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

CHANGES

B. CHANGES IN APPARATUS

B.1 Removed — Replaced By

1-18BM Res. (STP) Fig. 3)
1-0.5 MFD Cond. (STP) Fig. 3) 1-177F Network

B.2 Added

1-3P12C Cord (MB1) Fig. 14
1-3P12D Cord (MB2) Fig. 14

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

C.1 On page 5 of the Circuit Requirement table the DPL relay was formerly shown as DLP on page 4.

C.2 On page 17 of the Circuit Requirement table the "Test Clip Data" for the TN1 and TN2 relays was formerly "Conn Grd" to T (Rel. Tst.) and "Test Set Prep" was GRD.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 On sheet -0101 the following changes were made.

D1.1 In note 103 the A or B terminal of the LRD contact protection network was formerly shown connected to "GRD" and the C or D terminal was formerly shown connected to "8T(LR)" relay. The STP contact protection network was formerly shown as an 18BM resistance and an 0.5 MF condenser.

D1.2 In note 102 opposite "Busy Test", "Crossbar No. 5" Fig. 14 under quantity formerly read "1 per Test and MB Bay".

D.2 On sheet -0102 the following changes were made.

D2.1 At the TN1 or TN2 relay the 5B was formerly connected to battery and the 6T was formerly connected to 4T of the TN1 or TN2 relay and the 5T of the BT1 or BT2 relay.

D2.2 In figure 13 the routing of the leads TN, S and BAT formerly read "to figure 14".

D2.3 In figure 14 the routing of lead TNR formerly read, "To Succeeding Figure 14 or to Figure 13". The routing of the S lead formerly read "To Figure 13". The routing of the BAT or TNR lead formerly read "to figure 13 or to Preceeding Fig. 14". The routing of the strapping on the sleeve of the jacks formerly read "To All Fig. 14".

D2.4 In figure 14 the (MB1) and (MB2) cords were added.

D2.5 In figure 1 leads designated LB and OF routed to No. 5 Crossbar Int. Ckt." were formerly designated SDR and OFL respectively.

D.3 On sheet -0112, figure 57 is added, figure 55 was removed a new fig. 55 was added. Changes were made in figures 52, 54 and 56.

D.4 On sheet -0105, figure 3, a lead is added from the 6T of the (RP1) relay to the 4T of the (ST1) relay.

All other headings, no change.

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

1. PURPOSE OF CIRCUIT

This circuit is for testing out on the cable pair of outgoing trunk circuits by patching between the test circuit test jack and the test and make busy jack of the outgoing trunk, appearing on the test and make busy jack bay. The test circuit is arranged to make a voltmeter test of the outgoing trunk and to pulse out calls for the number depressed on the register keys. The pulsing may be Revertive, Panel Call Indicator, Multi-frequency or Step-by-Step loop dial pulsing.

When a trunk is to be tested its test jack at the Test and Make busy jack bay is patched to the test jack of the test circuit. When a No. 5 Crossbar outgoing trunk is to be tested and it is made busy due to trouble it is patched in the same way. When a No. 5 Crossbar trunk, which is in service, is to be tested, in addition to the test jack, the MB jack of the trunk is patched to the test circuit MB jack for making the trunk busy when it is idle. For all tests the test jack is closed thru Fig. 1. The trunks in every case are connected first to the Busy Test Fig. 12 or Fig. 13 where the trunk is tested for a Busy and if idle it is made busy. When the trunk is made busy a start signal is then sent to the other figures to start functioning. The voltmeter test is made in Fig. 1. When a RP trunk is tested the test is routed from the test jack thru the Connector Fig. 1 to the Revertive Pulsing Fig. 3. When the signal is received that the trunk is made busy the pulses are sent out and when pulsing is completed the circuit functions to connect the trunk thru to the supervisory test circuit Fig. 4. When a trunk requiring PCI pulsing is tested the routing is from the test jack thru Fig. 1 Connector, thru the RP Fig. 3 to the PCI pulsing Fig. 5. The PCI call is then completed the same as the RP call. When MF pulsing trunks are tested the routing is from the test jacks thru the connector Fig. 1, to MF pulsing Fig. 7 for pulsing while for supervision it is routed from Fig. 1 to Fig. 4. MF pulsing is thru the repeat coil. When pulsing has been completed the MF pulsing Fig. 7 is disconnected and the trunk is connected to the supervisory Fig. 4 only. In a similar manner when step-by-step dial pulsing trunks are tested the test is routed thru Fig. 1 to the Dial pulsing Fig. 10 for SxS loop pulsing and thru Fig. 10 to Fig. 11 for SxS loop resistance pulsing or SxS battery and Ground pulsing. In the same way as for MF pulsing the trunk is closed thru Fig. 1 to the supervisory test Fig. 4 for supervision. The O.K. signal is given by the flashing of a supervisory lamp when trunk tests are completed to final multiple or incoming trunk test lines. Repeat tests may be made by leaving the trunk patched to the test circuit, disconnecting the test call completed and restarting in the regular way.

2. WORKING LIMITS

2.1 The test jacks T1 and T2 may be connected to any trunk whose test and make busy jack appears on the test and make busy jack bay. The limits for this circuit are based on the following:

PB-239 FM Relay - Trunk Supervision	20-28V	45 to 50V
Max. Ext. Ckt. Loop Res.	4,000 ohms	10,000 ohms
Min. Ins. Res.	30,000 ohms	30,000 ohms

2.20 Revertive Pulsing

2.21 268A (STP) relay - Selections

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

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

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

Min. Comp. Res. for selection - 900 ohms
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

2.23 B167 (MTG) relay - Short Trunk Loop Tests

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

2.24 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

3. FUNCTIONS

3.01 Connects to the trunk to be tested by means of a patching cord between the test circuit test jacks and the trunk circuit test and make busy jacks on the Test and Make Busy Jack Bay. When Fig. 12 is provided the test jack (T1 or T2) is patched to the trunk test jack. When Fig. 13 and 14 are provided (No. 5 Crossbar) the test jack (T1 or T2) is patched to the trunk T jack if the trunk is made busy for trouble and the test jack (T1 or T2) is patched to the trunk T jack also the make busy jack (MB1 or MB2) is patched to the trunk MB jack, when the trunk to be tested is in service.

3.02 Makes a busy test of the trunk patched for test.

3.03 Lights a busy lamp (BY1 or BY2) when the trunk is busy when patched and extinguishes the busy lamp when the trunk becomes idle.

3.04 Makes the trunk test busy if idle when picked and the test key (TST1 or TST2), voltmeter (VM1 or VM2), talking key (TLK1 or TLK2) or no test key (NT1 or NT2) is operated.

3.05 When a trunk is picked while busy to make it busy after is has become idle and the busy test feature has functioned.

3.06 Makes busy retest when a busy trunk becomes idle to prevent interference.

3.07 Starts a test call when the trunk to be tested is idle and the busy test feature has functioned.

3.08 Lights an off normal lamp (ON1 or ON2) when the test circuit relays are operated.

3.09 Reverses the tip and ring leads from the test circuit test jack to the test circuit when the reversing key (RS1 or RS2) is operated.

3.10 Connects the voltmeter circuit to the test jack when the voltmeter key (VM1 or VM2) is operated and the trunk is idle.

3.11 Tests the ringside using the 150 volt scale of the voltmeter when all keys in the voltmeter circuit are normal.

3.12 Tests the tipside using the 150 volt scale of the voltmeter when the REV key is operated.

3.13 Reverses the tip and ring to the voltmeter test when the REV key is operated.

3.14 Tests for foreign potential when the FEMF key is operated.

3.15 Tests for short circuits when the G and REV keys are used.

3.16 Makes a ballistic test for capacity with the G and REV keys.

3.17 Reverses the connections of the voltmeter when the VM REV key is operated.

3.18 Makes a milliammeter test for resistance with the 20,000 ohm, 1000 ohm and AM keys.

3.19 Provides test conditions on the three scales of the volt milliammeter as follows:

Range	Full Scale (ma)	Resistance
0-120 volts	1.2 ma	100,000 ohms
0-24 volts	1.2 ma	20,000 ohms
0-24 volts	24 ma	1,000 ohms
0-300 ma	300 ma	3 ohms

3.20 Connects Test Jack T1 to the test circuit when TST1 key is operated.

3.21 Connects Test Jack T2 to the test circuit when TST2 key is operated.

3.22 Overrides a busy when the no-test feature (NT1 or NT2 key Fig. 12) is operated.

3.23 Closes thru a bridged polar relay supervisory circuit to the test jack when the talking key (TLK1 or TLK2) is operated.

3.24 Indicates the supervision when the bridged polar relay is connected to the test jack by means of the supervisory lamp (SUP1 or SUP2).

3.25 Provides compensating resistances and keys for distant office selections DOS COMP in 300 ohm steps from 0 to 1500 ohms.

3.26 Provides compensating resistances and keys for trunk compensation (TRK COMP) from 0 to 3600 ohms with one step of 250 ohms and subsequent steps of 300 ohms. The 250 ohm step being provided for compensating the operate test of the "S" type trunk A relay.

3.27 Provides resistances and keys (A RY OPR COMP) in 500 ohm steps from 0 to 17,500 ohms for making operate tests of the trunk A relay.

3.28 Provides test resistances in 500 ohm steps from 0 to 5500 ohms for L RY NON OPR RES and from 0 to 12,500 ohms for A RY NON OPR RES.

3.29 Provides a (RICR-20,000) ohm resistance to compensate for repeater incoming selector (L) relay non-operate test.

3.30 Provides TAN H, TAN T, TAN U, TH, H, T, U and STA register keys.

3.31 Provides means for making distant office selections. Distant office brush 0 to 4 is set up by depressing key in TAN T row and office group 0 to 9 by depressing key in TAN U row.

3.32 Provides a KR key for releasing the register keys operated.

3.33 Provides means for sending RP pulses on revertive pulse trunks when the RP key is operated.

3.34 Provides means for making trunk test on RP trunks with 24 volts on the supervisory relay by operation of the TFV key.

3.35 Provides means for MF pulsing the called number on MF pulse trunks when the MF key is operated.

3.36 Provides means for pulsing SxS loop pulses for the called number on Dial Pulse trunks when the DP key is operated.

3.37 Provides means for testing Panel Call Indicator trunks when the PCID for direct P.C.I. or PCIT for tandem P.C.I. is operated.

3.38 Provides means for making RP trunk L relay non-operate test.

3.39 Provides means for making RP trunk A relay non-operate test when A NO key is operated.

3.40 Provides means for making RP trunk A and L relay premature operation tests on cable charging condition (Battery cut-off Panel only) when the PRE - OPR A & L RYS key is operated.

3.41 Provides means for sending Panel Call Indicator pulses on direct PCI trunks when PCID key is operated or tandem PCI trunks when PCIT key is operated.

3.42 Provides means for making a trunk guard and overflow test on PCI trunks before starting the PCI pulses.

3.43 Provides means for pulsing SxS loop pulses on Dial Pulse trunks when the DP & LPD keys are operated.

3.44 Provides means for pulsing SxS loop resistance pulses on DP trunks when the DP and LRD keys are operated.

3.45 Provides means for pulsing SxS loop battery and ground pulses on DP trunks when the DP and BGD keys are operated.

3.46 Provides means for listening for dial tone before pulsing is started on DP trunks when the DT key is operated.

3.47 Makes a polarity test of the MF or DP trunk before pulsing MF or DP pulses.

3.48 Arranges the test circuit polar supervisory relay for GO start MF or DP pulsing signal when the GO key is operated.

3.49 Arranges the test circuit polar supervisory relays for a STOP-GO start MF or DP pulsing signal when the DLP key is operated.

3.50 Arranges the test circuit polar supervisory relay for WINK Start MF or DP pulsing signal when the GO and DLP keys are normal and either the MF or DP key is operated.

3.51 Sends MF or DP pulses for the digits depressed on the register keys.

3.52 Flashes a sender lamp (SDR) while pulsing RP, PCI, MF or DP call.

3.53 Lights the sender lamp steadily (SDR) when pulsing has been completed.

3.54 Sends a KP pulse of at least 100 millisecond duration before pulsing the MF digits.

3.55 Sends an ST pulse after all the digits have been MF pulsed.

3.56 Opens the paths to the telephone circuit during MF pulsing.

3.57 Pulses either MF or DP pulses under control of the same pulse generator.

3.58 Stops the pulse generator when the ST pulse for MF pulsing has been pulsed out.

3.59 Stops the pulse generator when all DP digits have been pulsed out.

3.60 Closes thru the Tip and Ring from the MF or DP feature when the trunk becomes idle and the busy test circuit has functioned.

3.61 Removes the momentary open check while MF or DP pulsing is in progress.

3.62 Does the momentary open check on calls to the incoming trunk test line after RP, PCI, MF or DP pulsing has been completed and the MO key is operated.

3.63 Arranges the pulsing contacts in the fundamental circuit for SxS loop pulsing.

3.64 Removes the pulsing contacts from the fundamental circuit after SxS loop pulsing is completed.

3.65 Starts delayed closure time on DP calls after the busy test circuit indicates that the trunk to be tested is idle.

3.66 Waits for the start pulsing signal after delayed closure time has been completed.

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

3.68 Short circuits the polar supervisory relays and repeat coil during DP pulsing.

3.69 Removes short circuit from polar supervisory relays and repeat coil for polarity check of trunk during interdigital time.

3.70 Stops the pulse generator during interdigital time.

3.71 Advances the digit steering circuit during interdigital time.

3.72 Completes interdigital timing and starts pulsing the next digit after the polarity check of the trunk.

3.73 Accepts a STOP-GO signal with the SGO key operated after DP pulsing has started and before U digit is pulsed. Flashes the OFL lamp if a STOP signal is received after this STOP-GO signal.

3.74 Provides means for flashing the overflow lamp (OFL) when all trunks are busy, a selector goes to tell-tale or a reorder is encountered on an MF trunk.

3.75 Flashes the OFL lamp if an MF or DP trunk tested is reversed to its normal polarity.

3.76 The R ± key is provided to apply 105 ± volts continuous ringing current to the trunk when the key is operated.

3.77 The SX key is provided to apply simplex ringing current to the trunk when the key is operated.

3.78 The types of circuits that may be tested with this circuit are:

Panel Incoming Selector
Crossbar Incoming Trunk
Panel Distant Office Selector
Panel Call Indicator Trunk
Tandem Call Indicator Trunk
Panel Repeating Incoming Selector
Panel Sender Tandem Trunk
Tandem O.G.T. to Central Desk Operator or to Official P.B.X.
Tandem Announcement Trunk
Outgoing Repeater to Step-by-Step Office
Outgoing Repeater CX or SX to Step-by-Step Office
Step-by-Step Incoming Trunks
Outgoing Toll Switching Reverse Supervision Trunks
Outgoing Toll Switching TX Trunks

4. CONNECTING CIRCUITS

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

4.01 Test and Make Busy Jacks - SD-96376-01, SD-68203-01 and SD-25762-01.

4.02 Test Circuit for Testing Outgoing Trunks for Continuity and Reversals - SD-96370-01.

4.03 Office Link and Connector Circuit - SD-25033-01.

4.04 Distant Office Selector - SD-21733-01.

4.05 Panel Incoming Selector such as SD-21917-01.

4.06 Crossbar Incoming Trunk such as SD-25295-01.

4.07 Crossbar Tandem Incoming Trunk Repeated Supervision - SD-25887-01.

4.08 Tandem Call Indicator Trunk such as ES-11573-01.

4.09 Telephone Key and Lamp Circuit - SD-95524-01.

4.10 Interrupter Circuit - SD-25742-01 and SD-25062-01.

4.11 Miscellaneous Circuit - SD-95525-01.

4.12 Clock Circuit - SD-96343-01.

4.13 Tandem Overflow Trunk - SD-25442-01.

4.14 Tandem O.G.T. to Central Desk Operator or to Official P.B.X. - SD-21634-01.

4.15 Tandem Announcement Trunk - SD-21734-01.

4.16 Outgoing Trunk Circuit to Panel, Crossbar and SxS - SD-68011-01.

4.17 Step-by-Step Trunk such as SD-31726-01.

4.18 Crossbar Tandem Outgoing Trunk Loop or Battery & Ground Pulsing - SD-25634-01.

4.19 Crossbar Tandem Outgoing CX Trunk - SD-25490-01.

4.20 Toll Switching System No. 4A - TX or Combined TX and Toll Switching Trunk Circuit - SD-68239-01.

4.21 Toll Switching System No. 4A - Toll Switching Trunk Circuit Dial or MF - Straightforward - SD-68242-01.

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.

5. DESCRIPTION OF OPERATION

5.01 General

This circuit is arranged to test trunks having battery on the tip for ON-HOOK called subscriber's supervision. When trunks with battery on the ring for ON-HOOK called subscriber's supervision are tested the RS1 or the RS2 key is operated to reverse the tip and ring leads from the test jack T1 or T2 to the test circuit. 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 the keys are normal.

5.02 Busy Test using Fig. 12

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 the SR1 to operate which in turn will operate the slow operate ON1 relay. The ON1 relay is slow operate to allow time for the slow release SR1 relay to soak. When the ON1 relay operates it locks, opens the operate path of the SR1 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 SR1 relay to the ON1 lamp and furnishes a ground thru its locking contacts, the SR1 relay normal and the BH1 relay operated to the ST lead to the test circuit. When the slow release SR1 has released it closes thru the ST ground from the locking contacts of the ON1 relay. If the trunk connected is busy, relays BY1 and TB1 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 D relay normal. Relay BH1 operated locks to the D relay ground and lights the ON1 lamp. Should the trunk become idle while still connected to the test circuit relays BY1 and TB1 will release. Relay TB1 released operates relay SL1 thru relay BH1 operated thru relay ON1 normal. Relay SL1 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 SL1 operated to operate relay BY1 on its primary winding, b - opens the operate circuit of relay SL1 and c - prepares the busy ground. Relay BY1 operated closes its secondary winding thru the winding of relay TB1 to the sleeve of the test jack to make a second busy test. When the slow release SL1 relay is normal relay BY1 releases unless there is a busy ground on the sleeve. Relay ON1 will lock to the D relay ground thru relay TB1 normal under this condition, when relay SL1 is normal. 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 normal contacts of the ON1 relay when the BY1 relay releases.

5.03 Busy Test using Fig. 13 & 14

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 made 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 is as for the T and MB jacks being patched to the T1 and MB1 jacks respectively for the trunk in service test and the T jack connected to the T1 jack for the trunk MB test.

5.031 Busy Test (Fig. 13 & Fig. 14) - Trunk in Service - TLK or TST Key Normal in Fig. 1

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 to operate the TB1 relay, close the TN1 relay to the TNR lead to operate in series with a relay in the trunk, close part of the operate path for the ON1 relay and operate the ON1 lamp. 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 close a path to operate the SR1, close the ST lead to Figure 1, open the operate path of the TB1 relay, supply additional ground to operate the ON1 lamp and locks itself to the ground on the D1 relay normal contacts. When SR1 relay operates it opens the ST lead path 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 releases it closes thru the ground from the locking contacts of the ON1 relay to the ST lead to Fig. 1.

5.032 Busy Test (Fig. 13 & Fig. 14) - Trunk in Service - TLK or TST Operated in Fig. 1

When TLK1 or TST key is operated the BH1 relay will be operated. The BH1 relay operated will lock to ground on D1 relay, close part of the ST lead path, light the ON1 lamp, operate 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 the ground on the S lead from the trunk. The BT1 relay operated will, release the TB1 relay, close the winding of the TN1 relay to the TNR lead to operate in series with a relay in the trunk to make the trunk busy to all calls, close in part the operate path of the ON1 relay and close an additional ground to keep the ON1 lamp lighted. 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 provides 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.

5.033 Busy Test (Fig. 13 & 14) - Trunk Made Busy With MB Plug

When a trunk is to be tested that has been made busy with an MB plug, 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 TN1 relay operates to a 700 ohm battery thru the normal contacts of the D1 relay. The circuit operations are similar to those described in par. 5.031 and 5.032. The trunk being tested however may be picked by the Master Test Frame and cause interference since the MTF can override a MB plug in the MB jack on a test call.

5.04 Operator Class Trunks Test

5.041 For operator class of trunks the TLK1 key is operated after the trunk has been patched to the test jacks. When the busy test has

functioned and the trunk is idle the TLK1 relay will operate and close thru 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 RS1 key normal. The PB relay will operate in series with the trunk A relay when the TLK1 relay operates and light the SUP1 lamp. When the distant operator answers the trunk reverses its battery and ground the PB relay releases and extinguishes the SUP1 lamp.

5.05 Voltmeter Test

5.051 Preparation

The trunk to be tested is patched to the test jack and the VM1 key is operated to make a voltmeter test of the trunk. When the busy test has functioned and the trunk is idle the VM1 relay will operate and close thru the trunk to the voltmeter and voltmeter test keys.

5.052 Tip and Ring Test

With only the VM1 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 VM1 key. With the VM1 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.

5.053 Test for Foreign Battery

To test for foreign grounded negative battery on the ringside of the trunk, keys (FEMF) and (G) are operated. To test for foreign grounded positive battery on the ringside of the trunk keys (FEMF), (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 (FEMF). Test for foreign metallic battery having its positive side connected to the ringside of the trunk are made by operating keys (FEMF) and (VM REV).

5.054 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 301. 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 megohm. 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 (AM) scale the resistance may be computed by multiplying the milliammeter reading by 203, subtracting from the test voltage and dividing by the milliammeter reading.

5.055 Ballistic Capacity Test

This test may be made to determine the approximate capacity of an open trunk. To make a ballistic test, keys G and REV are operated. The REV key is operated both ways in synchronism with the movement of the voltmeter needle as the capacity of the circuit under test charges and discharges, giving a fairly steady position of the voltmeter needle.

5.06 Testing Revertive Pulse Trunks

5.0601 Preparation

When testing revertive pulse trunks the called number is depressed on the Register Keys, the required

trunk compensation keys are operated, if the call is to be first routed thru a distant office the DOS Key (Fig. B) is operated, the distant office brush and group is set up by depressing the TAN T and TAN U keys (Fig. 2) respectively also the DOS COMP keys (Fig. B) are operated for the office compensation, the ANO key (Fig. 3) is operated to make an A relay non-operate test, the PRE OPR A & L RYS key (Fig. 3) is operated to make an A & L relay false operate test on cable charge, when the A & L relay tests are made the A RY NON-OPR COMP & L RY NON-OPR COMP keys are operated as required, the TST1 key (Fig. 1) is operated and the class RP key (Fig. 3) is operated. The trunk test jack is then patched to the test circuit test jack. The Register keys depressed in Fig. 2 close thru leads to be Revertive Pulse Fig. 3 to control the IB, IG, FB, FT and FU pulses. The DOS key closes a path in part to operate the DOS relay which when operated will arrange the circuit to close the DOS COMP into the T and R and send out the office brush and group pulses as indicated by the keys depressed on the TAN T and TAN U keys, ahead of the incoming and final selections. The TST1 key operated will close thru the ST lead to Fig. 3 to start the call when the trunk is idle and the busy test circuit has functioned (see par. 5.02 and 5.03). The RP key closes thru a circuit to operate the RP relay which closes thru the ST lead path in Fig. 3 to operate the ST relay when the ST lead is grounded. The DOS COMP keys are arranged to cut-in resistance for distant in 300 ohm steps up to 1200 ohms. The trunk compensating keys are arranged to cut in one step of 250 ohms and then 300 ohm steps up to 3600 ohms. The L RY NON-OPR RES Keys and the A Ry NON-OPR RES keys are arranged to cut in resistance in 500 ohm steps up to 5500 ohms for L Relay NON-OPR test and up to 12,500 ohms for the A Relay NON-OPR test.

5.0602 Start of Call

When the busy test circuit has functioned and the trunk is idle the busy test circuit grounds the ST lead to Fig. 3. The ground on the ST lead will operate the STR relay. 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 C1 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 use, e closes the "FL" lead to the SDR interrupter causing the SDR lamp to flash, f opens the switch return to normal ground and g closes a lock ground for relay AV.

5.0603 Distant Office Trunk Test
Figure B

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 STR 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 arranges 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 relays 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 selections (minimum time required is 100 milliseconds.)

5.0604 Distant Office Brush Selection 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 FS 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.

5.0605 Distant Office Group Selection RS Switch Term. 3

Relays DOS and FS remain 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.

5.0606 Distant Office Test Line Trunk Test - 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 RP1 key 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 TG1. Relay TG1 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 TG1 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.

5.0607 Crossbar Tandem Office - Transmission Test Line Test RS Switch Term. 18

To make a transmission test line test a transmission test circuit such as the 12A may be patched between the test circuit T1 jack and to the T jack of the crossbar tandem trunk to be tested at the T and MB jack bay. The call is then made as described in par. 5.0605. When the call has terminated on the test line the transmission measurements are made with the 12A set.

5.0608 Terminal 19 RS Switch Overflow Check

Ground from arc 1 operates relay FS on its secondary winding thru the DOS relays 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 FO1 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 TG1 thru arc 5 of the RS switch. Relay TG1 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 TG1 relay. The release of relay FO2 allows the O, BO, and FO relays to release if relay TG1 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 transfers 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.

5.0609 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.

5.0610 Dist. Off. Test Line Overflow Condition 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 TG1 as explained in paragraphs 5.0606 and 5.0608 and relay OF opens the ground to TG1 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 slow release of relay OF2, c supplies a ground to relay OF2 for use in

operating and locking relay OF3 later, d closes the OFL interrupter in part to the OFL lamp and e closes the OF relay lock ground to the IA1 relay causing it to operate. Relay IA1 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 operates 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 closes the front contact of relay OF2 to a make contact of relay FO2 for operating relay O when relay FO2 is operated later. The release of relay FO will allow the slow release FO1 relay to release. Relay FO1 released releases the slow release 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, FO2 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.

5.0611 Dist. Office Overflow Call Routed to Regular Selector Circuit

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 IA1. Relay IA1 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 locks 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 reoperate. 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 5.0610. 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.

5.0612 Distant Office Telltale

The test circuit functions 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.

5.0613 Incoming Trunk Test

When the RS switch is on terminal 7, the RP1 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 RP1 relay winding. Relay RP1 operated, a supplies a 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 c 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 VM1 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 RP1 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, VM1 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. Relays TG or MTG operated will operate relay TG1. Relay TG1 operated will operate relays O, BO and FO thru the OF relay normal. Relay FO operated operates relays 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 TG1 is released, and c allow the energized RS switch to step to terminal 8.

5.0614 Trunk Guard Test on Twenty-Four Volt 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.

5.0615 Incoming Brush Selection RS Switch Term. 8

With the RS switch on terminal 8 and the RP1 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 makes 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 relay FO3. 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.

5.0616 Incoming Group Selection 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 hundreds 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 resistances (25,500 ohms) across the fundamental cut thru 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 the HF key will be operated.

5.0617 Final Brush Selection 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 form 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.

5.0618 Direct Mechanical Final Tens Selection 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.

5.0619 Final Units Selection (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 12 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 relays 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.

5.0620 Incoming Overflow or Telltale RS Switch Term. 8, 9 or 10

During selections reversed battery may be received due to an overflow or telltale. Under these conditions the OF relay which is in series with the STP relay will operate. The OF relay operated locks to ground on relay FS operated and operates the OF1 relay thru relay IA the slow release OF2 relay, b operates relay IA1 from ground thru relay OF operated, c supplies a ground for holding the RS switch, d closes in part the OFL interrupter to the OFL lamp and e supplies a ground to relay FO2 for operating and locking relay OF3. Relay IA1 operated closes the O counting relay to the STP relay contact causing relay O 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 O then its release when the fundamental is opened at the selector will allow relays BO and FO to operate. On distant office overflow or telltale 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 OFL 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.

5.0621 **Battery Cut-Off Panel Incoming - Test for False Operation of the Incoming L Relay on Cable Charge Condition 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 par. 5.0601 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 par. 5.0613 to par. 5.0619. When the RS switch reaches terminal 13 on a test call to a panel incoming selector relay LC operates thru the RP1 relay (held operated with the (PRE. OPR. A & L RYS) key operated) thru relay FO1 normal. Relay LC 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. 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 is closed across the line for 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 advance and may operate as the cable charges and thus cause the 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 "FR" lead, c opens the OFL interrupter circuit and d releases the FO2 relay. 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 LC releases and releases relay CK.

5.0622 **Panel Incoming - L Relay Non-Operate Test 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 RP1 relay operated thru the FO1 and CK relays normal. Relay LNO operated locks to the same ground by passed around relays FO1 and CK and, a closes ground thru relay CK normal to operate relay FO2, b closed ground to the FO1 relay for operating relay CK, c closes the FT lead thru relay ST1 operated thru the RP1 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, and f closed the OFL interrupter thru the CK relay normal to number 3 counting relays. The L relay of the panel incoming selector

is given a non-operate 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 3 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. Relays 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 non-operate test. (Grd. Tip and Bat. Ring of Trk.). If, however, the L relay had operated during the non-operate 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 non-operate compensating resistance keys should be operated to limit the current thru the L relay as near as possible to its non-operate test value. Key RICR-20000 is used to compensate for the repeating incoming selector L relay non-operate 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 non-operate test shall be omitted.

5.0623 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 IA1, 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 relays 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 IA1 relay. Relay IA1 operated closes the ground from OF2 operated thru relay OF3 normal thru the STP relay operated to the O 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 O. This path is only needed on incoming trunks that give a short reverse battery period and is under control of the TFV key. The IA1 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.

5.0624 False Operation of Incoming A Relay on Cable Charge. Battery Cut-Off Panel Incomings Only. RS Switch Term.16

This test is made only when the test circuit is connected directly to the 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 O 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 relays 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 winding 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 & L 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 RP1 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.

5.0625 Circuit Restored 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 RP1 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 lights the SDR lamp 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 ST1 operated to the "AV" lead. Ground on the "AV" lead to Fig. 1 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.

5.0626 Advance of RS Switch Under Rapid Test

In case both the ANO and PRE. OPR. A & L RYS. keys are normal on a direct mechanical call the RP1 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 PRS. OPR. A & L RYS. key normal thru arc 6, thru terminal 16 by ground from key ANO normal thru arc 6.

5.0627 A Relay Non-Operate Test (RS) Switch Term. 16 Panel Incoming Selector 24 Volt Trunk and Crossbar Incoming Trunk-Test Call to Busy Lines

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 of RS switch advances the RS switch to terminal 15 where incoming advance is made the same as explained in paragraph 5.0623 which causes the switch to step to terminal 16. On terminal 16 relay RP1 is held thru the ANO key and RP relay operated. Under this condition ground from arc 1 operates the ANO relay thru the RP1 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, c 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 RP1 relay operated thru relay ANO operated thru the A relay non-operate resistance thru relay ANO thru the L relay non-operate resistance thru the winding of relay CH thru the ANO key operated thru the ANO 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 relays 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 under control operation. 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 RP1 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.

5.0628 Advance for Call Indicator Operation Thru Distant Office, Fig. B

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.

5.07 Testing Panel Call Indicator Trunks

5.0701 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 keys 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 digits, P.C.I. pulsing thru Sender Tandem or Tandem P.C.I. trunks. The six digits would consist of the TAN T, TAN U, 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 and the TST1 key 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 and the busy test is made as described in par. 5.02, and 5.03. When the PCID key is operated it operates the PCID relay. When the PCIT key is operated it operates the PCIT relay. When the 6, 7 or 8 button is depressed in any row of register keys in Fig. 2 they operate the CI6, CI7, or CI8 relay respectively and in turn these relays operate the 1-2, 3-4, PT or PR relay in the various pulse periods to pulse out the proper pulses for 6, 7 or 8. 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 P.C.I. 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 Z options are wired. The operation of the PCID relay 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 will operate the STR relay in Fig. 3. The operation of the STR relay in Fig. 3 will close ground thru the RP1 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.

5.0702 Panel Call Indicator Direct - 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 CI1 normal to the "FR" lead, d closes ground thru relay OFC normal to operate relay CI1 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 PG1 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 CI1 is operated, b closes ground from relay CI operated thru relay OFC normal to operate CI1 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 CI1 relay normal and e opened the operate circuit of relay SP. Relay CI1 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 relays 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 PCI trunk. When the fundamental leads of the trunk are connected to the control circuit the battery and ground thru the trunk (A) relay is removed and the PCI 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 CI1 relay operate circuit, and c operates the SP relay to ground on relay CI1 operated. Relay SP is the pulse start relay and causes the pulsing relays PG, 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 CI1 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.

5.0703 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 removes the circuit which causes relay PGC to operate towards its back contact. Under this

condition ground from relay CI1 operated shunts battery thru resistance BH and starts to operate relay PGC on 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 CI1 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 CI1 and SP relays are operated.

5.0704 Pulse Counting and Steering

The PG1 relay operated operates the PG2 relay thru relay CI1 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 "FT" lead, depending upon the stations register key operated. Ground from the CI1 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 of 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 PG1 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 PG1 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 PG1 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 PG1 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.

5.0705 Heavy Positive Pulse, "S" Wiring

When the last pulse of the pulse chain is sent the CI switch steps to terminal 17 where ground from relay CI1 operated thru, the brush of arc 1 CI switch is closed to operated relay FP1. Relay FP1 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 PG1 used to step the CI switch, to the winding of relay FP. The PG1 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 PG1 releases causing relay FP to operate. Relay FP operated, a opens the circuit to relay PG1, b closes the "FT" lead to the low resistance battery, c closes

the "FR" lead to ground on relay PG1 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 CI 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 CI1, c closes ground to the brush of arc 4 CI switch to cause it to return to normal. The transfer of the "FT" and "FR" leads terminate the heavy positive pulse. Relays CI and CI1 released restore the pulsing circuit to normal. Relay CI1 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 FP1 and completes restoring the pulsing circuit to normal.

5.0706 No Heavy Positive "R" Wiring

In this case relay FP1 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 PG1, 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 5.0706.

5.0707 Sender Tandem or Tandem Call Indicator - 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 V 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.

5.0708 Ground Period 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 PG1 and GR operate which they do in cascade at the end of the second and fourth pulse periods. Relay PG1 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 PG1 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 PG1 make contact until 1 and 2T of relay GR are opened.

5.0709 Overflow on Call Indicator Test Thru Distant Office Selector

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". Relay CG, and relay OFC will operate in series in this case as the battery will be reversed. Relays CG1 and CG2 will also operate as on a regular call indicator trunk test but relay OFC being operated opens the operate ground for relay CI1. This prevents the CI pulsing circuit from starting. Relay OFC in operating locks to the CI relay operated and operates relay OFX thru relay CI1 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 PG1 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 normal.

5.0710 Pulsing Numerical Digits Over Ten Thousand

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.

5.0711 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, C6, C7 and C8 are used to multiply the circuits from the numerical register keys to the PT and PR relays and are necessary 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.

5.08 Testing Multi-frequency Pulsing Trunks Arranged for WINK START PULSING SIGNAL

5.0801 Preparation

The number to be called is depressed on the Register Keys in Fig. 2. The required TRUNK COMP keys in Fig. 1 are operated. The required A OPR COMP keys in Fig. 4 are operated to compensate up to the operate value of the trunk A relay. The DPL key is normal for the WINK start pulsing signal. A WINK start pulsing signal is when the trunk is picked with ON HOOK called subscriber supervision. The polarity of the trunk is then reversed to OFF HOOK when the sender is picked and reversed back to ON HOOK polarity when the sender is ready to receive pulses. The TST1 and the MF keys are operated. The test circuit test jack is then patched to the trunk test jack and the busy test is made as described in par. 5.02 and 5.03. When the busy test circuit has functioned and the trunk is idle a ground is put on the ST lead to Fig. 7. When the MF key is operated it operates the MF relay. When the MF relay operates it a - disassociates the tip and ring leads of the test jack from the telephone circuit and connects them thru the supervisory relays, SU and SUR, in series and in reverse polarity to each other, b - it places a 1200 ohm short circuit across the tip and ring, c - closes thru in part the operate path of the RO relay in Fig. 4, and d - operate 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 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.

5.0802 Polarity Test

When the TL relay in Fig. 1 operates it closes thru the tip and ring from the test jack as follows - tip of the test jack, thru the VM1 relay normal, thru the RS1key normal, thru the TLK1 relay normal, thru TST1 relay operated, thru the TRUNK COMP keys operated, thru the TL relay operated, thru the FDP relay operated, thru the R1 relay normal, thru the TST repeat coil, over T lead to supervisory test figure 4, thru the A RY OPR COMP keys operated, thru the SU and SUR relays polar supervisory relays, over the R lead to Fig. 1, thru the TST repeat coil, thru the R1 relay normal, thru the FDP relay operated, thru the TL relay operated, thru TRUNK COMP 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. 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.

5.0803 Trunk Test and Start 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 sent out. This reversal is to ON HOOK and causes the SUR relay to release and the SU relay to reoperate. The SU relay operate will close thru a ground from its 5 contact thru the 2 contact, 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.

5.0804 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 controls 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 in Fig. 6 is used both for MF pulsing and automatic DP pulsing. 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, in Figures 10 and 11 for DP 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 provides 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 LPD and LRD network when the LPD or LRD relay is operated; the BGD network when the BGD relay is operated. Each network forms a voltage divider with its intermediate point being connected thru operated contacts of the MF circuit or DP circuit relays, 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. When DP pulsing is used only the PG condenser is connected. When MF pulsing is used 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 contact 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 LPD & LRD network or when the BGD network is connected to the pulse generator, the pulse generator pulses 10 p.p.s.

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 - operates the BD relay, d - 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 SK- 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 towards its front contact and the P relay operates. The P relay operated 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 C0 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 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 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

5.0805 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. 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.

5.0806 Connection to Telephone Circuit

When all the digits have been pulsed for the call and it is desired to connect to the telephone circuit for talking or listening the TTLK key is operated. Should it be desired to hold a completed call on one cord and send another call on the other cord the first call may be held by operating the associated TLK1 or TLK2 key of the cord with the completed call. The operated key will operate its associated relay to close a polar relay bridge across the T and R.

5.0807 Ringing

The test circuit is arranged so that continuous machine ringing may be applied to the trunk by operating the R+ key or Simplex Ringing may be applied by the operation of the SX key.

5.0808 Disconnection and Repeat Test

The call may be disconnected by releasing the various keys operated for the call and then operating the DISC 1. To make a repeat test on a cord the DISC 1 or DISC 2 key is operated until the ON1 or ON2 lamp is extinguished and then the disconnect key is released. The circuit will then function as previously described.

5.09 Testing MF Pulsing Trunks Arranged for STOP-GO Start Pulsing Signal

5.0901 Preparation

The preparation for testing MF pulsing trunks arranged for STOP-GO start pulsing signal is the same as described in par. 5.0801 for WINK start pulsing signal except that the DPL key is operated. The STOP-GO 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 GO signal.

5.0902 Polarity Test

The polarity test of the trunk is made the same as described in

par. 5.0802. With the STOP-GO 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 par. 5.0802.

5.0903 Trunk Test and Start 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 STOP-GO start pulsing signal the SU relay will operate. The SU relay will operate the SU1 relay. The SU1 relay will perform the same functions as described in par. 5.0803. 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, a - locks 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 SGO lead to Fig. 6, thru the SG relay winding to battery. The SG relay operated will perform the same functions as described in par. 5.0803.

5.0904 Pulsing and Steering

Same as described in par. 5.0804 with the exception that the SUR relay operates the SG relay in Fig. 6 to start pulsing.

5.0905 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. 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 par. 5.0805.

5.0906 Connection to Telephone Circuit

These functions are the same as described in par. 5.0806.

5.0907 Ringing

These functions are the same as described in par. 5.0807.

5.0908 Disconnection and Repeat Test

The functions are the same as described in par. 5.0809.

5.10 Testing Dial Pulsing Trunk Arranged for GO START PULSING SIGNAL

5.1001 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 is Fig. 10 is operated for loop resistance pulses or the BGD key in Fig. 11 is operated for battery and ground loop pulses. The GO key is operated for the GO start pulsing signal. The S-GO key operated 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 keys in Fig. 1 and the required A OPR COMP keys in Fig. 4 are operated. The TST1 key in Fig. 1 is operated and the DP key in Fig. 10 is operated. The test circuit test jack is then patched to the trunk test jack and the busy test is made as described in par. 5.02. When the busy test circuit has functioned as described in par. 5.02 or par. 5.03 and the trunk is idle a ground is put on the ST lead to Fig. 10. 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 the 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. The TST1 key operates the BH1 relay and closes a ground to operate the BH1 relay in the busy test circuit. The TST1 relay operated, a - closes thru the Tip and Ring to the test circuit and b - closes thru the ST lead from the busy test circuit. When the DP key is operated it operates the DP relay. The DP relay operated, a - operates the DP1 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 the S-GO relay it connected the SK1 and SK2 relays in the circuit to absorb a STOP-GO signal after pulsing has started. The DP1 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 busy test circuit has functioned and the trunk becomes idle a ground is put on the ST lead. 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 - closed a ground to the pulse generator circuit to operate the PG relay in its release direction closing the 4 and 7 contacts, c - closed a ground to operate the FDS relay, d - closed 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 arranged to receive dial pulses when picked will send a start pulsing signal to the test circuit to start pulsing immediately when picked. These trunks are arranged for GO start pulsing signal. 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.

5.1002 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 SG relay removes the ground from the midpoint of the pulse generator PG relay which causes it to start pulsing. Although the P relay will operate and release, since the TL relay in Fig. 1 is not operated, no dial pulses will be sent out on the T and R. The CKP relay will

operate and release control relays for the delayed closure time counting the pulses on the LC, LD and LE, and P1 to P5 relays. When the P5 relay operates the ground from the FDS 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 contacts and the SP1 relay operates.

5.1003 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-operate, 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 VM1 relay normal, RS1 key normal, TLK1 and TST1 relays normal, thru TRUNK COMP 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 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 keys operated, thru TST1 and TLK1 relays operated, thru RS1 key normal, thru VM1 relay operated to Ring of test jack. 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. 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 LC to LE and P1 to 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.

5.1004 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 is closed thru to the T1 and the BD relay operated short circuits the repeat coil and

the polar supervisory relay 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 contacts 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 par. 5.1003 and then pulse out the next train of pulses for the next digit under control of the CKP and P relay as previously described. 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 DP1 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 DP1 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.

5.1005 Polarity check of Trunk 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 par. 5.0802 except that the DP relay will be released instead of the MF.

5.1006 Polarity Check of Trunk - During Interdigital Time 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 par. 5.0802 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 relay the SK1 will light 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.

5.1007 Connection to Telephone Circuit

These functions are the same as described in par. 5.0806.

5.1008 Ringing

These functions are the same as described in par. 5.0807.

5.1009 Momentary Open Check

These functions are the same as described in par. 5.0808.

5.1010 Disconnection and Repeat Test

These functions are the same as described in par. 5.0809.

5.11 Testing Dial Pulsing Trunks Arranged for STOP-GO Start Pulsing Signal

5.1101 Preparation

The preparation will be the same as described in par. 5.1001 except that the GO and DPL keys will be operated for the STOP-GO 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.

5.1102 Delayed Closure Time

The circuit functions the same as described in par. 5.1002,

5.1103 Trunk Test and Completion of Timing

The circuit functions the same as described in par. 5.1003 except that with the DPL relay operated, the SUR relay operated will close a ground to operate the SG relay to complete timing.

5.1104 Pulsing

The circuit functions the same as described in par. 5.1004.

5.1105 Polarity Check of Trunk after Delayed Closure Time

The circuit functions the same as described in par. 5.1005 except that the DPL key is operated for STOP-GO. 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 par. 5.0802 except that the DP relay will be released instead of the MF relay.

5.1106 Polarity Check of Trunk - During Interdigital Time after Pulsing has Started

The circuit will function the same as described in par. 5.1006.

5.1107 Connection to Telephone Circuit

The circuit will function the same as described in par. 5.0806.

5.1108 Ringing

The circuit will function the same as described in par. 5.08077.

5.1109 Disconnection and Repeat Test

The circuit will function the same as described in par. 5.0909.

5.12 Testing Dial Pulsing Trunks Arranged for WINK Start Pulsing Signal

5.1201 The preparation will be the same as described in par.5.1001 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.

5.1202 Delayed Closure Time

The circuit functions the same as described in par. 5.1002.

5.1203 Trunk Test and Completion of Timing

The circuit functions the same as described in par. 5.1003

except that with the GO and DPL relays normal when the SU relay operates the second time for the WINK start pulsing signal it will close a ground to operate the SG relay to complete the timing and start pulsing the digits.

5.1204 Pulsing

The circuit functions the same as described in par. 5.1004.

5.1205 Polarity Check of Trunk after Delayed Closure Time

The circuit functions the same as described in par. 5.1005 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 par. 5.0802 except that the DP relay will be released instead of the MF relay.

5.1206 Polarity Check of Trunk - During Interdigital Time after Pulsing has Started

The circuit will function the same as described in par. 5.1006 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.

5.1207 Connection to Telephone Circuit

The circuit functions the same as described in par. 5.0806.

5.1208 Ringing

The circuit functions the same as described in par. 5.0807.

5.1210 Disconnection and Repeat Test

The circuit functions the same as described in par. 5.0809.

5.13 Momentary Open Check

When the momentary open check is to be made the MO key is operated and a call is directed 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 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.