Walthill

T-1048
ISSUE 2

STROMBERG-CARLSON

TYPE C
TEST TURRET

Operating Instructions

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TYPE C WIRE CHIEF'S TEST TURRET OPERATING INSTRUCTIONS

INTRODUCTION

1. PURPOSE AND USE

a. *General.*

The Type C Wire Chief's Test Turret is used as an aid in the maintenance and repair of inside and outside plant equipment of dial central offices. The following subparagraphs list the testing paths, testing facilities, and miscellaneous circuitry available with the Test Turret. The actual equipment supplied with each Test Turret is determined by the requirements and specifications of the individual office.

Ignore reference in this instruction book to equipment not supplied as part of your particular test turret.

b. *Testing Paths.*

(1) Incoming from selector level.
(2) Outgoing to test selector.
(3) Outgoing through test shoe or MDF test trunk.
(4) Outgoing through the test binding posts.
(5) Outgoing through test jack (injack field).

c. *Testing Facilities.*

The following tests can be made:
(1) Loop and leakage resistance.
(2) Capacitance.
(3) Battery.
(4) Ground.
(5) Pulse speed and percent make.
(6) Wheatstone Bridge (portable).

d. *Miscellaneous Facilities.*

(1) Order wire circuits.
(2) Two-way to line trunk.
(3) Local and toll ringing.
(4) Manual howler with or without automatic cutoff.
(5) Meter adjust.
(6) Night alarm.

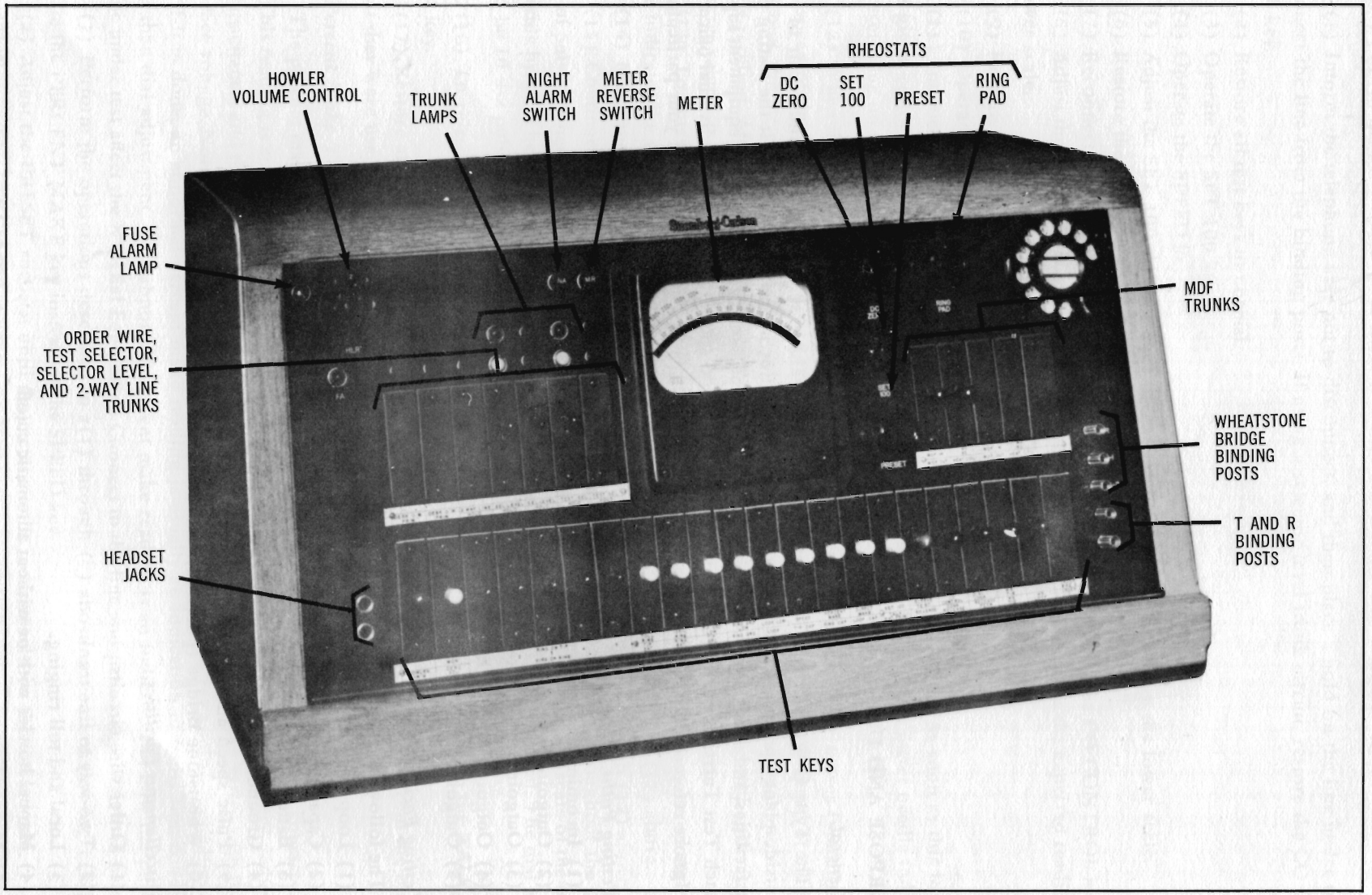

Figure 1. Type C Test Turret

2. SYSTEM APPLICATION

a. *Dial Switching Equipment.*

The Test Turret is accessible from the dial switching equipment through the banks of the selectors (selector level trunks), generally, the second selector. The maximum number of selector level trunks that can be equipped is two.

b. *Dial Test Switching Equipment.*

The dial test switch train consists of the test selector and the test connector. The test switch train can be seized from the Test Turret through test selector trunks. The maximum number of test selector trunks that can be equipped is two.

c. *Test Shoe or MDF Trunks.*

These trunks permit the Test Turret operator to test lines and trunks without going through the central office equipment. The test shoe is manually inserted into the protector blocks (of the pair to be tested) on the MDF, or the line or trunk is patched to the jack field of the MDF trunk. The maximum number of test shoe or MDF trunks that can be equipped is two.

d. *Order Wire Circuit.*

A direct connection to another Test Turret, Attendant's Switchboard, or other facility is provided from the Test Turret through the order wire circuit. The maximum number of order wire circuits that can be equipped is four.

e. *Two-Way Line Trunk.*

A circuit is provided from the Test Turret to a magneto or dial line for the purpose of transmission only. This line is used to reach the Test Turret operator directly from a phone outside the Central Office. Tests cannot be made over this line.

3. TECHNICAL CHARACTERISTICS

a. *Operating Requirements.*

Battery Voltage	44- to 54-volts dc battery.
Dial Characteristics:	
Percent make	38% ± 2%
Speed	8 to 12 impulses per second (pps)
Interrupted Ground	60 to 120 interruptions per minute (ipm)
Ringing Voltage	5 frequency (as required) 135 cps, 20 cps insulated
Number of Trunks (maximum)	
Incoming:	
Selector level	2
Two-way to line	1
Outgoing:	
MDF (test shoe)	2
Order wire	4
Test selector	2

b. *Volt-ohm-milliammeter (meter).*

Characteristics:

Full scale deflection current..... .00075 ampere.

Internal resistance..... 600 ohms.

Scales:

Bottom Scale:

ac-dc voltage..... 0 to 150 volts.

dc current..... 0 to 150 milliamperes.

Top Scale: (ohms)..... 0 to infinity.

OPERATION

4. CONTROLS AND INSTRUMENTS AND THEIR USES

The charts below list the controls and instruments of the Test Turret and their type and functions. The normal position of the switches and keys are not listed since the normal position merely disconnects its associated circuit from the main testing circuit.

a. *Miscellaneous Controls.*

CONTROL OR INSTRUMENTS	TYPE	FUNCTION
Volt-ohm-milliammeter	Meter with two scales on meter face:	
	0 to infinity	Measures loop resistance of any circuit or unit connected to T and R binding posts.
	0-150	Measures:
		Voltage of ringing supply. Voltage of inside plant equipment.
		Voltage of foreign source when testing outside plant lines.
		Central office battery on loop.
		Percent make of dial.
		Direct make of dial.
		Speed of dial.
		Capacitance of line loop.
RING PAD	Rheostat	Adjusts ringing voltage output.
PRESET	Rheostat	Presets meter needle to expected value when making pulse speed or percent make tests.

a. *Miscellaneous Controls* (Cont).

CONTROL OR INSTRUMENT	TYPE	FUNCTION
MR switch	Rotary switch	Reverses polarity to volt-ohm-milliammeter.
DC ZERO	Rheostat	Zero adjusts the meter.
SET 100	Rheostat	Presets meter needle to 100 when making percent make or pulse speed tests.
TEST SELECTOR	Lamp	When lighted, indicates trunk is being used (busy).
SELECTOR LEVEL	Lamp	When lighted, indicates trunk is being used (busy).
TWO-WAY LINE lamp	Lamp	When lighted, indicates incoming call.
DESK OW lamp	Lamp	When lighted, indicates incoming call.
SELECTOR LEVEL key	Bent handle, 2 position, locking	First position (answer) connects tip and ring test leads to tip and ring of incoming call. Second position (hold), disconnects test leads but holds selector trunk.
HLR	Selector, Switch (3 step)	Used to control the output volume of the Howler.
TEST SEL key	Bent handle, 2 position, locking	First position (seize), connects tip and ring leads to test selector. Second Position (hold), disconnects test leads but holds test selector.
2 WAY LINE key	Bent handle, 2 position, locking	First position (seize or answer) used to establish a direct connection between Test Turret and magneto telephone or dial line equipment. Second position (hold), disconnects test leads but holds line circuit.
MDF OUT key	Locking	Used to test outside plant (bypassing heat coils) through test shoe.

a. *Miscellaneous Controls* (Cont).

CONTROL OR INSTRUMENT	TYPE	FUNCTION
HEAT COIL key	Locking	Used to test into central office line equipment over test shoe through heat coils of line.
WH BG key	Locking	Disconnects ground from GR binding post.
ORDER WIRE key	Two position, locking	Connects transmission circuit to other Test Turrets or switchboards for communication purposes.
DESK OW key	Locking	Connects transmission circuit to other Test Turrets or switchboards for communication purposes.
NA key	Locking (twist)	Disconnects night alarm buzzer.
FA lamp	Lamp	When lighted, indicates blown fuse in Test Turret.
Dial		Used to step dial equipment.
T and R binding posts		Used to connect *loose* equipment (dial, etc.) to Test Turret.
X-1, X-2 and GR binding posts		Used to connect Wheatstone Bridge to testing circuit.

b. *Test Keys.*

KEY	TYPE	FUNCTION
RING ON TIP (5)	Nonlocking	Supplies ringing current to tip lead, and ground to ring lead.
RING ON RING (5)	Nonlocking	Supplies ringing current to ring lead, and ground to tip lead. Either position connects meter as 0- to 150-volt ac voltmeter. Meter indicates ringing voltage supplied.
TIP BAT	Nonlocking	Used to test for battery on tip lead. Connects meter as 0- to 150-volt dc voltmeter. Meter indicates battery voltage present between the lead being tested and ground.

b. *Test Keys* (Cont).

KEY	TYPE	FUNCTION
RING BAT	Nonlocking	Used to test for battery on ring lead. Connects meter as 0- to 150-volt voltmeter. Meter indicates battery voltage present between the lead being tested and ground.
TIP GROUND	Nonlocking	Used to test for ground on tip lead. Connects meter as ohmmeter.
TIP GROUND LOW	Locking	Functions same as TIP GROUND, except meter readings indicate 100 times the value and half-scale deflection is 500 ohms. (If resistance to ground is less than 5,000 ohms, TIP GROUND LOW key is used for more accurate resistance reading.)
RING GROUND	Nonlocking	Used to test for ground on ring lead. Connects meter as ohmmeter.
RING GROUND LOW	Locking	Functions same as RING GROUND, except meter readings indicate 100 times the value and half-scale deflection is 500 ohms. (If resistance to ground is less than 5,000 ohms, RING GROUND LOW key is used for more accurate resistance reading.)
LOOP	Nonlocking	Used to measure resistance between tip and ring leads. Connects meter as ohmmeter.
LOOP LOW	Locking	Functions same as LOOP key except meter readings indicate 100 times the value and half-scale deflection is 500 ohms. (On loops of less than 5,000 ohms, LOOP LOW key is used for more accurate resistance readings.)
SPEED	Locking	Used to test speed of dial.
TIP CAP	Nonlocking	Used to test capacity between tip lead and ground.
PERCENT MAKE	Locking	Used to determine the length of time pulsing contacts are closed.

b. *Test Keys* (Cont).

KEY	TYPE	FUNCTION
RING CAP	Nonlocking	Used to test capacity between ring lead and ground.
DIRECT MAKE	Locking	Used to test speed of a pulsing source.
LOOP CAPACITY	Locking	Used to test capacity between tip and ring leads.
WB TG	Locking	Connects tip lead to X-2 terminal of external Wheatstone Bridge and ring lead to ground.
WB RG	Locking	Connects ring lead to X-1 terminal of external Wheatstone Bridge and tip lead to ground.
WB LOOP	Locking	Connects test tip and ring leads to X-1 and X-2 terminals of external Wheatstone Bridge.
SET 100	Nonlocking	Used with the SET 100 rheostat. These controls are used to preset the meter needle to 100 before making pulse speed or percent make tests.
REVERSE	Locking	Reverses tip and ring leads. (Connects tip lead to test ring lead; connects ring lead to test tip lead.)
TOLL RING	Nonlocking	Connects toll ringing current (insulated generator) across tip and ring leads. Connects meter as a 0- to 150-volt voltmeter.
MON	Locking	Disconnects operator's transmitter from transmission circuit. (Operator's receiver remains connected across transmission circuit to permit monitoring.)
ZERO ADJ	Nonlocking	Connects meter as an ohmmeter. The DC ZERO rheostat and the LOOP or LOOP LOW keys are used with this key to adjust meter.

b. *Test Keys* (Cont).

KEY	TYPE	FUNCTION
CO CONTROL	Locking	Prepares a metallic testing circuit when used with selector level trunk. Also used to release cutoff relay in dial line circuit when test selector trunk is being used.
CONN RELEASE	Nonlocking	Releases the test connector without releasing the test selector.
DIAL LOOP	Locking	Provides a holding loop for XY® Dial Equipment when MDF trunk is being used. Also used with the test selector trunk to provide a holding loop after the CO CONTROL key has been operated.
RELEASE PERM	Nonlocking	Used with test selector trunk to release line equipment which is in a permanent (continually operated) condition.
HOWLER PRIM	Locking	Connects howler tone to tip and ring test leads.
TALK BATTERY PRIM	Locking	Connects transmission battery to tip and ring test leads.
SLEEVE TEST	Locking	Connects sleeve of equipment under test to the test tip lead. (All tip tests can be made on sleeve of equipment under test.)
135 RING	Nonlocking	Supplies 135 cps ringing to equipment under test.

PREOPERATIONAL CALIBRATIONS

5. GENERAL

This section provides the proper procedures for checking the calibrations of the Test Turret. The rheostats and resistors referred to in paragraphs 6 through 8 are located on a circuit plate at the rear of the Test Turret.

6. CALIBRATING METER TO INDICATE CORRECT VOLTAGE

This calibration is to ensure that the meter indicates the proper voltage when a voltage source is being tested.

a. Set all keys in their non-operated positions.

b. Connect the positive side of a 45-volt dry-cell battery to the T binding post, and the negative side of the battery to the R binding post.

c. Adjust RH7 until the meter needle indicates (on the lower scale) the voltage of the battery connected to the binding posts.

d. Disconnect the battery from the T and R binding posts.

7. CALIBRATING METER TO INDICATE CORRECT RINGING VOLTAGE

This calibration is to ensure that the proper ringing voltage is being supplied by the Test Turret and that the meter indicates the correct voltage.

a. Set all keys in their non-operated positions.

b. Connect a 0- to 150-volt ac voltmeter, which is known to be accurate, across the T and R binding posts. (To prevent damage to this meter, be sure to use the high measuring range.)

c. Operate one of the RING ON TIP or RING ON RING keys.

d. Adjust the selector switch on the external ac voltmeter until a center scale reading (approximately) is indicated.

e. Turn the RING PAD control to the center of its movement.

f. Adjust rheostat RH8 until the Test Turret meter indicates the same voltage as the external ac voltmeter. (The RING PAD rheostat can be regulated to increase or decrease the ringing voltage output).

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

8. CALIBRATING METER TO INDICATE ACTUAL RESISTANCE

This calibration is made to ensure that the meter indicates the proper resistance.

a. Set all keys in their non-operated position.

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

c. Remove the operator's telephone set from the headset jacks.

d. Connect a strap across the T and R binding posts.

e. Operate the LOOP LOW key.

f. Adjust RH5 until the meter needle indicates 0 (full scale deflection) on the upper scale.

g. Disconnect the strap from the T and R binding posts and connect a 500-ohm resistor across these terminals.

h. Adjust rheostat RH3 until the meter needle indicates half scale on the upper scale.

i. Disconnect the 500-ohm resistor from across the T and R binding posts and then strap these binding posts together.

j. Adjust rheostat RH5 until the meter needle indicates 0 on the upper scale.

k. Repeat the steps described in g through j above until the meter is accurately calibrated. The meter is considered to be calibrated when additional adjustments of rheostats RH5 and RH3 do not appreciably affect the deflection of the meter needle. When this calibration is satisfactory, remove the strap from the T and R binding posts and proceed to the next step.

l. Restore the LOOP LOW key, and then operate the LOOP key.

m. Connect a strap across the T and R binding posts.

n. Adjust rheostat RH6 until the meter needle indicates 0 on the upper scale.

o. Disconnect the strap from the T and R binding posts and connect a 50,000-ohm resistor across these terminals.

p. Adjust rheostat RH4 until the meter needle deflects to half scale on the upper scale.

q. Remove the 50,000-ohm resistor and repeat the steps in n through p above until the meter is accurately calibrated. The meter is considered to be calibrated when additional adjustments of rheostats RH6

and RH4 do not appreciably affect the deflection of the meter needle. When this calibration is satisfactory, proceed to the next step.

r. Connect a strap across the T and R binding posts. Adjust the DC ZERO rheostats until the meter needle indicates 0 (full-scale deflection) on the lower scale.

s. Disconnect the strap from the T and R binding posts and connect a 50,000-ohm resistor across these terminals. The meter needle should indicate 50,000 ohms.

t. Restore the LOOP key, and then operate the LOOP LOW key. The meter needle should indicate 5M.

u. Replace the 50,000-ohm resistor with the 500-ohm resistor. The meter needle should indicate 50,000 ohms.

v. Disconnect the 500-ohm resistor and connect a strap across the T and R binding posts. The meter needle should indicate 0 (full-scale deflection).

w. If the meter needle does not read as described in r, s, u, and v above, it is an indication that the calibration procedures preceding sub-paragraph r have not been done properly. If this condition exists, remove the strap and recalibrate the meter in the manner described in a through v above.

x. If the meter needle reads as described in r, s, w, and v above, it is an indication that the meter is properly calibrated. When this condition exists, restore all keys to normal and disconnect the external equipment from the T and R binding posts.

9. PRELIMINARY CAPACITANCE TEST

This test is made to prepare a capacitance conversion chart. This chart will be required to convert voltage readings to capacitance (in microfarads) when making capacitance tests (par. 23 and 24). To prepare this chart, connect two 1-uf capacitors, two 2-uf capacitors, and one 4-uf capacitor as indicated in the *connection* column of the chart below, and then connect them across the T and R binding posts of the Test Turret and operate the LOOP CAPACITY key. Record the maximum reading (lower scale of the meter), in the *voltage* column of the chart. The readings indicated in the chart below are approximate readings. Insert the actual readings in the prepared chart.

Note: This operation is necessary only when reasonably accurate capacitance measurements must be made. The Test Turret is not an accurate measuring set when used for capacitance tests. Usually, the experience of the operator in interpreting the deflection of the meter needle provides an indication of the capacitance of the line under test.

Voltage (volts)		Capacitance (uf)	Capacitors required	Method of connection
Approx.	Actual			
10		0.5	Two 1 uf	Series
20		1.0	1 uf	
38		2.0	2 uf	
55		3.0	1 uf & 2 uf	Parallel
68		4.0	4 uf	Parallel
80		5.0	1 uf & 4 uf	Parallel
95		6.0	2 uf & 4 uf	Parallel
108		7.0	1 uf, 2 uf, & 4 uf	Parallel
116		8.0	Two 2 uf & 4 uf	Parallel
125		9.0	1 uf, two 2 uf, & 4 uf	Parallel
132		10.0	Two 1 uf, two 2 uf, & 4 uf	Parallel

OPERATING PROCEDURES

This section provides detailed procedures for operating the Type C Test Turret. It includes the procedures for answering incoming calls, originating calls, adjustments and calibrations, and all the tests that can be performed with the Test Turret.

10. 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 Turret 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 even though the operator's headset plug is not in the headset jacks. However, the recommended operating procedure is to insert the operator's headset plug into the headset jacks whenever the Test Turret is being used and to disconnect the operator's headset plug when it is anticipated that the Test Turret will not be used for periods of 30 minutes or more or when the Test Turret is left unattended.

c. Paragraph 11 describes the adjustments which should be made before measuring resistance. Paragraphs 12 through 17 describe the methods of connecting to a line, trunk, or piece of equipment to be tested. Paragraphs 18 through 33 describe the methods of performing the desired tests. The chart in paragraph 34 can be used as a reference for marking various tests on a line or trunk.

11. METER ADJUSTMENT FOR RESISTANCE MEASUREMENTS

a. Operate the ZERO ADJUST key.

b. Adjust the DC ZERO rheostat until the meter needle indicates zero (0) on the upper scale (full-scale deflection).

c. Restore the ZERO ADJUST key after this adjustment is completed.

d. Make this adjustment prior to *each* resistance measurement.

12. SELECTOR LEVEL TRUNKS

The selector level trunks are used to reach the Test Turret through the dial equipment. Follow the procedure described below when a selector level trunk is being used.

a. ***Incoming Call Indication.***

The supervisory lamp associated with the selector level trunk in use lights and the night alarm buzzer sounds (when the NA switch is operated). The SEL LEVEL key is a bent-handle key with two operating positions. The first position is used to answer the call and the second position is used to hold the call. This permits transfer from answer to hold, or hold to answer, without moving the key through the OFF position.

b. ***Answering Call.***

(1) Operate the SEL LEVEL key associated with the lighted supervisory lamp.

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

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

c. ***Holding After Call is Answered.***

To disconnect the testing leads from the trunk but to hold the established path to the telephone user:

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

(2) Operate the SEL LEVEL key associated with the trunk in use to the HOLD position. This holds the trunk operated and permits the Test Turret operator to answer or originate other calls or perform other operations.

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

(4) If, during the holding process, the supervisory lamp flashes, it is an indication that the calling party is recalling the Test Turret operator. When this occurs, proceed as described in (5) below. If the supervisory lamp lights, it is an indication that the calling telephone has disconnected. When this occurs, proceed as described in (f(1) below).

(5) To re-establish the circuit between the Test Turret operator and the telephone, operate the SEL LEVEL key associated with the trunk in use to the answer position. Transmission can now take place.

d. *Testing.*

After connecting to the line through the selector level trunk, operate the CO CONTROL key and proceed with the desired tests as described in paragraphs 18 through 33.

e. *Holding During Testing.*

To disconnect the testing leads from the trunk but to hold the established path to the calling telephone:

(1) Operate the TALK BATTERY PRIM key and inform the calling party of the approximate length of time the trunk will be in the hold condition.

(2) Operate the SEL LEVEL key associated with the trunk in use to the HOLD position. This holds the trunk operated and permits the Test Turret operator to answer or originate other calls or perform other operations.

(3) Restore all other test keys to normal.

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

(5) If, during the holding process, the supervisory lamp flashes, it is an indication that the calling telephone is recalling the Test Turret operator. If this occurs, proceed as described in (6) below.

(6) To re-establish the circuit between the Test Turret operator and the telephone, operate the SEL LEVEL key associated with the trunk in use to the answer position. Re-operate the CO CONTROL key. Testing or transmission can now take place.

f. *Disconnect.*

(1) Calling Telephone Disconnects First.

If the calling telephone disconnects first, the supervisory lamp associated with the trunk in use lights. The supervisory lamp remains lighted until the Test Turret operator disconnects. To disconnect, restore all keys to normal. The supervisory lamp goes out. At this point the trunk is restored to normal and is available for use by other telephone users.

(2) Test Turret Operator Disconnects First.

To disconnect, restore all keys to normal. The supervisory lamp remains lighted. When the calling telephone disconnects, the supervisory lamp is extinguished. At this point the trunk is restored to normal and is available for other telephone users.

13. TWO-WAY LINE

The two-way to line circuit from the Test Turret can be terminated at a magneto telephone or a dial line. This trunk is used for transmission only. Tests cannot be made over this trunk. Use the following procedure when connecting to a two-way to line circuit.

a. *Incoming Call.*

An incoming call is indicated by the intermittent lighting of the supervisory lamp associated with the circuit and by the intermittent sounding of the night alarm buzzer (when the NA key is operated).

b. *Answering Call.*

(1) Operate the 2 WAY LINE key to the answer position.

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

(3) During transmission, the supervisory lamp remains lighted if the trunk is connected to a dial line that does not provide reverse battery supervision. If reverse battery supervision is provided, the supervisory lamp is extinguished.

c. *Holding after Dial Line Call is Answered.*

To disconnect the testing leads from the trunk but to hold the established path to the telephone, follow the procedure described below. (The holding operation is not required on magneto telephone calls.)

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

(2) Operate the 2 WAY LINE key to the HOLD position. This holds the trunk operated and permits the Test Turret operator to answer or originate other calls or perform other operations.

(3) During the hold process, the supervisory lamp associated with the trunk is lighted.

(4) Recall supervision is not provided.

(5) To re-establish the circuit between the Test Turret operator and the telephone, operate the 2 WAY LINE key to the same position as in b above. Transmission can now take place.

d. *Disconnect on Incoming Calls.*

(1) Magneto Telephone.

(a) Telephone user disconnects first.

If the circuit is connected to a magneto telephone, and the telephone user disconnects, he must *ring-off.* The supervisory lamp lights during the ringing period. (If the telephone user does not *ring-off,* the supervisory lamp does not light.) To disconnect, restore the 2 WAY LINE key to normal. At this point the circuit is available for use by other telephone users or by the Test Turret operator.

(b) Test Turret operator disconnects first.

To disconnect, restore the 2 WAY LINE key associated with the circuit to normal. When the telephone user *rings-off,* the supervisory lamp lights during the ringing period. (If the telephone user does not *ring-off* the supervisory lamp does not light.) At this point the circuit is available for use by other telephone users or the Test Turret operator.

(2) Dial Line.

(a) Telephone user disconnects first.

If the telephone user disconnects first, the supervisory lamp (if lighted), remains lighted until the Test Turret operator disconnects (b(3) above). To disconnect, restore the 2 WAY LINE key to normal. The supervisory lamp is extinguished and the trunk circuit is restored to normal.

(b) Test Turret operator disconnects first.

To disconnect, restore the 2 WAY LINE key to normal. This causes the supervisory lamp to be extinguished. However, the circuit cannot be used until the calling telephone disconnects. No supervision is given at the Test Turret when the telephone user disconnects.

e. *Outgoing Call to Magneto Telephone.*

(1) Connecting to Line.

To connect to the line, operate the 2 WAY LINE key to the answer position.

(2) Ringing.

Ring the magneto telephone by intermittently operating one of the RING ON TIP or RING ON RING keys. Each time ringing current is supplied, the supervisory lamp associated with the line lights. When the called telephone answers, restore the RING ON TIP or RING ON RING key to normal.

(3) Called Party Answers.

When the called party answers, conversation can take place.

(4) Disconnect.

The disconnect procedure on outgoing calls is the same as d(1) above.

f. *Outgoing Call to Dial Line.*

(1) Connecting to Dial Line Equipment.

Operate the 2 WAY LINE key to the answer position. The supervisory lamp lights. Dial tone is heard in receiver of the operator's headset.

(2) Dialing.

Dial the number to be called. Each time the dial is turned off-normal, the supervisory lamp associated with the line is extinguished. This lamp lights after each digit is dialed. Dial tone is not heard in the operator's receiver after the first digit has been dialed.

(3) Dialing Completed.

After all of the digits have been dialed, the supervisory lamp lights and remains lighted. Ringback tone is heard in the operator's receiver.

(4) Called Party Answers.

When the called party answers, the supervisory lamp associated with the line is extinguished, and ringback tone is disconnected. Conversation between the Test Turret operator and the called party can take place at this time. (The supervisory lamp remains lighted on those lines that do not provide reverse battery supervision.)

(5) Holding after Called Party Answers.

The procedure for *holding* the circuit after the called party answers is the same as c above.

(6) Disconnect on Outgoing Dial Line Calls.

(a) Telephone user disconnects first.

If the called telephone disconnects first, the supervisory lamp lights. To disconnect, restore the 2 WAY LINE key to normal. The supervisory lamp goes out. The circuit is restored to normal.

(b) Test Turret operator disconnects first.

To disconnect, restore the 2 WAY LINE key to normal. The circuit is restored to normal even if the called telephone has not disconnected.

14. ORDER WIRE

The Test Turret operator uses the order wire circuit to monitor and talk with the operator at the Attendant's Switchboard, another Test Desk or Test Turret, Information Desk, or any other equipment which requires operating personnel. Connection to the equipment to be monitored is made by operating an ORDER WIRE switch. No provision is made for signaling on order wires.

Two different Order Wire circuits are available with the Type C Test Turret. Two single-position keys designated DESK OW PRIM are normally used for order wires to other Test Desks or Turrets. One double-position key designated ORDER WIRE 1 and ORDER WIRE 2 is normally used for order wires other than Test Desks. The procedure is the same for using either of the keys. In the following description, the key designated ORDER WIRE refers to either type.

a. *Operating Procedure.*

(1) Operate the MON key.

(2) Operate the ORDER WIRE key. The Test Turret operator can now monitor the conversation on the order wire.

(3) To talk with the operator of the equipment being monitored, restore the MON key. Conversation can take place as soon as this key is restored.

b. *Disconnect.*

When monitoring or conversation is completed, restore the ORDER WIRE and MON keys to normal.

15. MDF TRUNK

Either of the two MDF trunks may be used by the Test Turret operator to make tests on the outside lines and trunks and the inside central-office equipment. The MDF trunks are also used for making three-wire Wheatstone Bridge tests by the use of the WH BG key. *Before performing any of the operations described below be sure that the test shoe associated with the MDF trunk to be used is inserted into the protector terminals associated with the line or trunk. Upon completion of the tests remove the test shoe from the MDF.*

a. *Testing Outside Plant Lines.*

(1) Operate the MDF OUT key associated with the inserted test shoe.

(2) Perform the desired tests as described in paragraphs 18 through 33.

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

b. *Testing Inside Plant, By-passing Heat Coils.*

(1) Operate the MDF IN key associated with the inserted test shoe.

(2) Perform the desired tests as described in paragraphs 18 through 33.

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

c. *Testing Inside Plant, Through Heat Coils.*

(1) Operate the HEAT COIL key associated with the inserted test shoe.

(2) Perform the desired tests as instructed in paragraphs 18 through 33.

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

d. *Outgoing Call without Using Dial Equipment.*

(1) Connecting to Line or Trunk.

Operate the MDF OUT key associated with the inserted test shoe.

(2) Ringing.

Ring the telephone or equipment on the line by intermittently operating the appropriate RING ON TIP or RING ON RING key. The meter will indicate the ringing voltage being supplied. When the called telephone or switchboard operator answers, restore the RING ON TIP or RING ON RING key to normal.

(3) Called Party Answers.

When the called party answers, supply transmission battery by operating the TALK BAT PRIM key. Conversation can take place as soon as this key is operated.

(4) Disconnect.

To disconnect, restore the MDF OUT key to normal and remove the test shoe.

e. *Outgoing Call using Dial Equipment.*

(1) Connecting to Line or Trunk.

Operate the MDF IN or the HEAT COIL key.

(2) Dial Loop.

Operate the DIAL LOOP key to establish a dialing 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 can take place at this time.

(6) Disconnect.

To disconnect, restore all keys to normal and remove the test shoe.

f. *Wheatstone Bridge Tests.*

Wheatstone Bridge tests over the MDF trunk are described in paragraph 18.

g. *Testing Trunks.*

(1) Dialing Out on Trunk.

Connect to the trunk by inserting the test shoe into the protector on the MDF.

(a) Seizing equipment.

To seize the automatic equipment at the distant end of the trunk, operate the MDF OUT and the DIAL LOOP keys.

(b) Dialing.

Dial the desired number in the distant exchange.

(c) Dialing Completed.

After all the digits of the desired number are dialed, the Test Turret operator hears ringback tone if the line is idle or busy tone if the line is busy.

(d) Called party answers.

When the called party answers, ringback tone is no longer heard in the operator's receiver and conversation can take place.

(e) Disconnect.

To disconnect, restore all keys to normal and remove the test shoe.

(2) Ringing In on Trunk.

On ringdown trunks entering the local office, connect to the trunk by inserting the test shoe into the protector on the MDF.

(a) Operate the MDF IN key.

(b) Operate the appropriate RING ON TIP or RING ON RING key. The meter will indicate the ringing voltage supplied. When the switchboard operator answers the call, restore the RING ON TIP or RING ON RING key to normal.

(c) When the switchboard operator answers, conversation can take place.

(d) To disconnect, restore all keys to normal and remove the test shoe.

16. TEST BINDING POSTS

The T and R binding posts are used to connect the testing leads to any unmounted equipment. Follow the procedure below when using the test binding posts.

a. *Testing.*

Connect the equipment to be tested to the binding posts and perform the desired tests as instructed in paragraphs 19 through 34.

b. *Transmission Battery.*

If transmission battery is required by the equipment under test, operate the TALK BAT PRIM key.

c. *Test Completed.*

When testing is completed, restore all keys and disconnect the equipment under test.

17. TEST SELECTOR TRUNK

Test selector trunks provide access from the Test Turret to any one of the lines served by the connectors of an XY® Dial Central Office. Incoming calls cannot be made over these trunks. These trunks are primarily used to connect to station lines for testing.

a. *Testing.*

(1) Connecting to Line.

Operate the TEST SEL key to the seize position. When the test selector is seized, the test selector supervisory and busy lamps light. Dial the number of the telephone to be tested. After the last digit is dialed, the testing leads of the Test Turret 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 flashes, the line under test is busy ((2)(b)), 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) To hold the trunk operated, operate the TEST SEL key associated with the trunk in use to the hold position. This operation holds the trunk operated and permits the Test Turret operator to answer or originate other calls or perform other operations. When the test selector trunk is in the hold condition, the busy lamp is lighted. To reconnect to the line, operate the TEST SEL key associated with the held trunk to the seize position.

(3) Testing.

After connecting to the line as described in (1) above, perform the desired tests as described in paragraphs 18 through 33. For multiline testing, refer to paragraph 34.

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. Thus, when making resistance measurements, the meter reading includes the combined resistance of resistors R1 and R2, the loop resistance to the test selector, and the circuit under test. The resistance of resistors R1 and R2, and the loop to the test selector must be subtracted from the meter indication to obtain an accurate reading. This is especially important when low resistance measurements are being made. Since the distance between offices will vary, the resistance to be subtracted will depend upon the requirements and specification of the office.

(4) Disconnect.

To disconnect from a test selector trunk, restore all keys to normal.

b. *Outgoing Call.*

(1) Connecting to Line.

Connect to the line as described in a(1) above.

(2) Monitoring.

If the called station is busy, a transmission path is extended to the line under test. The Test Turret operator can monitor the call after operating the MON key. If there is no one talking on the line, the line has a permanent condition (par. 31). If the called line is not busy, follow the procedure described below.

(3) Ringing.

To ring the called telephone, operate the appropriate RING ON TIP or RING ON RING key. The meter indicates the ringing voltage being supplied. When the called telephone answers, restore the RING ON TIP or RING ON RING key to normal.

(4) Called Party Answers.

When the called party answers, supply transmission battery by operating the TALK BAT PRIM key. Transmission can take place as soon as this key is operated.

(5) Disconnect.

To disconnect restore all keys to normal.

18. WHEATSTONE BRIDGE

The Wheatstone Bridge provides a means for making precise resistance measurements. A portable Wheatstone Bridge can be connected to the Test Turret through the GR, X-1, and X-2 binding posts. Connect to the line under test over the MDF trunk (par. 15a). Subparagraphs a through d below describe the tests that can be made after the Wheatstone Bridge testing terminals are extended through the Test Turret to the line under test.

a. *Loop Resistance.*

To make loop resistance measurements, operate the WB LOOP key. Operate the controls on the Wheatstone Bridge as described in the operating instructions 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 TG key and make the measurement 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 RG key and make the measurement with the Wheatstone Bridge. Restore all keys to normal after testing is completed.

d. *GR Binding Post Ground.*

Operate the WH BG key to remove the ground from the GR terminal of the Wheatstone Bridge when required during resistance measurements.

19. LOOP BATTERY MEASUREMENT

This test is performed to determine if a foreign battery is connected to the tip and ring of an outside plant line and to determine the voltage of this battery. Connect to the line at the T and R binding posts (par. 16a or b), over the test selector trunks (par. 17a), or over the MDF trunks (par. 15a). *As soon as connection to the line is made, the meter indicates if foreign battery is connected to the tip and ring of the line*

under test. The only keys that are to be operated at this time are those that are needed to connect to the line. Make the observations described in a through c below as soon as the connection to the line is made.

a. *Meter Needle Deflects to Left.*

If the meter needle deflects to the left, the negative side of a foreign battery is connected to the tip conductor and the positive side of this foreign battery is connected to the ring conductor of the line under test. *Immediately operate the MR (meter reverse) switch 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 voltage of the foreign battery.

b. *Meter Needle Deflects to Right.*

If the meter needle deflects to the right, the negative side of a foreign battery is connected to the ring conductor and the positive side of this foreign battery is connected to the tip conductor of the line under test. Read the lower scale of the meter to determine the voltage of the foreign battery.

c. *Meter Needle Does not Deflect.*

If the meter needle does not deflect, there is no foreign battery connected between the tip and ring of the line under test. However, a source of foreign battery 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. 20).

d. *Line not Faulty.*

If it is determined that the line under test is not faulty, restore all keys to normal and proceed with other tests.

20. TESTING FOR BATTERY ON TIP OR RING

This test is performed to determine if a source of foreign battery is connected between the tip or ring of an outside plant line and ground (the earth), and to determine the voltage of this foreign battery. Connect to the line at the T and R binding posts (par. 16a or b), over the test selector trunks (par. 17a), or over the MDF trunks (par. 15a). Use the following procedure when making battery on tip or ring measurements after connecting to the line.

a. *Testing for Battery on Tip.*

Operate the TIP BAT key. Make the observations described in (1) through (3) below.

(1) Meter Needle Deflects to Right.

If the meter needle deflects to the right, a negative foreign battery (whose positive side is connected to ground) is connected to the conductor under test. Read the lower scale of the meter to determine the voltage of the foreign battery.

(2) Meter Needle Deflects to Left.

If the meter needle deflects to the left, a positive foreign battery (whose negative side is connected to ground) is connected to the conductor under test. *Immediately restore the TIP BAT key to prevent damage to the meter.* Then operate the MR (meter reverse) switch and the TIP BAT key. The meter needle should deflect to the right. Read the lower scale of the meter to determine the voltage of the foreign battery.

(3) Meter Needle does not Deflect.

If the meter needle does not deflect, there is no foreign battery between the conductor under test and ground. However, foreign battery may still be present on the conductor under test, but will not cause the conductor under test to be faulty. For example, one side of a foreign battery is connected to the conductor under test, but the other side of the foreign battery is not connected to ground. Another example

is a foreign battery source connected across the tip and ring of the line under test. However, this condition would be determined by the battery loop measurement (par. 19).

(4) Restore Switches.

After determining the condition of the conductor under test, restore all keys to normal

b. *Testing for Battery on Ring.*

The test for foreign battery on the ring side of the line is the same as that described in a above with the exception that the RING BAT key is operated instead of the TIP BAT key.

21. MEASURING LOOP OR LEAKAGE RESISTANCE

This test is used to determine whether the loop (tip and ring) of the line under test is completed (shorted), and to measure the loop or leakage resistance of the line under test. Connect to the line at the T and R binding posts (par. 16a or b), over the selector level trunk (par. 12), test selector trunk (par. 17a), or the MDF trunks (par. 15a). To measure the leakage resistance, the line must be open at the distant end. To measure the loop resistance of a line terminated in a telephone, the handset of that telephone must be removed before the measurement can be made. To measure the loop resistance of a line that 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 or leakage resistance measurement, make the meter zero adjustment as described in paragraph 11b. Then, make the resistance measurement by operating the LOOP key. Subparagraphs a through c below describe the observations to be made as soon as this key is operated.

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). (If the line is short and/or equipped with tube type ringers, a slight deflection will be caused by the line or cable capacitance.) 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. (Be sure the test reading is made under the same conditions as the readings on the line record card, i.e., on-hook or off-hook telephone, line shorted, etc.). If the loop resistance is much higher or lower than it should be, the line is faulty. If the loop resistance is approximately the same as it should be, the loop of the line under test is not faulty. However, it is possible to have foreign 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 19 and 20.

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 key and then operate the LOOP LOW key. (This changes the meter circuit so that the actual resistance is 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 above.

22. TESTING FOR GROUND ON TIP OR RING

This test is used to determine if the tip or ring of an outside plant line is connected to ground (the earth), and to determine the resistance between the test point and the ground. Connect to the line at the

T and R binding posts (par. 16a or b), over the test selector trunks (par. 17a), or over the MDF trunks (par. 15a). The following subparagraphs describe the procedure for making ground on tip or ring measurements. Before making these measurements, make the meter zero adjustment as described in paragraph 11.

a. *Testing for Ground on Tip.*

Operate the TIP GROUND key. Make the observations described in (1) through (3) below.

(1) Meter Needle does not Deflect.

If the meter needle does not deflect, the conductor under test is not grounded, or is grounded through an infinite resistance (line capacitance will cause a momentary deflection). 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), the conductor under test is connected to ground. Record the reading observed. This reading is the resistance in ohms from the Test Turret 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), the conductor under test is connected to ground. Restore the TIP GROUND key to normal and operate the TIP GROUND LOW key. (This changes the meter circuit so that the actual resistance is 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 Turret 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 exception that the RING GROUND and RING GROUND LOW keys are used instead of the TIP GROUND and TIP GROUND LOW keys.

23. MEASURING LOOP CAPACITANCE

This test is used to determine the capacitance between the tip and ring of the line under test. Before making this test, make the preliminary capacitance test described in paragraph 9. Connect to the line at the T and R binding posts (par. 16a or b), over the selector level (par. 12), the test selector trunks (par. 17a), or over the MDF trunks (par. 15a). After connecting to the line, make the loop capacitance test as described below.

a. Operate the LOOP CAP key.

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 voltage column in the chart prepared in paragraph 9.

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

24. MEASURING TIP OR RING TO GROUND CAPACITANCE

This test is used to measure the capacitance between the tip or ring of an outside plant line and ground. Before making this test, make the preliminary capacitance test described in paragraph 9. Connect

to the line at the T and R binding posts (par. 16a or b), over the selector level (par. 12), test selector trunks (par. 17a), or over the MDF trunks (par. 15a). Follow the procedure described below to make the tip and ring to ground capacitance tests.

a. *Tip to Ground Capacitance.*

(1) Operate the TIP CAP key.

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

(3) Determine the capacitance by comparing the reading obtained to the voltage column in the chart prepared in paragraph 9. The chart indicates the approximate capacitance between the tip conductor of the line under test and ground.

b. *Ring to Ground Capacitance.*

(1) Operate the RING CAP key.

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

(3) Determine the capacitance by comparing the reading obtained to the voltage column in the chart prepared in paragraph 9. The chart indicates the approximate capacitance between the ring conductor of the line under test and ground.

c. *Test Complete.*

Restore all keys to normal after testing is completed.

25. APPLICATION OF RINGING VOLTAGE

Ringing voltage can be applied to any line served by the central office. Subparagraph a below describes the method of applying ringing voltage to dial, common battery, and local battery lines or trunks served by the exchange. Subparagraph b below describes the method of applying ringing voltage to toll lines. Connect to the line at the T and R binding posts (par. 16a or b), over the selector level (par. 12), test selector trunks (par. 17a), or over the MDF trunks (par. 15a).

a. *Ringing Local Lines.*

(1) Ring on Tip.

To ring a line over the tip conductor, operate the appropriate RING ON TIP key for about one 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.

(2) Ring on Ring.

To ring a line over the ring conductor, operate the appropriate RING ON RING key for about one second.

b. *Ringing Toll Lines.*

To supply ringing to toll lines served by the exchange, connect to the line by using the MDF trunks (par. 15a) or the jack field. Then operate the TOLL RING key, if insulated generator is required; or the 135 RING key, for about 2 seconds, if 135 cps generator is required. 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.

26. PULSE SPEED AND PERCENT MAKE TEST

The pulse speed test is used to determine the number of pulses per second received from the impulse springs at the telephone dial. The percent make test is used to determine the length of time the pulsing contacts are closed. Connect to the line by the T and R binding posts (par. 16a or b), over the selector level trunks (par. 12), over the test selector trunks (par. 17a), or over the MDF trunks (par. 15a).

a. *Pulse Speed Tests.*

(1) Inform the telephone user not to disconnect, and then place a hold on the line under test or disconnect the line from the binding posts. If using a selector level trunk circuit, restore the CO CONTROL key.

(2) Restore all test keys to normal.

(3) Operate the SET 100 key.

(4) Operate the SPEED key.

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

(6) Restore the SET 100 key.

(7) Reconnect to the line under test. On selector level trunks, operate the CO CONTROL key.

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

(9) Restore the SPEED key.

(10) Operate the TALK BAT PRIM key.

(11) Instruct the person, at the telephone under test, to dial the digit "0". As soon as this instruction is given, restore the TALK BAT PRIM key, and operate the SPEED key. The meter needle indicates the preset value on the lower scale.

(12) When the dial at the telephone under test is released, 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.

(13) 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 (12) above.

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

(15) 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 $\pm$2 pulses per second unless specified otherwise by the operating company.

(16) To re-establish a transmission circuit, restore the SPEED key and operate the TALK BAT PRIM key.

(17) 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 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 also varies with the central-office voltage. Normally it is not necessary to make percent make tests over a subscriber's line. However, if it is done, an abnormal percent make reading is usually an indication of faulty line conditions, rather than dial adjustment. This abnormal percent make reading is an indication of how the pulses on the line under test affect the XY Dial Equipment. Connect to the line and proceed as described below.

(1) Perform the operations described in a(1) through (7) above with the following exception: Operate the PERCENT MAKE key instead of the SPEED key.

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

(3) Restore the PERCENT MAKE key.

(4) Perform the instructions described in a(10) and (11) above with the following exception:

Operate the PERCENT MAKE key instead of the SPEED key.

(5) When the dial at the telephone under test is released, the meter needle will move slowly in the direction of the actual percent make of the dial. 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 (3) through (5) 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. This reading is the percent make of the pulsing contacts. Dial impulse springs should indicate approximately 38 percent.

(9) To re-establish a transmission circuit, restore the PERCENT MAKE key and operate the TALK BAT PRIM key.

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

27. TESTING TEST TURRET DIAL AND LOOSE DIALS

The Test Turret operator can make pulse speed and percent make tests on the Test Turret dial or on dials which are not in use (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 Turret dial. If desired, the Test Turret dial can be removed and tested as a loose dial (a and b below) or the Test Turret 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) Make the SET 100 adjustment as described in paragraph 26a (3) through (6).

(2) Connect the impulse springs of the dial under test to the T and R binding posts.

(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) Operate the dial as described in paragraph 26a(11) and (12).

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

(7) Readjust the PRESET rheostat and make another test as described in paragraph 26a(13) and (14).

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

b. *Percent Make Tests on Loose Dials.*

(1) Make the SET 100 adjustment as described in paragraphs 26a(3) through (6) with the following exception: Operate the PERCENT MAKE key instead of the SPEED key.

(2) Connect the impulse springs of the dial under test to the T and R binding posts.

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

(4) Dial the digit "0".

(5) Check the percent make as described in paragraph 26b(5).

(6) Readjust the PRESET rheostat until the meter needle indicates the value nearest to the steady value indicated by the meter needle.

(7) Repeat the percent make test as described in paragraph 26b(7) and (8).

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

c. *Pulse Speed Test on Test Turret Dial.*

(1) Perform the operations described in paragraph 26a(3) through (6).

(2) Operate the DIAL LOOP key.

(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) Check the pulse speed as described in paragraph 26a(12) and (13).

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

(7) Repeat the tests as described in paragraph 26a(15).

(8) Restore all keys when testing is completed.

d. *Percent Make Test on Test Turret Dial.*

(1) Perform the operations described in paragraph 26a(3) through (6) above with the following exception: Operate the PERCENT MAKE key instead of the SPEED key.

(2) Perform the preset adjustment as described in c(2) above.

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

(4) Dial the digit "0".

(5) Check the percent make as described in paragraph 26b(5) and (6).

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

(7) Repeat the tests as described in paragraph 26a(8).

(8) Restore all keys when testing is completed.

28. DIRECT MAKE TESTS

The direct make test determines the length of time the pulsing contacts from a pulsing source are closed. During this test, the pulsing source is connected directly to the meter and the pulses are not repeated by a pulsing relay. Connect to the equipment supplying the pulses at the T and R binding posts (par. 16) or over the MDF trunks (par. 15). Do not connect the pulse source to the binding posts until instructed to do so.

a Restore all test keys to normal.

b Make the SET 100 adjustment in the following manner.

(1) Operate the SET 100 key.

(2) Operate the DIRECT MAKE key.

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

c Restore the SET 100 and DIRECT MAKE keys to normal.

d Connect the pulsing source to the binding posts.

e Operate the DIRECT MAKE key.

f 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.

g Restore all keys to normal when testing is completed.

29. HOWLER

a. The howler circuit applies a manually graduated howler tone to a subscriber's telephone to attract the attention of the user. This tone is used when the handset has not been replaced on the cradle, or has been improperly replaced. The howler will not provide a satisfactory tone level when used with

high-efficiency telephones (SC 1543W, WG CO 500, etc.). Connect to the line over any one of the methods described in (1) through (4) below.

(1) T and R Binding Posts.
Connect to the line at the T and R binding posts as described in paragraph 16a or b.

(2) Selector Level Trunks.
Howler tone can be applied over a selector level trunk after the call has been answered (par. 12).

(3) Test Selector Trunks.
Connect to the line over the test selector trunks as described in paragraph 17a. (It may be necessary to operate the RELEASE PERM key to release the permanent condition on the line under test.)

(4) MDF Trunks.
Connect to the line over the MDF trunks as described in paragraph 15a.

b. After connecting to the line, apply howler tone by operating the HOWLER PRIM key until the handset is replaced, or until deciding that the handset will not be replaced.

c. Vary the level of the howler tone by rotating the HLR switch with a pause between each of the 3 steps. When the HLR switch has been rotated to the full clockwise position, return it to the left and repeat the clockwise rotation. The howler will stop automatically when the handset is replaced.

d. Restore all keys to normal when the howler tone is no longer needed.

30. REVERSING TESTING LEADS

This feature permits the Test Turret operator to electrically reverse the test leads. Under normal conditions, the tip test lead is extended to the tip of the line under test and the ring test lead is extended to the ring of the line under test. Operate the TEST REVERSE key to reverse the testing leads so that the tip of the line under test is extended to the ring test lead and the ring of the line under test is extended to the tip test lead.

31. 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 release the dial equipment that is causing a permanent signal alarm. A permanent signal alarm exists when a battery feed relay remains operated. Connect to the line causing the permanent signal over the test selector trunk (par. 17a). The supervisory lamp associated with the trunk in use flashes at the rate of 120 times per minute when a permanent condition exists. To release the permanent line, operate the RELEASE PERM key and hold it operated 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 occurs restore all keys to normal.

b. After operating the RELEASE PERM key as described in a above, test the line to determine the cause of the permanent alarm signal. Perform the tests as described in paragraphs 18 through 32. When it is determined that the permanent alarm signal is caused by an off-hook condition (telephone user fails to hang up), apply the howler to the faulty line.

32. LINE EQUIPMENT TEST

a. This test is used to determine if the line equipment associated with a telephone line is functioning properly. Connect to the line which is associated with the line equipment to be tested over a test selector trunk (par. 17a).

b. After connecting to the line, test the line equipment as described below.

(1) Operate the CO CONTROL key.

(2) Operate the DIAL LOOP key. 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) Restore the DIAL LOOP key. This causes the dial equipment, seized by the line equipment under test, to release.

Note: Be sure to restore the DIAL LOOP key before the CO CONTROL key is restored, otherwise the seized switch train will lock up and will not release when the DIAL LOOP 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 key.

(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 equipments, connect to the other lines as described in paragraph 33b. Then test the line equipment as described in (1) through (6) above.

(8) Restore all keys to normal.

33. MULTILINE TESTING

a. This feature is used to test the entire group of lines (100 lines) served by a test connector. Connect to the desired test connector over a test selector trunk. To connect to the test connector, operate any one of the TEST SEL keys and dial the digits required to connect to the connector group to be tested. This extends the Test Turret facilities to the test connector.

b. After connecting to the test connector follow the procedure described below.

(1) Dial the digits 1 and 1. The test connector will step to line 11 and extend the test facilities to line 11 of the group of lines to be tested.

(2) Tests can now be performed on line 11. Perform the desired tests as described in paragraphs 19 through 32.

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

(4) To make tests on 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 CONN RELEASE key. The test connector will restore to normal.

(6) Dial the digits 2 and 1. The test connector will 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 CONN RELEASE key. The test connector will restore to normal.

(9) 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 are 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 above.

34. TESTING CHART

After connecting to the line or trunk, the Test Turret operator can determine the condition of the line or trunk. The following chart lists a group of tests which are normally performed on all lines under test. This list is to be used as a reference. The types of tests which can be performed by the Test Turret

operator, the keys to be operated, and the interpretations of the meter readings are listed in the order in which they should be performed. For detailed procedures for making the tests, refer to the paragraph referenced in the chart.

TESTING CHART

Test	Key Used	Meter Interpretations		Par. Ref.
		Meter Reading	Indication	
Foreign battery	None	a. No reading	No foreign battery	19c
		b. On scale	Foreign battery on loop	19b
		c. Off scale (left)	Foreign battery on loop; operate MR switch to read voltage	19a
Foreign battery (tip)	TIP BAT	a. No reading	No battery on tip	20a(3)
		b. On scale	Foreign negative battery on tip	20a(1)
		c. Off scale (left)	Foreign positive battery on tip; operate MR switch to read voltage	20a(2)
Foreign battery (ring)	RING BAT	a. No reading	No battery on ring	20a(2)
		b. On scale	Negative battery on ring	20b
		c. Off scale (left)	Positive battery on ring	20b
Shorts and leakage	LOOP LOW OR LOOP	a. (1) No reading	No short	
	a. LOOP	(2) On scale	Short or closed loop	20a
	b. LOOP LOW	b. Same as a.	Divide reading by 100	22b
Tip ground	TIP GROUND or TIP GROUND LOW			
	a. TIP GROUND	a. (1) On scale	Ground on tip	22a(1)
		(2) No reading	No ground	22a(2)
	b. TIP GROUND LOW	b. Same as a.	Divide reading by 100	and (3)
Ring ground	RING GROUND or RING GROUND LOW	a. (1) On scale	Ground on ring	22b
		(2) No reading	No ground	
	a. RING GROUND			
	b. RING GROUND LOW	b. Same as a.	Divide by 100	22b
Loop capacitance	LOOP CAPACITY	a. On scale	Capacitance of line	23
		b. No reading	Open line	
Tip capacitance	TIP CAPACITY	a. On scale	Capacitance of tip to ground	24a
		b. No reading	Open tip conductor	
Ring capacitance	RING CAPACITY	a. On scale	Capacitance of ring to ground	24b
		b. No reading	Open ring conductor	

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