

COMMON SYSTEMS
MANUAL OUTGOING TRUNK
TEST CIRCUIT
FOR USE WITH
CROSSBAR NO. 5, CROSSBAR TANDEM OR
TOLL SWITCHING SYSTEM NO. 4 OR 4A

CHANGES

A. CHANGED OR ADDED FUNCTIONS

A.1 Provision is made for testing outgoing four-wire trunks arranged for E&M lead signaling.

B. CHANGES IN APPARATUS

B.1 Added

Relays - YT Option - Fig. 17

- 1 - 280R - A
- 1 - U587 - AL
- 1 - Y263 - ALG
- 1 - U990 - EL
- 1 - U1024 - EM4W
- 2 - U1112 - EMX & EMX1

Capacitors - YT Option - Fig. 17

- 1 - 1MF - V
- 1 - 4MF - S

Jacks - YT Option - Fig. 17

- 4 - 248-type - EMDROP, EMLINE, TR, & TR1

Lamps - YT Option - Fig. 17

- 1 - 24 - EMAL

Resistors - YT Option - Fig. 17

- 2 - 18AE - CR & CT
- 1 - 18F - CS
- 1 - 19RL - CU
- 1 - 18BH - CV
- 1 - 18BA - CW
- 1 - 19TL - CX

B.2 Removed

Capacitor - YS Option - T - 4MF Fig. 17

B.3 Added - YU Option - Fig. 17

- 1 - 280-type jack - A
- 1 - 13A lamp - A

C. CHANGES IN CIRCUIT REQUIREMENTS TABLES OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 Page 4 "Insulate 47 relay under test" information added for relays D1 and D2 Figs. 12 and 13.

C.2 Page 5 "Insulate 47 PGI" added for relay FP1.

C.3 Page 9 Under Block or Insulate for relay OF3 previously read 3B(OF1), now reads 37(OF1).

C.4 Page 11 Insulate 1B(LE) added for relay P5.

C.5 Page 11 Under Test Clip Data, Conn Grd. for relay P6 previously read TF TF(P6) now reads TR(P6).

C.6 Page 14 Insulate 2T(SP1) added for relay SP1.

C.7 Page 16 Insulate 3T TANH added for relay TANH.

C.8 Page 18 Under Block or Insulate for relay Z previously read 1B(W) now reads 1T(W).

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 To provide for testing outgoing four-wire E&M lead signaling toll switching trunks, YT & YU option apparatus and wiring and looping of leads at contacts of EM4W relay is added in Fig. 17. The previous wiring is shown as YS option - rated MFR. DISC.

D.11 In Fig. 17, YT wiring provides for the use of the previously unused half of C1DK key (MF4W) as a class key (EM4W) for the four-wire E&M lead trunk.

In Fig. G, sheet 0102, YT option provides for the use of the previously unused half of C1G key (BAT) as a control key (EM) for testing the E&M leads.

In Fig. D, Sheet 0105, YT option provides a start ground thru the operated EM4W key to start the test call.

In Fig. 12, Sheet 0102, YT option provides a locking ground for the AL relay YT option Fig. 17.

In Fig. 1, Sheet 0102, YT option arranges the tip and ring leads for testing.

D.2 Additional designations have been added to the T, R, T1, & R1 lamps in Fig. 17. The added designations are ON (for called subscriber ON Hook) on the T and R

lamps; and OFF (for called subscriber OFF Hook) on the T1 and R1 lamps. This has been done to facilitate testing both for the four-wire REV BAT trunks and for the four-wire E&M lead trunk.

D.3 The added EMDROP, EMLINE, TR, and TR1 jacks are added to provide test access to the leads for voltmeter testing, etc.

D.4 Cross connection Figs. 51 & 54 have been modified and Fig. 63 is added in accordance with the changes on this issue.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit provides means for testing the outgoing trunks in No. 5 and tandem crossbar offices and the toll completing trunks in a No. 4 or 4A toll crossbar office.

In the No. 5 crossbar and No. 4 or 4A toll crossbar offices the trunk test jacks are arranged so that this test circuit tests directly into the tip and ring leads of the cable to the distant office. It does not test the outgoing trunk relay equipment except to determine when the trunk is idle.

In the tandem crossbar office, the trunk test jack is a multiple of the office secondary switch multiple and when outgoing trunk relay equipment is provided it will be tested. There may be two crossbar tandem outgoing trunk test jacks for trunks with outgoing relay equipment - one as described above for crossbar tandem and a second jack connected to the cable side of the outgoing trunk as described above for No. 5, 4 and 4A crossbar offices. This permits voltmeter tests on the cable pair.

1.2 Provision is made for directing a call over various types of trunks to a test line in the distant office, using a straightforward operation, revertive, panel call indicator, multifrequency, and dial or step-by-step pulsing.

In conjunction with the test line at the distant office this circuit tests that the trunk is capable of reaching a particular destination code or number and that the ringing or signaling circuit as well as the supervision is functioning satisfactorily. This circuit may be used to facilitate transmission testing of the trunk by providing rapid means of directing the trunk to a transmission test line in the distant office.

2. WORKING LIMITS

The limits for this circuit are based on the following:

2.1 Talking - Supervision

280FG PB Relay

20-28V 45-50W

Max. Ext. Ckt. Loop Res. 3,415 ohms 8,000 ohms
Min. Ins. Res. 30,000 ohms 30,000 ohms

280B SU, SUR Relays -

Max. Ext. Loop 10,000 ohms
Min. Ins. Res. 30,000 ohms

S520 PBl Relay -

Max. Ext. Loop 3,600 ohms
Min. Ins. Res. 30,000 ohms

2.2 Revertive Pulsing

2.21 268A STP, 280G OF Relays - Selections

Max. Ext. Ckt. Loop Res. - 3,330 ohms
Min. Ins. Res. 30,000 ohms

The trunk shall not exceed 2900 ohms or 32 miles of cable.

Min Comp. Res. distant office - 900 ohms with L relay of 900 ohms or more

Min. Comp. Res. distant office - 1200 ohms with L relay of 650 ohms or less

2.22 B421 TG relay - Office and Long Trunk Loop Test

Max. Ext. Ckt. Loop Res. - 12,780 ohms
Min. Ins. Res. 30,000 ohms

2.23 B167 MTG relay - 24V trunks.

Max. Ext. Ckt. Loop Res. - 2,300 ohms
Min. Ins. Res. 30,000 ohms

2.3 B421 CG relay - Panel Call Indicator Trunks

20-28 Volts 45-50 volts

Max. Ext. Ckt. Loop Res. 10,000 ohms 20,000 ohms
Min. Ins. Res. 30,000 ohms 30,000 ohms

2.4 280B relay TR, TR1, TT1 and TT - 4-wire MF Pulsing

Max. Ext. Ckt. Loop Res. - 5,900 ohms
Min. Ins. Res. 30,000 ohms

3. FUNCTIONS

3.01 Makes a busy test of the trunk patched for test and lights a busy lamp BY1 or BY2 when the trunk is busy.

3.02 Makes the trunk test busy (if it is idle when picked) by the operation of test key TST1 or TST2, voltmeter VM1 or VM2, talking key TLK1 or TLK2.

3.03 Lights an off normal lamp ON1 or ON2 when the trunk is seized and made busy.

3.04 Provides means for reversing the supervisory polarity of the trunk by operation of the RS1 or RS2 keys.

3.05 Provides means for talking and supervision on either T1 or T2 jacks by operation of the TLK1 or TLK2 keys. A Receiver "on hook" is indicated by a lighted SUP1 or SUP2 lamp.

3.06 Provides means for making voltmeter, ammeter, and foreign EMF tests on either the tip or ring of the Trunk when VM1 or VM2 key is operated.

3.061 When four-wire toll switching trunks with E&M lead signaling are provided, provides access to the tip and ring leads by means of the TR & TR1 jacks and to the E&M leads-drop side & line side by means of the EMDROP and EMLINE jacks for E&M lead trks.

3.07 Provides eight ten button keys designated Tan H, Tan T, Tan U, TH, H, T, U and STA for controlling the automatic pulsing of the code and number of the called line or Trunk.

3.08 Depending on the type of trunk under test, a class key may be operated for revertive, panel call indicator, multifrequency, and dial pulsing trunks and arrange the circuit to function for that type pulsing.

3.081 For revertive pulsing trunks the operation of the RP or RP and DOS class keys together with the compensating resistance keys arranges the circuit to:

3.0811 Apply an operate and non-operate current flow test for incoming relay L (panel).

3.0812 Apply an operate and non-operate current flow test for incoming relay A.

3.0813 Apply a trunk guard and overflow test on RP and PCI trunks before pulsing is started.

3.0814 Check trunk polarity and blocks on reorder, overflow, and tell tale condition and causes lamp OFL to flash as an indication.

3.0815 When key MO is operated, check for momentary opens of the tip and ring during test of supervisory relay and indicates trouble by lighting lamp MO.

3.0816 Flashes the SDR lamp while pulsing RP, PCI, MF, or DP call.

3.0817 Extinguishes SDR lamp when pulsing is completed.

3.082 For panel call indicator pulsing trunks operation of the PC1D or PC1T class keys together with the A RY OPR COMP RES keys will arrange the circuit for testing direct or tandem trunks.

3.083 For straightforward trunks requiring battery and ground start signal, operate keys BAT and TLK1 or TLK2.

3.084 For straightforward trunks requiring SX or 20 cycle ringing as a start signal, operate the TST-STF key and the SX or $\pm R$ key, respectively.

3.085 For multifrequency pulsing trunks operation of the zero TRK COMP RES key and the MF or MF and MF4W or EM4W class keys together with the A RY OPR COMP RES keys will arrange the circuit for testing two or four wire multifrequency trunks or four-wire trunks with E&M lead signaling.

3.0851 Testing on a multifrequency basis.

3.0852 Check for WINK or DELAY DIAL start pulsing signal.

3.0853 Outpulsing of 3 to 7 digits.

3.0854 Testing of supervisory features of tandem trunks used for handling local traffic.

3.0855 Check polarity of trunk before and during outpulsing.

3.086 Provides means for out dial pulsing on a loop basis into (A) local switch train, (B) AB toll train, (C) incoming repeaters, (D) other two wire trunk circuits such as SD-95060, (E) senders. Provides means for resistance loop dial outpulsing into four wire repeater and trunk circuits such as SD-25490-01 or SD-25634-01. The start of outpulsing may be delayed by the operation of the dial tone DT key if it is desired to check for dial tone. Provides means for converting loop dial pulses to

E&M lead signaling on E&M lead toll switching trunks 4-wire dial pulsing SD-68514-01.

3.0861 Checks polarity of trunk before outpulsing and during interdigital timing.

3.0862 Checks for WINK, DELAY DIAL, DELAY DIAL with STOP-GO, GO or GO with STOP-GO start pulsing signal.

3.0863 Provide means for battery and ground dial outpulsing for long loops requiring 96 volts instead of 48 volts into:
A. Local switch train. B. AB Toll train.
C. Senders.

3.0864 Bridges the contacts of the pulse generator across the trunk for pulsing.

3.0865 Controls operation of pulse generator during delayed closure, outpulsing, and interdigital timing.

3.0866 Waits for the start pulsing signal after delayed closure time is completed.

3.0867 Controls the length of the interdigital time for DP calls.

3.0868 Short circuits the polar supervisory relays and repeat coil during DP pulsing and interdigital timing.

3.0869 Advances the digit steering circuit during interdigital time.

3.091 Provides means of testing incoming trunks in the same office on a remote control basis by means of a "belt line" to the incoming trunk frames.

3.092 Provides means of testing outgoing trunks from another Crossbar No. 5 office in the same building on a remote control basis by means of a "tie line" to the master test frame.

3.093 Provides means of selecting the "belt line" or "tie line" by means of the BL or TL key.

3.094 Provides means of testing auxiliary outgoing dial trunks (No. 5 X Bar): Including signaling forward, by passing repeat coil during dialing. Restoring repeat coil after dialing for check on tones.

3.095 Provides means for supplying talking battery to trunk under test so repairman may communicate with the central office from a pole or underground cable.

3.096 When key EM is operated, battery is applied, to the line side of the "M" lead and ground is applied to the drop side of the "E" lead, thus providing a check on these leads.

3.0961 Provides for checking the drop side of the "M" lead by means of relays TT & TT1 and for checking the line side of the "E" lead by means of relay EL.

3.1 Test Frame Keys with Functions

After the necessary patches are made, the test is controlled by the manual operation of keys. The following is a list of the keys used and the functions they serve.

Key

Purpose

ADV

Advance:

To control the advance of the test circuit from the test frame when the "belt line" or "tie line" is used.

AM

Ammeter:

To apply an ammeter test on the tip or ring of the trunk for resistance to ground using 45-50 volts office battery thru 200 ohms.

ANO

A Non-operate

To impose a non-operate current flow test on the trunk A relay, (revertive pulse trunks).

A RY NON-OPR COMP RES

A relay Non-operate Comp. Res.:

To control the value of the series compensating resistance connected in the trunk during the A relay non-operate current flow test, (revertive pulse trunks).

500 4000 5000
1000 7000 4000

<u>Key</u>	<u>Purpose</u>
<u>A RY OPR COMP RES</u> 500, 1000, <u>2000</u> , <u>6000</u> 4000 12000	<u>A RY Oper. Comp. Res.:</u> To control the value of the series compensating resistance connected in the trunk during A relay operate current flow test, (RP, DP, and MF pulse trunks).
<u>BAT</u>	<u>Battery:</u> To close battery and ground to a straightforward trunk arranged for high-low or reverse high-low supervision:
<u>BGD</u>	<u>Battery Ground Dial</u> To close battery and ground to the tip and ring of a step-by-step trunk to aid the battery and ground thru the windings of the trunk relay and thus increase the dialing range by effectively raising the trunk voltage to 90-100 volts.
<u>DISC1/DISC2</u>	<u>Disconnect:</u> To restore to normal the test equipment associated with test Jack T1 and T2 respectively.
<u>DOS</u>	<u>Distant Office Selector</u> To prepare the test circuit for revertive pulse testing over a trunk loop that includes a two-wire office selector or a crossbar tandem trunk.
<u>DOS COMP</u> 0 300 600 900 1200 1500	<u>Distant Office Selector Comp.:</u> To control the value in the selection compensating resistance in an RP trunk when the trunk loop includes a two-wire office selector or a crossbar tandem trunk.
<u>DP</u>	<u>Dial Pulsing:</u> To prepare the test circuit, in part, for sending out the called number by means of automatic dial pulses.
<u>DPL</u>	<u>Delay Pulse Loop:</u> To connect the SU and SUR supervisory relays across the trunk loop in order to recognize a "delay dial" signal and thus delay the start of pulsing until the polarity of the trunk changes.
<u>DT</u>	<u>Dial Tone:</u> To delay the start of automatic pulsing over trunks appearing at the DSA switchboard until dial tone is heard in the head set.
<u>EM</u>	<u>E&M Leads</u> To close grd to the "E" lead (drop side), and battery to the "M" lead (line side) when testing 4 wire trunks with E&M lead signaling.
<u>EM4W</u>	<u>E&M Four-wire</u> To prepare the test circuit for pulsing out the called number on an MF (MF key operated) or DP (DP key operated) basis over 4-wire trunks with E&M lead signaling.
<u>FEMF</u>	<u>Foreign Electromotive Force:</u> To test a lead of a trunk for foreign potential.

<u>Key</u>	<u>Purpose</u>
<u>G</u>	<u>Ground</u> To ground one trunk conductor and thus permit a metallic test of the trunk by operating key MA, 1,000 or 20,000 ohms.
<u>GO</u>	<u>Go:</u> To connect the SU and SUR supervisory relays across the trunk loop to recognize a "go" start pulsing signal, (DP trunks).
<u>HF</u>	<u>High Five:</u> To provide means for making channel check through the second unit when incoming trunks are common two office units. (RP trunks).
<u>KR</u>	<u>Key Release:</u> To release the operated register keys.
<u>L RY NON-OPR COMP RES</u>	<u>L Relay Non-operate Comp. Res.:</u> To impose a non-operate current flow test on the trunk L relay. (RP trunks).
<u>1000 2000 500 500</u>	
<u>LPD</u>	<u>Loop Pulsing Dial:</u> To short circuit the trunk loop without compensation during automatic out dial pulsing.
<u>LRD</u>	<u>Loop Resistance Dial</u> To close a 1481 ohm bridge across the tip and ring of a step-by-step trunk during automatic loop dial pulsing.
<u>MF</u>	<u>Multi-frequency:</u> To prepare the test circuit for pulsing out the called number by means of MF pulses.
<u>MF4W</u>	<u>Multi-frequency 4-Wire</u> To prepare the test circuit for pulsing out the called number when the MF key is also operated, over a 4-wire trunk by means of MF pulses.
<u>MO</u>	<u>Momentary open:</u> To detect a momentary open of the trunk supervision on RP or RCI calls.
<u>NT1/NT2</u>	<u>No Test 1 and 2:</u> To over-ride a plugged busy trunk associated with test jack T1 or T2 respectively. (Crossbar tandem or #4 or 4A Toll Crossbar)
<u>PCID/PCIT</u>	<u>Panel Call Indicator Direct or Tandem:</u> To prepare the test circuit for transmitting call indicator pulses over a direct PCI or a Tandem PCI trunk respectively.
<u>PRE OPR A&L RYS</u>	<u>Preoperate A & L Relays:</u> To apply a test for false operation due to cable charge on the A & L RP trunk relays.
<u>R±</u>	<u>Ringings ±:</u> To apply 20 cycle ringing current to the trunk under test.

<u>Key</u>	<u>Purpose</u>
<u>RC</u>	<u>Remote Control:</u> Makes the use of the "Belt Line" or "Tie Line" effective.
<u>REV</u>	<u>Reverse:</u> To reverse the T and R leads of the trunk to the voltmeter and ammeter.
<u>RICR</u>	<u>Repeater Incoming Comp. Res. - 20,000</u> To compensate for non-operate test of L relay in panel repeater incoming trunks.
<u>RP</u>	<u>Revertive Pulse:</u> To prepare the test circuit for transmitting the called number by revertive pulses.
<u>RS1/RS2</u>	<u>Reverse Supervision 1 & 2</u> To reverse the T & R leads of the trunk connected to jack T1 and Jack T2 respectively.
<u>STF</u>	<u>Straightforward</u> To test reverse battery supervision straightforward trunks that require a ring start signal.
<u>S-GO</u>	<u>Stop-Go:</u> To enable the test circuit to recognize a momentary reversal of the trunk after dial pulsing has started, as a "stop" and "start" pulsing signal rather than as a "reorder" signal.
<u>SX</u>	<u>Simplex Ringing Signal</u> To apply simplex battery to the trunk under test.
<u>TAN H, TAN T, TAN U, TH, H, T, U, STA</u>	<u>Register Keys:</u> To record and prepare the test circuit for pulsing out the number depressed on the keys. The TAN H, T and U keys are used to record the office code when testing PCI, DP and MF trunks to a distant tandem office. The TAN U and T keys are also used to record the office brush and office group selection to be made in a distant office by RP pulsing.
<u>TFV</u>	<u>Twenty-four Volts:</u> To prepare the test circuit for making trunk test on RP trunks which have 24 volts on the trunk A relay.
<u>TK COMP RES Keys</u> 0 - 250 300 ,600 900 ,1200 1500,1800 2100,2400 3300,3600	<u>Trk. Comp. Res. Keys:</u> To control the value of the series trunk compensating resistance in steps of 300 ohms from 0 to 3600 ohms. (Use Key 0 when testing MF trunks to insure a strong pulse signal).
<u>TLK1/TLK2</u>	<u>Talk 1 & 2:</u> Used on all straightforward trunks requiring battery and ground start and to establish a talking or holding circuit over the trunk patched to jack T1 or T2 respectively.

<u>Key</u>	<u>Purpose</u>
<u>TST1/TST2</u>	<u>Test 1 & 2: (Start key)</u> To connect the test circuit to the trunk patched to jack T1 or T2 respectively.
<u>TTLK</u>	<u>Test Talk:</u> Used to talk over an MFP, DP, RP, PCI or STFWD trunk that is under test.
<u>VM1/VM2</u>	<u>Voltmeter 1 & 2:</u> To connect the voltmeter circuit to the trunk patched to jack T1 or T2 respectively.
<u>VM REV</u>	<u>Voltmeter Reverse:</u> To reverse the voltmeter connections to the trunk patched to jack T1 or T2.

4. CONNECTING CIRCUITS

When this circuit is listed on a key sheet the connecting information thereon is to be followed.

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| <p>4.01 Test and Make Busy Jacks SD-96376-01, SD-68203-01 and SD-25762-01.</p> <p>4.02 Test Circuit for Testing Outgoing Trunks for Continuity and Reversals - SD-96370-01.</p> <p>4.03 Office Link and Connector Circuit - SD-25033-01.</p> <p>4.04 Distant Office Selector - SD-21733-01.</p> <p>4.05 Panel Incoming Selector such as SD-21917-01.</p> <p>4.06 Crossbar Incoming Trunk such as SD-25295-01.</p> <p>4.07 Crossbar Tandem Incoming Trunk Repeated Supervision - SD-25887-01.</p> <p>4.08 Tandem Call Indicator Trunk such as ES-11573-01.</p> <p>4.09 Telephone, Key and Lamp Circuit - SD-95524-01.</p> <p>4.10 Interrupter Circuit - SD-25742-01 and SD-25062-01.</p> <p>4.11 Miscellaneous Circuit - SD-95525-01.</p> <p>4.12 Clock Circuit - SD-96343-01.</p> <p>4.13 Tandem Overflow Trunk - SD-25442-01.</p> <p>4.14 Tandem O.G.T. to Central Desk Operator or to Official P.B.X. - SD-21634-01.</p> <p>4.15 Panel Tandem Announcement Trunk - SD-21734-01.</p> | <p>4.16 Outgoing Trunk Circuit Loop to CX signaling SD-95060-01.</p> <p>4.17 Step-by-step Incoming Trunk Circuit such as SD-31726-01.</p> <p>4.18 Crossbar Tandem Outgoing Repeater Circuit to SXS office, SD-25634-01, (Requires Fig. 22 & YI option).</p> <p>4.19 Crossbar Tandem Outgoing CX trunk to SXS office - SD-25490-01, (Requires Fig. 22 & YI option).</p> <p>4.20 Toll Switching System No. 4A - TX or Combined TX and Toll Switching Trunk Circuit - SD-68239-01.</p> <p>4.21 Toll Switching System No. 4A - Toll Switching Trunk Circuit Dial, MF or Straightforward - SD-68242-01.</p> <p>4.22 Toll Switching System No. 4 - Toll Switching Trunk Circuit to Crossbar No. 1, Panel or Step-by-step Office Call Announcer or P.C.I. to Manual Office - SD-68326-01.</p> <p>4.23 Tandem Office Incoming Trunk Circuit, 4 wire - SD-25943-01.</p> <p>4.24 Crossbar Tandem - Misc. Circuit For Tandem Trunk Frame - SD-25370-01.</p> <p>4.25 Crossbar No. 5 - Misc. Relay Rack Frame - SD-25781-01.</p> <p>4.26 Crossbar No. 5 - Master Test Frame, Jack, Key and Lamp Circuit - SD-25762-01.</p> <p>4.27 Multi-frequency Current Supply and Distribution Circuit - SD-95391-01.</p> <p>4.28 Tandem Office - 2 Way Toll Trunk Circuit, MF Pulsing - SD-27000-01.</p> |
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5. GENERAL METHOD OF OPERATION

5.01 Access to Trunks:

This test frame is manually connected to a trunk by means of patching cords at the outgoing trunk test frame jack bay. It is used in testing incoming trunk relay equipment located in a distant office. Connection to the trunk is made by means of patching cords between the test circuit test jacks and the trunk circuit jacks on the Test and Make Busy Jack Bay.

5.011 Crossbar Tandem or Toll Crossbar No. 4 or 4A

Fig. 12 is provided for making busy test on trunks. Test jack T1 or T2 is patched to the trunk test jack to test either 2-wire trunks or jack T1 is patched to the trunk test jack to test 4-wire trunks (MF or DP pulsing) with E&M lead signaling. The NT1 or NT2 key is provided so that if the trunk under test is plugged busy and if it is desired to override the busy, the operation of the key will permit test on the trunk.

Fig. 18 is provided for 4-wire trunks REV. BAT. SUPV. MF pulsing (such as SD-25943-01) test jacks T&R are patched to the T&R jacks of the trunk to be tested.

In addition to the T1 & T2 jacks Fig. 12, the S1 and S2 jacks of Fig. 22 are provided for patching to outgoing trunks to SXS or outgoing repeaters in Crossbar Tandem Office.

5.012 Crossbar No. 5 Office

Figs. 13 and 14 are provided for making busy test on trunks. Test jack T1 or T2 is patched to the trunk test jack. Make busy jacks MB1 or MB2 Fig. 14 are patched to the trunk MB jack when it is desired to exclude the master test frame which otherwise could override the busy. In addition, it is necessary to patch the MB1 or MB2 jack to the trunk MB jack when testing an outgoing trunk such as SD-26085 which connects to an auxiliary trunk converter (MF loop to CX) such as SD-27009. This patch holds the auxiliary trunk.

Fig. 23 is also provided to test outgoing trunks which connect to an auxiliary trunk converter (DP loop to CX) such as SD-26110. In addition to the T1 or T2 and MB1 or MB2 patches described above, it is necessary

to patch the D1 or D2 jack to the trunk D jack. This closes the dialing path between the test circuit and the trunk under test.

The operation of Key TST1 or TST2 closes the testing and pulsing circuit across the tip and ring of a trunk that is patched to test jack T1 or T2, respectively. This key serves as a test start key for revertive, call indicator, dial, and multi-frequency pulsing trunks and also for straight-forward trunks that do not require the closure of battery and ground as a start signal.

The TLK1 or TLK2 key is operated to hold or monitor on a connection already set up. When a connection is thus held the testing and pulsing equipment of the test circuit is free for use in setting up a second connection via the unused test jack, T2 or T1.

The TTLK key, when operated, permits monitoring and talking over the completed connection. When testing straight-forward trunks that require the closure of battery and ground as a start signal, operate the TLK1 or TLK2 key in addition to the BAT key.

5.02 Tie line:

In a Crossbar No. 5 office the "tie line" extends the testing facilities associated with jack T1 of this test frame to the master test frame of another office (in the same building) not equipped with a manual outgoing trunk test frame. This makes the test frame available by means of a patch at the master test frame, for testing trunk conductors and distant relay equipment, outgoing from that office. The progress of the test is controlled from the master test frame by means of a 32A test set.

5.03 Belt line

The "belt line" extends the testing facilities associated with jack T1 of this test frame to all incoming trunk frames in a Crossbar No. 5 or a Crossbar Tandem Office. The test frame is connect to the individual trunk by patching the "belt line" jack at the incoming trunk frame to the T jack of the trunk to be tested. The progress of the test is controlled from the incoming trunk frame by means of a 32A test set.

5.04 Straightforward Trunks

Incoming trunks to toll, DSA and manual switchboards arranged for reversed battery, reverse high-low, or wet-dry supervision, or controlled start of ringing are tested by requesting the operator at the distant switchboard to complete the call to the desired test line. Successful completion of a test call is indicated by observing the SUP- or TSUP lamp on the outgoing trunk test frame.

5.05 PCI Trunk

Trunks to a panel call indicator position are tested by requesting the

operator at the distant switchboard to direct the call to the desired number.

5.06 Trunk Options

Incoming trunks in a Crossbar No. 5 Crossbar No. 4 or 4A office must be arranged so that they can serve the several different types of connecting offices. Optional wiring is provided in the trunks so that the initial polarity of the trunk and the polarity while awaiting subscriber answer may be made the same or opposite depending upon whether an "on hook" or "off hook" initial trunk polarity is required. Trunks from offices requiring a "wink" start pulsing signal, straightforward, or revertive pulsing operation are wired for an initial "on hook" trunk polarity. Trunks from offices requiring "delay dial" or "dial tone" start pulsing signals are wired for an initial "off hook" trunk polarity.

5.07 Key Operation Chart for Typical Circuits ("ZL" Option)

A detailed chart follows which lists the keys to be operated when test circuit is equipped with "ZL" option. It will be noted that the TST- or TLK- key is operated when testing. This key shall not be operated until the trunk under test is patched from the test and make busy jack bay to the test frame and all other keys required to make the test are operated.

When trunks using "ZK" option and having "Go" on "Delay Dial" start of pulsing signal are tested and they appear at this circuit with battery on the Ring for "off-hook" called subscriber supervision, the RS1 or RS2 key must be operated. If the trunk has battery on the Tip for "off-hook" called subscriber supervision, the RS1 or RS2 key must be operated for testing trunks using the "wink" start (of multi-frequency or dial pulsing) signal and also when test calls are completed on a manual, P.C.I. or revertive basis. When transferring from the pulsing supervisory circuit (SU and SUR relays with TSUP lamp) to the holding supervisory circuit (PB relay with SUP- lamp), the supervisory lamp indications will be reversed in the case of trunks having "delay dial" on "go" start of pulsing signal. This may be corrected by changing the position of the associated RS- key.

Trunks having "Go with Dial Tone" start of pulsing signal shall be tested in the normal manner except that the TTLK and DT keys shall be operated. The DT key shall be restored to normal after dial tone is received to start the circuit pulsing.

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Typical Circuit	Pulsing	Start Pulse Signal	Man. OGT Appearance Eatt. on T or R		Keys Operated In Addition To Compensation And Register Keys
			Trunk	Called Sub. Rec.	
			Normal	Off Hook	
SD-25887-01	D.P. (Loop)	Delay Dial	R T	R T	DP,LPD,DPL,TST-DP, LPD,DPL,RS-, TST-
Assoc. Co.	D.P.	Delay Dial with Stop-Go	R T	R T	DP,LPD,DPL,S-GO, TST- S-GO,RS-,TST-
SD-31841-01	D.P.	GO	T R	R T	DP,LPD,GO,TST- DP,LPD,GO,RS-, TST-
SD-25887-01	D.P.	Dial Tone only or GO with Dial Tone	T R	R T	DP,LPD,GO,DT,TST- DP,LPD,GO,DT,RS-, TST-
SD-31241-01	D.P.	GO with Stop-Go	T R	R T	DP,LPD,GO,S-GO, TST- DP,LPD,GO,S-GO, RS-,TST-
SD-25887-01	D.P.	Wink	T R	R T	DP,LPD,TST- DP,LPD,RS-,TST-
SD-25694-01 SD-68135-01 SD-27003-01	D.P.	Wink (Delay Dial)	T R	R T	DP,LPD,TST- DP,LPD,RS-,TST-
SD-68230-01 SD-27000-01	M.F.	Wink (Delay Dial)	T R	R T	MF,TST- MF,RS-,TST-
SD-25634-01 SD-25490-01	D.P. (Resist- ance)	GO	T	R	DP,LRD,GO,TST-
SD-30200-01	D.P. (Batt. & Grd.)	GO	T R	R T	DP,BGD,GO,TST- DP,BGD,GO,RS-, TST-
SD-25582-01	D.P. (Batt. & Grd.)	Wink	T R	R T	DP,BGD,TST- DP,BGD,RS-,TST-
SD-25887-01	M.F. (2-wire)	Delay Dial Wink	R T T R	R T R T	MF,DPL,TST- MF,DPL,RS-,TST- MF,TST- MF,RS-,TST-
SD-25943-01 SD-68289-01	M.F. (4-wire)	Delay Dial Wink	T-R T1-R1	T-R T-R	MF,MF4W,DPL,RS-, TST- MF,MF4W,TST-
SD-21116-01	R.P.	-	T R	R T	RP,TST- RP,RS-,TST-
SD-21733-01*	RP Test Line on Mult. of Distant Office Selector	-	R T	T R	DOS,RS-,TST- DOS,TST
SD-21733-01*	(RP Thru Dis- tant) (Office Selector)	-	R	T	RP,DOS,RS-,TST-

*When SD-25887-01 is used as an RP or PCI trunk, it should be considered as located at the (DOS) distant office selector.

Typical Circuit	Pulsing	Start Pulse Signal	Man. OGT Appearance Batt. on T or R		Keys Operated In Addition To Compensation And Register Keys
			Trunk Normal	Called Sub. Rec. Off Hook	
SD-21733-01*	(PCI Thru Distant) (Office Selector)	-	T R	R T	PCID,DOS,TST- PCID,DOS,RS-,TST-
ES-10423-01	PCI Direct	-	T R	R T	PCID,TST- PCID,RS-,TST-
SD-21143-01 ES-11573-01	(PCI SDR. TDM) (or PCI TDM)	-	T R	R T	PCIT,TST- PCIT,RS-,TST
SD-12900-01	STFWD STFWD	-	T High Res-Dry	R Low Res-Dry	STF,TST-,TTLK BAT,TLK-
SD-55872-01	STFWD		DRY	R	RS-,BAT,TLK-
SD-68513-01	MF (4-wire)	Delay Dial Wink	OPEN E OPEN E	GRD E GRD E	MF,EM4W,TST- MF,EM4W,TST-
SD-68514-01	DP (4-wire)	Delay Dial Wink GO	OPEN E OPEN E OPEN E	GRD E GRD E GRD E	DP,EM4W,LPD,TST- DP,EM4W,LPD,TST- DP,EM4W,LPD,GO,TST-

*When SD-25887-01 is used as an RP or PCI trunk, it should be considered as located at the (DOS) distant office selector.

6. DETAILED DESCRIPTION OF OPERATION

6.01 Busy Test, Crossbar Tandem, Crossbar No. 4 or 4A (Fig. 12 and Fig. 18 or 22).

In describing the operation of this test call it will be assumed that the T1 jack is patched to the trunk to be tested and all test frame keys are normal.

If the trunk to be tested is not busy when patched, the busy test feature will not function until one of the following keys is operated, TST1, VM1, or TLK1. When one of these keys is operated, it closes thru a circuit to operate the BH1 relay. The BH1 relay will lock. The BH1 relay will light the ON1 lamp, close a circuit for relay SRI to operate and operate relay ON1. The ON1 relay is slow operate in order to allow time for the slow release SRI relay to soak.

Operate key NT1 when testing a Crossbar Tandem or a Crossbar No. 4 or 4A trunk that is plugged busy if it is desired to override the make busy plug. The operation of key NT1 closes an auxiliary circuit for operating relay ON1 thus overriding a busy plug. When the ON1 relay operates it locks, opens the operate path of the SRI relay,

puts a ground on the sleeve of the test jack to make the trunk busy, furnishes an additional ground thru the normal contacts of the SRI relay to the ON1 lamp, and furnishes a ground thru its locking contacts, the contacts of the SRI relay normal, and the BH1 relay operated to the ST lead of the test circuit. When the slow release SRI has released it closes thru the ST ground from the locking contacts of the ON1 relay.

If the trunk connected is busy, relay BY1 and TBI will operate thru BY1 relay secondary winding and thru relay ON1 normal to the busy ground on the sleeve of the test jack from the busy trunk. Relay BY1 operated lights the BY1 lamp as a busy trunk indication. Relay BH1 operates from ground on the D1 relay normal. Relay BH1 operated locks to the D1 relay ground and lights the ON1 lamp. Should the trunk become idle while still connected to the test circuit, relays BY1 and TBI will release. The BY1 lamp is extinguished when BY1 relay releases. Relay TBI released operates relay SRI thru relay BH1 operated thru relay ON1 normal. Relay SRI operates the slow operate relay ON1 and prepares the circuit to reoperate relay BY1 over its primary winding. Relay ON1 operated, a - closes ground thru relay SRI operated

to operate relay BY1 on its primary winding, b - opens the operate circuit of relay SR1 and c - prepares the busy ground. Relay BY1 operated closes its secondary winding thru the winding of relay TE1 to the sleeve of the test jack to make a second busy test. When the slow release SR1 relay is normal relay BY1 releases unless there is busy ground on the sleeve. Relay ON1 will lock to the D1 relay ground thru relay TB1 normal under this condition. The open interval on the sleeve from the time relay BY1 releases the first time until it releases the second time is to insure that any circuit having a relay held on the sleeve will release before the busy ground is connected. The trunk is made busy by a ground from the front contacts of the ON1 relay when the BY1 relay releases.

6.02 Busy Test, Crossbar No. 5 (Figs. 1, 13 & 14 and Fig. 23)

When trunks are tested in service, the trunk T and MB jacks are patched to this test circuit T1 and MB1 jacks respectively, or to the T2 and MB2 jacks respectively. This arrangement allows the busy test circuit to make the trunk busy to service calls and to test calls.

When trunks are tested which are make busy with an MB plug due to trouble, only the T Jack of the trunk is patched to the T1 jack or the T2 jack of the test circuit. This arrangement allows the Master Test Frame to pick the trunk while this test circuit is making a test on the same trunk and cause interference.

The following description assumes that the T and MB jacks are patched to the T1 and MB1 jacks respectively for the trunk in service test or that the T jack is patched to the T1 jack for the trunk plugged busy.

6.021 Trunk in Service, TLK- or TST- Key Normal

When the TLK1 or TST1 key is normal the BH1 relay will be normal and if the trunk is busy, the BT1 relay will not operate since the sleeve will be open. When the trunk becomes idle the BT1 relay will operate to the ground on the S lead. The BT1 relay operated will, open the ground used to operate the TB1 relay, close the TN3 (Fig. 1) relay to the TNR lead to operate in series with a relay in the trunk and, in turn, operate relay TN1 which will close part of the operate path for the ON1 relay. The TN1 relay operated will extinguish the BY1 lamp and close part of the SR1 relay operate path. When the TLK1 or TST1 key in Fig. 1

is operated, the BH1 relay will operate and complete a path to operate relay SR1 and close an additional ground to light the ON1 lamp. The BH1 relay locks to ground on the D1 relay normal contacts. When SR1 relay operates it opens the ST lead and closes the operate path for the ON1 relay. The ON1 relay is a slow operate relay to allow time for the SR1 relay to soak. When the ON1 relay is operated it locks, opens the operate path of SR1 relay which starts to release, and provides an additional ground to the ON1 lamp. When the SR1 relay has released it closes ground thru the locking contacts of the ON1 relay to the ST lead to Fig. 1.

6.022 Trunk in Service, TLK- or TST- Operated

When the TLK1 or TST1 key is operated the BH1 relay will operate. The BH1 relay operated will lock to ground on D1 relay, close part of the ST lead path, light the ON1 lamp, operates the TB1 relay if the trunk is busy, and close in part the path to operate the SR1 relay.

When the trunk becomes idle the BT1 relay will operate to ground on the S lead of the trunk via the T, T1, or MB1 jack and patching cord of the remote control feature. The BT1 relay operated will, release the TB1 relay, close the winding of the TN3 relay, Fig. 1, to the TNR lead to operate in series with a relay in the trunk, make the trunk busy to all calls and close in part the operate path for the ON1 relay. The TN3 relay operates the TN1 relay. When the TN1 relay operates it will extinguish the BY1 lamp and close part of the SR1 relay operate path. When the TB1 relay releases it closes the path to operate the SR1 relay. When the SR1 relay operates it opens the path to the ST lead and closes a path to operate the ON1 relay. The ON1 relay operated will lock, open the operate path of the SR1, which will start to release and provide an additional ground to the ON1 lamp. When the SR1 relay releases it closes thru the ground from the locking contacts of the ON1 relay to the ST lead to Fig. 1.

6.023 Trunk Made Busy with MB Plug

When a trunk that has been made busy with an MB plug is to be tested, the T1 Jack is patched to the T jack of the trunk. The busy test is made similar to that made for trunks in service except that the TM3 relay operates to a 700 ohm battery thru the normal contacts of the B1 relay. The circuit operations are similar to those described in Paras. 6.021 & 6.022. The trunk being tested, however, may be seized

by the Master Test Frame and cause interference since the Master Test Frame can override a MB Plug in the MB jack.

6.03 Talking and Monitoring

The T TLK (test talk) key should, in general, be used for talking and monitoring on any type of trunk except a straightforward trunk that requires the test circuit to supply battery and ground to signal the distant operator. On such trunk keys BAT and TLK- should be operated instead of Key T TLK-. It is not necessary to release the T TLK key between calls. If it is desired to establish a talking connection to a distant point using one of the test cords for close supervision in finding a trouble in a trunk under test, a connection may be established by using the directing keys and one of the test cords. Then after the connection is established the TLK- key associated with that test cord is operated to hold the connection and permit talking by the OGT test man through the TLK repeat coil. The PB polar relay bridge is across the tip and ring of the trunk. The use of the sender directing keys, TST repeat coil, SU and SUR supervisory relays may be used with the other test cord in setting up a connection for test purposes.

6.04 Belt Line Operation

The belt line is used when tests are to be made on trunks incoming from other offices, referred on account of trouble. A belt line is provided per office enabling one test frame to test trunks incoming to a number of offices on a remote control basis. The proper office is selected by means of placing a make busy plug in the BL jack of the Fig. 21 associated with that office. Supervisory, monitoring, and recycling facilities are arranged so that the attendant may control the test from the trunk frame or the OGT test board.

The TST, RC-1 and TEL-1 jacks and the SUPV lamp appear on alternate trunk frames. The T jack of the trunk to be used in establishing the call is patched to jack TST. If control is to be from the trunk frame, a 32A test set is connected to jack RC 1 and a telephone headset to jack TEL 1. At the OGT test frame keys are operated in accordance with the test to be made. Operate the RC key, Fig. 19. This will operate relay BL of Fig. 21 and extend the TST and RC jacks and the SUPV lamp to the OGT test board. Test advance and disconnection are under control of the 32A test set or ADV and DISC 1 keys of the OGT test board. Momentary operation of the white key of the 32A test set or ADV key of the OGT will operate the RC1 and RC2 relays, Fig. 19. The operation

of the RC2 relay will operate the TST 1 relay and cause the circuit to test as explained when a trunk is patched to the T1 jack. Relay RC2 also starts the busy test feature normally controlled by the TST 1 key and operates the BT1 relay of Fig. 13 thru relay BL. Relay RC1 in addition to extending the tip and ring to the test circuit also connects the telephone circuit to the belt line.

When two or more belt lines or tie lines are provided or any combination of belt lines or tie lines, option ZC and/or ZE shall be provided. To select a particular belt line or tie line insert a make busy plug into the associated BL or MT jack.

6.05 Tie Line Operation

In a multi-office building where only one of the offices is equipped with a Manual OGT test frame, the testing facilities of the frame can be extended via the tie line to the Master Test Frame of another office and thus made available at the other office for testing the associated trunks.

When using the tie line the test frame functions in the same manner as when using the belt line with the exception of the TST jack which is not provided at the master test frame. The T and MB jacks at the master test frame are extensions of the T1 and MB1 jacks respectively, at the OGT test frame. This T-jack is patched to the T jack of the trunk to be tested, thus extending the trunk over the tie line to OGT test frame. The MB-jack is patched to the MB of the trunk to be tested. A make busy plug may be used instead of this patch. Operate the RC key. This key operates the MT relay in Fig. 20, which closes the supervisory signal and the test advance circuits. It also transfers the make busy paths to the control of the tie line. Insert a make busy plug into the MT jack associated with the particular tie line to be used. The leads to the make busy jack, Fig. 14, are opened by the operation of the tie line relay, TL, and extended to the master test frame where they terminate in a make busy Jack.

6.06 Ringing

The test circuit is arranged so that continuous machine ringing may be applied to the trunk by operating the R_t key. Simplex Ringing may be applied by the operation of the SX key. When testing ring start straightforward type trunks operate Key STF before operating the TST- key then operate Key SX or R_t to signal the operator.

6.07 Disconnection and Repeat Test

The call may be disconnected by releasing the various keys operated for the call and then operating the DISC- key. To make a repeat test on a cord operate the DISC- key and hold it operated until the ON lamp is extinguished then release the key. The circuit will then repeat the test set up on the test frame keys.

7. SUPERVISION

7.1 Call to Test Line

Test calls are normally directed to test lines beyond the trunk under test. This, in general, provides a test of the ringing feature, if provided, and also the supervisory features of the trunk. The supervisory lamp is lighted when the called subscriber's receiver is "on hook" thus providing a dark lamp for the receiver "off hook" condition except as noted below under wet dry supervision. These test lines usually provide called subscriber flashing of a known pattern so that a check is made of the supervisory feature. Frequently a busy line is called for a more rapid test or calls may be made to switchmen for special tests. In each case the lighted SUP lamp indicates the called subscriber has not answered.

7.2 Reverse Battery Supervision - .

Most trunks are arranged for reverse battery supervision and a lighted T SUP (Test Supervisory), SUP1 or SUP2 lamp indicates that the called subscriber has not answered.

7.3 Wet-Dry Supervision, Crossbar or Panel

There are a few trunks which provide battery and ground over the tip and ring as long as the called subscriber's receiver is "on hook". Battery is then removed from the trunk as a dry condition when the called subscriber's receiver is "off hook". When a revertive pulse trunk having wet-dry supervision is tested the connection is established in the usual manner and any of the T SUP, SUP1, or SUP2 lamps used will give the normal supervision. However, there is no assurance from this that the trunk is not a reverse battery trunk since the supervisory relay releases on open or dry circuits just as it does on reverse battery. The trunk may be checked for this dry condition by operating the RS- key after the connection is established if the key was normal when setting up the call, or vice versa. The supervisory lamp would under this condition be dark for both "on hook" and "off hook" unless there is a reversal

of current since the polarized relay would never operate to light the lamp, operation of the listening key (T TLK or TLK) would give an indication that the flashing was continuing.

7.4 Wet-dry Supervision, Step-by-step

When testing a step-by-step dial trunk having wet-dry supervision, the connection is set up using the dial pulsing and the GO class keys. The T SUP lamp would remain lighted for both "on hook" and off hook conditions since the T SUP lamp is lighted under control of a back contact of the SU supervision relay. With the operation of the RS- key, if it were normal while establishing the call or vice versa, the T SUP lamp would be dark for "on hook" and lighted for "off hook". If instead of operating the RS- key the TLK- key had been operated after the flashing condition was established the SUP- would have flashed with a dark lamp for "off hook" as described above for revertive pulsing wet-dry trunk.

7.5 Straightforward Trunks -

When testing straightforward trunks that require closure of battery and ground from the test circuit to signal the distant operator, operate Keys BAT and TLK- after the trunk is patched to the test jacks. When the busy test has functioned and the trunk is idle, the TLK- relay will operate and close the tip and ring of the trunk thru the TLK repeat coil to the winding of the PB relay. The PB relay is a polarized relay arranged in the circuit to operate with battery on the tip of the test jack and the RS- key normal. The PB relay will operate in series with the trunk A relay when the TLK- relay operates and light the SUP- lamp. When the distant operator answers, the trunk reverses its battery and ground and the PB relay releases extinguishing the SUP- lamp.

When testing straightforward trunks that require "ring start" or that do not require the closure of battery and ground from the test circuit to signal the distant operator operate Keys T TLK and TST- after the trunk is patched to the test frame. When the busy test has functioned and the trunk is idle the TST- and T TLK relays will operate and close the tip and ring of the trunk thru the TRK COMP RES Keys, TST repeat coil, A REL OPR COMP RES Keys to bridge the windings of relay SU and SUR across the trunk for polarity and supervision tests.

7.51 Bridged Supervision Trunks (Fig. G)

When it is desired to test a bridged supervision trunk operate the BAT and the TLK- Key after the trunk is patched to the test jack. When the busy test has functioned and the trunk is idle the TLK- relay

will operate relay BAT which closes the tip and ring of the trunk thru the TLK repeat coil to the winding of relay PBI. Relay TLK- also closes a circuit for lighting lamp SUP-. Relay PBI will not operate in series with the bridged supervision trunk relay until the distant operator answers the call thereby closing a low resistance bridge around one winding of the trunk relay. The operation of relay PBI extinguishes the SUP- lamp. This lamp relights when the operator disconnects.

7.52 High-Low Supervision Trunks (Fig. G) -

Operate Keys BAT and TLK- after the trunk is patched to the test frame. Relay PBI will not operate when testing a high low supervision trunk until the distant operator answers the call and thereby shunts out the high winding of the trunk relay. When the operator disconnects, the shunt is removed, relay PBI releases and lights the SUP- lamp as an "on hook" signal.

7.53 Reverse High-low Supervision Trunks (Fig. G) -

There are a few trunks that present a dry bridge when seized. These trunks require the operation of the BAT and TLK- keys in order to signal the operator. The SUP- lamp lights when the TLK- Key is operated. When the operator answers the dry bridge is replaced by battery and ground and the SUP- lamp is extinguished. If the battery is closed to the ring and ground to the tip of the trunk, operate the RS- key to extinguish the SUP- lamps.

8. VOLTMETER TEST

The following test procedure applies to both four-wire as well as to two-wire trunks. However, when testing four-wire trunks, jack T1 is patched to jack P, R, or TR, TR1 EMLINE, or ENDROP of the trunk depending upon the cable pair under test. These tests on four-wire trunks are made from jack T1 only. The circuit does not provide means for making these test from jack T2.

8.1 Preparation

The trunk to be tested is patched to the test jack and the VMI key is operated to make a voltmeter test of the trunk. When the busy test has functioned and the trunk is idle the VMI relay will operate and close thru the trunk to the voltmeter and voltmeter test keys.

8.2 Tip and Ring Test

With only the VMI key operated the 100 volt test battery thru the 100,000 ohms

resistance of the voltmeter is connected to the ring of the test jack. To test the tip the REV key is operated in addition to the VMI key. With the VMI and REV keys operated the 100 volt test battery thru the 100,000 ohms resistance of the voltmeter is connected to the tip of the test jack. The voltmeter needle deflection is read on the 120 volt scale.

8.3 Test for Foreign Battery

To test for foreign grounded negative battery on the ringside of the trunk, keys FEMP and G are operated. To test for foreign grounded positive battery on the ringside of the trunk keys FEMP, VM REV and G are operated. Tests for foreign grounded battery on the tipside of the trunk are made with the reverse key REV operated. Tests for metallic battery having its negative side connected to the ringside of the trunk are made by operating key FEMP. Test for foreign metallic battery having its positive side connected to the ringside of the trunk are made by operating keys FEMP and VM REV.

8.4 Tests for Short-circuits and Resistance

The test for short-circuits may be made by operating G key. If the trunk is short-circuited and free from ground, the voltmeter needle will show a deflection which will be unchanged when the REV key is operated. The lower the resistance of the short-circuited trunk, the greater will be the deflection. With the 20,000 ohm or the 1000 ohm key operated 20 volt test battery through the 20,000 ohms or 1000 ohms meter resistance is connected to the ring lead and with the AM key operated the 45-50 volt office battery through 200 ohms and the meter is connected to the ring lead. To make metallic tests the G key should be operated in addition to the desired voltmeter range key or AM key. The resistance to ground or loop resistance may be read directly from the curves of circuit Note 303. The point of intersection of a line corresponding to the observed meter deflection and the curve corresponding to the meter range in use gives the resultant external resistance to ground or loop resistance in ohms. As seen from the curves, more accurate readings of resistance are obtained by using the 100,000 ohm range for resistances above 10,000 ohms, the 20,000 ohm range for resistances between 2000 and 200,000 ohms, the 1000 ohm range for resistances between 100 and 10,000 ohms and the milliammeter range for resistances below 2000 ohms. There is considerable overlap of these ranges permitting the accurate reading of resistances from below 20 ohms to over 1 megohms. The value of resistance may also be computed when using the voltmeter ranges

by multiplying the difference between the test battery voltage and the voltmeter reading by the resistance in series with the voltmeter and dividing by the voltmeter reading. When using the MA scale the resistance may be computed by multiplying the milliammeter reading by 203, subtracting from the test voltage the dividing by the milliammeter reading.

8.5 Cable Capacity Test

This test may be made to determine the approximate capacity of an open trunk. To make this test, operate keys G and REV. As the REV key is operated to and fro the needle of the voltmeter moves at a fairly uniform rate of speed to indicate the charge and discharge of the cable.

9. TRANSMISSION TEST

9.1 Two-wire Trunks or Four-wire E&M Lead Trunks

The transmission test circuit (such as the 12B) is patched between the test circuit T1 jack and the T jack of the crossbar tandem trunk to be tested. The call is then made as described in par.

11.06. The transmission measurements are made when the call has terminated on the test line.

9.2 Four-wire Trunk (REV BAT SUPV)

Connection to the trunk and a busy test of the trunk are made in the regular manner as described under paragraph 13.013. The T1, T, R1, and R lamp signals indicate the polarity of the trunk under test. Transmission and balance tests can be made over each pair of the four-wire tandem trunks by the use of the 12B or similar transmission test set. The plug of the sending cord is inserted in Jack TT1 and the plug of the receiving cord is inserted in Jack TT2 if a test is to be made on the "T1" and "R1" pair. This order is reversed if the test is to be made on the "T" and "R" pair.

10. MOMENTARY OPEN TEST ("YL" option)

This test is made on revertive pulse and call indicator type trunks only and is not intended for use on other trunks.

Operate the MO key and direct the call to an incoming trunk test line. When the MO relay is closed into the fundamental circuit after pulsing has been completed, it operates in series with the polar supervisory relays and in turn operates the MO1 relay. The MO1 relay operates the MO2 relay. Relay MO3 is held shunted to the ground which operates MO2 relay. The incoming circuit should advance and ringing should start. The incoming trunk test line, to which the incoming is connected, tests the ringing, tripping and supervision.

The ringing induction may be checked with the telephone set by operating the T TLK key in Fig. 1. After the ringing is tripped, the incoming advances to its talking position and an interrupter in the test line circuit operates and releases the incoming S relay; the reversing relay in the trunk should follow the flashes, reversing the current thru the SU relay which should follow the flashes and in turn flash the TSUP lamp. During the time the flashing test is being made, should an open or short circuit occur long enough to release the MO, MO1, and MO2 relays, relay MO3 which was shunted will operate. The MO3 lights the MO lamp as an indication of failure.

11. TESTING REVERTIVE PULSE TRUNKS

11.01 Preparation

Operate the RP class key, depress the called number on the Register keys and operate the required trunk compensation keys. The trunk compensating keys are arranged to cut-in one step of 250 ohms and then cut-in 300 ohm steps up to 3600 ohms.

If the call is to be routed through a distant office, operate the DOS key Fig. B and depress the desired distant office brush and group on the TAN T and TAN U keys respectively Fig. 2, also operate the DOS COMP keys. The DOS key closes a path, in part, to operate the DOS relay which inserts the DOS COMP resistance into the T and R leads. The DOS COMP keys are arranged to cut-in resistance in steps of 300 ohms up to 1200 ohms.

Operate the ANO key Fig. 3 to make an A relay non-operate test. Operate the PRE OPR A & L RYS key to make the A & L relay false operate test on cable charge. To make the A & L relay tests operate the A RY NON-OPR COMP & L RY NON-OPR COMP key as required. The L RY NON-OPR RES keys and the A RY NON-OPR RES keys are arranged to cut-in resistance in steps of 500 ohms up to 5500 ohms for L relay NON-OPR test and up to 12,500 ohms for the A relay NON-OPR test.

Patch the trunk test jack to the test circuit test jack and operate the TST1 key Fig. 1. With the Register Keys in Fig. 2 depressed the revertive pulse leads from Fig. 3 are closed to control the IB, IG, FB, FT, and FU pulses. The pulses for distant office brush and group, as indicated by the depressed TAN T and TAN U keys, are pulsed out ahead of the pulses for incoming and final selections.

When the trunk is idle and the busy test circuit has functioned (See Par. 6.01 and 6.02) the operated TST1 key will close ground over lead ST to Fig. 3 and the operated TST1 relay will close ground from Fig. D over lead TSTG to Figs. 3, 4 and 5.

With the BP key operated, the operation of the TST1 relay operates, Z1 option,

relay RP which, in turn, extends the ST lead ground to operate relay STR.

11.02 Start of Call

When the busy test circuit has functioned and found the trunk idle it closes ground to the ST lead to Fig. 3. The ground on the ST lead operates the STR relay, under control of relay TST- and RP operated, with ZH option. Option "ZH" is required when Figs. A and E (or C) are furnished. Option "ZI" is required when Figs. A and D are furnished and relay RPCI operates under control of relay RP. With Figs. B and D and ZI option the operation of relay TST- closes ground through key DOS operated to operate relay RPCI which, in turn, (a) operates relay STR, (b) closes ground for operating the No. 5 Crossbar timing interrupter and (c) closes a circuit for controlling the TSUP lamp. On RP and PCI calls relay RPCI is operated under control of relay RP, PCId or PCIt operated using ZI option. Relay STR operated, (a) closes a path from ground through the normal terminal of arc 3 RS switch to operate and lock relay ST1, (b) supplies a ground to lock the CI relay, Fig. 5 and (c) supplies ground to the ANO, Pre. Opr. A&L RY, RP and DOS key for use in causing the RS selector to pass by on certain terminals if the keys are normal, (d) supplies battery to the winding of the OF2 and the counting relays. Relay OF2 operated supplies ground to the armature of the STP relay thru relay OF3 normal. Relay ST1 operated, (a) closes its lock circuit to relay STR operated, (b) closes ground, thru arc 6 RS switch normal terminal to the RS switch magnet thru its interrupter contact causing it to step to terminal 1, (c) partly closes the "FT" and "FR" leads, (d) closes the "AV" lead to the AV relay contacts for later SDR interrupter causing the SDR lamp to flash at 120 IPM while selections are being made, (f) opens the switch return to normal ground and (g) closes a lock ground for relay AV.

11.03 Trunk Test, Distant Office Figures B and D with ZI Option

In this case the operated DOS class key and the proper DOS COMP, TAN T and TAN U keys will have been operated prior to the operation of the ST relay explained above. The RS which will be in position 1 as a result of the operation of the ST1 relay. Ground from arc 3 terminals 1 to 3 will operate relay DOS thru the DOS key operated. Relay DOS operated, (a) closes in part the fundamental circuit thru the DOS COMP RES keys and resistance, (b) operates relay FO2 from ground thru arc 1 RS switch, (c) prepares the operate circuit of relay FS (d) supplies ground to move the RS switch off terminals 18 and 19 on revertive pulse calls thru a distant office, (e) arranged the circuit so that the TG relay will be used on

office test regardless of how the TFV key is operated. Relay FO2 operated, (a) closes the lock circuit from the counting relays, (b) closes ground thru arc 4 of the RS switch to its magnet energizing it, (c) prepares circuits for operating or holding the OF2 relay and for operating the O relay from OF2 operated on overflow and telltale conditions, (d) closes the fundamental for distant office test. The fundamental circuit is as follows: "FT" lead thru relay ST1 operated thru relay DOS operated thru the DOS COMP keys and resistances thru the FO2 relay operated thru relay IA and FS normal thru the D high resistance thru relay DOS operated thru the TG relay winding thru relay ST1 operated to the "FR" lead. Under this condition relay TG operates to the distant office trunk relay battery and ground. The distant office trunk relay should not operate under this condition. Relay TG operates relay TG1 which in turn closes ground thru relay OF normal to operate the O, BO and FO relays in a series parallel circuit. Relay FO operated, causes the slow release FO1 and FO3 relays to operate which opens the operate circuit of relay FO2 causing it to release and open the fundamental to release the TG relays. Relay FO2 released, opens the locking circuit of the counting relays and allows the RS switch to step to terminal 2. The release of relays FO2 and TG1 will cause the O; BO and FO and FO1 relays to release. Relays FO1, FO3 and FO2 are made slow release to insure enough time between selection (minimum time required is 100 milliseconds.)

11.04 Brush Selection, Distant Office RS Switch Terminal 2

Relay DOS holds and relay FS operates on its secondary winding from ground on arc 1, when the RS switch reaches terminal 2. Relay RS operated, (a) connects ground to operate relay FO2 thru relay FO3 normal (b) closes ground to the armature of relay OF for use on overflow etc., (c) closes the non-inductive secondary winding of relay OF around its primary winding to provide a better revertive pulsing circuit, and (d) closes the "FT" lead thru the windings of relay STP thru the BO and FO1 relays normal thru the "PRI" and "TER" windings of relay OF in parallel thru relay ST1 operated to the "FR" lead. Under this condition relay STP operates in series with and causes the trunk L relay in the distant office selector to operate. Relay STP operated closes ground from relay OF2 operated thru relay OF3 normal thru arc 5 terminal 2 of RS switch thru the operated TAN T key to the corresponding counting relay, causing it to operate. Relay FO2 operated completes the fundamental circuit and energizes the RS selector magnet thru arc 4. The operation of the distant office trunk L relay will cause the selector to advance and

make brush selection during the process of which ground pulses will be passed back to the STP relay causing it to release and reoperate, operating the counting relays in sequence until the BO and FO relays are operated. The operation of relay BO opens the fundamental to release the distant office trunk L relay as an indication that the sender is satisfied. Relay FO operated, operates the slow release relay FO1 which further opens the fundamental and operates relay FO3. Relay FO3 operated releases relay FO2 which still further opens the fundamental, releases the counting relays, and allows the RS switch to step to terminal 3. Relay FO released, releases the slow release relays FO1 and FO3 which allows relay FO2 to reoperate.

11.05 Group Selection, Distant Office - RS Switch Term. 3

Relay DOS and FS remains operated on terminal 3 of the RS switch and as soon as the slow release FO2 relay is operated it again energizes the RS switch magnet over the path previously described, closes the fundamental and the counting relay locking circuits. The closure of the fundamental by the FO2 relay will again cause the distant office trunk L relay to operate for group selection. The STP relay also operates as in brush selection and operates the counting relay corresponding to the TAN U key operated thru arc 5 terminal 3 of the RS switch. The STP relay releases and reoperates from the shunt pulses passes back by the distant office during selection causing the counting relays to operate in sequence until the BO and FO relays operate. Relay BO as explained before opens the fundamental to release the distant office L relay as an indication that the sender is satisfied. Relay FO operates relay FO1 which in turn operates relay FO3 which releases relay FO2. Relay FO2 released releases the counting relays and causes the RS switch to step to terminal 4. Relays DOS and FS release as the RS switch leaves terminal 3. Relay FO released allows the slow release FO1 and FO3 relays to release. When RS switch reaches terminal 4 ground from STR relay is closed thru arc 6 of RS switch to advance the switch to terminal 5. This same ground is closed thru terminals 5 and 6 of arc 6 of RS switch to advance the RS switch to terminal 7.

11.06 Test Line Trunk Test, Distant Office - RS switch Term. 18

The TAN T and TAN U keys are operated for office brush and group selection to direct the call to a test line. The only class key operated is the DOS key, the RS switch will advance to terminal 4 as the office test, office brush and office group selections are made.

The RS switch will be moved from terminals 4 to 18 as follows: (a) ground from STR relay operated is supplied to move switch RS from terminals 4 to 7 thru arc 6, (b) the RS switch is moved off terminals 7 to 12 and 15 by the STR relay ground thru the RP relay normal, (c) the RS switch is moved off terminals 13 and 14 by the STR ground thru the (Pre. Opr. A & L Rys) key normal, (d) off terminal 16 thru the ANO and Pre. Opr. A & L Rys keys normal, and (e) off terminal 17 by the STR ground thru PCID and PCIT keys normal in figure 5 over leads "STG" and "KG". On terminal 18 the DOS relay operates. The DOS remains operated over this same circuit on terminals 18 and 19. Relay DOS operated (a) partly closes the fundamental and (b) closes ground from arc 1 - RS switch to operate relay FO2 thru the CK and FO3 relays normal. The fundamental circuit is traced from the "FT" lead from Fig. 1 thru the ST1 relay operated thru the DOS relay operated thru the office compensating resistance thru relay FO2 operated thru relays IA and FS normal thru the TG resistance thru relay DOS operated thru the winding of relay TG thru relay ST1 to the "FR" lead to Fig. 1. Relay FO2 operated also closes the lock circuit for the counting relays and energizes the RS magnet thru arc 4 of the RS switch. Relay TG operates in the fundamental circuit either to the test line L relay battery and ground or to reverse battery from the distant office selector in case it is at overflow. The test line L relay will not operate in this circuit to the high resistance of the TG circuit. Relay TG operates relay TGI. Relay TGI operated operates the O, BO and FO relays in series parallel. Relay FO operated operates relays FO1 and FO3. Relay FO3 operated releases the slow release FO2 relay. Relay FO2 released, (a) opens the lock circuit for the O, BO and FO relays allowing them to release if relay TGI is released, (b) causes the RS switch to step to terminal 19, (c) opens the fundamental. Relay FO released releases the slow release FO1 and FO3 relays.

11.07 Overflow Check, Terminal 19

Ground from arc 1 operates relay FS on its secondary winding thru the DOS relay operated. Ground from relay FS operated operates relay FO2. Relay FS also transfers the fundamental circuit from the TG relay circuit to the STP and OF relay circuit and closes the non-inductive winding of relay OF around its primary winding. Relay FO2 operated completes the fundamental circuit as follows: "FT" lead, from Fig. 1 thru relay ST1 operated thru the DOS relay operated thru the proper office compensating resistance thru relay FO2 operated thru relay IA normal thru relay FS operated thru relay STP winding thru relay BO normal thru relay NO1 normal thru the primary and

tertiary windings of the OF relay in parallel to the FR lead thru relay ST1 operated to Fig. 1. In case the office test line has been selected relay STP will operate in series with the test line L relay also causing it to operate. Relay STP operated operates relay TGI thru arc 5 of the RS switch. Relay TGI operated closes ground thru relay OF normal to operate the O, BO, and FO relays in series parallel. Relay BO operated opens the fundamental which releases the STP relay and the test line L relay. Relay FO operated operates relays FO1 and FO3 which releases relay FO2. Relay STP released starts the release of slow release TGI relay. The release of relay FO2 allows the O, BO, and FO relays to release if relays TGI is released and causes the RS switch to step to terminal 20. Relay FS releases as soon as Terminal 19 is passed. As soon as the RS switch reaches terminal 20 ground from arc 1 operates relay AV. Relay AV operated, (a) locks to the ST1 relay operated, (b) transfer the winding of the STP relay to battery thru resistance CA and direct ground to condition it for future use, (c) lights the SDR lamp steady, and (d) closes the "AV" lead from Fig. 1 to the contact of the STP relay. The STP relay operates in this circuit and operates the TL relay in Fig. 1 which causes the ST and ST1 relays to release which in turn causes the revertive pulsing and steering unit to restore to normal.

The advance in case of an office overflow is the same thru TG test position as on regular operation and the RS switch advances to the next selection position to check for overflow.

11.08 Test Line Overflow, Distant Office - RS Switch Term. 19

In this case the fundamental is closed thru the STP and OF relay windings in series and the overflow reverse battery operates both relays. Relay STP operated operates relay TGI as explained in paragraphs 11.06 and 11.07 and relay OF opens the ground to TGI relay used to operate the O, BO and FO relays. Relay OF locks to relay FS operated and operates relay OF1 thru the IA relay normal. Relay OF1 operated, (a) places a supplementing ground on the RS magnet to hold it operated, (b) starts the release of slow release relay OF2, (c) supplies a ground to relay FO2 for use in operating and locking relay OF3 later, (d) closes the OF1 interrupter in part to the OFL lamp and (e) closes the OF relay lock ground to the IAL relay causing it to operate. Relay IAL operated closes ground from relay OF2 operated thru the relay OF3 normal thru relay STP operated to the O counting relay. As soon as the slow release OF2 relay is normal the circuit to the O counting relay thru the STP relay is opened which will allow the BO and FO relays to operate. Relay BO operated opens the fundamental and relay FO operated relay FO1. Relay FO1 operated (a) operates

relay FO3, (b) further opens the fundamental. Relay FO3 operated releases the slow release FO2 relay. Relay FO3 released further opens the fundamental and opens the locking ground of relays O, BO and FO and operates the OF3 relay from ground on relay OF1 operated. Relay OF3 operated, (a) removes ground from the armature of relay FO, (b) opens the emergency operate circuit for the O, BO, and FO relays used when the TFV key is operated, (c) locks to the OF1 relay operated, (d) closes the winding of relay OF2 thru the FO2 relay normal to ground on relay OF1 operated causing it to operate and (e) extends ground from the front contact of relay OF2 to a make contact of relay FO2 for operating relay O when relay FO2 operates. The release of relay FO will allow the slow release FO1 relay to release. Relay FO1 released releases the slow releases FO3 relay which will reclose the FO2 relay's operate circuit causing it to reoperate and again close the fundamental circuit. Relay FO2 operated, (a) closes the lock circuit for the counting relays, (b) closes ground from relay OF2 operated to relay O causing it to operate and (c) releases the slow release OF2 relay. Relay OF2 released removes the shunt from the BO and FO relays causing them to operate. Relay BO operated opens the fundamental. Relay OF2 released closes the interrupter thru the OF1, OF2 and OF3 operated to the OFL lamp. On the first closure of the fundamental the polar relay in the distant office operated. The operation of relay BO opens the fundamental which causes the polar relay in the distant office to release. This operation and release of the polar relay will cause the distant office to advance for trunk closure. The next closure of the fundamental when relay FO2 reoperates will cause the distant office selector to make trunk closure so that it will return to normal when the fundamental is opened the second time. The test circuit blocks with the RS switch on terminal 19 under this condition with the OFL lamp flashing as an indication of the overflow condition.

11.09 Regular Selector Overflow, Distant Office

In this case the RS switch will be on terminal 7 or 17 depending upon which type of connection is under test. In the case of the condition where the RS relay is on terminal 7 the TG test is made the same as on a regular call and the RS switch is advanced to terminal 8 which is the next selection position. In this position the OF and STP relays operate from the reverse battery. Relay OF operates relays OF1 and IAL. Relay IAL closes the O counting relay to the STP relay contact causing it to operate from ground on relay OF2 operated thru relay OF3 normal and closes ground from relay OF3 normal if key TFV is operated to provide an operate circuit for relays BO and FO in case STP is not operated long enough.

Relay OF1 operated releases slow release OF2 relay which opens the ground from the STP relay contact to allow the BO and FO relays to operate. Relay BO opens the fundamental and relay FO operates relay FO1 which operates relay FO3 which in turn releases relay FO2. Relay FO2 released releases the counting relays and operates relay OF3. Relay OF3 operated looks to relay OF1 operated and closes ground from relay OF1 operated thru relay FO2 normal to operate relay OF2. Relay FO released releases relay FO1 which releases relay FO3. Relay FO3 released allows relay FO2 to re-operate. Relay FO2 operated closes ground from relay OF2 operated to operate relay O and start the release of the slow release OF2 relay. When relay OF2 is normal the shunt is removed from the BO and FO relays causing them to operate and open the fundamental. The distant office selector operation is the same as explained in paragraph 11.08. Under this condition the test circuit will block with the OFL lamp flashing. When the DISC-1 key in Fig. 1 is operated the STR relay will release releasing the other operated relays and cause the RS switch to return to normal. If the distant office selector goes to overflow on a call to a call indicator trunk the RS switch will be on terminal 17. In this case the overflow check is made in the call indicator pulsing and steering circuit, Figure 5.

11.10 Telltale, Distant Office

The test circuit function the same in this case as on an overflow. The distant office does not, however, wait for trunk closure. The second closure made by the test circuit should be finished in this case before the office selector is normal.

11.11 Trunk Test, Incoming Selector

When the RS switch is on terminal 7, the RPl relay will operate from ground on the operated contacts of the STR relay, thru arc 3 of the RS switch, thru operated contacts of the RP relay, normal contacts of the DOS relay (Fig. B) to battery on the RPl relay winding. Relay RPl operated, (a) supplies ground for operating relay IG if one of the H numerical keys, 5, 6, 7, 8 or 9 are operated, (b) partly closes the "FT" lead, (c) closes in part circuits to the windings of relay FS, (d) closes in part circuits for operating the LO, LNO, ANO and IA relays and (e) closes circuit for operating relay FO2 thru relays FO3 and CK normal from ground on arc 1 terminal 7 of RS switch. The operation of relay FO2, (a) completes the fundamental circuit traced from T of the test jack Fig. 1 thru VMI relay normal, RS1 key, TLK1 relay normal, TST1 key operated, trunks comp keys operated. TL relay normal over lead "FT" to Fig. 3 thru relay ST1 operated thru relay RPl operated thru relays ANX, LNO, CK and LO normal thru relay FO2 operated thru relays IA and FS normal thru resistance TG thru the DOS relay

normal thru the TFV key thru either the TG or MTG relay thru the ST1 relay, "FR" lead to Fig. 1, TL relay normal trunk comp keys operated, TST1 relay operated, TLK1 relay normal RS1 key normal, VMI relay normal, to R of test jack, (b) supplies a locking ground for the counting relays, and (c) energizes the RS switch magnet thru arc 4. Under this condition the TG or MTG relay operates depending upon the position of the TFV key. Relay TG or MTG operated will operate relay TGl. Relay TGl operated will operate relays O, BO and FO thru the OF relay normal. Relay FO operated operates relay FO1 and FO3 which releases the FO2 relay. The release of relay FO2 will, (a) open the fundamental causing the TG relays to release, (b) open the locking ground of the counting relays so they can release as soon as relay TGl is released, and (c) allow the energized RS switch to step to terminal 8.

11.12 Trunk Test, 24 Volt Incoming Trunk Relays

If the TFV key is operated the MTG trunk guard relay will be used during trunk test. This relay has a non-operate requirement which prevents its operation on a trunk which has twenty-four volts on the trunk A relay. This key also closes the emergency path to counting relays required on incomings having short reverse battery periods.

11.13 Brush Selection, Incoming RS Switch Term. 8

With the RS switch on terminal 8 and the RPl relay operated a circuit is closed from ground on arc 1 of switch RS to operate relay FS on its secondary winding. Relay FS operated, (a) shunts the non-inductive winding of the OF relay around its primary winding to facilitate revertive pulsing, (b) transfers the fundamental from the TG resistance and relay, to the STP and OF relay circuit and (c) operates the FO2 relay thru the FO3 relay normal. Relay FO2 operated, (a) closes ground to lock the counting relays, (b) completes the fundamental circuit for pulsing, (c) energizes the RS magnet thru arc 4 of the RS switch. The STP relay operates in this circuit in series with the incoming L relay panel incoming or the A relay on crossbar incoming trunks. After the trunk A relay operates the circuit is functioned to substitute the terminating sender L relay for the trunk A relay in crossbar offices. The STP operated operates a counting relay from ground on relay OF2 operated thru relay OF3 normal thru arc 5 of RS switch and the operated TH numerical register key. The STP relay is released and reoperated operating the counting relays as the panel incoming selector make brush selection, or as the crossbar terminating sender registers the information. The operation of the BO relay opens the fundamental as an indication that sufficient pulses have been sent for the selection

desired and the FO relay operated operates the FO1 relay. Relay FO1 operated operates the FO3 relay. Relay FO3 operated releases the slow release FO2 relay. Relay FO2 released allows the RS switch to step to terminal 9 and releases the operated counting relays. Relay FO released allows the slow release FO1 and FO3 relays to release.

11.14 Group Selection, Incoming RS Switch Term. 9

When relay FO3 is released from the previous operation, relay FO2 will reoperate, the RP1 and FS relays being operated to close the fundamental for incoming group selection. This selection is made the same as incoming brush except that terminal 9 and the contacts of the IG relay are included in the counting circuit. The IG relay being operated or normal depending upon which key in the hundred H numerical register keys is operated. The BO and FO relays operate as before opening the fundamental and causing the FO1 and FO3 relays to operate and relay FO2 to release which moves the RS switch to terminal 10. If the TFV key is operated relay DF operates in parallel with the primary winding of relay FS thru arc 1 and the RP1 relay operated. Relay FS holds or reoperates under this condition. Relay DF closes a path thru the DF and DF1 resistance (25,500 ohms) across the fundamental under control of the slow release FO3 relay operated. This path is necessary to discharge the fundamental cable loop before final brush selection and must be closed a minimum of 50 milliseconds. If it is desired to increase the incoming group selection pulses by five, operate the HF key. This key is operated only when testing troubles on incoming trunks common to two office units and a channel check is required on the second unit.

11.15 Brush Selection, Final-RS Switch Term. 10

When the slow release FO3 relay is again normal the fundamental discharge path is opened and relay FO2 reoperates to energize the RS switch magnet and closes the fundamental for the final brush selection. Final brush selection is made the same as incoming brush selection except that terminal 10 of arc 5 of the RS switch and the H numerical register keys from the counting relay circuit. The counting relays and BO and FO operate, as explained before operating relays FO1 and FO3 causing relay FO2 to release and advance the RS switch to terminal 11.

11.16 Tens Selection Final-RS Switch Term. 11

On terminal 11 final tens selection is made. Relay FS holding circuit is again transferred to its secondary winding. Relay FO2 reoperates to close the fundamental and

energizes the RS switch magnet. The counting relay circuit in this case includes terminal 11 arc 5 of the RS switch and the T tens row of numerical register key. The release of relay FO2, after the counting relay function is complete, allows the switch to advance to terminal 12.

11.17 Units Selection Final-(RS) Switch Term. 12

Relay FO2 reoperates as soon as the slow release FO3 relay is normal to start final units selection. In this selection the counting relay circuit is thru terminal 21 of arc 5 RS switch and the U units row of numerical register keys. At the completion of the selection the operation of relay FO operates relay FO1 and FO3 which in turn releases relay FO2 the same as stated for the other selection. Relay FO2 released releases the counting relays and allows the RS switch to step to terminal 13.

11.18 Overflow or Teletale, Incoming Selector RS Switch Term. 8, 9 or 10

During selections reversed battery may be received due to an overflow or teletale. Under these conditions the OF relay which is in series with the STP relay will operate. The OF relay operated (a) locks to ground on relay FS operated and operates the OF1 relay thru relay IA the slow release OF2 relay, (b) operates relay IAL from ground thru relay OF operated, (c) supplies a ground for holding the RS switch, (d) closes in part the OF1 interrupter to the OF1 lamp and (e) supplies a ground relay FO2 for operating and locking relay OF3. Relay IAL operates closes the 0 counting relay to the STP relay contact causing relay 0 to operate if STP relay is not operated long enough and closes a ground from relay OF3 normal thru the TFV key operated for operating the BO and FO relays. (This is for incomings having only one position reverse battery periods.) The STP operated prevents the operation of relays BO and FO. In case the STP relay was operated long enough to operate relay 0 then its release when the fundamental is opened at the selector will allow relays BO and FO to operate. On distant office overflow or teletale the fundamental will not be opened, the release of the slow release OF2 relay, started by the operation of relay OF1 will remove the shunt from the BO and FO relays allowing them to operate. Relay BO operated opens the fundamental. Relay FO operated operates relay FO1 which in turn operates relay FO3. Relay FO3 operated will release the slow release relay FO2 which causes relay OF3 to operate. The release of relay FO2 will also cause the counting relays to release. Relay OF3 operated, (a) locks direct to relay OF1 operated, (b) closes ground to hold or reoperate the slow release OF2 relay, (c) transfers the front contact of relay OF2 from the armature of relay STP to a make contact of relay FO2, (d) opens the ground

from the armature of relay FO to prevent operating relay FO1 on its next operation and (e) prepares a path to flash the OF1 lamp. The release of relays FO1 and FO3 cause relay FO2 to reoperate and close the fundamental as a trunk closure signal to the incoming attached. Relay FO2 also closed ground from relay OF2 operated thru relay OF3 operated to the O relay operating it and releasing the slow release OF2 relay. (Min. 200 milliseconds.) Relay OF2 released opens the shunt from the BO and FO relays allowing them to operate. Relay BO operated opens the fundamental. The circuit will block in this position with the OFL lamp flashing as an indicating signal. The operation of the DISC 1 key in Fig. 1 will cause the test circuit and incoming to restore to normal.

11.19 Test L Relay for False Operation on Cable Charge, Battery Cut-Off Incoming-RS Switch - Term. 13

Since this test applies directly to the panel battery cut-off incoming trunk the call must be set up on the trunk directly and not thru a distant office. The test circuit is prepared as described in paragraph 11.01 with the DOS key normal and the PRE OPR L & A RYS key operated. When the busy test circuit functions and the trunk becomes idle the RS switch will advance to terminal 7. The call will then proceed as described in paragraph 11.11 to paragraph 11.17. When the RS switch reaches terminal 3 on a test call to a panel incoming selector relay LR operates thru the RPI relay (held operated with the (PRE. OPER. A & L RYS) key operated) thru relay FO1 normal. Relay LR operated locks to the same ground by passed around relay FO1 and (a) opens the fundamental circuit, (b) closes the CK relay winding thru its continuity springs to the make contact on relay FO1 thru relay FS normal, (c) closes in part a circuit thru the LNO resistance and ANO resistance (enough resistance should be keyed into the circuit to prevent a weak L relay from operating falsely on the check condition) for later use in checking for a false operation of the L relay in the incoming trunk, (d) closes a ground for locking relay CK, (e) closes ground thru relay CK normal to operate relay FO2 which closes the counting relay locking circuit, (f) closes ground to the armature of relay FO1 for use in operating relay CK later, (g) closes the OFL interrupter thru the CK relay normal to the number 4 counting relay, for use in timing the test interval and (h) closes a supplementary ground over lead "ST1" to the No. 5 Crossbar Interrupter Circuit "ZS" option. The operate circuit of relay LC is carried thru relay FO1 normal to prevent a false operation of relay CK due to the slow release of relay FO1 after final units selection. Under this condition the fundamental being open in this circuit, the L relay of the panel incoming advance causing

the cable to be charged thru the L relay winding. The OFL interrupter operates counting relays, 4, 4', 3, 3', 2, 2', 1, 1', 0, BO and FO. During this time interval the incoming and final selectors advance and the L relay in the incoming is connected to the fundamental for incoming switch to advance to trunk closure position falsely. The operation of relay FO operates relay FO1. Relay FO1 operates relay CK. Relay CK operated, (a) locks to relay LO, (b) closes the "FT" lead thru the winding of relay CH thru the LNO resistance thru the ANO resistance to the "FT" lead, (c) opens the OLF interrupter circuit, (d) releases the FO2 relay and (e) closes a supplementary ground over lead "ST1" to the No. 5 Crossbar Interrupter Circuit, "ZS" option. Relay FO2 released, releases the counting relays including relay FO which starts the release of the slow release FO1 relay. If the L relay operated and advanced the incoming falsely the test circuit will block in this position. If the L relay did not operate falsely the current thru the winding of polar relay CH will cause it to operate (Grd. Tip & Bat. Ring.). Relay CH operated closes the ground thru relay FO1 operated to operate relay CK thru the ANO relay normal to the magnet of the RS switch causing it to energize. When the slow release FO1 relay is released the RS switch will step to terminal 14. When the RS switch leaves terminal 13 relay LR releases and releases relay CK.

11.20 Incoming Selector, Nonoperate Test of L Relay, RS Switch Term. 14

This test is made only when connected directly to the panel incoming. With the RS switch on terminal 14 ground from arc 1 will operate the LNO relay thru the RPI relay operated thru the FO1 and CK relays normal. Relay LNO operated locks to the same ground by passed ground relays FO1 and CK and, (a) closes ground thru relay CK normal to operate relay FO2, (b) closes ground to the FO1 relay for operating relay CK, (c) closes the FT lead thru relay ST1 separated thru the RFI relay operated thru the ANX relay normal thru LNO operated, thru the winding of relay CH through the LNO resistances, thru LNO relay operated thru the winding of relay CH through the LNO resistances, thru LNO relay operated to the "FR" lead thru the ST1 relay operated, (d) closed ground for locking the CK relay, (e) closed in part the circuit for operating relay CK thru its continuity contacts, (f) closed the OFL interrupter thru the CK relay normal to number 3 counting relays and (g) closes a supplementary ground over lead ST1 to the No. 5 Crossbar Interrupter Circuit, "ZS" option. The L relay of the panel incoming selector is given a nonoperate test in its incoming advance position over the "FT" and "FR" lead bridge which includes the CH relay winding. The OFL interrupter operates number 3 counting relay on its

first make period after relay LNO operates and operates the prime relay on its first open period. The balance of the counting relays 2 to 0 are operated on subsequent interruptions of OFL interrupter. This time covers one sequence switch start in the incoming selector plus misc. other relay times. Relay BO and FO are the last of the counters to operate. Relay FO operates relay FO1. Relay FO1 operated closes ground thru the LNO relay operated to the CK relay causing it to operate, and thru the CH relay if operated to the RS switch magnet causing it to energize. The CH polar relay will be operated if the L relay remained normal during the nonoperate test. (Grd. Tip and Bat. Ring of Trk.). If, however, the L relay had operated during the nonoperate current interval the incoming will be advanced to trunk closure position where the current thru the CH relay winding will be reversed causing it to remain normal. With the CH relay normal the path to energize the RS switch is open and the circuit blocks. Relay CK operated releases relay FO2 and opens the OFL interrupter circuit. Prior to this test the proper L relay nonoperate compensating resistance keys should be operated to limit the current thru the L relay as near as possible to its nonoperate test value. Key RICR-20000 is used to compensate for the repeating incoming selector L relay nonoperate except where the L relay is required to operate, in incoming advance position, in parallel with a noninductive shunt. In case tests are made of repeating incoming selectors using minimum trunk compensation, the L relay nonoperate test shall be omitted.

11.21 Incoming Advance-RS Switch Term. 15

When the RS switch reaches terminal 15 relay IA operates from ground on arc 1 thru the RP1 relay operated. Relay IA operated, (a) connects ground thru relays FO3 and CK normal to operate relay FO2, (b) closes the FT lead thru relay RP1 operated thru relays ANX, LNO, CK and LR normal thru relay FO2 operated, AV relay normal thru the windings of relay STP AV relay normal thru the BO relay normal thru relay FO1 normal thru the "PRI" and "TER" windings of relay OF in parallel to FR lead thru relay ST1 operated, (c) prepares the operate circuit of relay IAI, (d) supplies a lock ground for relay OF and (e) closes the "Ter." winding of OF relay in parallel with its "PRI." winding. The incoming L relay and the STP and OF relay operate in this reversed battery fundamental circuit. The operation of the incoming L relay causes the incoming to advance to the trunk closure position. Relay OF operated locks to relay IA operated and operates the IAI relay.

Relay IAI operated closes the ground from OF2 operated thru relay OF3 normal thru the STP relay operated to the 0 counting relay, and closes ground from relay OF3 normal thru the TFV key operated for operating the BO and FO relays if the STP is not operated long enough to operate relay 0. This path is only needed on incoming trunks that give a short reverse battery period and is under control of the TFV key. The IAI relay has a sequence contact arrangement which insures that the ground thru the STP relay will close first. When relay STP releases due to the fundamental being opened at the incoming as it advances to trunk closure the shunt is removed from the BO and FO relays, allowing them to operate. Relay BO opens the fundamental circuit and relay FO operated operates relay FO1 and FO3. Relay FO3 operated releases relay FO2. Relay FO2 released holds the fundamental open, allows the RS switch which was energized when FO2 operated to step to terminal 16.

11.22 Test of A Relay for False Operation Battery Cut-Off Incoming. RS Switch Term. 16

This test is made only when the test circuit is connected directly to this incoming. With the RS switch on terminal 16 a ground is closed thru relay RP1 held operated, thru relay FO1 normal to operate relay ANO. Relay ANO operated, (a) locks to its operate ground by passing around relay FO1, (b) operates relay ANX (c) opens in part the 0 relays locking circuit leaving it under control of 8 relay, (d) closes ground from relay FO2 operated to the armature of relay CH, (d) closes the contact of relay CH to 9 counting relay and (e) opens the circuit between the contact of 8' and the armature of 7' relay. Relay ANX operated (a) closes ground thru the FO3 and CK relay normal to operate relay FO2, (b) closes the "FT" lead thru relay ST1 operated thru relay RP1 operated thru the ANO resistances thru the LNO resistances thru the windings of relay CH to the ANO key. (The ANO key being normal this circuit is not completed) (c) closes the winding circuit of 7 counting relay to the OFL interrupter and (d) transfers the armature of relay FO from direct ground to ground thru the PRE. OPR. A & RYS. key operated. Under this condition the OFL interrupter operates in sequence the 7, 6, 5, 4, 3, 2, 1 and 0 sets of counting relays. This time covers the elevator return to normal of the final selector plus three sequence switch starts, one in the final selector and two in the incoming selector. Relay FO operated, operates the FO1 relay which in turn releases relay FO2. Relay FO2 when operated energized the RS magnet thru arc 4 and closed the lock circuits of the counting relays. Relay FO2 released, allows

the RS switch to step to terminal 17 and releases the counting relays. Relays ANO, ANX and RPl release as the RS switch leaves terminal 16. In case of a failure the incoming will be returned to normal falsely. When the TL relay in Fig. 1 operates and closes the circuit to the supervisory Fig. 4 the L relay of the incoming will be across the tip and ring lead and should not operate, thus the failure to receive supervisory flashes will be an indication of failure.

11.23 Circuit Restores to Normal

Position 17 is a pass-by position on all tests except a test of a P.C.I. trunk thru a distant office. Positions 18 and 19 are passed by if the DOS key is normal or if the DOS and RPl keys are both operated. On terminal 20 ground thru arc 1 operates relay AV. Relay AV operated, (a) locks to the ST1 relay operated, (b) changes the SDR lamp from 120 IPM flash to steady and (c) transfers the winding of relay STP from the fundamental to ground and battery thru resistance AN. This is done to condition the STP relay for future use. Relay STP operated closed ground from relay OF2 operated thru relay OF3 normal thru relays AV and FT1 operated to the "AV" lead. Ground on the "AV" lead to Fig. 1 operates relay TL and causes it to transfer the fundamental to the supervisory Fig. 4 and opens the "ST" lead. The "ST" lead open releases relay STR. Relay ST released, releases ST1 relay and causes the OF2 and the counting relays, or the OF1 relay if operated to release. Relay ST1 also closes ground to the brush of arc 2 of the RS switch causing the switch to return to normal by self-interruptions.

11.24 Rapid Advance of RS Switch

In case both the ANO and PRE. OPR. A & L RYS. keys are normal when a test is made the RPl relay will release on terminals 13, 14 and 16 and the RS switch will be advanced thru terminals 13 and 14 by ground on the PRE. OPR. A & L RYS. key normal thru arc 6, thru terminal 16 by ground from key ANO normal thru arc 6.

11.25 Non-Operate Test of a Relay Crossbar or 24V Panel Incoming - Test Call to Busy Lines - RS Switch Term. 16

This test is made with the test circuit connected directly to the incoming whose A relay is to be tested. Set the TH, H, T and U numerical register keys to select a busy line. The ANO key will be operated in making this test. After selections are completed, the RS switch advances to terminal 13. Ground from the PRE. OPR. A & L RYS. key normal thru arc 6 or RS switch advances the RS switch to terminal 15 where incoming advance is made the same as explained in paragraph 11.21

which causes the switch to step to terminal 16. On terminal 16 relay RPl is held thru the ANO key and RP relay operated. Under this condition ground from arc 1 operates the ANO relay thru the RPl relay operated when relay FO1 is normal. Relay ANO operated, (a) locks to its operate ground by passed around relay FO1, (b) operates relay ANX, (c) opens in part the O relay's locking circuit leaving it under control of 8 relay, (d) closes ground to the armature of relay CH from relay FO2 operated, (e) connects the contact of relay CH to 9 counting relay winding and (f) opens the circuit between 7 relay and 8' relay. Relay ANX operated, (a) closes the fundamental as follows "FT" lead thru ST-1 relay operated thru the RPl relay operated thru relay ANX. operated thru the A relay non-operate resistance thru relay ANX thru the L relay non-operate resistance thru the winding of relay CH thru the ANO key operated thru the ANX relay operated thru the ST1 relay operated to the "FR" lead, (b) closes the winding of 7 relay to the OFL interrupter, (c) closes a ground to relay FO3 for operating relay FO2 thru relay CK normal and (d) transfers the circuit on the armature of relay FO from ground to the make contact of relay 9 thru the PRE. OPR. A & L RYS. Under this condition the CH relay operates in series with the trunk A relay and the A relay non-operate resistance, causes the 9 counting relay to operate and closes ground from relay FO2 operated thru relay ANX operated thru OF3 normal to the armature of relay FO. This arrangement checks on the operation of the CH and 9 relays. The OFL interrupter will cause the 7, 6, 5, 4, 3, 2, 1 and 0 counting relays to operate in sequence. The FO relay operated operates relays FO1 and FO3 which releases relay FO2. Relay FO2 when operated energized the RS switch magnet thru arc 4 and closed the lock circuits of the counting relays. Relay FO2 released allows the RS switch to step to terminal 17 and releases the counting and the FO1 relay. Relays ANO, ANX and RPl release as the RS switch leaves terminal 16. If the A relay in the incoming trunk should operate on its non-operate test current during the counting interval, the incoming circuit will advance and close the busy line signal to the test circuit. The busy line signal will cause interrupted reversed battery to be connected to the CH relay causing it to release and reoperate. Relay CH operated causes the 9 counting relay to operate. The release of relay CH will allow the shunted 9' relay to operate and the next reoperation of relay CH will operate relay 8. Relay 8 operated opens the operating circuit of relays BO and FO thus preventing the operation of relay FO1. Under this condition the circuit will block. The time counted in this case is based on a busy line number on which the incoming selector does not have to wait on a pickup interrupter before advancing to the ringing position.

11.26 Advance for P. C. I. Thru Distant Office, Figs. B and D with ZI Option

The RS switch in this case is advanced from terminals 7 to terminals 12 and 15 by ground thru the RP relay normal thru arc 6 and thru terminals 13, 14 and 16 by ground thru keys ANO and PRE. OPR. A&L RYS. normal. When the RS switch reaches terminal 17 ground from arc 3 thru the DOS class key operated is closed to the "CIG" lead to the call indicator pulsing Figure 5, to operate the CI relay when either the PCID or PCIT class keys are operated.

12. TESTING P. C. I. TRUNKS, FIG. 5 AND "ZG" OPTION

12.1 Preparation

Calls may be made to panel call indicator terminations as follows:-

- (a) Four or five digits, panel call indicator pulsing direct to panel call indicator. The digits would consist of TH, H, T and U for four digits. The STA depressed if required would be the fifth digit. The PCID key is operated in addition to the numerical register key depressed.
- (b) Two digits revertive pulsing thru distant office, consisting of the distant office brush and group selections. These two digits would be set up by depressing a key in the TAN T and TAN U rows for the distant office brush and group respectively. The next four or five digits as required can be pulsed with PCI pulses to the panel call indicator on the trunk. The DOS and the PCID keys are operated for this type of call in addition to the register keys depressed.
- (c) Six or seven digit, PCI pulsing thru Sender Tandem or Tandem PCI trunks. The six digit would consist of the TAN, T, TAN, H, TH, H, T and U for six digits and with the STA digit for seventh digit. The PCIT key is operated in addition to the register keys depressed.
- (d) Seven or eight digits PCI pulsing thru Sender Tandem or Tandem PCI trunks. The seven digits would consist of the TAN H, TAN T, TAN U, TH, H, T and U with the STA key depressed for seven digits. The PCIT key would be operated in addition to the register keys depressed.

The trunk compensation keys are operated in addition to the register keys and either the PCID or PCIT keys as described above. The trunk test jack is then patched to the test circuit test jack, the TST1 key operated and the busy test is made as described in paragraphs

6.01 and 6.02. When the PCID key is operated it operates relays PCI and PCID. When the PCIT key is operated it operates relays PCI and PCIT. The operated PCI relay transfers one contact on Keys 3, 5, or 7 of the "TH" row and one contact on Keys 6, 7 or 8 of the "H" row from use in revertive pulse tests to use in PCI tests. The transferred contact is thereby made available for use in closing a circuit to operate relay PR in the PCI pulse periods required by the Key depressed. When the PCI pulsing feature is required only for PCI direct trunks the T, W and Z options are wired. When in addition to pulsing 5 digits PCI direct it is required to pulse 3 digits tandem PCI the V, W and Z options are wired. When 5-digits PCI direct is required and 2 digits for PCI tandem the V, Y and X options are wired. The operation of the PCID relay operates relay RPCI, Fig. D, and will cause the CI switch to advance to terminal 7 if it is not already on terminal 7. The operation of the PCIT relay for three digit tandem will advance the CI switch to position 1. The operation of the PCIT relay for two digit tandem will advance the CI switch to terminal 3. This gives the CI switch three different start positions 1, 3 and 7. When the busy test circuit has functioned and the trunk is idle the ground on the ST lead from Fig. 1 to Fig. 3, to Fig. D, will operate the STR relay in Fig. 3. The operation of the STR relay in Fig. 3 will close ground thru the RPI relay and DOS keys normal if Fig. B is used, over CIG lead from Fig. A or B thru the PCID or PCIT relay operated thru arc 6 of CI switch to the winding of relay CI causing the CI relay to operate.

12.02 Panel Call Indicator Direct Trunks Class Key PCID Operated

The operation of relay CI explained above also, (a) opens the return to normal ground for switch CI, (b) closes ground for locking relay CI and for operating relay CG2 thru relay CG1 for later use, (c) closes the fundamental tip thru relays OFZ and OFY normal thru the windings of relays CG and OFC thru relay CII normal to the "FR" lead, (d) closes ground thru relay OFC normal to operate relay CII when relay CG1 operates, (e) closes ground thru relay SP normal to cause the PGC relay to operate towards its back contact and (f) closes the PGI relay to the back contact of relay PGC. Relay PGC is carried to this contact for test purposes only. The CG relay operates in series with the OFC relay and the call indicator trunk A relay. The trunk A relay and relay CG operate in this circuit and relay CG operates the slow release CG1 relay. Relay CG1 operated, operates the CG2 relay from ground on relay CI operated. Relay CG2 operated, (a) prepares the circuit for

holding the CG relay in the fundamental circuit after relay CII is operated, (b) closes ground from relay CI operated thru relay OFC normal to operate CII relay, (c) connects the SDR lamp to the SDR interrupter, Figure 1, (d) closed a holding circuit for relay CG1 thru relay OFX normal to the GII relay normal and (e) opened the operate circuit of relay SP. Relay CII operated, (a) locks to relay CI operated, (b) prepares relay PGC for pulsing, causing it to operate relay PG1 thru the PG3 and FP1 relay normal, (c) supplies ground for locking relays PG2 and PG3 and ground to the armature of relay PGC. This ground is used for operating relay SP when CG2 relay releases, (d) closes ground to the brushes of arcs 1 and 2 of the CI switch for use in operating the PR, PT, 1-2 and 3-4 relays thru the register keys which were previously operated, (e) transfers the fundamental leads on a continuity basis to hold the CG relay circuit closed thru relay CG2 operated, (f) transfers the hold circuit of slow release relay CG1 on a continuity basis from its break contact thru the SP and PG2 relays normal, and (g) closes the operate circuit of relay PG2 to the PG1 relay. Relay PG1 operated operates relay PG2. This circuit waits for the call indicator pulsing loop to be substituted for the trunk A relay battery and ground in the PG1 trunk. When the fundamental leads of the trunks are connected to the control circuit the battery and ground thru the trunk (A) relay is removed and the PG1 control circuit bridge relays are substituted. Under this condition the CG relay releases and if the PG2 relay is operated at this time relays CG1 will also be released. Relay CG1 released releases relay CG2. Relay CG2 released, (a) transfers the "FT" and "FR" leads from the trunk test relay CG circuit to the pulsing circuit thru relay FP normal (b) opens the CII relay operate circuit, and (c) operate the SP relay to ground on relay CII operated. Relay SP is the pulse start relay and causes the pulsing relays PB, PG1, PG2 and PG3 to function to send out the call indicator pulses over the fundamental leads to the PCI control circuit in the distant office. Relay SP operated also, (a) supplies ground for energizing the CI switch thru the PG1 and FP1 relays normal, (b) closes ground from relay CII operated thru the PG1 relay operated to operate relay GR and (c) closes in part the circuit to operate the AV relay, figure 3 "S" wiring. Before relay SP operates the relays in the pulsing circuit are as follows: Relays PG1, GR and PG2 are operated, relays PG, PG3, PT and PR are normal.

12.03 Pulse Timing

When relay CI operates it causes relay PGC to operate to its back contact. The operation of relay SP connects the front

contact of relay PGC to the BC resistance to battery and to the negative side of primary winding and the positive side of the secondary winding of relay PGC. This is to prepare the circuit for releasing PGC after it is operated. This transfer also removed the circuit which causes relay PGC to operate towards its back contact. Under this condition ground from relay CII operated shunts battery thru resistance BH and starts to operate relay PGC or the primary winding, at the same time the E condenser discharges thru the secondary winding of relay PG to cause it to be slow operate. Under this condition the current thru the primary winding of relay PG is tending to operate it while the condenser discharge current thru its secondary winding tends to hold it on its back contact. When condenser E is discharged to the point where the current thru the secondary winding is low enough relay PGC will operate on its primary winding. As soon as relay PGC is operated ground from CII relay is connected to shunt resistance BC to reverse the current in its primary winding. This starts the release cycle of the PGC relay. Relay PG1 releases when relay PGC operates. The retarding of the operate and release of relay PGC due to the condenser current gives the proper pulse timing. Relays PGC and PG1 will continue to operate and release as long as the CII and SP relays are operated.

12.04 Pulse Counting and Steering

The PG1 relay operated operates the PG2 relay thru relay CII operated. Relay PG1 operated and relay CG2 normal starts the first pulse out over the fundamental. The first pulse period, with the CI switch on terminal 7, may be open or it may be a light positive pulse, ground on "FR" lead and high resistance battery on the "GT" lead, depending upon the stations register key operated. Ground from the CII relay operated is supplied to the brushes of arcs 1 and 2 of the CI switch, thru terminal 7 of each arc to the stations register key. In case the key depressed is a code requiring a positive pulse in first period a circuit will be closed by the key from ground thru terminal 7 to operate relay PT. Relays PT and PR may also be operated as a result of relay 1-2 being operated by the station key and when operated in this way the PT relay is operated in the first pulse period and the PR relay in the second pulse period thus causing a positive pulse to be sent in the first period and a heavy negative pulse in the second period. The first pulse is ended when relay PG1 is released as a result of the PGC relay operating. The release of relay PG1 starts the second pulse period of the stations digit and energizes the CI switch magnet. The second pulse period, as shown by the pulsing chart on the drawing, can either be a light or a heavy

negative pulse, i.e., battery on the "FR" lead and ground on the "FT" lead and, depends upon which station key is operated. The PR relay is always operated when a heavy negative is to be sent. When relay PGC releases the next time, relay PGI operates and CI switch steps. The terminals are strapped stagger fashion on the CI switch so that if one of the control relays PT, 1-2 or 3-4 are operated, for use in the pulse period which obtains when the switch steps they will remain operated thru the bridging brushes and terminals. Relay PR however, is carried thru arcs 4 and 5 in such a way that the PR can only operate on the even terminals if relay PG2 is normal and on the odd terminals if PG2 relay is operated. This arrangement is to prevent the possibility of a false heavy negative pulse at the time the CI switch is sampling the digit ahead. The third pulse period starts when the PGI relay operates and may be an open or a light positive pulse as in the first pulse period. The CI switch will step to terminal 8 keeping closed the circuit to the PT relay if it is operated. At the end of the third period relay PGC operates and releases relay PGI for the fourth pulse period, and to energize the CI magnet. The fourth pulse period may send a light or a heavy negative pulse the same as period two. At the end of the fourth period relay PGI is again operated allowing the CI switch to step to terminal 9 for the first pulse period of the thousands digit. Each digit has four pulse periods and the CI switch steps at the beginning of the first and third pulse periods except the first period of the first digit in a train of pulses.

12.05 Heavy Positive Pulse, "S" Option

When the last pulse of the pulse chain is sent the CI switch steps to terminal 17 where ground from relay CII operated thru, the brush of arc 1 CI switch is closed to operate relay FPI. Relay FPI operated, a locks to relay SP operated, b opens the high resistance battery used for light negative pulses, c opens the CI magnet energizing path, and d closes the ground thru back contact of relay PGI used to step the CI switch, to the winding of relay FP. The PGI relay operates to allow the CI switch to step to terminal 17 and is operated during a pulse period to give an open pulse before relay FP is operated. At the end of this period relay PGI releases causing relay FP to operate. Relay FP operated, a opens the circuit to relay PGI, b closes the "FT" lead to the low resistance battery, c closes the "FR" lead to ground on relay PGI normal, and d closes in part a path to operate relay AV over lead "AV" in the revertive pulsing, figure 3. At the end of the pulse period relay PG2 is released closing ground from relay CII operated, thru relay SP operated thru the FP relay operated over

the "AV" lead to operate relay AV in figure 3. Relay AV operated in the revertive pulsing figure 3, will function to cause ground to be closed to the "AV" lead to the TL relay of the connector figure 1 causing it to operate. The operation of the control TL relay causes the STR relay in the revertive pulsing figure 3 to release and transfers the fundamental leads to the supervisory figure 4. The release of relay STR, a opens the operate circuit of relay CI causing it to release and b releases relay CII, c closes ground to the brush of arc 3 CI switch to cause it to return to position 7. The transfer of the "FT" and "FR" leads terminate the heavy positive pulse. Relays CI and CII released restore the pulsing circuit to normal. Relay CII also a releases relay SP, b opens the circuit thru arcs 1 and 2 of the CI switch used to operate relays PR, PT, 1-2 and 3-4, c opens the operate circuit of the PG2 and PG3 relays, and d removes grounds from the "AV" lead. Relay SP released, releases relay FPI and completes restoring the pulsing circuit to normal.

12.06 No Heavy Positive Pulse, "R" Option

In this case relay FPI operates to close the ground which is used to operate the FP relay to the winding of relay AV over lead "AV" in figure 3. On the release of relay PGI, the CI switch steps to terminal 17 and closes the circuit to operate the AV relay. Relay AV locks and causes the circuit to restore to normal as explained above in paragraph 12.05.

12.07 PCI Tandem or Sender Tandem Trunks - Class Key PCIT Operated

In this case the operation of the PCIT class key will operate the PCIT relay which will cause the CI switch to step to terminal 1, for three tandem digits or to terminal 3 for two tandem digits. This circuit is traced from ground on relay CI normal thru arc 3 brush and terminal 7 thru the PCIT relay thru the CI switch interrupter contact to the magnet, causing it to step off terminal 7 which is the direct call indicator start position to terminal 1 with Z wiring or terminal 3 with Y wiring. On tandem calls three extra sets of pulses, the tandem hundreds TAN H, tandem tens TAN T, and the tandem units TAN U, may be sent before the pulses for the numerical digits. The circuit advances and releases the same as explained above for direct call indicator. In a two digit area where three digits are used for tandem operation, the key set up of tandem keys should correspond to the digits that are sent out by the subscriber's sender to the tandem call indicator and sender tandem offices.

12.08 Discharge of Cable Between Pulses

At the beginning of the first and third pulse periods if a positive pulse is not to be sent, PT relay normal, ground is connected to the "FT" lead from relay GR normal thru relay FT normal. This ground is maintained until relays PGI and GR operate which they do in cascade at the end of the second and fourth pulse periods. Relay PGI in operating closes ground to the "FR" lead and the combination of the GR normal ground on the "FT" lead and the ground on "FR" when relay PGI operates gives a ground period on both sides of the fundamental which will discharge the cable and thus prevent a false operation of the SN+ relay in the call indicator control circuit. This ground period occurs from the time springs 1T and 2T or 1B and 2B of relay PGI make contact until 1 and 2T of relay GR are opened.

12.09 PCI Overflow Test Thru Distant Office

Relay CI will operate in this case from ground on arc 3 of the RS switch in the revertive pulsing figure 3, thru the DOS key, over lead "CIG". Relays CG and OFC will operate in series in this case as the battery will be reversed. Relays CGI and CG2 will also operate as on a regular call indicator trunk test but relay OFC being operated opens the operate ground for relay CII. This prevents the CI pulsing circuit from starting. Relay OFC in operating locks to the CI relay operated and operates relay OFX thru relay CII normal. Relay OFX operated, a locks to the CI relay operated thru relay OFC operated, b closes ground thru relays OFX normal to start the "P.C.I." impulser, c closes the PG2 and PG3 relay operate path, d short circuits the CG relay winding to reduce the resistance of the circuit to insure operating the distant office polar relay and e closes the windings of relays OFY and OFZ to terminals 9 and 11 respectively of arc 6 CI selector. Under this condition the condenser timed interrupter functions to operate and release the PGC and PGI relays which steps the CI switch to terminal 9 where relay OFY operates to open the fundamental to allow the distant office polar relay and associated relays to release. The impulser continues to step the CI switch and the OFY relay releases when the brush leaves terminal 9 to close the fundamental for trunk closure. When the CI switch reaches terminal 11 relay OFZ is operated thru relay OFX operated. Relay OFZ operated again opens the fundamental, stops the impulser and lights the OFL lamp as an indication of an overflow or Telltale of the two-wire office selector. When the disconnect key in the connector Fig. 1 is

operated the circuit will function to release the CI relay which in turn will release the OFC, OFX and OFY relays and cause the CI switch to return to its normal position 1, 3, or 7.

12.10 Pulsing Numbers Over 10,000

If it is desired, to send pulses for numbers 10,000 or above, the 1 Key of the stations row will be operated. There will never be a number of 10,000 or over which will also have a party designation. If the number desired is not a party line or a number 10,000 or above then no key in the station row need be operated. If no key is operated in the stations row the circuit will function to send an open in the first and third periods and a light negative pulse in the second and fourth periods.

12.11 Misc. Conditions

Relays PG2 and PG3 are used to steer the PR and PT relay circuit to the proper pulse periods.

Relays 1-2, 3-4 and PCI are used to multiply the circuits from the numerical register keys to the PT and PR relays due to the lack of contacts on certain register keys.

Jack PGC is provided for making current flow tests and per cent make break tests of the PGC relay.

13. TESTING MULTI-FREQUENCY PULSING TRUNKS

13.01 WINK Start Pulsing Signal

A WINK start pulsing signal is given when a trunk is seized with ON HOOK called subscriber supervision. The polarity of the trunk is changed to OFF HOOK supervision when the sender is seized and changed back to ON HOOK supervision when the sender is ready to receive impulses.

The WINK type of pulsing signal is also used in a number of cases by trunks working with an originating sender that is arranged to receive a DELAY DIAL pulse start signal. In these cases the originating sender introduces a time delay sufficient for the ON HOOK trunk supervisory signal to travel to the distant end of the trunk and to return before the sender recognizes the trunk. This test circuit, however, checks the normal ON HOOK polarity of the trunk as well as the stop dial receiver OFF HOOK polarity of the trunk imposed while it is looking for a sender and continuing until the sender is ready to receive pulses. This signal is functionally the same as the WINK start pulsing signal except that the OFF HOOK signal is given by the No. 4A

Intertoll or Tandem Incoming Trunk Circuit and is of a slightly longer duration than that of the WINK signal described above. The OFF HOOK signal is changed to ON HOOK supervision when a sender is seized and ready to receive impulses. The preparation of this circuit for testing trunks that give this type of signal is the same as hereinafter described for the WINK start pulsing signal.

13.011 Preparation

13.012 Two-Wire Trunk

The number to be called is depressed on the Register Keys in Fig. 2. Operate the TRUNK COMP RES 0 key in Fig. 1. The required A RY OPR COMP RES keys in Fig. 4 are operated to compensate up to the operate value of the trunk A relay. Operate the MF and TST keys. The test circuit test jack is then patched to the trunk test jack, and the busy test is made as described in paragraphs 6.01 and 6.02. When the busy test circuit has functioned and the trunk is idle a ground is put on the ST lead to Figs. 3, 5, 7, and D. When the MF key was operated relay MF operated. When the MF relay operates it (a) opens the "T2" and "R2" leads to the telephone circuit, (b) places 1200 ohms in parallel with the input side of the TST repeating coil across the "PT" and "PR" leads from the MF current supply, (c) closes thru in part the operate path of the RO relay in Fig. 4, and (d) operates the MF1 relay. The MF1 relay operated, (a) connects the MF resistance network to the pulse generator in Fig. 6, (b) removes the 600 ohm ground from the MF condenser and connects the MF condenser in parallel with the PG condenser for MF pulsing, (c) closes thru the PGA relay operate path to the P relay in Fig. 6 for pulsing, (d) closes the ST lead path to operate the PON relay in Fig. 8, and (e) closes thru the path to operate the TL relay in Fig. 1 when the PON relay operates. The TL relay operated closes thru the tip and ring from the test jack to the supervisory relays. The DPL -GO key normal arranges the supervisory relays to check for a WINK start pulsing signal. When the PON relay in Fig. 8 operated it, (a) closed a ground to operate the TL relay in Fig. 1, (b) operated the FDP relay in Fig. 1 to remove the momentary open check feature during pulsing, c - closed a ground to the pulse generator to close its 4 and 7 contacts (PG relay in Fig. 6), d - closed a ground to the MF resistance network for MF pulsing, e - closed a ground to operate the FDS relay, f - closed a locking ground for the RO relay in Fig. 4, g - closed a ground to lock the SU-1 and RB relays in Fig. 4, h - closed a ground to the contacts of the P relay in Fig. 6 for operating the PGA relay during pulsing, j.- provides a ground to lock the SG relay in Fig. 6. The FDS relay operated, a - removes the short circuit from around the 2700 ohm

MF network resistance to increase the time of the KP pulse, b - opens the operate path of the RO relay, c - closes thru its locking ground to a path to operate the next steering relay whose register key is operated, d - operates the FDS1 relay in Fig. 9, e - closes thru a path to start the pulse generator for delayed closure time when automatic dial pulsing is provided.

13.013 Four-Wire Trunks

The number to be called is depressed on the register keys in Fig. 2. Operate the TRUNK COMP RES 0 key. The operation of the TRUNK COMP RES key will close the tip and ring leads between Figs. 1 and 17 and thereby satisfy the test circuit, but this key is chosen to check the continuity of all of the trunk compensation resistors in the test set. Operate the MF and MF4W or EM4W keys. The operation of A RY OPR COMP RES key is not required since the tip and ring leads are closed through the normal contacts of these keys. The DPL key is normal if a WINK start pulsing signal is expected. The test circuit test jacks, T and R are patched to the trunk test jacks and the TST1 key is operated. For four-wire MF pulsing trunks, REV BAT SUPV, the operation of key MF4W operated relay MF4W which closes the sleeve "S" lead of the trunk through for busy test. Relay MF4W closes battery and ground to light lamps T1, T, R1, and R to indicate that relays TT1, TT, TR1, and TR respectively, are normal. Key MF operated relay MF and key TST1 operates relay TST1. When the trunk is idle and the busy test circuit has functioned it will close ground to lead "ST" operating relay CI4W to cut in the four-wire trunk. Leads "T1" and "T" are connected through the windings of polarized relays provided for testing leads "T1" (relay TT1) and "T" (relay TT). These two polarized relays are connected in series and in reverse polarity. Likewise leads "R1" and "R" are connected through polarized relays provided for testing leads "R1" (relay TR1) and "R" (relay TR). These relays are also connected in series and in reverse polarity, thus enabling the test circuit to make a test of leads "T1", "T" and "R1" and "R" for continuity, polarity and cross with battery or ground.

Assume the trunk is free from trouble and is poled to give a WINK start pulsing signal. Under this assumption relays TT1 and TR1 will operate when relay CI4W operates and extinguish lamps T1 and R1. Lamps T and R will remain lighted. Battery and ground of the same polarity as the trunk circuit battery and ground is closed by the operation of relays TT1 and TR1 to cause relay SU (Fig. 4) to operate. If the trunk conductors are reversed, relays TT and TR will operate and operate relay SUR (Fig. 4) which, in turn, will operate relay RO. The operation of relay RO closes ground through

interrupter OFL to lamp OFL to give a flashing visual signal as an indication that the trunk is reversed. If the trunk is open lamps T1, T, R1 and R will remain lighted. If the trunk is crossed with battery or ground the location of the cross will control the visual signals received.

If we assume the trunk is free from trouble and is poled to give a DELAY DIAL start pulsing signal relays TT and TR will operate and extinguish lamps T and R. Lamps T1 and R1 will remain lighted. Although battery and ground of the same polarity as the trunk battery and ground is closed by the operation of relays TT and TR, this polarity is reversed by key RS1 (which is operated when the DELAY DIAL start pulsing signal is expected) to cause the test circuit to function as described above for the WINK start pulsing signal. In other respects the circuit operates as described above under Paragraph 13.012 for two-wire trunks.

For four-wire MF Pulsing E&M lead signaling trunks, the operation of key EM4W operates relay EM4W when the busy test is completed and the ST lead from Fig. 12 has been grounded. Relay EM4W operates relays EMX and EMX1 to prepare for the cut-in of the leads from the trunk. Relays EMX and EMX1 are arranged to furnish a standing test on the trunk leads so that if they become crossed to battery or ground an alarm is sounded by relay AL. The operation of relays EMX and EMX1 removes the AL relay from the trunk leads in preparation for testing. In addition, relay EMX1 operates slow release relay ALG which is provided to perform the following function: to allow time at the disconnection of the test call for stabilization of cable capacitance potential on the leads thus preventing false operation of the alarm relay. When relay EMX operates it grounds lead RA to Fig. 1 which connects to the ring of the test jack T- and thence to the ring of the trunk test jack to operate the test cut-in relay in the trunk. The EM4W key also prepares a potentiometer arrangement to provide -24 volts for the TT and TT1 relays so that they may detect the presence of either -48 battery or ground on the M lead. In other respects, the circuit operates as described in Paragraph 13.012 for two wire trunks. The T ON, R ON, T1 OFF and R1 OFF lamps are lighted by the operation of relay EMX and function to indicate the condition of the trunk. Thus if the trunk is idle and available for testing, the T ON lamp will remain lighted to indicate the outgoing trunk is ON-Hook because the TT1 relay operates to ground on the MD lead extinguishing the T1 OFF lamp; and the R ON lamp will be lighted as long as the incoming trunk remains ON-Hook. Relay EL will follow the supervision of the distant incoming trunk and function the R ON and R1 OFF lamps accordingly. Provision is made for checking the drop side of the E&M leads; the trunk

can be seized via the Automatic Test Circuit and then this test circuit can override the busy condition and get access to the trunk. In this case, the TT and TT1 relays would find battery on the M lead to light the T1 OFF lamp (off-hook). Operation of the EM key puts ground on the E lead (drop side) allowing a check on the signaling between the AOTCT and the O.G.T. TST circuits.

13.014 Trunk Polarity Test

When the TL relay in Fig. 1 operates it closes thru the tip and ring from the test jack for two-wire trunks as follows - tip of the test jack, thru the VM1 relay normal, thru the RS1 key normal, thru the TLK1 relay normal, thru TST1 relay operated, thru the TRUNK COMP RES keys operated, thru the TL relay operated, thru the FDP relay operated, DP relay normal (Fig. 10) thru the R± relay normal, thru the TST repeat coil, over T lead to supervisory test figure 4, thru the A RY OPR COMP RES keys thru the SU and SUR relays polar supervisory relays, over the R lead to Fig. 1, thru the TST repeat coil, thru the R± relay normal, thru the FDP relay operated, thru the TL relay operated, thru TRUNK COMP RES keys operated, thru the TST1 relay operated, thru the TLK1 relay normal, thru the RS1 key normal, thru the VM1 relay normal, to the ring of the test jack. This path is traced the same for four-wire trunks except that test jack T1 is not used. For four-wire REV BAT trunks the operation of relay CI4W closes the test circuit thru to the test T and R jacks which are patched to jacks T and R on the test and make busy frame and the TT, TT1, TR, and TR1 relays repeat the reversals to the SU and SUR relays. For four-wire E&M lead trunks the path is traced the same except that the tip and ring leads are run thru the EM4W relay operated thru the A&B coils Fig. 17 to the A relay. This relay is furnished to convert the E&M lead signaling to reverse battery supervision. Relay EL follows the E lead closures of ground and acts to reverse the battery and ground functioning the SU and SUR relays.

The polar relays SU and SUR are arranged reverse to each other. When the supervisory relays are connected across the tip and ring of the trunk, should the trunk be poled for OFF-HOOK supervision the SUR relay will operate as an indication that the trunk is reversed. The SUR operated will operate the RO relay thru the normal contacts of the SU1. The RO relay operated, a - will close thru the OFL interrupter to flash the OFL lamp, b - will close a ground to the No. 5 crossbar interrupter circuit if it is provided, c - will close thru a ground from the PON relay contacts to the midpoint of the pulse generator in Fig. 6 to prevent it from pulsing, d - locks to a ground on the PON relay, e - removes the

ground from the MF key to release the MF relay which in turn releases the MF1 relay, and f - opens a circuit for operating the SG relay in Fig. 6 when automatic dial pulsing is provided.

13.015 Trunk Test and Start of Pulsing

When the polar supervisory relays SU and SUR are connected across the tip and ring of the trunk and the trunk is poled ON HOOK the SU relay will operate. The SU relay operates the SU-1 relay. The SU1 relay operated, a - closes a path from the SUR relay for operating the RB relay, b - opens the operate path of the RO relay, locks itself to a ground on the PON relay, c - closes in part a path to operate the SG for starting the pulse generator. When the terminating circuits have functioned and the sender is picked the polarity of the trunk is reversed to OFF HOOK. This polarity will release the SU relay and operate the SUR relay. The SUR relay will operate the RB relay. The RB relay operated, a - locks thru make before break contacts, to a ground on the PON relay, b - opens in part a path for the RO relay operation, c - closes in part a path to operate the SG relay in Fig. 6, d - opens the operate path of the SU1 relay, and e - closes in part a path for operating the steering relays. When the MF receiver is ready to receive MF pulses in the terminating office it signals the terminating sender which in turn reverses the polarity to the originating end as a signal that MF pulses may be send out. This reversal is to ON HOOK and causes the SUR relay to release and the SU relay to reoperate. The SU relay operated will close a ground thru the DPL and GO relays normal, thru the operated SU-1 and RB relays, thru the PS relay normal, thru the DT key normal (if it is provided) to operate the SG relay. The SG relay operated, a - locks to a ground on the PON relay, thru W relay normal when provided and thru the RO relay normal, b - closes a ground to start the No. 5 Crossbar Interrupter circuit when it is provided, c - closes thru the SDR interrupter to flash SDR lamp, d - closes thru a ground from the DP relay thru W relay normal to operate the BD relay in Fig. 1 when automatic DP is provided, and e - removes the ground from the midpoint of the pulse generator to start it pulsing.

13.016 Pulsing and Steering

The steering relays TAN H, TAN T, TAN U, TH, H, T, U and STA relays in Fig. 8 control the steering of the pulses for the digits. Steering relay FDS controls the sending of the KP pulse for MF pulsing. The steering relay SST control the sending of the ST pulse for MF pulsing. The pulse stop PS relay operates at the end of a train of pulses to stop the pulses. The pulse generator circuit consists of a timing relay PG, the pulsing relay P, and a checking relay

CKP to work with networks of resistances in Fig. 7 for MF pulsing. The PG is a non-biased polarized relay and the windings of the P and CKP relays are connected in series with its primary winding. When the PON relay in Fig. 8 operates it provided a ground to the resistance network connected to the pulse generator circuit. The MF network will be connected when the MF1 relay is operated. The network forms a voltage divider with its intermediate point being connected thru operated contacts of the MF relay, thru windings of the P and CKP relays to the No. 2 terminal of the primary winding of the PG relay. This same ground is connected to one side of the condensers MF and PG to the armature of the PG relay. The MF condenser is connected in parallel with the PG condenser thru the operated contacts of the MF1 relay in Fig. 7. The ground from the PON is also closed thru the normal contacts of the SG relay, operated contacts of the PS and RO relays to the 5 terminal of the PG relay and the 3 contact of the PG relay also to the 300 ohm battery. The 1, 3, and 5 terminals of the PG relay are strapped together. When the PON relay operates and puts the ground on, current will flow in the primary winding to cause the PG relay to close its 4 and 7 contacts and this same current flowing thru the P and CKP relays will cause them to operate and close their 2 and 5 contacts. When the ground is removed from the midpoint of the PG relay (1, 3, & 5 terminals) by the operation of the SG relay, allowing the 300 ohm battery to become effective, the current in the primary winding of the PG relay will be reversed and tend to operate the armature towards the 3 contacts of the PG relay. The condensers will start to charge at the same time the ground is removed from the 1 terminal of the PG relay. Initially the charging current makes the secondary winding the more powerful, holding the armature on the 4 contact but as the charge builds up on the condensers the current thru the secondary winding diminishes and consequently its magnetic effect diminishes until the primary winding becomes more effective and the armature operates to the 3 contact. This causes the ground to the armature to be connected thru the 3 contact to the 300 ohm battery. The currents in both windings again reverse and cause the armature to move to the 4 contact after a delay due to the condenser discharge current in the secondary winding. This action on the PG relay continues as long as the ground to the 1, 3, and 5 terminals of the PG is removed. The P and CKP relays follow the PG relay primary winding current reversals and thus generate pulses. The pulse generator generates approximately 60 millisecond pulses with the MF network except the KP pulse which is about 100 milliseconds due to a 2700 ohm resistance being connected into the MF network when the FDS relay is operated.

When the SU relay operates the second time for the WINK start pulsing signal it

operates the SG relay. The SG relay operated, a - removes the ground from the midpoint of the pulse generator PG relay and PG relay starts to time the pulses, b - closes a path to flash the SDR lamp, c - supplies a ground to the No. 5 crossbar interrupter circuit when it is provided and d - closes in part a path to operate the RO relay if the trunk should be reversed after pulsing has started. The P relay, a slave relay of the pulse generator PG relay, which has been on its front contacts, moves to the back contact when the ground is taken off the midpoint of the PG relay. This closes thru a path to operate the PGA relay which in turn operates the FDS1 relay to send the KP pulse frequencies to the terminating sender and at the same time it operates the next steering relay.

The operate path of the next steering is ground from the operated PON relay, thru the normal steering relays, thru the locking contact of the FDS relay, over ASR lead, to Fig. 4, thru the operated RB relay, over ASR lead to Fig. 7, thru the operated contacts of the PGA relay, over ASR lead to Fig. 8, thru operated contacts of the FDS relay, thru the normal contacts of SD- relays (the SK- relay will be normal if the register key is not depressed), thru the operated contacts of the SK- relays (the SK- relay will be operated for the register key depressed) thru the steering relay to battery. When the PG has timed for the KP pulse it moves toward its front contact and the P relay operates. The P relay operates will release the PGA relay and cause the FDS relay to release. When the P relay again releases it operates the PGA relay which operates one of the CO to C9 pulse relays (Fig. 9) depending on which register key is operated. The circuit to operate the C- relay is ground from the operated contacts of the PGA relay over the PC lead to Fig. 6, thru the operated SG relay, over PC lead to Fig. 8, thru the normal FDS relay, thru any steering relay that is normal, thru the operated steering relay, thru the operated register key to the C- relay for the key depressed, thru the C- relay to battery. The CO to C9 pulse relay that operates closes thru the frequencies for its number to the terminating sender. The PGA operates and releases, operating a pulse relay for each digit depressed and advancing the steering circuit until the operation of the SST relay in the steering circuit when the ST pulse will be sent out to the terminating sender. When the ST pulse has been sent out and the PS relay operates, a ground will be put on the midpoint of the PG relay to stop its pulsing, a ground will keep the SDR lamp lighted steadily, the MF relay will release in turn releasing the MF1 relay and the TSUP lamp will be closed thru to the SU relay contacts for flashing.

13.017 Reorder During MF Pulsing

Should the MF terminating sender go to reorder before the U steering relay

operates during pulsing it will reverse the polarity of the trunk and release the SU relay and operate the SUR relay. If a four-wire (REV BAT) trunk is under test, this reversal is repeated by relays TTL and TR1 or TT and TR. If a four-wire E&M lead trunk is being tested, the EL (E lead line side) relay will repeat the change to OFF-HOOK to the supervisory relays. Otherwise the circuit operation remains unchanged. The SUR relay operating will operate the RO relay. The circuit to operate the RO is ground from the SUR relay operated, thru the DPL relay normal, thru the GO relay normal, RO lead to Fig. 7, thru the MF relay operated, over RO lead to Fig. 6 thru the SG relay operated over RO lead to Fig. 8 thru U and STA relays normal, over ROP lead to Fig. 4, thru RO relay winding to battery. The RO relay operated, a - closes a ground from the PON relay to the midpoint of the pulse generator to stop pulsing, b - closes a path from the OFL interrupter to flash the OFL lamp, c - closes a ground to the No. 5 crossbar interrupter circuit when it is provided, d - locks to a ground on the PON contacts operated, e - releases the MF relay in Fig. 7, and f - opens the SG relay locking path.

13.02 DELAY DIAL Start Pulsing Signal

13.021 Preparation

The preparation for testing MF pulsing trunks arranged for DELAY DIAL start pulsing signal is the same as described in paragraph 13.011 for WINK start pulsing signal except that the DPL key is operated. The DELAY DIAL signal is where the trunk is picked OFF-HOOK called subscriber supervision. The trunk circuit functions the terminating circuits to pick a terminating sender which awaits a signal from the MF receiver that it is ready to receive pulses. When the sender receives the signal that the MF receiver is ready, it reverses the battery and ground to the originating end as a signal to start pulsing.

Trunk Polarity Test

13.022 The polarity test of the trunk is made the same as described in paragraph 13.014. With the DELAY DIAL start pulsing signal however the operation on the DPL key arranges the circuit to operate the SUR relay if the trunk is poled ON-HOOK when picked. The SUR relay operated performs the same functions as described in paragraph 13.014.

13.023 Trunk Test and Start of Pulsing

When the polar supervisory relays SU and SUR are connected across the tip and ring of the trunk and the trunk is poled OFF-HOOK with the DPL key operated for DELAY DIAL start pulsing signal the SU relay will operate. The SU relays will operate the SU1 relay. The SU1 relay will perform the same

functions as described in paragraph 13.015. When the terminating end is ready to receive MF pulses the polarity of the trunk will be reversed. When the polarity is reversed the SU relay will release and the SUR relay will operate. The SUR relay operated operates the RB relay which, a - lock thru its make before break contacts, b - opens in part the RO relay path, c - closes in the path to operate the SG relay in Fig. 6, d - opens the operate path of the SU-1 relay and e - closes in part a path for operating the steering relays. The SG relay in Fig. 6 operates from ground on the operated SUR relay contacts, thru the DPL relay operated, thru the SU-1 relay operated, thru the RB relay operated, over SG lead to Fig. 8, thru the PS relay normal, over SG lead to Fig. 10 if it is provided, thru the DT key normal over SCO lead to Fig. 6, thru the SG relay winding to battery. The SG relay operated will perform the same functions as described in paragraph 13.015.

13.024 Pulsing and Steering

Same as described in paragraph 13.016 with the exception that the SUR relay operates the SG relay in Fig. 6 to start pulsing.

13.025 Reorder During MF Pulsing

Should the MF terminating sender go to reorder before the U steering relay operates during pulsing it will reverse the polarity of the trunk and release the SUR relay and operate the SU relay. If a four-wire trunk is under test this reversal is repeated by relays TT1 and TR1 or TT and TR. If a four-wire E&M lead trunk is being tested, the EL (E lead line side) relay will repeat the change to OFF-HOOK to the supervisory relays. Otherwise the circuit operation remains unchanged. The SU relay will close a ground to operate the RO relay thru the DPL relay operated, over the RO lead to Fig. 7, thru the MF relay operated, over RO lead to Fig. 6, thru the SG relay operated, over the RO lead to Fig. 8 thru U and STA relays normal, over ROP lead to Fig. 4, thru RO relay winding to battery. The functions of the RO relay are the same as described in paragraph 13.017.

14. TESTING DIAL PULSING TRUNK

14.01 GO Start Pulsing Signal

14.011 Preparation

When testing trunks which require step-by-step loop dial pulses to prime the terminating end, this circuit is arranged to send step-by-step loop dial pulses, step-by-step loop resistance pulses and step-by-step battery and ground loop pulses. The LPD key in Fig. 10 is operated for loop dial pulses, LRD key in Fig. 11 is operated for loop resistance pulses, or the BGD key in

Fig. 11 is operated for battery and ground loop pulses. Operate the GO key. When a community dial office is included in the connection operate the S-GO key. This key provides means for absorbing a STOP-GO signal after pulsing has started. The number to be called is depressed on the Register Keys in Fig. 2. The required TRUNK COMP RES keys in Fig. 1 and the required A RY OPR COMP RES keys in Fig. 4 are operated. The DP key in Fig. 10 is operated. The test circuit test jack is then patched to the trunk test jack, the TST1 key operated and the busy test is made as described in paragraph 6.01 and 6.02.

When the DP key is operated it operates the DP relay. The DP relay operated, a - operates the DPL relay, b - closes thru the ST lead from Fig. 1, to Fig. 8 for operating the PON relay c - opens the T and R lead from Fig. 1 and closes thru the pulsing contacts for loop pulsing, d - closes thru a path for operating the SG relay in Fig. 6 for pulsing delayed closure time and e - closes a circuit to omit the SST steering relay. The S-GO key operated connected the SK1 and SK2 relays in the circuit to absorb a STOP-GO signal after pulsing has started. The DPL relay operated, a - provides grounds to the LPD, LRD and BGD keys to operate their respective relays, b - closes a ground thru the W relay normal to operate the BD relay in Fig. 1, c - closes locking ground to the SK1 and SK2 relays, d - closes ground to the pulse generator in Fig. 6, e - closes off normal ground to the pulsing relays.

When the LPD key is operated, it operates the LPD relay. The LPD relay operated, a - closes thru the LPD and LRD resistance network to the pulse generator in Fig. 6 for pulsing step-by-step loop pulses, b - closes thru the LPD contact protection to protect the pulsing contacts of the P relay in Fig. 6, and c - closes thru the pulsing contacts of the P relay into the T and R. When the LRD key is operated it operates the LRD relay. The LRD relay operated, a - closes thru the LPD and LRD resistance network to the pulse generator in Fig. 6 for pulsing step-by-step loop resistance pulses, b - closes thru 1481 ohms resistance into the R lead and c - closes thru the LRD contact protection to protect the pulsing contacts of the P relay. When the BGD key is operated it operates the BGD relay. The BGD relay operated, a - closes thru the BGD resistance network to the pulse generator in Fig. 6 for pulsing step-by-step loop battery and ground pulses and b - closes the PLS relay thru the 2 and 5 contacts of the P relay operated to a ground on the BGD relay operated. The PLS relay operated, a - closes thru the short circuit bridge thru the ON relay contacts across the Tip and Ring, and opens the operate path of the ON relay. When the GO key is operated it operates the GO relay. The GO relay operated, a - operates the SU-1 relay, b - closes a path to operate the RO relay if the

SU relay operates and c - closes a path to operate the RB relay when the SUR relay operates.

When the busy test circuit has functioned and the trunk becomes idle a ground is put on the ST lead. If a four-wire E&M lead trunk is to be tested, the operation of the EM4W key prepares the circuit by operating the EM4W relay after the ST lead is grounded and connecting to the four-wire trunk. The ground on the ST lead will operate the PON relay in Fig. 8. The PON relay operated, a - operates the FDP relay in Fig. 1 to remove the momentary open check feature during pulsing, b - closes a ground to the pulse generator circuit to operate the PG relay in its release direction closing the 4 and 7 contacts, c - closes ground to operate the FDS relay, d - closes a ground for locking the RO, SU-1, RB, and SG relays, and e - provides ground to operate the SG relay thru the FDS relay operated for pulsing the delayed closure time. The FDS relay operated, a - opens the path to operate the RO relay, b - closes its locking ground for operating the next steering relay, c - closes thru a path to operate the SG relay for delayed closure time, d - closes a path to operate the FDS1 relay. The FDS1 relay operated controls the delayed closure time. The delayed closure time is provided to allow time for the trunk circuit to restore to normal from the previous call.

When delayed closure time has been completed the circuit goes into interdigital time and stops during this period to wait for the start pulsing signal from the terminating end. Trunks are arranged for GO start pulsing signal when they transmit a start pulsing signal to the test circuit immediately upon seizure. When the test circuit receives the proper start pulsing signal it completes interdigital time and pulses the first digit. Each successive digit is pulsed, for the keys depressed, with timing for interdigital time between digits. When the S-GO key is operated the test circuit will accept one reversal of polarity from the terminating end. Should a second reversal be received the OFL lamp will flash. When the S-GO is normal the circuit is arranged to operate the RO relay and flash the OFL lamp should the terminating end reverse the polarity of the trunk after pulsing has started.

14.012 Delayed Closure Time

When the FDS relay operates it closes a path to operate the SG relay to start delayed closure time. The path to operate the SG relay is ground from the PON relay operated, over the DCT lead to Fig. 4, thru the RO relay normal, over the DCT lead to Fig. 10, thru the W relay normal, over the DCT lead to Fig. 8, thru the FDS relay operated, over DCT1 lead to Fig. 10, thru the DP relay operated, over SGO lead to

Fig. 6, thru SG relay winding to battery. The operation of relay SG removes the ground from the midpoint of the pulse generator PG relay which causes it to start pulsing. The P relay will also pulse but no dial pulses will be sent out on the trunk until the TL relay in Fig. 1 is operated. The CKP relay will operate and release the control relays for the delayed closure time counting the pulse on the LC, LD, and LE, and P1 to P5 relays. When the P5 relay operates, the ground from the FDS1 relay operated is extended to the SP1 relay winding. The SP1 relay does not operate at this time as a ground from the 3 contact of the CKP relay is connected to the outer winding. When the CKP relay operates it removes ground from its 3 contact and the SP1 relay operates.

14.013 Trunk Test and Completion of Timing

When the SP1 relay operates it will, a - prepare a circuit for operating the SP2 relay, b - close a circuit to operate the W relay and hold Z relay non-operated, c - operate the TL relay in Fig. 1 and d - closes a short circuit around the P relay contacts. The W relay operating will, a - hold operated thru WR relay normal contacts, b - close thru a path for advancing the steering relays when the Z relay operates, c - close an additional short circuit around the P relay contacts, d - release the BD relay to remove the short circuit from around the repeat coil and the polar supervisory relays, e - open the operate path of the SG relay thru the FDS relay to release the SG relay and stop the pulse generator, and f - close the path from the supervisory relay contacts to the RO relay (the RO will operate if a reversal is encountered when the W relay is operated).

When the TL relay operates it closes thru the T & R from the trunk to the test circuit. The polar supervisory relays are now in series with the trunk A relay for trunk test. This circuit is Tip of the test jack, thru VML relay normal, RS1 key normal, TLK1 and TST1 relays normal, thru TRUNK COMP RES keys operated, TL relay operated, FDP relay operated, over T lead to Fig. 10, thru DP relay operated, thru LPD, LRD, or BGD relays operated, over PA lead to Fig. 6, thru operated P relay contacts, over PO lead to Fig. 10, thru LPD, LRD or BGD relays operated, thru the DP relay operated over T1 lead to Fig. 1, thru R± relay normal, thru repeat coil TST, over T lead to Fig. 4, thru A RY OPR COMP RES keys operated, thru the polar supervisory SU and SUR relays, over R lead to Fig. 1, thru TST repeat coil, thru R± relay normal, thru FDP and TL relays operated, thru TRUNK COMP RES keys operated, thru TST1 and TLK1 relays operated, thru RS1 key normal, thru VML relay operated to Ring of test jack. For four-wire E&M lead trunks, the path is the same except the T1 jack is not used but the tip and ring goes thru the A&B coils Fig. 17 to the A relay Fig. 17.

Since the GO key is operated the start pulsing signal will be the operation of the SUR relay. The SUR relay operated will close a ground to operate the SG relay, thru relays DPL normal, GO operated, SU1 operated, RB operated, PS normal and DT key normal. When testing trunks with dial tone and GO start of pulsing signal, the DT key is operated, before the TST1 key, at the start of test. This key opens the circuit to the SG relay to prevent the completion of delay loop closure timing. When dial tone is heard, using the associated telephone circuit, the DT key is restored to normal to permit the SG relay to operate.

The SG relay will remove the ground from the midpoint of the pulse generator PG relay and start to complete the delayed closure time which goes into interdigital time. The release of the CKP relay operates the SP2 relay thru the operated contacts of the SP2 relay. The SP2 relay operated will, a - hold the SP1 relay operated to the ground on the CKP relay contacts, b - release the operated counting relays LD to LE and P5. When the CKP relay again operates to remove the ground from its 3 contact the SP1 and SP2 relays release. The release of the SP1 relay causes the Z relay to operate. The Z relay operated will, a - close thru a path for the WR to operate when the SP1 relay will again operate during interdigital time, b - close thru a ground to operate the SP1 relay when the P3 relay operates to stop interdigital time, c - closes a circuit to operate the next steering, and d - release the FDS1 relay. When the CKP has operated and released to count the number of pulses for the interdigital time on the LC to LE and P1 to P3 relays the SP1 relay operates when the CKP is operated after the P3 is operated. The SP1 operated will close a circuit thru the Z relay operated to operate the WR relay. The WR relay will cause the W relay to release and provides an additional locking ground for the SG relay. The W relay released will provide a locking ground for the SG relay and close a path to operate the BD relay and release (FDS) relay. The BD relay operated will short circuit the polar supervisory relays SU and SUR also the repeat coil. The next release of the CKP relay will operate the SP2 relay which will release the operated counting relays and hold the SP2 operated to the ground on the CKP contacts. When the CKP operates the SP1 and SP2 relays will release. The SP1 relay releasing will release the WR and Z relays. The Z relay released will close a ground thru the operated steering relay, and operated register key to operate one of the 0 to 9 relays. The 0 to 9 relay operated will close thru a ground to the P1 to P6 relays to stop the pulsing when the proper number of pulses have been sent for the digit depressed. The WR relay released will remove a locking ground to the SG relay.

14.014 Pulsing

When the SP1 relay releases, it also removes the short circuit around the P relay contacts which are operated at this time. With the P relay operated the T lead is closed thru to the T1 lead and the BD relay operated short circuits the repeat coil and the polar supervisory relays SU and SUR for pulsing of the digits causing the polar relay operated to release. When the PG relay reverses the current the P and CKP relays will open their 2 and 5 contacts. The P relay opens the loop for the first open period of the digit and the CKP contact functions the counting relays. The PG relay will continue to pulse, reversing the current until the combination of P- relays is reached which connects the ground from the 0 to 9 relay operated thru the P- relays to the inner winding of the SP1 relay. The ground from the CKP relay contacts will prevent the SP1 relay operating. When the CKP operates to its 2 contact and removes the ground from its 3 contact the SP1 relay will operate. The SP1 operated will cause the W relay to operate. Both the SP1 and the W relay will short circuit the contacts of the P relay to prevent further pulsing of this relay from being effective on the loop. The W relay will also release the BD relay which will remove the short circuit from the repeat coil and the polar supervisory relays will check the polarity of the trunk during the period that the W relay is operated. The SP1 relay initially closes the short circuit around the P relay contacts at the beginning of the interdigital interval and opens it at the end of the interdigital interval, while the W relay maintains the closure when the SP1 releases during the interdigital interval. The P relay operates to its 2 contact with the CKP relay and recloses the loop for the last pulse of the digit. Since the WR relay is normal and the W relay is operated the locking grounds for the SG relay will be removed and the SG relay will release since the polar supervisory relay will be normal. When the BD relay removes the short circuit from around the polar relays they are again in the T and R circuit and if the proper polarity is still on the trunk the polar supervisory relay will operate and reoperate the SG relay. The SG relay operated will remove the ground from the midpoint of the PG relay and cause it to start pulsing again. The PG will pulse the interdigital time to completion as previously described in paragraph 14.013 and then pulse out the next train of pulses for the next digit under control of the CKP and P relays as previously described. When testing four-wire E&M lead trunks, the dial pulsing operates the A relay YT option Fig. 17 which repeats the dial pulsing converting the loop pulsing to M lead pulsing.

When all the digits have been pulsed and the steering relay PS is operated it

will, a - release the FDP relay in Fig. 1 and close thru the momentary open check, b - release the DP relay in Fig. 10, c - close thru the TSUP lamp for supervision, d - close thru a ground to keep the SDR lamp lighted steadily, e - put a ground to the midpoint of the pulse generator to stop it from pulsing and f - open the operate path of the SG relay. The DP relay released, a - releases the DPL relay, b - opens the ST lead from Fig. 1, c - removes the pulsing contacts from the fundamental circuit, d - closes thru the STA and SST steering relays back to operate after the U digit operates and e - opens the path to operate the SG relay for delayed closure time. The DPL relay released, a - releases the LPD, LRD or BGD relay, b - releases the BD relay, c - removes the ground to the contacts of the CKP relay in Fig. 6 for operating the pulsing relays, d - releases the pulsing relays locked operated, and e - opens the path of the pulse generator PG, P and CKP relays to the LPD and LRD or BGD resistance network. The BD relay released removes the short circuit from around the repeat coil and the polar supervisory relays. The LPD, LRD, or BGD relay released opens the pulsing path, and disconnects the LPD and LRD or BGD resistance network from the pulse generator.

14.015 Trunk Polarity Test After Delayed Closure Time

When the test circuit has completed delayed closure time and goes into the interdigital timing period, the pulse generator stops pulsing and the polar supervisory relays are connected into the fundamental circuit to make a polarity check of the trunk. Should the trunk be OFF HOOK with the GO relay operated the SU relay will operate and in turn operating the RO relay. The RO relay operated will perform the same functions as described in paragraph 13.014 except that the DP relay will be released instead of the MF.

14.016 Trunk Polarity Test Between Digits - After Pulsing Has Started

When pulsing has started and the BD relay releases during interdigital time to remove the short circuit from around the TST repeat coil and the polar supervisory relay a check is made of the polarity of the trunk. An OFF HOOK polarity of the trunk will operate the SU relay. With the S-GO key normal, the SU relay will close a ground to operate the RO relay to flash the OFL lamp and perform the functions described in paragraph 13.014 except that the DP relay will be released instead of the MF relay; with the S-GO key operated, the SU relay operated will operate the SK1 which lights the OFL lamp. When the trunk is reversed to ON HOOK the SK2 relay will operate, the SU relay will release and the SUR relay will operate. The SUR relay operate will close

a ground to operate the SG relay to continue interdigital and pulse out the rest of the digits. Should another OFF HOOK condition be encountered before the U steering relay is operated the SU relay will operate to close a ground to operate the RO relay and flash the OFL lamp.

14.02 DELAY DIAL Start Pulsing Signal

14.021 Preparation

The preparation will be the same as described in paragraph 14.011 except that the DPL key will be operated instead of the GO Key for the DELAY DIAL start pulsing signal. The DPL key operated operates the DPL relay. The DPL relay operated, a - closes a path to operate the SU-1 relay when the SU relay operates, b - closes a path to operate the RO relay if the SU relay operates after pulsing has started and c - closes a path to operate the TSUP lamp when the 3 and 5 contacts of the SU relay are closed.

14.022 Delayed Closure Time

The circuit functions the same as described in paragraph 14.012.

14.023 Trunk Test and Completion of Timing

The circuit functions the same as described in paragraph 14.013 except that with the DPL relay operated, the SUR relay operated will close a ground to operate the SG relay to complete timing.

14.024 Pulsing

The circuit functions the same as described in paragraph 14.014.

14.025 Trunk Polarity Test After Delayed Closure Time

The circuit functions the same as described in paragraph 14.015 except that the DPL key is operated for DELAY DIAL. The DPL key operated the DPL relay. The DPL relay operated arranges the polar supervisory relays so that if the trunk is ON HOOK after delayed closure time the SUR relay will operate and in turn operate the RO relay to flash the OFL lamp. The RO relay operated will perform the same functions as outlined in paragraph 13.014 except that the DP relay will be released instead of the MF relay.

14.026 Trunk Polarity Test Between Digits

The circuit will function the same as described in paragraph 14.016.

14.03 WINK Start Pulsing Signal

14.031 Preparation

The preparation will be the same as described in paragraph 14.011 except that

the GO and DPL keys will be normal. The GO and DPL keys normal arrange the polar supervisory relays SU and SUR for a WINK start pulsing signal.

14.032 Delayed Closure Time

The circuit functions the same as described in paragraph 14.012.

14.033 Trunk Test and Completion of Timing

The circuit functions the same as described in paragraph 14.013 except that with the GO and DPL relays normal when the SU relay operates the second time for the WINK.

14.034 Pulsing

The circuit functions the same as described in paragraph 14.014.

14.035 Trunk Polarity Test After Delayed Closure Time

The circuit functions the same as described in paragraph 14.015 except the GO and DPL relays normal arrange the polar supervisory relays so that if the trunk is OFF HOOK after delayed closure time the SU relay will operate and in turn operate the RO relay to flash the OFL lamp. The RO relay operated will perform the same functions as described in paragraph 13.014 except that the DP relay will be released instead of the MF relay.

14.036 Trunk Polarity Test Between Digits

The circuit will function the same as described in paragraph 14.016 except that if the trunk is OFF HOOK during interdigital time the SUR relay will operate. The SUR relay operated will operate the RO relay.

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