition exists by the calls that come in from other telephone users who will complain of receiving busy tone while trying to establish a connection with the telephone user, or by the permanent signal condition which exists on the equipment seized by the line. After it has been determined that this condition exists, howler tone should be applied to the line that serves the telephone. Connection to the line can be established over any one of the methods described in (1) through (4) below.

(1) Primary or auxiliary binding posts. Connection to the line is established over the primary or auxiliary binding posts in the manner described in paragraph 23a or b. If the auxiliary binding posts are being used, do not operate the TEST AUXILIARY key to apply howler tone to the line.

(2) Inspector's trunks. Howler tone can be applied over an inspector's trunk (par. 17) after the call has been answered. If the howler tone is to be applied over the auxiliary testing leads, do not operate the TEST AUXILIARY-CO AUXILIARY key.

(3) Test selector trunks. Connection to the line is established over the test selector trunks in the manner described in paragraph 26a(1). If howler tone is applied over the auxiliary testing leads, restore the TEST AUXILIARY-CO AUXILIARY key to normal after the connection to the line is established. (It may also be necessary to operate the DIAL LOOP-RELEASE PERM key to the RELEASE PERM position to release the permanent condition on the line under test.)

(4) MDF trunks. Connection to the line is established over the MDF trunks in the manner described in paragraph 22a. If the howler tone is applied over the

auxiliary testing leads, do not operate the TEST AUXILIARY-CO AUXILIARY key.

b. After connection to the line has been established, supply howler tone by operating the HOWLER AUXILIARY-HOWLER PRIMARY key to the HOWLER AUXILIARY position (to supply howler tone over the auxiliary testing leads), or the HOWLER PRIMARY position (to supply howler tone over the primary testing leads). As soon as this key is operated, the HLR lamp flashes at the rate of 60 times per minute, the night alarm buzzer sounds (if the NA key is on (counterclockwise position)), and howler tone is applied to the line which serves the telephone under test. This tone should be supplied to the telephone under test until the handset is replaced, or until it has been decided that applying tone for a longer period of time would not result in the replacement of the handset.

c. If the telephone user is attracted to the telephone, and replaces the handset on the cradle of the telephone, the howler circuit functions in one of two ways depending on the wiring options used. One wiring option causes the tone to be continually supplied to the telephone until the test desk operator restores the HOWLER AUXILIARY-HOWLER PRIMARY key to normal. The other wiring option causes the howler tone to be disconnected from the line as soon as the handset is replaced on the cradle of the telephone under test. If the second wiring option is used, the HLR lamp stops flashing as soon as the handset is replaced. If the first wiring option is used, no indication is given when the telephone user replaces the handset. In this case the tone should be applied periodically and the line should be tested after each application of tone to determine when the handset is replaced. The loop resistance test (par. 30) can be used to determine this condition.

d. Restore all keys to normal after it has been decided that the howler tone should no longer be applied to the line under test.

Note. On lines which the handset has failed to be restored to the cradle of the telephone, establish a connection to the line under test using an MDF trunk and the test shoe (par. 22). Operate the SOUNDER AUXILIARY-SOUNDER PRIMARY key to the same position as the MDF out keys. Operate the SDR REV key. Leave these keys operated until the sounder operates. When the sounder operates, restore all keys to normal and remove the test shoe from the main frame.

45. SOUNDER (S-50295 OR EQUIVALENT)

The sounder is used to provide a means for the cable repairman (with the aid of the test panel operator) to identify paired conductors of outside plant lines. The sounder is also used as an aid in clearing shorted outside plant lines. Before the sounder is connected to the line to be tested, a cable pair which is known to be good should be used to establish a transmission circuit between the test panel operator and a cable repairman. Connection to the line can be made through the order wire (par. 20), MDF trunks (par. 22), binding posts (par. 23), test cords (par. 25) or test selector (par. 26). After connection to the line has been established, the line should be tested to determine whether it is open, shorted, or has battery or ground connected to either the tip or the ring. After the line has been tested for these conditions, the sounder can be applied for identification tests as described in a below, or for shorted line tests as described in b on page 44.

a. Identifying Cable Pairs. If the tip of the line to which the sounder is connected, is connected to battery, or the ring of the line is connected to ground, operate the SDR REV key and proceed as described below. If neither of these conditions exist on the line do not operate the SDR REV key and proceed as described on page 44.

(1) Operate the SOUNDER AUXILIARY-SOUNDER PRIMARY key to the SOUNDER AUXILIARY position or to the SOUNDER PRIMARY position.

(2) The sounder will not function until the cable repairman identifies (touches together) the tip and ring of the line under test.

(3) When the tip and ring leads are identified, the sounder sounds and the SDR lamp lights. When this condition exists, notify the cable repairman that the leads have been identified.

(4) Restore all keys to normal after testing is completed.

b. Clearing Shorted Line. If the tip of the line to which the sounder is connected, is connected to battery or if the ring side of the line is connected to ground, operate the SDR REV key and proceed as described below. If neither of these conditions exist on the line do not operate the SDR REV key and proceed as described below.

(1) Operate the SOUNDER AUXILIARY-SOUNDER PRIMARY key to the SOUNDER PRIMARY position. Since the line under test is shorted, the sounder sounds and the SDR lamp lights.

(2) Operate the SDR SW key. This causes the sounder to stop operating and the SDR lamp to go out. This condition will exist until the cable repairman removes the short from the line.

(3) When the tip and ring short is cleared, the sounder will sound, and the SDR lamp will light. When this condition exists, notify the cable repairman that the tip and ring short is cleared.

(4) Restore all keys to normal after testing is completed.

46. REVERSING TESTING LEADS (S-50290)

This feature is used to permit the test panel operator to reverse the primary or auxiliary tip and ring leads of the main testing circuit. The test tip and test ring leads of the main testing circuit are extended to lines to be tested over the primary or auxiliary tip and ring leads. Under normal conditions, the primary or auxiliary tip lead is extended to the tip of the line under test, and the primary or auxiliary ring lead is extended to the ring of the line under test. However, in some cases the tip and ring of the line under test may be reversed purposely. This in effect, would mean that the tip of the line under test would be extended to the test ring lead of the main testing circuit (over the primary or auxiliary tip lead) and the ring of the line under test would be extended to the test tip of the main testing circuit (over the primary or auxiliary tip lead). To remedy this situation the TEST SLEEVE-REVERSE key should be operated to the REVERSE position. This reverses the connection between the test tip and ring leads and the primary or auxiliary tip and ring leads. It extends the test tip lead to the tip of the line under test (over the primary or auxiliary tip lead), and the test ring lead to the ring of the line under test (over the primary or auxiliary tip lead).

47. DISCONNECTING TRANSMISSION CIRCUIT FROM AUXILIARY TESTING LEADS (S-50290)

The purpose of the CO AUXILIARY position of the TEST AUXILIARY-CO AUXILIARY key is to allow the test man to disconnect the auxiliary tip and ring leads from the operator's telephone circuit. Under normal conditions the operator's telephone

circuit is metalically connected to the primary tip and ring leads, and the auxiliary tip and ring leads are bridged across the operator's telephone circuit by capacitors (through the CO AUXILIARY contacts of the TEST AUXILIARY-CO AUXILIARY key in its normal position). At times when the test panel operator desires to use both the auxiliary and primary testing leads (for testing or transmission purposes) this key can be used to disconnect the transmission circuit from the auxiliary testing leads. The following example is provided to illustrate when this switch can be used. Assume that a call comes in over an inspector's trunk and is answered using the AUXILIARY TEST position of the inspector's TRK key and that conversation is taking place between the test desk operator and a repairman. Further assume, that another call comes in over another inspector's trunk and the test panel operator desires to answer this call. This situation can be handled as described in paragraph 17c, or it can be handled by operating the TEST AUXILIARY-CO AUXILIARY key to the CO AUXILIARY position to temporarily disconnect the first call. Then by proceeding with the operations described in paragraph 17b, a transmission circuit can be established to the second trunk over the primary testing leads. This method of operation is more rapid than that described in paragraph 17c. However, it must be remembered that the TEST AUXILIARY-CO AUXILIARY key can be used only to disconnect the transmission circuit when the auxiliary testing leads are being used. A transmission circuit established over the primary testing leads cannot be disconnected in this manner.

48. RELEASING PERMANENT SIGNALS

Note. When the permanent condition cannot be removed, test the defective pair using the test shoe and a MDF trunk.

a. This feature is used to provide a means for the test panel operator to release seized dial equipment causing a permanent signal alarm. A permanent signal alarm exists when a CB or AB relay remains operated. Connection to the line causing the permanent signal is established over the test selector trunk (par. 26a). When connection to the line is established, the supervisory lamp associated with the trunk in use flashes at the rate of 120 times per minute. To release the CB or AB relay, operate the DIAL LOOP-RELEASE PERM key to the RELEASE PERM position and hold it there for 2 or 3 seconds. When the XY dial equipment releases (which disconnects the permanent signal alarm) the supervisory lamp associated with the test selector trunk goes out. When this condition exists restore all keys to normal.

b. After applying the operation described in a above, test the line to determine the cause of the permanent alarm signal. When it is determined that the permanent alarm signal is caused by an off-hook condition (subscriber fails to hang up), apply the howler to the faulty line (par. 44).

49. LINE EQUIPMENT TEST (S-50290)

a. This test is used to determine if the line equipment associated with a subscriber's telephone is functioning properly. Connection to the line which is associated with the line equipment to be tested is established over a test selector trunk (par. 26).

b. After connection to the line is established, make the line equipment test as described below.

(1) Operate the CO CONTROL-CONNECTOR RELEASE key to the CO CONTROL position.

(2) Operate the DIAL LOOP-RELEASE PERM key to the DIAL LOOP position. Dial

tone is heard in the receiver of the operator's telephone set.

(3) Dial the number of one of the telephones within the central office. The called telephone rings if the line equipment under test is functioning properly.

(4) When this test is completed, restore the DIAL LOOP-RELEASE PERM key. This causes the XY dial equipment, seized by the line equipment under test, to release.

Note. Be sure to restore the DIAL LOOP-RELEASE PERM key before the CO CONTROL-CONNECTOR RELEASE key is restored. If the CO CONTROL-CONNECTOR RELEASE key is restored first, the switch train will be locked up and will not release when the DIAL LOOP-RELEASE PERM key is restored.

(5) If desired, this test can be performed again by following the procedure described in (2) through (4) above. If it is not desired to make this test again, restore the CO CONTROL-CONNECTOR RELEASE key to normal.

(6) If other tests are to be made at this time, refer to the preceding paragraphs for the applicable tests.

(7) If it is desired to perform this test on other line equipment, refer to paragraph 51 for the procedure to be followed in establishing connections to other lines. Then proceed with the line equipment test as described in (1) through (6) above.

(8) If no other testing is desired at this time, restore all keys to normal.

50. DIAL LEG (S-50299, 50300, 50301, 50422)

a. When trunks terminate in the jack field section, they may contain several types of signaling circuits. The test panel is provided with facilities for testing these signaling circuits. The circuits which may be provided are:

(1) Polar Duplex and E & M dial leg Signaling.

(2) Positive-Negative dial leg Signaling.

(3) Differential Duplex dial leg signaling.

(4) Hi-Lo dial leg Signaling.

b. Each of the above four circuits function in the same manner. That is, each circuit has a test key and a rheostat (or two) which must be adjusted to match line requirements. The only difference in the operation of either of these trunks is the key and the rheostat associated with it.

c. The test panel operator must be familiar with the type of signaling circuit which is used with each of the trunk circuits that terminate at the jack field of the test panel. To test the signaling circuit, a transmission path must be established with the AUX test cord. When the transmission path is established, the test panel operator can test the signaling circuit. Tests can be made for dialing out, or for measuring the percent make of incoming pulses. To make these tests, proceed as follows:

(1) Dialing out.

(a) When the transmission path is established, insert the PRIM test cord into the signal jack which connects the test circuit to the trunk circuit in the desired direction.

(b) Operate the LEG DIAL-WB LOOP key to the LEG DIAL position.

(c) Operate the dial leg key for the type of signaling required for the trunk being tested.

(d) Adjust the rheostat or rheostats associated with the dial leg key being used to the prescribed position required for the trunk being tested. This prepares the test panel circuit to simulate the signal circuit of the trunk being tested.

(e) Dial the desired number using the dial on the test panel.

(f) Upon completion of the tests, remove the test cords and restore all keys to normal.

(2) Measuring dial pulses.

(a) Perform the steps described in c(1)(a) through (d) above.

(b) Operate the SET 100 key and make a set 100 adjustment as described in paragraph 41a(3)(a) and (d).

(c) Restore the SET 100 key.

(d) Inform the party at the distant end of the trunk to dial the digit "0".

(e) Observe the meter. When the party at the distant end is dialing, the meter needle should indicate the percent make value on the lower scale. Divide the meter indication by 10. The result (quotient) is the percent make of the pulses received.

(f) Perform steps (d) and (e) at least three times to obtain a true reading.

(g) Upon completion of tests, remove the test cords from the jacks and restore all keys to normal.

51. MULTILINE TESTING (S-50290)

a. The purpose of this feature is to permit the test panel operator to test the entire group of lines (100 lines) served by a test connector. Connection to the desired test connector is established over a test selector trunk. To establish a connection to the test connector, operate any one of the TEST SELECTOR keys to the AUXILIARY TEST position or to the PRIMARY TEST position. If the key is operated to the AUXILIARY TEST position, the TEST AUXILIARY-CO AUXILIARY key must also be operated to the TEST AUXILIARY position. Dial the digits required to connect to the connector group to be tested. This extends the test panel facilities to the desired test connector.

b. After the connection to the desired test connector is established, follow the procedure described below.

(1) Dial the digits 1 and 1. This causes the test connector to step to line

11 and extend the test panel facilities to the line 11 of the group of lines to be tested.

(2) Tests can now be performed on line 11. Perform the desired tests.

(3) After testing is completed on line 11, dial the digit 1. This causes the test connector to step to line 12. Tests on line 12 can now take place.

(4) To make tests on lines 13 through 10 continue to dial the digit 1.

(5) After all the lines on the first level (lines 11 through 10) of the test connector have been tested, momentarily operate the CO CONTROL-CONNECTOR RELEASE key to the CONNECTOR RELEASE position. This will cause the test connector to restore to normal.

(6) Dial the digits 2 and 1. This causes the test connector to step to line 21. Tests can now be performed on line 21.

(7) To make tests on lines 22 through 20 continue to dial the digit 1 after each series of tests.

(8) After all lines on the second level (lines 21 through 20) of the test connector have been tested, momentarily operate the CO CONTROL-CONNECTOR RELEASE key to the CONNECTOR RELEASE position. This causes the test connector to restore to normal.

(9) Continue to test the remainder of the levels (levels 3 through 0) in the same manner as level 1 and 2 until all lines (11 through 00) served by the test connector have been tested.

(10) After all the lines served by one test connector have been tested, restore all keys to normal.

c. To test the group of lines served by another test connector, follow the procedure described in a and b on page 47.

52. SLEEVE TEST (S-50290)

When it is desired to test the condition of the sleeve circuit of a jack in the jack field section, the sleeve test can be made as follows:

a. Insert a test cord into the jack to be tested. (If the AUX cord is used, operate the TEST AUXILIARY-CO AUXILIARY key to the TEST AUXILIARY position.)

b. Operate the SLEEVE TEST-REVERSE key to the SLEEVE TEST position.

c. Perform the desired tests.

d. Upon completion of testing, restore all keys to normal and remove the test cord.

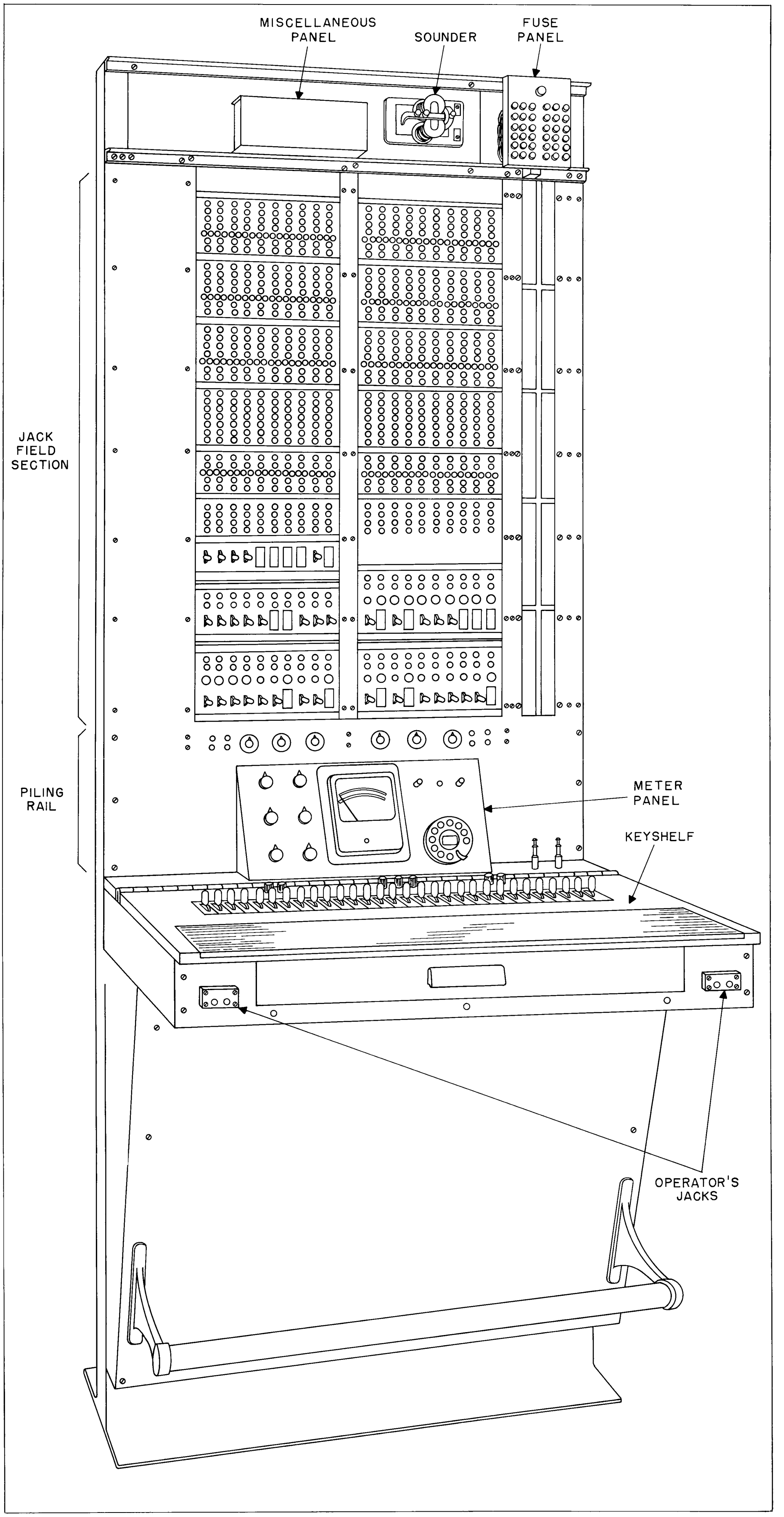
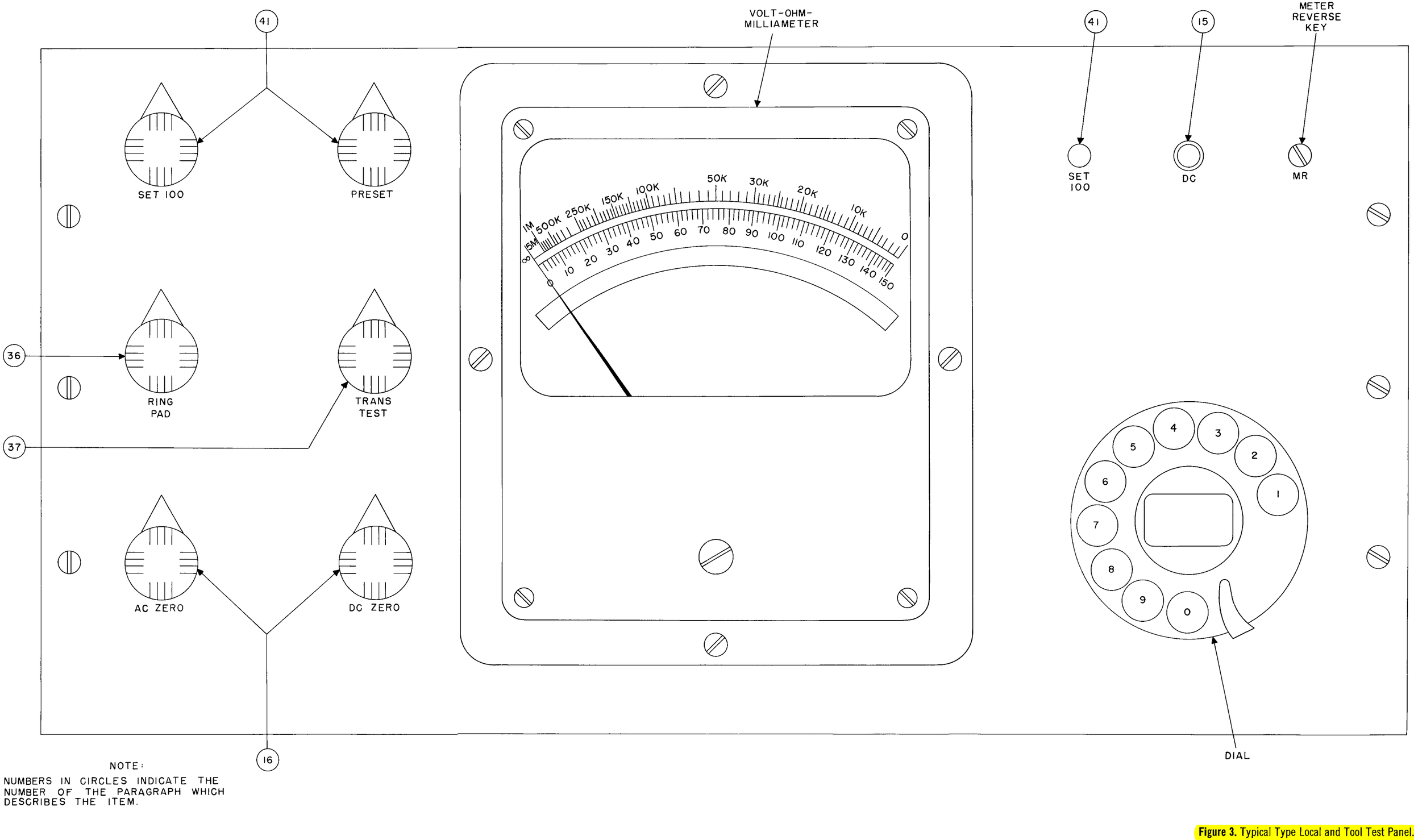


Figure 1. Typical Type E Local and Toll Test Panel.

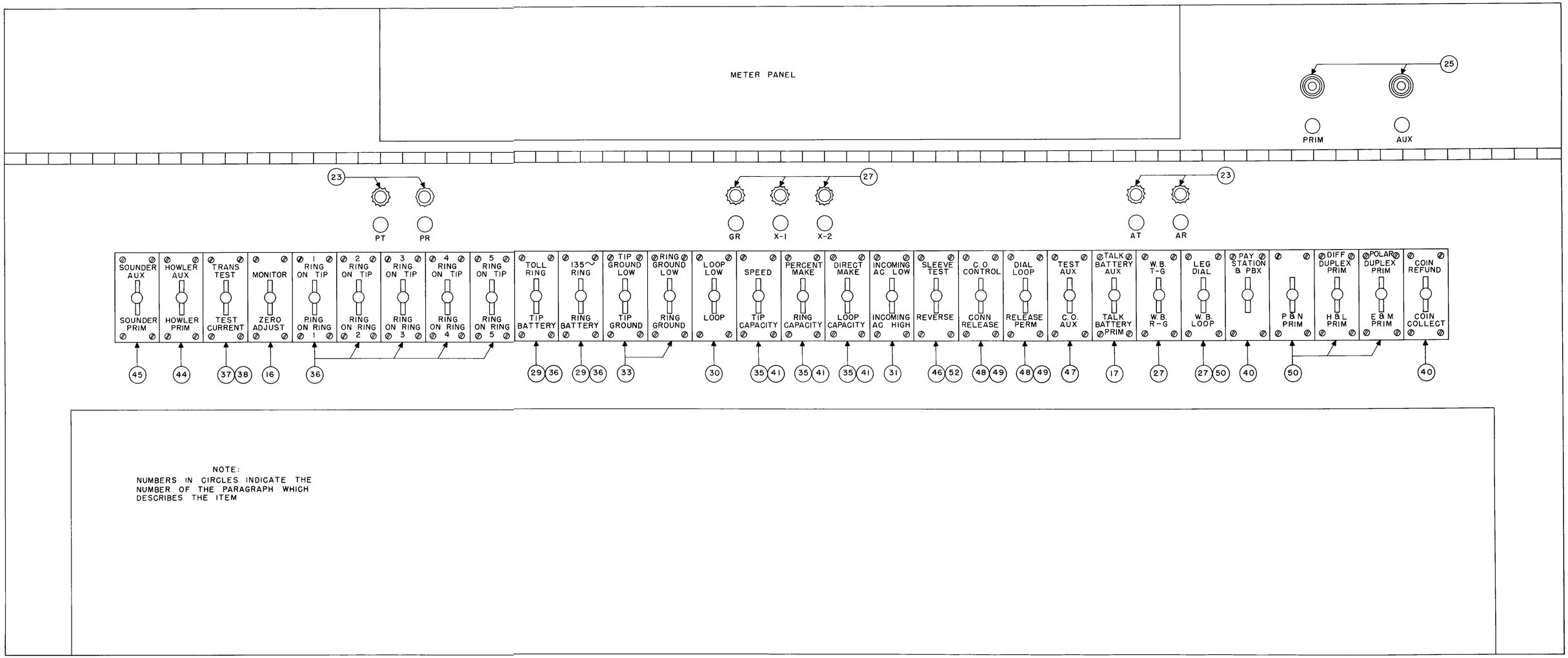
Figure 2. Face Equipment, Type E Local and Toll Test Panel.



NOTE:

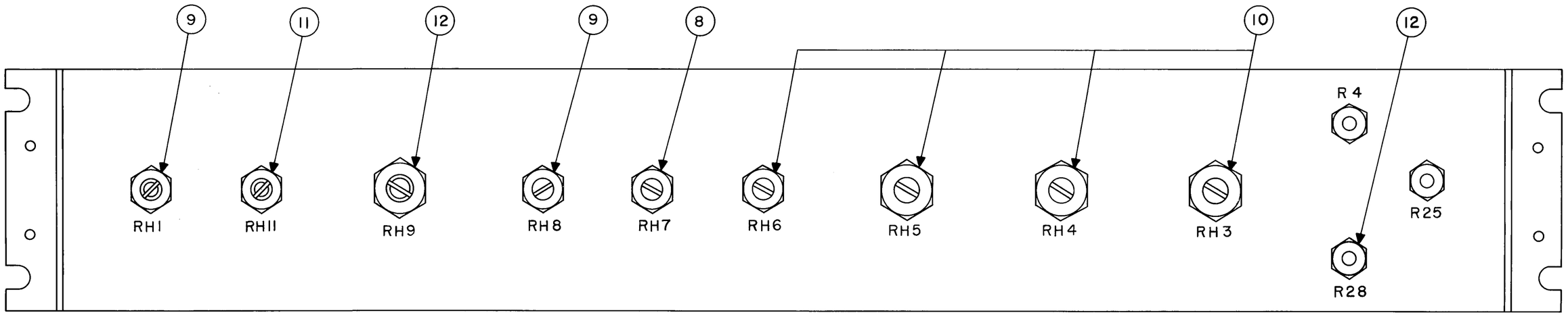
NUMBERS IN CIRCLES INDICATE THE NUMBER OF THE PARAGRAPH WHICH DESCRIBES THE ITEM.

Figure 3. Typical Type Local and Tool Test Panel.

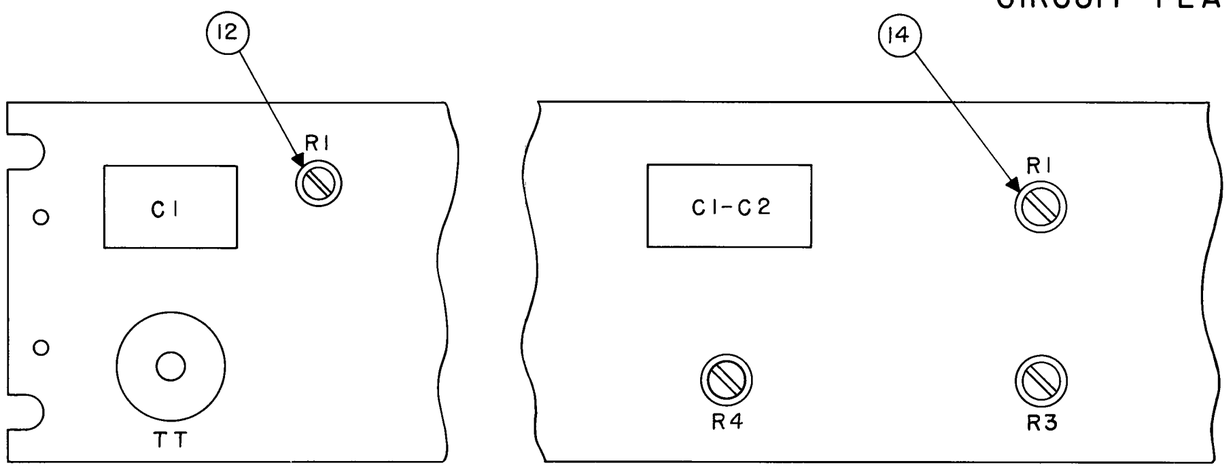


NOTE:
NUMBERS IN CIRCLES INDICATE THE NUMBER OF THE PARAGRAPH WHICH DESCRIBES THE ITEM

Figure 4. Keyshelf Type E Local and Toll Test Panel.



CIRCUIT PLATE 1



PART OF CIRCUIT PLATE 3

PART OF CIRCUIT PLATE 5

NOTE:
NUMBERS IN CIRCLES DESIGNATE THE PARAGRAPH DESCRIBING THE ADJUSTMENT OF THE ITEM.

FIGURE 5: LOCATION OF ADJUSTABLE RESISTORS

Figure 5. Location of Adjustable Resistors.

STROMBERG-CARLSON

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