COMMON SYSTEMS
TEST LINE CIRCUIT
FOR ONE WAY TRANSMISSION TESTING
FOR USE WITH SWITCHBOARD NO. 1, 1C, 1D, 9C, 10, 11, 12, 13, 14 OR 15
MANUAL TANDEM SWITCHBOARD NO. 1
TOLL SWITCHBOARD NO. 1, 1B, 2, 3, 3C OR 3CL
TOLL TANDEM SWITCHBOARD NO. 1 OR 3
TOLL TEST BOARD NO. 5, 16, 17B OR 18B
PANEL, STEP BY STEP, CROSSBAR NO. 1 OR 5
CROSSBAR TANDEM, TOLL SWITCHING
SYSTEM NO. 4 OFFICE OR
SXS INTERTOLL SELECTOR

CHANGES

B. CHANGES IN APPARATUS

B.1 Added

Fig. 25
(CB1) 274J Inductor Option "WW"
(B) 4.28-4.36 Capacitor Option "WW"
Fig. 30
(CB1) 274J Inductor Option "WW"

B.2 Superseded

Fig. 23
(TR) 18ET Resistor Option "K"
(TR) 18AF Resistor Option "J"
(TP) 18AF Resistor Option "YD"

Superseded by

Fig. 23
(TR) 353A Electron Tube Option "WU"

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Changes in circuit operation on this issue are included in Issue 21-AR of the CD sheets.

D.2 In Fig. 23 Option "YM" is rated Mfr. Disc. and Option "WX" is added as an alternate for Option "YN." Option "YN" is used for "on-hook" supervision and Option "WX" is used for "off-hook" supervision.

D.3 In Fig. 23 Options "J," "K" and "YD" are rated Mfr. Disc. and are superseded by Option "WU" which is added to provide for tripping ringing and meet the wide variations in ringing plants encountered in the use of this circuit.

D.4 In Figs. 9, 25 and 30 Option "WV" is designated and Option "WW" is added to provide for optional "on-hook" or "off-hook" supervision.

D.5 In Fig. E reference to its use with Toll Testboard 17B or 18B is rated Mfr. Disc. since connections for Toll Testboard No. 5, 17B or 18B are covered on SD-95101-01.

D.6 Figs. L and P are rated Mfr. Disc., since to maintain accuracy in testing the test lines should not be bridged.

D.7 In Fig. 2 the connecting information is added for 600Ω, or 900Ω impedance connections to the milliwatt distributing circuit.

D.8 Connecting information is added in Fig. 2 for the Test Termination Circuit.

D.9 Titles are added to Figs. 3 and 4.

D.10 In Fig. 19 at capacitor (B) reference to "WZ" option is removed and reference to Option "WJ" is added. This change agrees with the manufacturing drawings and was inadvertently shown in error on the previous issue.

D.11 The straps on the interrupter leads in Fig. X are changed to show connection to other circuits in the same bay. This change is in agreement with the manufacturing drawings.

D.12 Circuit Note 102 is changed (a) to delete reference to Figs. L and P which are rated Mfr. Disc., (b) to clarify the use of Options "WH" and "WG" with Fig. X, (c) at Fig. 2 reference is added for Test Termination circuit and miscellaneous circuits for Master Test Frame, (d) reference for Fig. 23 is simplified, and (e) reference is added for Options "WV," "VW,"WW" "YN," and "WX."

D.13 Note 103 is changed to add reference to Options "J," "K," "YD," "WU," "WV," "WW," "WX," "YM," and "YN" and Figs. L and P which are changed or added on this issue.

D.14 The Options Used table is changed to add reference to Options "WU," "WV," "WW" and "WX" which are added on this issue.

D.15 Note 109 is changed to agree with manufacturing drawings and shows realistic values instead of theoretical values for the resistors.

D.16 This circuit is rated Mfr. Disc. and is replaced by SD-98100-01 and for Toll Testboards by SD-95101-01. This change is made in the rating box and replacement box.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2321-GAB-AAB-LN

COMMON SYSTEMS
TEST LINE CIRCUIT
FOR ONE WAY TRANSMISSION TESTING
FOR USE WITH SWITCHBOARD NO. 1, 1C, 1D, 9C, 10, 11, 12, 13, 14 OR 15
MANUAL TANDEM SWITCHBOARD NO. 1
TOLL SWITCHBOARD NO. 1, 1B, 2, 3, 3C OR 3CL
TOLL TANDEM SWITCHBOARD NO. 1 OR 3
TOLL TEST BOARD NO. 5, 16, 17B OR 18B
PANEL, STEP BY STEP, CROSSBAR NO. 1 OR 5
CROSSBAR TANDEM, TOLL SWITCHING
SYSTEM NO. 4 OFFICE, OR
SXS INTERTOLL SELECTORS

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Option "WH" is extended to include additional wiring on 6-7T of relay (LO) in Figs. 22 and 23 to maintain ground on the "ST" lead of the interrupter circuit, during the period when (LO) relay is operated and relay (OS) is normal.

All other headings under "Changes," no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit is used as a test line circuit outgoing from subscriber's or outgoing trunk multiple in manual offices, from the trunk multiple in manual tandem offices, from trunk multiple in toll offices, from toll line multiple in toll tandem offices, from the bank multiple of intertoll dialing step by step selectors, from test line circuit for transmission measuring toll test board, from the final multiple in panel offices, from the primary switch of the subscriber's line link and group control circuit of No. 1 Crossbar Offices, from the (OS) jack on district selector test frames panel and No. 1 Crossbar Offices, from the send 1MW jack of the miscellaneous circuit for tandem trunk frame, from the line switch of the line, line link and connector circuit in the No. 5 Crossbar Office, from the connector multiple in step by step offices, from the trunk multiple of panel, step by step, and crossbar"A" switchboards and the trunk multiple of the office link and connector circuit in crossbar tandem offices, from the 1MW jack of the automatic outgoing intertoll trunk test circuit, or from the switchboard jack multiple of No. 3, 3C or 3CL switchboard, sleeve supervision No. 10 switchboard or No. 11 Toll Switchboard, or No. 1 Type Toll Switchboard to the sending circuit of the one way transmission testing system in the same office.

This circuit also provides a balance test termination from the trunk multiple of the office link and connector circuit in crossbar tandem offices or from SXS tandem selector multiples, from the subscriber multiple in manual offices, the final multiple in panel offices, the line, line link and connector circuit in No. 1 or No. 5 Crossbar Offices, the selector multiple of intertoll dialing step-by step selectors from the multiple jacks of No. 13, 15 or 15 DSA switchboard or from the multiple jacks of the No. 3, 3C or 3CL DSA switchboard or from the No. 1 type toll switchboard for use by toll test boards in determining singing margins on toll trunks.

This circuit also provided short circuit and open circuit terminations for use in testing "E" type repeaters.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS

Figs. 1, 2, 3, 4, 5 or 6.

3.01 Operates to start the test on either ringing or silent battery.

3.02 Trips machine ringing on either ringing or silent periods.

3.03 Prevents advance of circuit until manual operator discontinues ringing on test line.

3.04 Arranged to close a bridge across the tip and ring or battery and ground through a retardation coil and resistance to the tip and ring to stabilize contact resistance.

3.05 Arranged to operate the supervisory relay over the tip of the test line of L.D. incoming and toll transmission selectors arranged to give tone to intercepting operators, to cause the (TD) relay to be shunted from the circuit during transmission tests.

3.06 The feature which operates the L.D. supervisory relay is functioned on

an interrupter basis to allow an interval for release on disconnect condition.

3.07 Transfers the leads from the 1000-cycle power supply circuit from the artificial load to the test line.

3.08 Removes the direct current path through the (R) relay when the tripping resistance is applied.

3.09 Closes ground to start the 1000-cycle power supply circuit.

3.10 Closes the ringing ground to the (INT) relay when "A" wiring and apparatus are specified in accordance with Note 106.

3.11 Provides a means of applying the trip circuit on each succeeding ringing interval if ringing is not tripped on the first trip circuit closure.

3.12 Provides battery through a retardation coil to operate the bridged relay in No. 1 local tandem switchboard trunks.

3.13 When Fig. "Y" is furnished provides for operation with No. 10 switchboard local cords (low resistance jack sleeve) and also for toll cords (high resistance jack sleeve).

3.14 Provides a jack to make connections to the panel or crossbar office "B" switchboard telephone circuit when using the "transmission measuring set."

3.15 Provides 1MW tone supply in No. 5 Crossbar Office when "transmission measuring set" is calibrated.

Fig. 1, 15 or Figs. 7 or 8 and 3, 4 or 13

3.16 Operates to start test on ringing interval only, Fig. 1 or 7. Operates to start test on either ringing or silent battery, Fig. 15.

3.17 Trips machine ringing on ringing interval only, Fig. 1 or 7. Trips machine ringing on either ringing or silent period, Fig. 15.

3.18 Prevents advance of circuit until manual operator discontinues ringing on test line.

3.19 Provides a means of applying the trip circuit on each succeeding ringing interval if ringing is not tripped on the first trip circuit closure.

3.20 Arranged to close a bridge across the tip and ring, providing a current flow to stabilize contact resistance.

3.21 Transfers the leads from the 1000-cycle power supply circuit from the artificial load to the test line.

3.22 Closes ground to start the 1000-cycle power supply circuit.

3.23 Closes ground to start the 60 IPM interrupter circuit.

3.24 Disconnects the test line from the 1000-cycle power supply after being connected for approximately 10 secs.

3.25 Provides a balance termination after the tone is removed.

Figs. 16 and R, S, T, U, V, Z, AD

3.26 Transfers the leads from the 1000-cycle power supply circuit from the artificial lead to the test line.

3.27 Closes ground to start the 1000-cycle power supply.

3.28 Closes 60 IPM ground from the interrupter supply to the selector switch to start timing.

3.29 When Fig. R or U is furnished, provides battery through a retard coil on the tip, "ZP" option, or ring, "ZO" option, to provide off hook supervision while tone is applied and on hook supervision when tone is removed.

3.30 When Fig. S is furnished, "ZS" option, provides a balanced bridge across the tip and ring to remove the pad while "YA" option provides an unbalanced bridge to retain the pad. On hook supervision is provided by"YB" option while tone is applied and off hook supervision when tone is removed, "YC" option provides off hook supervision while tone is applied and on hook supervision when the tone is removed.

3.31 When Fig. T is furnished, provides a bridge across the tip and ring for pad control purposes, operates the sleeve relay on its high resistance winding to provide off hook supervision while tone is applied, shunts the high resistance winding with the low resistance winding to provide on hook supervision when tone is removed.

3.32 When Fig. V or AD is furnished, provides a 500 or 34 ohm sleeve for pad control purposes, provides off hook supervision while tone is applied and places battery and ground on tip and ring to provide on hook supervision when tone is removed.

3.33 Disconnects the test line from the 1000-cycle power supply after being connected for approximately 10 seconds.

3.34 Provides a balance termination after the tone is removed.

Figs. 9, 10, 12, 17, 18, 19, 20, 21, 24, 25, 26, or 27

3.35 Provides a balance test termination in accordance with the impedance requirements of the outward office.

3.36 Fig. 9 or 25 is arranged to trip machine ringing during the ringing interval only.

3.37 Provision is made for repeatedly applying 1000-cycle tone for nine seconds followed by 1 second without tone on transmission test line which may be used by a PBX repairman for testing PBX cords.

3.38 Fig. 28 provides a 2 DB pad for test lines where office switching is a via net loss.

3.39 Provision is made for testing E type repeaters with either 600ω, 900ω or short circuit or open circuit terminations.

3.40 Provides for building-out the office cable capacity, on balance terminations when required, for offices switching at via net loss.

4. CONNECTING CIRCUITS

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

4.01 Transmission Measuring Milliwatt Distributing Circuits

4.011 Motor Driven (2A Panel) - SD-95000-01

4.012 Transitor Type - SD-98083-01

4.02 Jack Circuits

4.021 Switchboard No. 1 1C, 1D, 2 9C, 9D, 10 or 11 - SD-15345-01 or SD-90645-01.

4.022 Switchboard No. 12 - SD-15441-01.

4.023 Switchboard No. 13, 14 or 15 - SD-90468-01.

4.024 Toll Switchboard No. 1, 1B 3, 3C Toll Tdm. No. 1 and No. 3 - SD-64545-01.

4.03 Interrupter Circuits

4.031 Panel - GCO, SD-21666-01.

4.032 Panel - BCO, SD-21667-01.

4.033 Step-by-Step - SD-31606-01.

4.034 Crossbar No. 1 or Tandem - SD-25062-01.

4.035 Crossbar No. 5 - SD-25814-01.

4.036 Manual or Toll - SD-95078-01, SD-95036-01.

4.037 Power Signal Circuit - SD-80771-01.

4.04 Testboard Circuits

4.041 Local Test Desk No. 12 or 14 or WC Desk No. 2 - ES-96233-01.

4.042 Toll Testboard 18B or 17B Test and Maintenance Transmission Test Line - SD-62447-01.

4.043 Toll Test Board No. 5 - Test Trunk Circuit - SD-61172-01.

4.044 Test Termination Circuit - SD-96476-01.

4.05 Panel Circuits

4.051 Subscribers Line Circuit Ground Cutoff - ES-240292 or SD-21715-01.

4.052 Subscribers Line Circuit Battery Cutoff - SD-21712-01.

4.053 Miscellaneous Circuits for District Selector Test Frame - SD-21222-01.

4.06 Step-by-Step Circuits

4.061 Intertoll Dial, 1st, Auxiliary or Intermediate Selector (Typical) - SD-55242-01.

4.062 Selector Circuit (Typical) - SD-30200-01.

4.063 Connector Circuit (Typical) - SD-30215-01.

4.064 Connector Test Line - SD-32198-01.

4.065 Transmission Test Line and Switchmans Talking Line - SD-32021-01.

4.066 Automatic Trunk Test Circuit - SD-32206-01.

4.07 Crossbar No. 1 Circuits.

4.071 Subscriber Line, Line Link and Controller Circuit - SD-25553-01.

4.072 Number Group Connector Circuit - SD-25276-01.

4.073 Line Choice Connector Circuit - SD-25034-01.

4.074 Misc Circuits District Junctor Test Frame - SD-25173-01.

4.08 Crossbar No. 5 Circuits.

4.081 Line, Line Link and Connector Circuits - SD-25548-01.

4.082 Master Test Frame Circuit - SD-25762-01.

4.09 Crossbar Tandem Circuits.

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

4.092 Misc. Circuits for Tandem Sender Test Frame - SD-25377-01.

4.093 Misc. Circuits for Tandem Trunk Frame - SD-25370-01.

4.094 Misc. Circuits for Tandem Trunk Automatic Trunk Test Frame - SD-25378-01.

4.10 Toll Switching System No. 4.

4.101 Misc. Circuits for Automatic Toll Connecting Trunk Test Frame - SD-68209-01.

4.102 Automatic Outgoing Intertoll Trunk Test Circuit - SD-68404-01.

DESCRIPTION OF OPERATION

5. GENERAL

The test line circuit provides a connection from the transmission circuit under test to the 1000-cycle power supply which is the transmitting element of the one way transmission measuring system. When used in offices having intertoll trunks, provision is made for removal of 1000-cycle tone after approximately 10 seconds to permit disconnection from the calling end over an intertoll trunk employing single frequency signaling. The test line provide supervision which will cause the circuit under test as well as the originating test circuit to function properly as follows:

In Crossbar Tandem Offices handling intertoll traffic and with intertoll step by step selectors, receiver off hook supervision is provided while the tone is applied and receiver on hook supervision is provided after the tone is removed to provide uniform supervision with other toll line testing. Fig. "U" provides termination on an option basis to meet the need of the associated outward office for testing intertoll trunks switched to a subscriber's line but not when switched to a second intertoll trunk.

When used in any local office, No. 1 and No. 5 Crossbar and Step by Step, appearing in the subscriber's multiple, the circuit is arranged to trip ringing and provide receiver on hook supervision at all times. Also when used in crossbar tandem offices not having any intertoll trunks receiver on hook supervision is provided at all times. On this type of operation, tone is applied as long as the connection is held except for No. 5 Crossbar where a few intertoll trunk circuits may be encountered and consequently tone is applied for 10 seconds.

When used in No. 1, 3 or 11 type toll switchboards receiver off hook supervision is provided while tone is applied, receiver on hook supervision is provided as a disconnect signal to the operator when tone is removed.

Balance test lines, when used in connection with the test of any intertoll line, provide receiver off hook supervision so as to remove all single frequency signaling tones which may be used in the test connection. This single frequency signal tone, although it is not of high enough intensity to interfere with testing when the 1000-cycle tone is present, might interfere with balance tests. Provision is made to retain the pad.

6. OPERATION OF FIG. 1 (600 OR 9000 IMPEDANCE)

When the test line is seized the (SL) or (SL1) relay in Figs. A, B, C, D, L, M or N operates, or the "SL" and "CB" relays or the "PB" relay of Fig. P operates. The (R) relay will operate over the ring side of the line on either ringing current or battery. In either case the (R) relay will operate through its primary and secondary windings in series. A 9000 ohm resistance (R) is introduced in parallel with the "AC" path of the line (R) relay circuit to allow the (R) relay to operate on silent battery without tripping machine ringing or operating the supervisory relay of the trunk under test. The operation of relay (R) operates relay (R1) which in turn operates relay (TP1). The (R1) relay is made slow release, (minimum of approximately .275 second) and is used to close the tripping condition long enough to insure tripping machine ringing. When "ZM" option is furnished, the (R) thermistor delays the operation of the (R1) relay to prevent tripping if the (R) relay operates on line continuity test made by the marker.

Option "YE"

The operation of relay (TP1) partly closes trip circuit and operates relay (TP). Relay (TP) operated (a) locks to the (SL) or (SL1) relay of Fig. A, B, C, D, L, M or O, or the (PB) or (CB) relay of Fig. P, (b) connects ground to start the 1000-cycle power supply circuits, (c) prepares the circuit to operate relay (OS) Fig. 1, (d) closes the tripping resistance (TP) to the ring of the test line (e) opens the "DC" path through the (R) relay winding and (f) closes ringing ground to the (INT) relay winding if "A" wiring and apparatus are used. If the (R) relay operated on battery under this condition it would release. If, however, the (R) relay is being

held operated on ringing current it may not release until the machine ringing is tripped. On manual ringing trunks the (R) relay will not release until ringing is removed from the line. When the (R) relay releases, the (R1) and (TP1) relays release. The release of the (TP1) relay will cause the (OS) relay to operate through the (TP) relay operated.

Option "YD"

The operation of relay TP1 partly closes the path to operate relay TP2 and operates relay TP. Relay TP operated (a) locks to relay SL of Fig. D, (b) operates relay TP2, (c) opens the DC path through the R relay winding, (d) partly closes the path to operate the OS relay and (e) closes ground to the INT relay winding if "A" wiring and apparatus is provided.

If the R relay operated on battery it would release at this time. If, however, the R relay is being held operated on ringing current it may not release until ringing is tripped.

The operation of relay TP2 is delayed to insure that relay TP is operated before tripping of ringing can start.

The operation of the TP2 relay (a) connects ground to start the 1000-cycle power supply circuit, (b) closes resistance ground to the ring and resistance battery to the tip of the test line to trip ringing with polarity and value of battery which will not operate the called subscribers supervisory relay in the connector.

When the R relay releases the R1, TP, and TP2 relays release in order. Release of the TP1 relay operates relay OS through the TP2 relay released and the TP relay operated.

In case the machine ringing is not tripped after this operation, relay (R) will operate on the next ringing period causing the (R1) and (TP1) relay to operate and the (OS) relay to release which again closes the tripping circuit. The operation of relay (OS) will (a) close the (BR) resistance "M" wiring or the (TB) retardation coil in series with the (BR) resistance "N" or "ZA" wiring across the tip and ring of the line to cause a current flow, (which will help to stabilize the contact resistance of base metal contacts), (b) opens the (L) resistance and closes the 1000-cycle tone through condensers (T) and (R) to the trunk under test, and (c) closes battery to the (INT) relay contacts for use in operating the toll trunk supervisory relay on the tip of the line if "A" wiring and apparatus are specified. Under this condition the test attendant will hear the 1000-cycle tone and make the necessary transmission measurement. If the trunk under test is an L.D. incoming or toll transmission selector arranged to give a tone to the intercepting operator, the tone will only be heard clearly during the four second period, that the (INT) relay is normal. The (INT) relay follows the machine ringing interrupter in order to allow the transmission test to be made during a 4 second period and the test line to release during the 2 second period when the (INT) relay is operated thus removing the battery from the tip of the trunk. This battery on the tip of the trunk operates the (S) relay of the selector under test which in turn causes the circuit to function to shunt out the (TD) relay winding which is in series with the tip of the trunk. When the test attendant disconnects, the (SL), (SL1) or "SL" and "CB" or "PB" relay releases, which in turn releases the (TP) relay. Relay (TP) released allows the (OS) relay to release, restoring the circuit to normal. If this release had occurred on the toll trunk referred to above the release would wait on the 2 second period in which the battery is removed from the tip of the trunk before the disconnect could occur.

When Fig. "M" is used relay (SL) is operated over the "ANS" lead and locks on the "ALS" lead through the line choice or number group connector circuit.

When Fig. "O" is used relay (SL) is operated in parallel with the line hold magnet. This figure is used for testing No. 5 crossbar incoming and intra-office trunks.

Fig. "P". This figure provides for testing of lines in combined G.C.O. panel office and the No. 1 crossbar terminating unit (single or multi-office). For crossbar lines the (PB) relay operates over the "ANS" lead and closes the "ALS" lead to operate the LH magnets and locks to ground from the incoming trunk. The (PB) relay operated places a busy condition on the (S) lead to the G.C.O. panel office and grounds the "H" lead to Fig. 1 or 7 providing a locking path for the (TP) relay. "T" wiring option is used for individual or last line busy condition and "S" wiring option is for first or intermediate terminal hunting busy condition. For G.C.O. panel lines the (SL) relay operates over the "S" lead. Operation of (SL) relay, with the (PB) relay normal, operates the (CB) relay which places a busy condition on the "ANS" lead to the No. 1 crossbar office and closes ground to the "H" lead to Fig. 1 or 7 providing a locking path for the (TP) relay.

Fig. "L". This figure is used where one Fig. 1 or 7 is provided for use with a ground and a battery cut-off office in the same building. Relay (SL) operates from the final multiple sleeve ground in battery cut-off offices and connects battery through high or low resistance depending upon the type of line, to the

sleeve of the final multiple in the ground cut-off office as a busy condition. Relay (SL1) operates when the test line is selected by the final in a ground cut-off office. Relay (SL1) closes a combination ground and battery busy condition to the sleeve of the final multiple in the battery cut-off office as a busy condition. Either (SL) or (SL1) relay operated functions Fig. 1 or 7 as previously explained.

YH option and Fig. 22:

When used with Fig. 1 provides a means of modifying existing installations having Fig. 1, for repetitive timed disconnect of the 1000-cycle tone.

When the OS relay of Fig. 1 operates, the OSA "auxiliary" relay of Fig. 22 is operated in parallel with it. With "YS" option and Fig. 11 furnished, the (OSA) relay operated closes ground to the 60 IPM Interrupter Ckt. to start the INT Selector Stepping. With "YR" option and Fig. W furnished and the (OSA) relay operated ground is closed to lead FL on each closure of the back contact of the (TTO) Interrupter. This starts the INT Selector Stepping. With "YR" option and Fig. X furnished and the (OSA) relay operated interrupted ground is closed from the 60 and 120 IPM Interrupter Ckt. to operate the (FL) relay. The (FL) relay will follow the flashes of ground from the Interrupter Ckt. and a flashing ground on lead FL will start the INT Selector Stepping.

On each closure of ground to lead FL with relay OSA operated, selector INT will advance one terminal. When it closes the No. 9 terminal, relay LO will operate, and lock under control of the operated TP and normal TP1 relay. Relay LO operated, opens the holding path of relay OS.

The release of relay OS and OSA in position 9 of the INT selector removes 1000-cycle tone by (a) transferring the 1000-cycle tone from the trunk under test to the L resistance, (b) closes the trunk to a balanced termination to reduce singing and echo.

Relay LO operated also (1) with Fig. 11 furnished continues ground to the ST lead to the 60 IPM interrupter ckt. or with Fig. X furnished continues interrupted ground to the (FL) relay, (2) opens path to release magnet so that selector INT will not release in position 9, (3) restores the operate path of the rotor so that the selector will step to position 10.

In position 10 the CP "contact protection" relay will operate and (1) open the hold path of LO relay, (2) operate the release magnet of the INT selector. The selector will return to normal and ground on its off-normal ON contacts will prevent contact arcing.

As the INT selector leaves position 10 the LO relay releases which operates the OS and OSA relays to start the timing cycle.

This will put 1000-cycle tone on the line again for nine seconds followed by one second of no tone, to allow disconnection from a toll trunk employing single frequency signaling.

The circuit will continue to recycle providing the test attendant with nine seconds of tone for test followed by one second of silence for disconnect until the test in progress is completed.

7. OPERATION, FIG. 2 (600, 900, 1200 OR 1500 Ω) IMPEDANCE

When it is desired to make tests of cord circuits, telephone circuits, etc., connection can be made to Fig. 2. Under this condition the connection of a cord to either the high or low sleeve jack in the outgoing trunk multiple of the switchboard will operate the (SL) relay in Figs. "A", "E", "F", "G", "H", "I", "J", "K", "N" or "Y". When this circuit is used to test trunk circuits from the test board the patching of the test line to the trunk circuit operates the (SL) relay. The operation of relay (SL) operates relay (OS) which, (a) closes ground to start the 1000-cycle tone of the power supply circuit and (b) transfers the power supply circuit tip and ring leads from the (L) resistance to the tip and ring of theequipment under test. When connected to a crossbar tandem office link and connector circuit, the (OS) relay will operate to ground on the "S1" lead. When connected to the automatic outgoing intertoll trunk circuit, the (OS) relay will operate toground on the "H" lead.

The retardation coil and resistance across the tip and ring in Fig. 4 or the retardation coil and 48 volt battery in Fig. 3 provide a current flow to help stabilize the resistance of base metal contacts. In addition, the retardation coil in Fig. 3 connected to 24 volt battery is used to operate the bridged relay in No. 1 local tandem trunk circuits.

Fig. 2 will also be used in connection with Transmission tests of District selectors in panel and district junctors in No. 1 crossbar offices by connection to the (OS) jack on the district test frame. When used for transmission tests of outgoing trunk circuits in No. 5 crossbar the connection is established through the master test frame trunk test circuit. It is used for making transmission tests of tandem trunks via the tandem trunk automatic test circuit in tandem crossbar offices "ZZ"

option, to test outgoing switching trunks for transmission via the outgoing trunk automatic test circuit in No. 4 toll offices, by connection to the (OS) jack on the associated test frames, and to test outgoing and 2 way intertoll trunks in No. 4 and 4A offices by connection to the (1MW) jack on the automatic outgoing intertoll trunk test circuit in No. 4 and 4A toll offices. Fig. 2 is also used in connection with the Test Termination circuit at OGT Test Frames.

Fig. "H" employs a high resistance sleeve relay to prevent the operation of the marginal sleeve relay in the #1 toll tandem trunk thus preventing the start of ringing.

Fig. "I" employs a low resistance sleeve relay to insure operation of the marginal sleeve relay in the #3 toll tandem of trunk which prevents the start of ringing.

Fig. "J" employs a resistance and relay to simulate a No. 3 or No. 11 toll cord sleeve for making tests on toll lines from a No. 16 or 18B toll test board.

Fig. "K" employs a relay simulating a No. 1 or No. 2 toll cord sleeve for making tests on toll lines from a No. 5 toll test board.

When Fig. "F" and "ZN" option is furnished for use with Toll Switchboard No. 1B, the NON RING key of the Discriminating Circuit SD-64702-01 at the switchboard should be operated momentarily before the plug of a cord at the Toll Switchboard No. 1B is inserted in the jack connected to the (SL) relay, in order to cut through the cord circuit under test.

Fig. "G" employs a 25 ohm resistance (SL) to give a toll line sleeve condition when this figure is used with a #1 toll switchboard and a connection to Fig. 5 which will operate the (SL) relay through a 200 ohm resistance when the jack of Fig. 5 is used.

Figs. 5 and 6 are used in connection with Fig. "G" and when a plug is inserted in (Send 1MW) jack, battery is closed through (SL1) resistance, and "make contact" of (Send 1MW) jack through "P" winding of (SL) relay of Fig. "G" to ground operating (SL) relay, in turn operating (OS) relay. This (Send 1MW) jack is used to patch the 1000-cycle power supply to the "Tel. Ckt." under test in conjunction with the "transmission testing set."

Fig. N. The (SL) relay winding connects to the local contacts of jacks at a No. 12 Switchboard. A cord inserted in one of these jacks operates the (SL) relay, which operates the (OS) relay of Fig. 2 or B and connects ground to the sleeves of the jacks as a busy condition.

Fig. "Y" is furnished for use with No. 10 switchboard. The high resistance jack sleeve for toll cords is obtained by inserting resistance (SL) in series with the winding of relay (SL). The low resistance jack sleeve for local cords is omit resistor (SL). Relay (SL) operates relay (OS) of Fig. 2 or 8.

8. OPERATION, FIG.7 AND AB (600Ω OR 900Ω IMPEDANCE)

The presence of 1000-cycle tone termination will prevent effective disconnection from the calling end over a toll circuit employing single frequency signaling. Fig. 7 and AB provides for removal of the 1000-cycle tone after approximately 10 seconds to permit disconnection should a call from such a toll circuit be directed to this test line.

When the test line is seized the (SL) or (SL1) relay in Figs. A, B, C, D, L, M or O, the (SL) and (CB) relays or the (PB) relay of Fig. P operates as explained in Paragraph 5. Relay (R) will operate to ringing current over the ring side of the line, operating relay (TP1) to close in part the trip circuit. When ZM option is furnished, the (R) thermistor delays the operation of the (TP1) relay to prevent tripping if the (R) relay operates on line continuity test made by the marker. The (TP1) relay operated, operates relay (TP) which locks to ground on the "H" lead to the sleeve relay, closes in part the operate path for relay (OS) and completes closure of the tripping circuit through the vacuum tube (TR). Ringing current will fire the vacuum tube, trip ringing, causing relays (R) and (TP1) to be released. Release of (TP1) relay opens the trip path and closes a circuit to operate relay (OS).

Should the ringing interval be of insufficient duration to fire the vacuum tube, the second cycle of ringing current will reoperate the (R) and (TP1) relays. Relay (TP1) operated will release relay (OS). Selector (INT) will restore, if it has advanced from normal and the vacuum tube (TR) is again closed to the "T" and "R" leads to trip the ringing.

Relay (OS) operated holds under control of the (TP) relay operated and the (TP1) and (LO) relays normal, closes ground to the "ST" leads to the 1000-cycle power supply and the 60 IPM interrupter circuit if provided, closes in part a path to operate rotor (INT), opens the operate path for the (INT) release magnet, closes (BR) resistance in series with retardation coil (TB) to cause a current flow which will help stabilize the contact resistance of base metal contacts, and transfers the 1000-cycle tone circuit from the resistance (L) to the tip and ring of the trunk under test.

When "ZE" option and Fig. 11 is used, ground on the "ST" lead from this or some other circuit connected to the interrupter will cause the interrupter circuit to function to flash relay (FL) intermittently closing ground to the "FL" lead. When "ZE" option and Fig. 14 are used, a start ground is not required by the interrupter circuit and the winding of the (FL) relay is connected to the 60 IPM supply, causing the relay to flash continuously. When "ZF" option is used, ground will be closed to lead "B" at each closure of the back contact of the (TTO) interrupter.

On each closure of ground to lead "FL" or "B", with relay (OS) operated, selector (INT) will advance one terminal. When it closes number 10 terminal, relay (LO) will operate and lock under control of the operated (TP) and normal (TP1) relays. Relay (LO) operates, opens the holding path for relay (OS) and closes in part a balance termination circuit. Release of relay (OS) transfers the 1000-cycle tone from the trunk under test to the (L) resistance, closes the trunk to a balance termination to reduce "singing" and "echo", removes ground from the "ST" leads to the 1000-cycle power supply and, if used, the 60 IPM interrupter, and closes a path to the (RLS) magnet to restore the (INT) selector to normal.

When the 1000-cycle tone has been removed by the release of relay (OS), disconnection from a toll trunk employing single frequency signaling can become effective. Disconnection from other type trunks can occur at any time. When disconnection by the test attendant has become effective, the (SL), (SL1) or (SL) and (CB) or (PB) relay releases, which in turn releases the (TP) relay. This causes the release of relay (LO) or (OS) if relay (LO) has not operated, selector (INT), if off-normal, restores and the test selector is in a normal condition.

Should the tone be removed from the trunk before the test being made is complete, the tone can be restored and the timing recycled if the trunk under test is arranged to rering the called line. Otherwise disconnection must take place and a new call originated to the test line.

Fig. 7 and AC (600Ω or 900Ω Impedance)

Fig. AC when used with Fig. 7 provides a means of modifying existing installations having Fig. 7 and AB for repetitive timed disconnect of the 1000-cycle tone.

The operation of the circuit will be exactly as described previously until the (OS) relay operates. Relay (OS) operated holds under control of the (TP) relay operated and the (TP1) and (LO) relays normal. With Fig. 11 or 14 furnished the (OS) relay closes ground to the ST leads to the 1000-cycle power supply and the 60 IPM Interrupter Circuit, if provided. Relay OS closes in part a path to operate rotor (INT), opens the operate path for the (INT) release magnet, closes (BR) resistance in series with retardation coil (TB) to cause a current flow which will help stabilize the contact resistance of base metal contacts, and transfers the 1000-cycle tone circuit from the resistance (L) to the tip and ring of the trunk under test.

When "ZE" option and Fig. 11 is used, ground on the "ST" lead from this or some other circuit connected to the interrupter will cause the interrupter circuit to function to flash relay (FL) intermittently closing ground to the "FL" lead. When "ZE" option and Fig. 14 is used, a start ground is not required by the interrupter circuit and the winding of the (FL) relay is connected to the 60 IPM supply, causing the relay to flash continuously. When "ZF" option is used, ground will be closed to lead "B" or "FL" at each closure of the back contact of the (TTO) interrupter.

When "ZE" option and Fig. X are furnished interrupted ground from the 60 or 120 IPM Interrupter Circuit will operate the (FL) relay causing the relay to flash intermittently and transmit interrupted ground to the "FL" lead.

On each closure of ground to lead FL or B with relay OS operated, selector INT will advance one terminal. When it closes the No. 9 terminal, relay LO will operate, and lock under control of the operated TP and normal TP1 relay. Relay LO operated, opens the holding path of relay OS.

With "XE" option the Interrupter leads (ST), (ST1) and (FL) are closed by a parallel circuit on contacts of relay (LO) to maintain a path to the Interrupter when relay (OS) releases.

The release of relay OS in position 9 of the INT selector removes 1000-cycle tone by (a) transferring the 1000-cycle tone from the trunk under test to the L resistance, (b) closes the trunk to a balanced termination to reduce singing and echo.

Relay LO operated also (a) continues steady or interrupted ground to the ST lead to the 60 IPM interrupter circuit or the 60 and 120 IPM interrupter circuit, (b) opens path to release magnet so that selector INT will not release in position 9, (c) resistors operate path of the rotor so that the selector will step to position 10.

In position 10 the CP contact protection relay will operate and (a) open the whole path of LO relay, (b) operate the release magnet of the INT selector. The selector will return to normal and ground

on its off-normal ON contacts will prevent contact arcing.

As the INT selector leaves position 10 the LO relay releases which operates the OS relay to start the timing cycle.

This will put 1000-cycle tone on the line again for nine seconds followed by one second of no tone, to allow disconnection from a toll trunk employing single frequency signalling.

The circuit will continue to recycle providing the test attendant with nine seconds of tone for test followed by one second of silence for disconnect until the test in progress is completed.

When disconnection by the test attendant has become effective, the SL relay releases which in turn releases the TO and LO relays.

9. OPERATION, FIG. 8.

The presence of 1000-cycle tone termination will prevent effective disconnection from the calling end over a toll circuit employing single frequency signalling. Fig. 8, used when tripping of machine ringing is not required, provides for removal of the 100-cycle tone after approximately 10 seconds.

When the test line is seized, the "M" lead is grounded by the operation of the (SL) or (SL1) relay of Figs. A, B, F, G, H, I, K, or N as explained in Paragraph 6 or the "S1" lead is grounded from the office link and connnector circuit in crossbar tandem office or the "S" lead is grounded from the intertoll dialing step-by-step selector, to operate relay (OS). Relay (OS) holds to ground on the "H", "S" or "S1" lead under control of the normal (LO) relay, grounds the "ST" leads to the 1000-cycle power supply and the 60 IPM interrupter circuit when provided, opens the path to the (RLS) magnet of the (INT) selector, closes the path from the (ROT) magnet of the (INT) selector to the "FL or "B" lead, and transfers the 1000-cycle tone from the (L) resistance to the trunk or cord under test.

When "ZE" option and Fig. 11 are used, ground on the "ST" lead from this or some other circuit connected to the interrupter will cause the interrupter circuit to function to flash relay (FL) intermittently, closing ground to the "FL" lead. When "ZE" option and Fig. 14 are used, a start ground is not required by the interrupter circuit and the winding of the (FL) relay is connected to the 60 IPM supply, causing the relay to flash continuously. When "ZF" option is used, ground will be closed to lead "B" at each closure of the back contact of the (TTO) interrupter.

On each closure of ground to lead "FL" or "B" with relay (OS) operated, selector (INT) will advance one terminal. When terminal 10 is closed, relay (LO) will operate and lock to ground on lead "H" or "S1". Relay (LO) operated opens the holding path for relay (OS) and closes in part a balance termination circuit. Release of relay (OS) transfers the 1000-cycle tone from the trunk or cord under test to the (L) resistance, closes the trunk to a balance termination to reduce singing and echo while awaiting disconnection, removes ground from the "ST" leads, opens the path to the (ROT) magnet and closes the operate path of the (RLS) magnet with YK option to restore the (INT) selector to normal. When YL option is provided, ground to the release magnet of INT selector is closed through the normal contacts of OS relay. This prevents arcing of the INT selector terminals and provides contact protection.

When the 1000-cycle tone has been removed by the release of relay (OS), disconnection from a toll trunk employing single frequency signaling can become effective. Disconnection from other type trunks or cords under test can occur at any time. When disconnection by the test attendant has become effective, release of the sleeve relay, the step by step intertoll selector or the secondary hold magnets remove ground from the "H", "S" or "S1" lead. Relay (LO) is released or if the (LO) has not been operated, the (OS) relay is released. If off-normal, the (INT) selector is restored and the test line is in a normal condition.

Should the tone be removed from the trunk or cord under test before the test is complete, disconnection must take place and a new call originated to the test line.

The retardation coil in Fig. 3 connected to 24 volt battery is used to operate the bridged relay in No. 1 local tandem trunk circuits. The retardation coil in Fig. 3 connected to 48 volt battery or the retardation coil and resistance in Fig. 4 help stabilize the resistance of base metal contacts by providing a current flow. The battery through retardation coil in Fig. 13 is used to operate a relay in the intertoll dialing auxiliary trunk circuit.

10. OPERATION, FIG. 15 (MFR. DISC. REPLACED BY FIG. 23 WITH 900Ω IMPEDANCE CONNECTION)

When the test line is seized, the (SL) relay of Fig. O is operated in parallel with the line hold magnet. Relay (R) will operate over the ring side of the line either to ringing current or battery. A 9000 ohm resistance (R) is introduced in parallel with the A-C path of the line (R) relay circuit to allow the (R) relay to operate on silent battery without tripping machine ringing or operating the supervisory relay

of the trunk under test. The operation of relay (R) will operate relay (TP1) to close in part the trip circuit and to operate relay (TP). The (TP1) relay is made slow release and a thermistor (R) is added to delay the operation of the (TP1) relay to prevent tripping if the (R) relay operates on line continuity test made by the marker. Relay (TP) locks to ground on the "H" lead to the sleeve relay, closes in part the operate path for relay (OS), completes closure of the tripping circuit, and opens the D-C path through the (R) relay winding. If the (R) relay operated on battery, under this condition it would release. If, however, the (R) relay is being held operated on ringing current it may not release until the machine ringing is tripped. Release of the (R) relay releases relay (TP1), opening the trip path and causing the (OS) relay to operate. In case the machine ringing is not tripped after this operation, relay (R) will operate on the next ringing period, causing the (TP1) relay to operate and the (OS) relay to release which again closes the tripping circuit. Relay (OS) operated, holds under control of the (TP) relay operated and the (TP1) and (LO) relays normal, closes ground to the "ST" leads to the 1000-cycle power supply and the 60 IPM Interrupter Circuit, closes in part a path to operate rotor (INT), opens the operate path for the (INT) release magnet, closes the (BR) resistance in series with retardation coil (TB) to cause a current flow which will help stabilize the resistance of base metal contacts, and transfers the 1000-cycle tone circuit from the resistance (L) to the tip and ring of the trunk under test.

On each closure of ground to lead "FL" with relay (OS) operated, selector (INT) will advance one terminal. When it closes number 10 terminal, relay (LO) will operate and lock under control of the operated (TP) and normal (TP1) relays. Relay (LO) operated, opens the holding path for relay (OS) and closes in part a balance termination circuit. Release of relay (OS) transfers the 1000-cycle tone from the trunk under test to the (L) resistance, closes the trunk to a balance termination to reduce "singing" and "echo", removes ground from the "ST" leads to the 1000-cycle power supply and the 60 IPM interrupter circuit, opens the operate path of the rotor (INT) and closes a path to the release magnet with YK option to restore the (INT) selector to normal. When YL option is provided ground to release the magnet of the INT selector is closed through the normal contacts of the OS relay. This prevents arcing at the INT selector terminals and provides contact protection.

When the 1000-cycle tone has been removed by the release of relay (OS), disconnection from a toll trunk employing single frequency signaling can become effective. When disconnection by the test attendant has become effective, the (SL) relay of Fig. O releases which in turn releases the (TP) and (LO) relays.

Should the tone be removed from the trunk before the test being made is complete, the tone can be restored and the timing recycled if the trunk under test is arranged to rering the called line. Otherwise disconnection must take place and a new call originated to the testline.

11. OPERATION, FIG. 16

11.01 General

This figure provides a test line with timed disconnect of 1000-cycle tone for use with intertoll trunks. It is used in combination with Figs. R, S, T, U, V, Z or AA depending upon the balance termination and supervision required by the trunk under test. When the circuit is seized, ground on the sleeve lead operates relay (OS) under control of the (LO) relay normal, if Fig. R, S, or V is used or operated the (SL) relay which in turn operates the (OS) relay under control of the (LO) relay normal if Fig. T or V is used. The operation of the (OS) relay closes ground to the "ST" lead to the 1000-cycle power supply, opens the operate path for the (INT) release magnet, closes in part a path to operate rotor (INT), closes the operate path of the (FL) relay to the 60 and 120 IPM interrupter circuit, if Fig. X is furnished, removes the balance termination from the "T" and "R" leads of the trunk under test and transfers the 1000-cycle tone circuit from the (L) resistance to the "T" and "R" leads of the trunk under test.

11.02 With Fig. W

When Fig. W is furnished, ground is closed to lead "FL" on each closure of the back contact of the (TTO) interrupter. When Fig. X is furnished, ground is closed to lead "FL" through made contact of the "FL" relay which operates and released following the ground interruptions supplied by the 60 and 120 IPM interrupter circuit.

On each closure of ground to the "FL" lead with relay (OS) operated, selector (INT) will advance one terminal. When it closes number 10 terminal, relay (LO) will operate.

11.03 With Fig. R

When Fig. R is furnished, the 48 volt battery and (CB) retard coil provide a current flow to stabilize the resistance of base metal contacts and with the (LO) relay normal, battery on the tip side of the line provides "off hook" supervision, "ZP" option, for SXS tandem areas and "off hook" supervision, "ZO" option, for crossbar tandem areas. The "LO" relay operated, locks to ground on the "S1" lead, releases

the (OS) relay and reverses the battery and ground on the tip and ring leads changing the supervision to "on hook", "ZP" option, SXS tandem areas and "on hook" supervision, "ZO" option, for crossbar tandem areas.

11.04 With Fig. S

When Fig. S is furnished, a balanced simplex connection, "ZS" option, or the unbalanced simplex connection, "YA" option consisting of (PC) retardation coil, (TA), (TB), (TC) and (TD) resistances and 48 volt battery is provided to control the operation of the pad control relay in the intertoll trunk. This arrangement also provides a current flow to help stabilize the resistance of base metal contacts. The (LO) relay operated, locks to ground on the "S" lead, releases the (OS) relay and places ground on the "SP" lead, "YB" option, or removes ground from the "SP" lead, "YC" option, changing the supervision toward the selector multiple from "on hook" to "off hook", "YB" option; or "off hook" to "on hook", "YC" option.

11.05 With Fig. T

When Fig. T is furnished, a simplex connection consisting of (PC) retardation coil and (PC) resistance with 24 volt battery connected at the mid-point is provided to hold the switching pad of any toll line so equipped in the circuit while the test is being made and also provides a current flow to help stabilize the resistance of base metal contacts. If it is desired to test a toll line without the switching pads it will be necessary to arrange in advance of the test to have the proper relay blocked for the purpose. The (SL) relay which operated on its secondary winding alone when the trunk was seized provides "off hook" supervision over lead "S" while the (LO) relay is normal. The (LO) relay operated, locks under control of the (SL) relay operated, releases the (OS) relay closes ground to the (SL) relay primary winding which shunts the secondary winding causing the operator's supervisory lamp to light as a disconnect or "on hook" signal.

11.06 With Fig. V

When Fig. V is furnished the 500 ohm sleeve relay is provided for pad control purposes. The (LO) relay operated locks under control of the (SL) relay operated, releases the (OS) relay and connects 24 volt battery and ground through 900 ohm resistances to the tip and ring conductors respectively of the switchboard jack circuit changing the supervision from "off hook" to "on hook" as a disconnect signal.

11.07 With Fig. U

When Fig. U is furnished, the 48 volt battery through the windings of the (CB) retard coil provide a current flow to stabilize the resistance of base metal contacts. With relay (LO) normal battery is closed to the ring of the line, "ZO" option to provide off hook supervision as long as the 1 milliwatt power supply is closed to the line. The operation of relay (LO) at the end of a 10 second timing interval reverses the polarity of the line resulting in an "on hook" supervisory signal. The "ZP" option is provided when this circuit is used in areas where battery on the tip is required for "off hook" supervision. The termination impedance as required by the crossbar tandem trunk is obtained by the use of options "ZV", "ZW", "ZX" and "ZY". The desired termination impedance for use with the 1 milliwatt power supply is also obtained by the use of these options.

11.08 With Fig. Z

When Fig. Z is furnished the closure of a bridge across leads T and R by the step by step tandem selector causes the operation of relay A which in turn operates relay B. The operation of relay B closes a circuit which operates relay (OS) closing the 1 milliwatt power supply toward the step by step tandem trunk. It also closes ground over lead "S" to hold the step by step connector. After a 10 second timing interval relay (LO) operates reversing the polarity of the trunk to change the "off hook" supervision to an "on hook" supervisory signal.

11.09 With Fig. AA

When Fig. AA is furnished the seizure of the trunk operates the (SL) relay on 24 volt battery over the "S" lead providing "off hook" supervision. At the completion of the timing cycle the (LO) relay operates, locks under control of the (SL) relay and (A) relay, releasing the (OS) relay. The (LO) relay operated closes ground through the (A) relay winding to shunt the (SL) relay winding causing the operators supervisory lamp to light as a disconnect or "on hook" signal.

11.10 With Fig. AD

When Fig. AD is furnished with "YY" option, the 34 sleeve relay is provided for pad control purposes. The CB retard coil with 48 volt battery provides a current flow to stabilize the resistance of base metal contacts, and off hook supervision at the #11 switchboard.

11.11 When Fig. AD is furnished with Fig. N (YX option) it may be connected to a No. 12 switchboard and the operation is as stated for the No. 11 switchboard.

The LO relay operated, locks under control of the SL relay operated, releases the OS relay, and removes the CB retard coil from the tip and ring conductors changing the supervision to "on hook".

11.12 Disconnection

The release of relay (OS) caused by the operation of relay (LO), Fig. R, S, T, U, V, Z, AA or AB transfers the 1000-cycle tone from the trunk under test to the (L) resistance, closes the trunk to a balance termination to reduce "singing" and "echo", removes ground from the "ST" lead to the 1000-cycle power supply, open the operate path of the (FL) relay, if Fig. X is used, opens the operate path of the rotor (INT) and closes a path to the release magnet with YK option to restore the (INT) selector to normal. When "YL" option is provided ground to the release magnet of INT selector is closed through the normal contacts of the OS relay. This prevents arcing of the INT selector terminals, and provides contact protection. When the 1000-cycle tone has been removed by the release of relay (OS), disconnection from a toll trunk employing single frequency signaling can become effective. When disconnection by the test attendant has become effective, ground is removed from the sleeve lead releasing the (LO) relay, Fig. R, U or S or releasing the (SL) relay which in turn releases the (LO) relay, Fig. T, V or AA.

In Fig. Z the bridge across the T and R leads is opened releasing relay (A) which releases relay (B). The release of relay (B) releases relay (LO) and removes ground from the "S" lead.

12. BALANCE TEST TERMINATION AND "E" TYPE REPEATER TEST TERMINATIONS, FIGS. 9, 10, 12, 17, 18, 21, 24, 25, 26, 27, 30, 31, 32

12.01 General

Figs. 9, 10, 12, 17, 18, 21, 24, 25, 26, 27, 30, 31, and 32 provide terminations for use by toll test boards in determing singing margins on toll trunks and for testing "E" type repeaters. Where balance tests are made on single frequency supervision toll lines, the test line circuit provides "off hook" supervision to cause the removal of the single frequency tone and tilters. Fig. 9, 25 or 30 is used to permit the toll test attendant to test hybrid coils and networks on the local office side of a toll center. Provision is made for tripping of machine ringing in order to place the incoming trunk circuit in condition for testing. A vacuum tube is left across the "T" and "R" leads at all times. This will trip ringing in the incoming trunk but will not be detrimental during testing. The retardation coil and resistance provide a current flow to help stabilize the resistance of base metal contacts. When Fig. 9, 25 or 30 is provided for use with circuits on which no single frequency tone is expected, "on hook" supervision is provided to prevent charging a call that gets this line as a wrong number. When Inband Signaling or enabling control for "E" type repeaters is encountered "off hook" supervision is provided. A lettered Fig., AE, AF, AG, AH, L or P is associated with Fig. 9, 25, or 30 to provide a sleeve condition to permit the test line to be selected or to test busy. The operation of the associated lettered figure is similar to that described in Paragraph 5 or 6 except that "H" lead connection to Fig. 9, 25 or 30 is not required. When Fig. 9, 25 or 30 is in a No. 1 or No. 5 Crossbar Office an associated lettered figure is not required.

12.02 With Fig. 10

Fig. 10 is used to provide a termination for the toll trunk at a tandem office. The battery and ground through the (CB1) retardation coil provides a direct current flow path to help stabilize the resistance of base metal contacts. Battery is placed on the ring side of the line to provide "off hook" supervision.

12.03 With Fig. 12

Fig. 12 provides a termination at the step by step selector multiple for an intertoll dialing trunk. The simplex connection consisting of (CB1) retardation coil, (TA), (TB), and (TC) and (TD) resistances and 48 volt battery is provided to control the operation of the pad control relay in the intertoll trunk. Option "ZS" removes the pad while option "YA" retains the pad in the intertoll trunk. This arrangement also provides a current flow to help stabilize the resistance of base metal contacts. Ground on the "SP" lead provides "off hook" supervision toward the selector multiple.

12.04 With Fig. 17

Fig. 17 provides a termination for the toll trunk at a No. 13, 14, or 15 type D. S. "A" switchboard. The (CB1) retardation call provides a direct current flow path to stabilize the resistance of base metal contacts and to provide "off hook" supervision at the D.S. "A" switchboard.

12.05 Fig. 18

Fig. 18 provides a termination for the toll trunk at a No. 3, 3C or 3CL S.D. "A" switchboard where pad control is provided. The simplex arrangement consisting of (PC) retardation coil and (PC) resistance with 24 volt battery is used to control the operation of the pad control relay of the intertoll trunk circuit. Off hook supervision is provided by 1800 ohm ground on the sleeve.

12.06 Fig. 19

Fig. 19 provides a balance termination foruse by toll desk boards in determining singing margin on intertoll tandem

trunks. When balance tests are made on a single frequency supervision toll line, the test line current provides "off hook" supervision to cause the removal of the single frequency tone and filters. Option "ZO" is used when battery on the ring is required to give "off hook" supervision. Option "ZP" is used when battery on the tip is required to give "off hook" supervision. Fig. 19 is used with intertoll trunks that are switched to a subscriber line. It is not used in intertoll trunks that are switched to a second intertoll trunk.

12.07 Fig. 20

Fig. 20 provides a balance test for step by step tandem selector. It is used in making tests on intertoll dialing trunks switched to subscribers line. This figure should not be used in testing intertoll dialing trunks that are switched to a second intertoll dialing selector. It provides optional 900, 1200 or 1500 terminal impedance as required by the step by step trunk to which it is connected.

12.08 Fig. 21

Fig. 21 provides a termination for the toll trunk at a No. 3, 3C or 3CL D.C. "A" switchboard, in nonpad offices, or toll Swbd. No. 1 or 2. Off hook supervision is provided by 1800 ohm ground on the sleeve with "XH" option; or 500 ohm ground "X1" option.

12.09 With Fig. 24

Fig. 24 is used to provide a termination for local No. 11 switchboard arranged for outward toll service. The CB retardation coil provides a direct current flow path to stabilize the resistance of base metal contacts and provides off hook supervision at the No. 11 switchboard.

12.10 With Fig. 25

Fig. 25 provides a short circuit termination which, when connected to a subscriber number, can be used to determine singing margins on trunks equipped with E type or other repeaters. The ringing is tripped similar to the explanation in Paragraph 12.1. Condenser (B) furnishes the short circuit to the trunk in an on hook supervision basis to prevent charging if called in error from a customer's line. The resistance (BR1) is 10,000ω to prevent a charge but still give some current flow to stabilize the resistance of base metal contacts. This figure is used with lettered figures in the sleeve circuit as explained in Paragraph 12 1.

12.11 With Fig. 26

Fig. 26 provides a short circuit termination for use with No. 1, 2, 3, 3C 3CL Toll switchboards. A short circuit across tip and ring provides the termination while off hook supervision is given by the sleeve resistance, option "XA" or "WR" provides 500ω sleeve for switchboards No. 1D and 10 and Toll Swbds. No. 1 and 2. Option "XB" provides 1000ω sleeve for Toll Swbd. No. 1 and option "XC" provides an 1800ω sleeve for Swbds. No. 3, 3C and 3CL.

12.12 With Fig. 27

Fig. 27 provides a short circuit termination for use with No. 11, 12, 13, 14 and 15 type switchboards in determining singing margins on trunks equipped with E type or other repeaters. Condenser (B) furnishes the short circuit transmissionwise while retard coil (CB1) provides a DC short circuit to give off hook supervision. With "XF" option the 37ω sleeve resistance is used on swbds. No. 11, 13, 14 or 15. Option "XG" provides connection to Fig. N for use with a No. 12 switchboard.

12.13 With Fig. 30

Fig. 30 provides an open circuit termination which, when connected to a subscriber number, can be used to determine singing margins on trunks equipped with "E" type or other repeaters. The ringing is tripped as described in par. 12.1.

12.14 With Fig. 31

Fig. 31 provides an open circuit termination for use with switchboard cords which do not supply battery and ground to the test line. No connection is required to the tip and ring leads of the switchboard jack, the optional sleeve resistance is such that off hook supervision is provided on sleeve supervision cords.

12.15 With Fig. 32

Fig. 32 provides an open circuit termination for use with switchboard cords which supply battery and ground to the test line. Inductor (CB1) provides off hook supervision by providing a 500 ohm short circuit in the DC circuit, while the impedance of the inductor simulates an open circuit for testing purposes.

13. OPERATION, FIG. 23 (600Ω OR 900 Ω IMPEDANCE)

When the test line is seized, the (SL) relay of Figs. A, B, C, D L, M. O, or P is operated in parallel with the line hold magnet. Relay (R) will operate over the ring side of the line either to ringing current or battery. A 9000 ohm resistance (R) is introduced in parallel with the A-C path of the line (R) relay circuit to allow the (R) relay to operate on silent battery without tripping machine ringing or operating the supervisory relay of the trunk under test. The operation of relay (R) will operate relay (TP1) to close

in part the trip circuit and to operate relay (TP). The (TP1) relay is made slow release and a thermistor (R) is added to delay the operation of the (TP1) relay to prevent tripping if the (R) relay operates on line continuity test made by the marker. Relay (TP) locks to ground on the "H" lead to the sleeve relay, closes in part the operate path for relay (OS), completes closure of the tripping circuit, and opens the D-C path through the (R) relay winding. If the (R) relay operated on battery, under this condition it would release. If, however, the (R) relay is being held operated on ringing current it may not release until the machine ringing is tripped. Release of the (R) relay releases relay (TP1), opening the trip path and causing the (OS) relay to operate. In case the machine ringing is not tripped after this operation, relay (R) will operate on the next ringing period, causing the (TP1) relay to operate and the (OS) relay to release which again closes the tripping circuit. Relay (OS) operated, holds under control of the (TP) relay operated and the (TP1) and (LO) relays normal. With Fig. 11 furnished the (OS) relay operated closes ground to the ST lead to the 1000-cycle power supply and to the 60 IPM Interrupter Ckt., with Fig. W furnished the (OS) relay closes grd. to the ST lead to the 1000-cycle power supply, and with Fig. X furnished the (OS) relay connects solid ground to the ST lead of the 1000- cycle supply, and interrupted ground from the 60 or 120 IPM Interrupter Circuit to the ST lead to operate the (FL) relay. The (OS) relay operated also closes in part a path to operate rotor (INT), opens the operate path for the (INT) release magnet, closes the (BR) resistance in series with retardation coil (TV) to cause a current flow which will help stabilize the resistance of base metal contacts in those cases where "on hook" supervision is provided, and transfers the 1000-cycle tone circuit from the resistance (L) to the tip and ring of the trunk under test.

With Fig. 11 furnished the interrupted ground on lead FL is provided by the (FL) relay which follows the flashes of ground from the 60 IPM Int. Ckt., with Fig. W furnished the interrupted ground is provided by the (TTP) INT, and with Fig. X furnished interrupted ground is provided by the (FL) relay which follows the flashes of ground from the 60 or 120 IPM Int. Ckt.

On each closure ground to lead FL with relay OS operated, selector INT will advance one terminal. When it closes the No. 9 terminal, relay LO will operate, and lock under control of the operated TP and normal TP1 relay. Relay LO operated, opens the holding path of relay OS.

The release of relay OS in position 9 of the INT selector removes 1000-cycle tone by (a) transferring the 1000-cycle tone from the trunk under test to the L resistance (b) closes the trunk to a balanced termination to reduce singing and echo.

Relay LO operated also (a) continues interrupted or steady ground to the ST lead, (b) opens path to release magnet so that selector INT will not release in position 9, (c) restores the operate path of the rotor so that the selector will step to position 10.

In position 10 the CP contact protection relay will operate and (1) open the hold path of LO relay, (2) operate the release magnet of the INT selector. The selector will return to normal and ground on its off-normal ON contacts will prevent contact arcing.

As the INT selector leaves position 10 the LO relay releases which operates the OS relay to start the timing cycle.

This will put 1000-cycle tone on the line again for nine seconds followed by one second of no tone, to allow disconnection from a toll trunk employing single frequency signaling.

The circuit will continue to recycle providing the test attendant with nine seconds of tone for test followed by one second of silence for disconnect until the test in progress is completed.

When disconnection by the test attendant has become affected the SL relay releases which in turn releases the TP and LO relays.

14. Fig. 28 is provided to furnish a 2 DB pad and is cross-connected in series with the test line when testing in offices switching at via net loss. This will be usually used on the test lines provided in Fig. 8 or 16 since subscriber lines are reached through a 2 DB pad, or a line equivalent to it.

15. BUILDING-OUT CAPACITOR (FIG. 29)

Where balance terminations are provided, per Fig. 10, 12, 13, 17, 18, 19, 20, 21 and 24 and the office switching is at via net loss; if equalization of office cable capacity is required Fig. 29 is furnished and the (BO) capacitor is strapped as required.