

CENTRAL OFFICE AND TIE TRUNK CIRCUITS
DESCRIPTION OF SYSTEM OPERATION
NO. 101 ELECTRONIC SWITCHING SYSTEM

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL	2	A. 2-Way Automatic Tie Trunk Circuit— High-Low Loop Supervision (SD-1H044)	25
2. TYPES OF TRUNKS	2	B. 2-Way Dial Repeating Tie Trunk Circuit (SD-1H065, A and M Replaced by SD-1H083)	26
A. Control Unit Trunk Circuits	2	C. 2-Way Automatic Tie Trunk Circuit—E and M Lead Signaling (SD-1H061, A and M Replaced by SD-1H084)	29
B. Switch Unit Trunk Circuits	7	D. 2-Way Tie Trunk Circuit for Use with Dial PBX or No. 5 Crossbar Office Arranged for CCSA Service, E and M Lead Supervision (SD-1H083)	29
3. TRUNK CONNECTOR CIRCUIT	7	E. 2-Way Tie Trunk Circuit Incoming Automatic, Outgoing Automatic, or Dial Repeating E and M Lead Supervision (SD-1H084)	34
4. CENTRAL OFFICE TRUNKS	8	7. MISCELLANEOUS TRUNKS	36
A. 2-Way Central Office Trunk Circuit (SD-1H041, A and M Only Replaced by SD-1H077)	8	A. Foreign Exchange Trunk Circuit (SD-1H042)	36
B. Central Office Trunk Circuit for Use with Step-by-Step or Panel Central Office (SD-1H074)	11	B. Code Call Trunk Circuit for Control Unit (SD-1H066)	38
C. Central Office Trunk Circuit for Use with No. 1 Crossbar or No. 5 Crossbar Central Office for Control Unit, Including Direct Access Direct Inward Dialing (DADID) (SD-1H077)	13	8. REFERENCES	38
5. DIRECT INWARD DIALING TRUNKS	14	FIGURES	
A. One-Way Direct Inward Dialing Trunk Circuit (SD-1H043)	14	1. Typical Central Office Trunk Circuit	3
B. 2-Way Direct Inward Dialing Trunk Circuit for Use with No. 5 Crossbar Offices (SD-1H073)	19	2. 2-Way Dial Repeating Tie Trunks—Block Diagram	5
C. One-Way Direct Inward Dialing Trunk Circuit for Use with Step-by-Step Central Offices (SD-1H075)	21	3. Trunk Connector	9
6. TIE TRUNKS	25		

CONTENTS	PAGE
4. Central Office Trunk Circuit for Use with No. 5 Crossbar Central Office	11
5. Central Office Trunk Circuit for Use with Step-by-Step or Panel Central Office	12
6. Central Office Trunk Circuit for Use with No. 1 Crossbar or No. 5 Crossbar Central Office Option V	15
7. Central Office Trunk Circuit for Use with No. 1 Crossbar or No. 5 Crossbar Central Office Option S	17
8. One-Way Direct Inward Dialing Trunk Circuit	19
9. 2-Way Direct Inward Dialing Trunk Circuit	20
10. One-Way Direct Inward Dialing Trunk Circuit for Use with Step-by-Step Central Office	23
11. 2-Way Automatic Tie Trunk Circuit—High-Low Loop Supervision	25
12. 2-Way Dial Repeating Tie Trunk Circuit Detail	27
13. 2-Way Automatic Tie Trunk Circuit—E and M Lead Signaling	30
14. 2-Way Tie Trunk Circuit for Use with Dial PBX or No. 5 Crossbar Office	31
15. 2-Way Tie Trunk Circuit Incoming Automatic, Outgoing Automatic, or Dial Repeating E and M Lead Supervision	35
16. Foreign Exchange Trunk Circuit	37
17. Code Call Trunk Circuit	38

1. GENERAL

1.01 This section is reissued to include changes and additions in the trunks used to interconnect the No. 101 Electronic Switching System (ESS) and the different types of central offices. Since this reissue covers a general revision, arrows

ordinarily used to indicate changes have been omitted.

1.02 Trunks are used to carry calls between the No. 101 ESS and other connecting systems. These trunks form the interface between the electronic system and the electromechanical system. By using various combinations of these trunks at the control unit and the switch unit, it is possible to satisfy all standard trunking arrangements except ringdown tie trunks. Fig. 1 shows a typical central office trunk connection between the electronic and electromechanical systems.

1.03 Some of the trunk circuits are arranged for either 2- or 4-wire operation to the switch unit. Fig. 2 shows a block diagram of a typical 2- and 4-wire operation to the switch unit. All of the trunks that are arranged for 4-wire operation to the switch unit have been designed to meet or better via net loss (VNL) requirements. Tandem switching may also be required. For complete trunking arrangements, refer to SD-1H080-01.

22 TYPES OF TRUNKS

A. Control Unit Trunk Circuits

2.01 The control unit has available central office (CO), tie intercept, WATS, CCSA, and foreign exchange (FX) trunks. The central office trunks include the 1- or 2-way direct inward dialing trunk circuit and the central office trunk circuit which can provide direct access DID from No. 1 or No. 5 crossbar central offices to No. 101 ESS systems having three or more program stores per call processor. The tie trunks include the automatic tie trunk circuit (loop signaling), the automatic tie trunk circuit (E and M lead signaling), and the 2-way dial repeating tie trunk.

2.02 Central office trunk circuits provide the means for interconnecting the No. 101 ESS and all types of central offices. The trunk circuit repeats, on a 10 pulse per second dial pulse basis, calls originated from a switch unit. If the system has DADID it will not be necessary to pulse individual numbers but the complete number can be transferred from the central office. If the system does not provide DID, all incoming calls to the trunk are routed to the attendant.

2.03 Direct inward dialing (DID) trunk circuits provide the means for interconnecting the

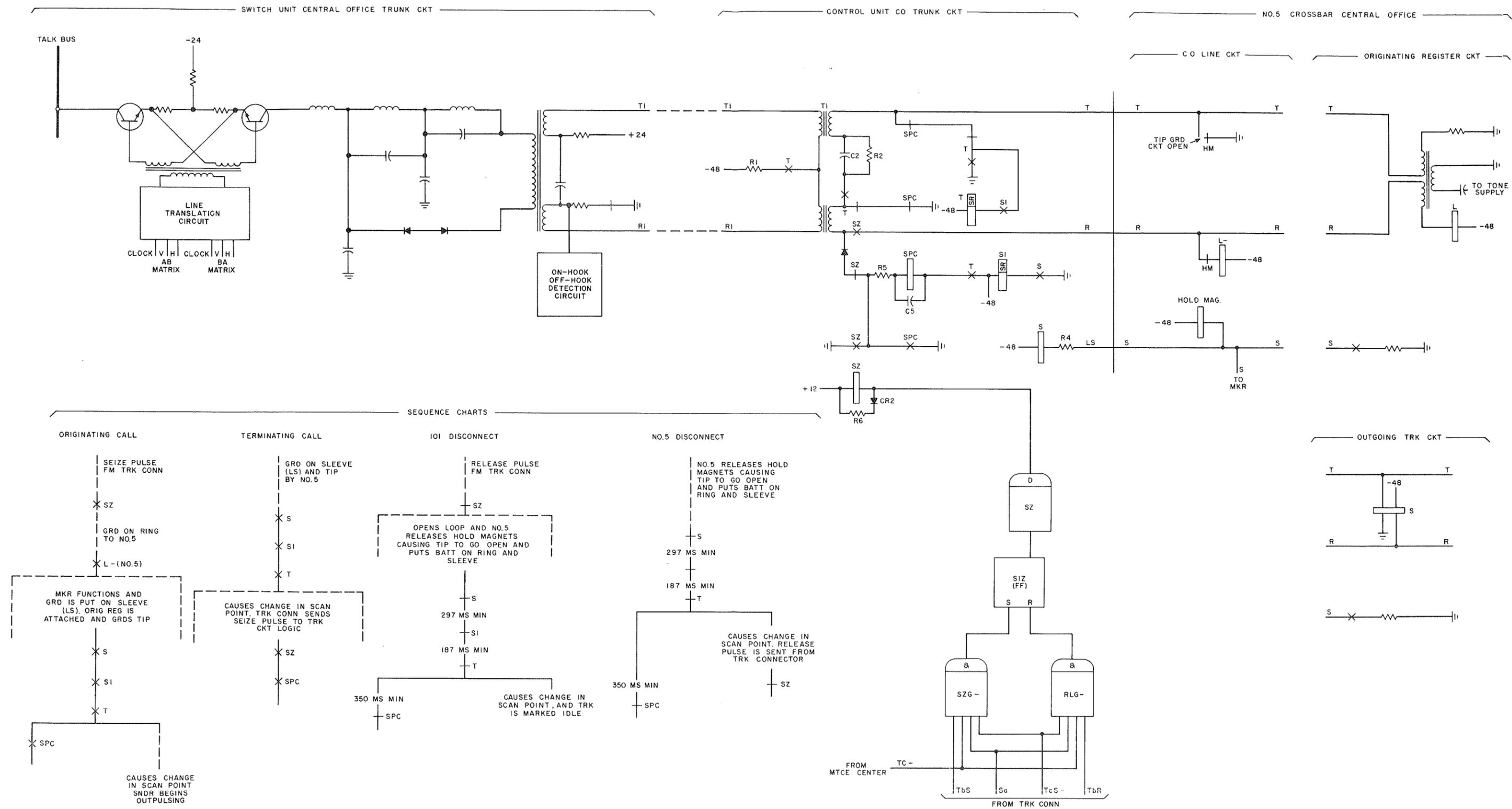


Fig. 1—Typical Central Office Trunk Circuit

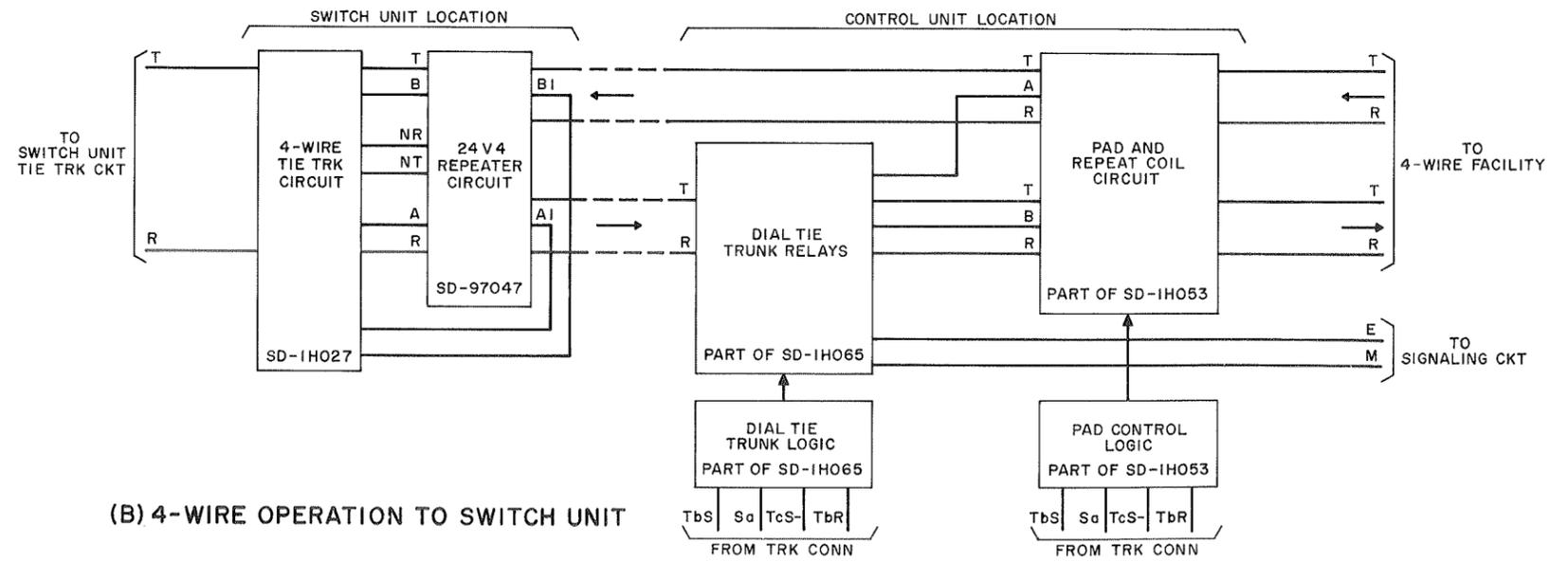
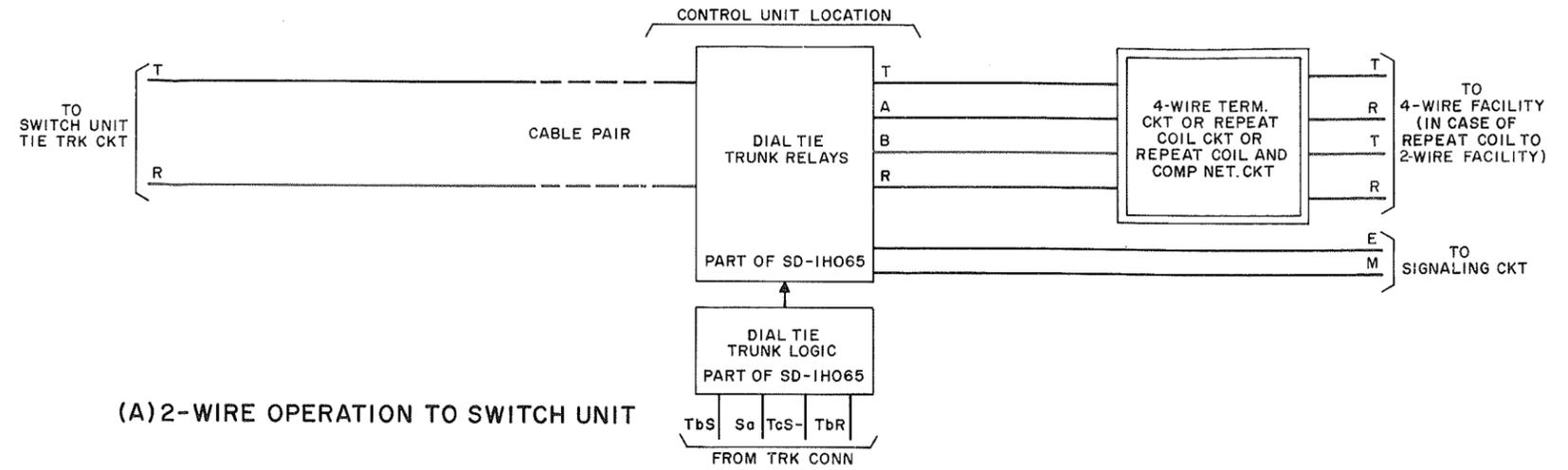


Fig. 2—Block Diagram-2-Way Dial Repeating Tie Trunks

No. 101 ESS and a crossbar tandem office, a No. 5 crossbar office which is arranged for line link pulsing, or a step-by-step office. Calls on these trunk circuits are directed to the dialed switch unit station. If a 2-way DID trunk circuit is used, outgoing calls may be placed in the same way as for a central office trunk.

2.04 The foreign exchange trunk circuit provides a means for interconnecting the No. 101 ESS and a central office which is remote from the control unit. This trunk circuit repeats, on a 10 pulse per second dial pulse basis, calls originated from a switch unit station. All incoming calls on this trunk are routed to the attendant.

2.05 The 2-way automatic tie trunk (loop signaling) provides a means of interconnecting the No. 101 ESS and a distant PBX. It is designed for use over relatively short distances. All incoming calls on this trunk circuit are handled by the attendant.

2.06 The 2-way automatic tie trunk (E and M lead signaling) provides a means of interconnecting the No. 101 ESS and a distant PBX when a carrier facility is required due to a relatively long distance between the two systems. This trunk circuit has provision for either 2- or 4-wire transmission from the carrier facility to the switch unit. All incoming calls on this trunk circuit are handled by the attendant. Outgoing, the trunk may be arranged to be dial repeating or automatic.

2.07 The 2-way dial repeating tie trunk is used to interconnect a tie trunk at the No. 101 ESS and a tie trunk at a distant PBX, which is arranged to provide inward and outward dialing with E and M lead supervision. This trunk circuit is also used to interconnect the No. 101 ESS with a No. 5 crossbar office arranged for CCSA service. This trunk circuit converts the incoming supervisory signals to loop supervision for the switch unit, and converts the outgoing supervision to E and M lead supervision.

2.08 A means for increasing the interdigital interval on dial repeating tie line calls that may be tandem switched through register controlled systems such as the No. 5 crossbar or No. 101 ESS is available. This feature will apply to all dial-repeating tie line calls originated at a switch unit requiring this feature.

B. Switch Unit Trunk Circuits

2.09 Four different types of trunk circuits are available at the 1A switch unit: the central office trunk circuit, the DID or direct inward dialing trunk circuit, the idle terminated trunk circuit, and a tie trunk circuit incorporating pad control which may be used for tandem switching. Three different types of trunk circuits are available at a 2A, 3A, or 4A switch unit: a trunk circuit used for central office or tie trunks when idle circuit termination is not required, a gain trunk used when 2 dB of gain and idle circuit termination is desired, and a switched gain trunk used for the trunks that may be tandem switched. (This circuit, in effect, provides pad control and does not require pad control at the control unit.) These trunk circuits are mainly composed of electronic devices since they are located within the No. 101 ESS and are not interface circuits. The trunk circuits are used to connect the control unit trunk circuits to the electronic switching network of the switch unit. A 4-wire trunk adapter circuit is also available at the switch unit. This circuit provides an applique between the control unit and the switch unit when 4-wire operation to the switch unit is used (Fig. 2B). All switch unit trunks are 2-wire, and switching is done on a 2-wire basis. Refer to SD-1H080 for information on the connection of the switch unit trunks to the control unit trunks under specific conditions, and for the various applications of the control unit and switch unit trunk circuits.

3. TRUNK CONNECTOR CIRCUIT

3.01 The trunk connector circuit (Fig. 3) is the connecting link between the program control, data control, sender control, and the trunk circuits. This circuit translates a 12-bit address from either the program control or data control into one out of up to 32 trunk sectors, one out of 56 trunk circuits per trunk sector, and seize or release information. The trunk connector is composed of three basic circuits: a translator, a distribution circuit, and a timing circuit.

3.02 The function of the translator is to translate the 12-bit address from the program or data control into three 1/n outputs upon request from either the program or sender control. The outputs are used to seize or release any one of a number of trunk circuits. The 1/n translation is derived from the switch unit or trunk sector number

translator, the trunk group translator, and the trunk number translator (Fig. 3).

3.03 The distribution circuit consists of the 46 output leads from the three translators that go to the trunk equipment locations. These outputs drive the trunk circuit logic gates in the trunk circuits to obtain final translation.

3.04 The timing circuit is used to interleave requests from the program control and the sender control. The sender control works on an 8-microsecond cycle, and the program control works on a 4-microsecond cycle.

4. CENTRAL OFFICE TRUNKS

A. 2-Way Central Office Trunk Circuit (SD-1H041, A and M Only Replaced by SD-1H077)

4.01 When an outgoing call is originated at the switch unit, a message is sent to the control unit which causes the trunk connector to send a seize pulse to the trunk circuit (see Fig. 4), causing ground to be extended to the trunk ring (R) lead, then to the No. 5 crossbar central office.

4.02 When the central office has attached an originating register to the trunk, a ground is placed on the trunk T lead, causing off-hook supervision to be extended on T1 and R1 leads to the switch unit.

4.03 Off-hook supervision on T1 and R1 leads is recognized by the switch unit as a change in the scan point. The switch unit scanner detects this change and transmits this information to the control unit. The calling party immediately receives second dial tone from the control unit digit receiver and can begin to dial. The dialed digits are stored and forwarded in the data and digit store and then outpulsed by the sender via the trunk connector. The T and R loop is opened and closed, thereby transmitting dial pulse make and break signals to the central office at a rate of 10 pps.

4.04 After dialing is completed, the central office must release the linkage used for dialing and establish linkage between the calling and called party. During this operation, the trunk T, R, and LS leads will be opened momentarily at the central office, causing momentary release and reoperation of some trunk circuit relays, but there is no change

in the state of the trunk circuit. The trunk is now in the talking condition.

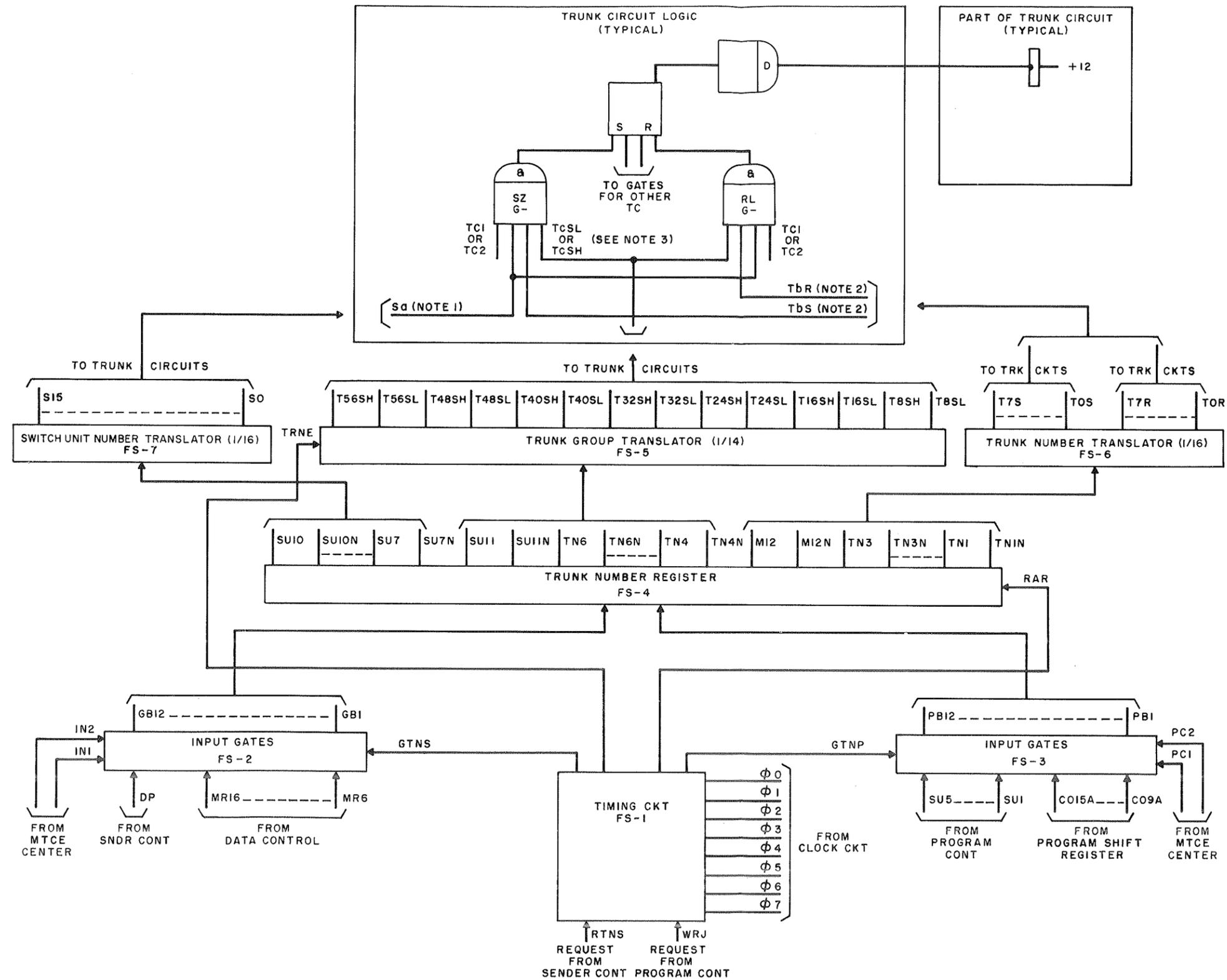
4.05 If the No. 101 ESS disconnects first, the change in the station scan point, caused by the on-hook condition, is detected by the scanner. The program control circuit sends a release signal from the trunk connector which opens the T and R loop to the central office. When the central office recognizes the open loop as a disconnect signal, it releases the linkage it has set up for the talking condition. The T lead is opened and the R and LS leads go to battery, causing on-hook supervision to be extended to the switch unit. The switch unit sends a message to the control unit that the trunk is idle. Slow release of the trunk circuit relays prevents premature reseizure of the trunk circuit.

4.06 If the called party disconnects first, the central office times for about 25 seconds before presenting a disconnect signal to the No. 101 ESS trunk circuit. At the end of the 25 seconds, the No. 101 ESS trunk will be released regardless of the action of the No. 101 ESS station. However, if the No. 101 ESS goes on-hook before the 25-second time-out occurs, the circuit release is the same as if the No. 101 ESS had disconnected first. The trunk is then returned to an idle condition.

4.07 When a call comes into the No. 101 ESS from the central office, the central office makes the trunk busy by putting ground on the LS lead. The central office seizes the trunk by placing ground on the T side of the loop, which causes off-hook supervision to be extended to the switch unit. This causes a change in the scan point which is detected by the switch unit, which sends an off-hook message to the control unit. The control unit then sends a return message to the switch unit to connect this trunk to the attendant. When the attendant goes off-hook, a seize pulse is sent to the trunk circuit logic, closing the loop to the central office for charging purposes. The trunk is now in a talking condition.

4.08 The disconnect from a call which originated at the central office is essentially the same as previously described.

4.09 The previously described operations are also indicated in the conventional sequence charts shown in Fig. 1. This diagram additionally shows



- NOTES:
1. THE S_a LEAD IS CONNECTED TO EVERY TRUNK FOR SWITCH UNIT NUMBER a AND SWITCH UNIT NUMBER $a + 16$ WHERE $a = 0$ THROUGH 15.
 2. THE T_{bR} AND T_{bS} LEADS ARE CONNECTED TO TRUNKS NUMBERED $b + 8, b + 16, b + 24, b + 32, b + 40, b + 48,$ AND $b + 56$ WHERE $b = 0$ THROUGH 7.
 3. THE T_{cSL} LEAD IS CONNECTED TO TRUNKS NUMBERED c THROUGH $c + 7$ FOR SWITCH UNITS 0 THROUGH 15. THE T_{cSH} LEAD IS CONNECTED TO TRUNKS NUMBERED c THROUGH $c + 7$ FOR SWITCH UNITS 16 THROUGH 31. $c = 8, 16, 24, 32, 40, 48,$ OR 56.

OPERATION SCHEDULE

SCHEDULE 1	LEAD ENABLED	SCHEDULE 2	LEAD ENABLED	CLOCK PHASE
PROGRAM CONTROL REQUEST	GTNP	RESET	RAR	ϕ_2
TRANSLATE	TRNE	SENDER CONTROL REQUEST	GTNS	ϕ_3
TRANSLATE	TRNE	TRANSLATE	TRNE	ϕ_4
RESET	RAR	TRANSLATE	TRNE	ϕ_5
SENDER CONTROL REQUEST	GTNS	RESET	RAR	ϕ_6
TRANSLATE	TRNE	PROGRAM CONTROL REQUEST	GTNP	ϕ_7
TRANSLATE	TRNE	TRANSLATE	TRNE	ϕ_0
RESET	RAR	TRANSLATE	TRNE	ϕ_1

Fig. 3 - Trunk Connector

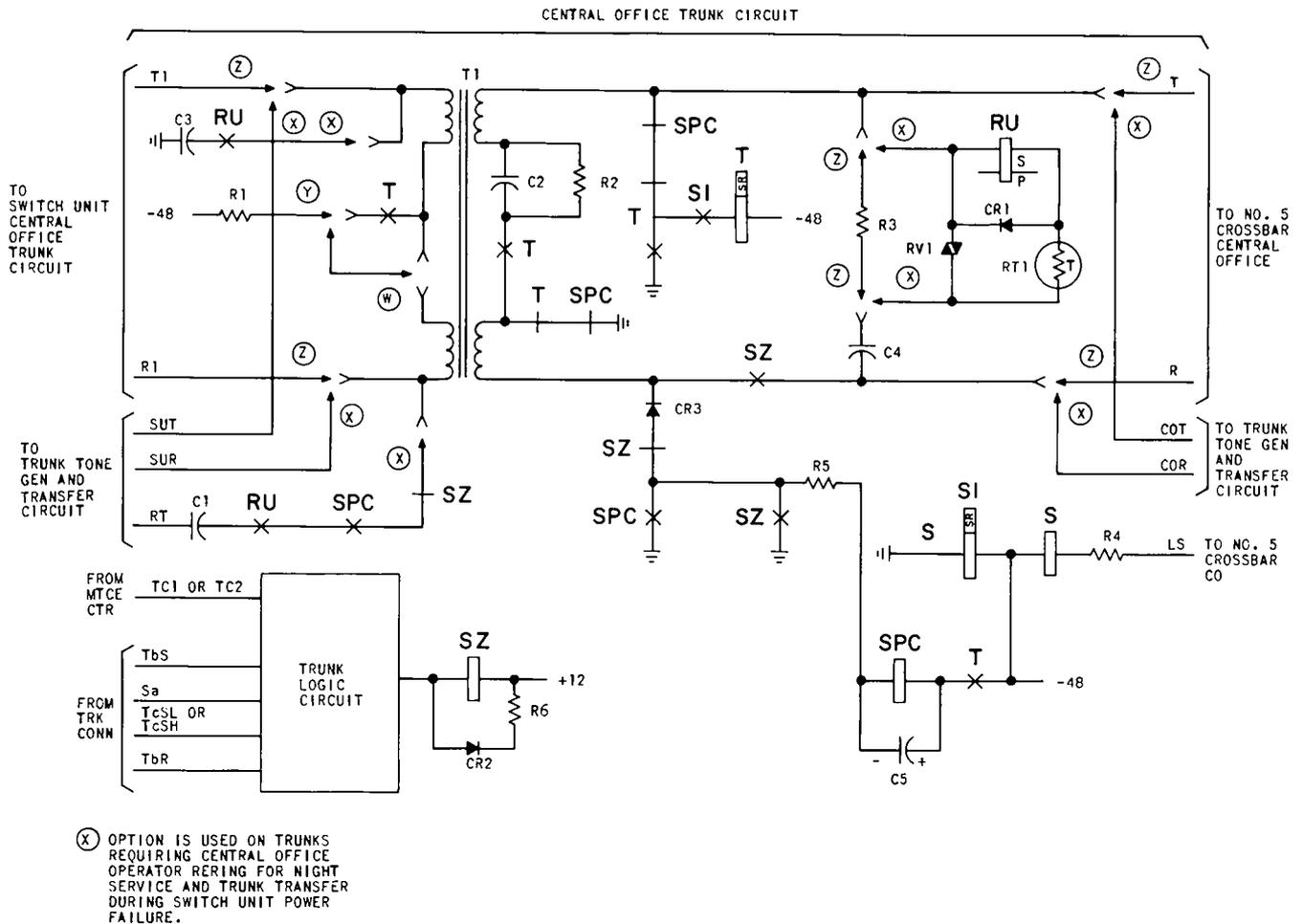


Fig. 4—Central Office Trunk Circuit for Use with No. 5 Crossbar Central Office

some of the switch unit and central office details associated with a typical trunk circuit.

B. Central Office Trunk Circuit for Use with Step-by-Step or Panel Central Office (SD-1H074)

4.10 The central office trunk circuit (Fig. 5) provides 2-way central office service from a No. 101 ESS to a step-by-step or panel central office. Originating calls from a No. 101 ESS station are dial pulsed to the connecting central office, and incoming calls are routed to the switch unit attendant. Protection against double seizure is also provided.

4.11 After a No. 101 ESS station dials 9, the control unit selects an idle trunk and sends a seize pulse through the trunk connector circuit and the trunk logic circuits, causing the operation of the SZ relay. The SZ relay places ground on

the R lead to operate the line relay in the subscriber line circuit and start the line finder hunting for the line. The connector multiple is disconnected from the subscriber line circuit, and ground is connected to the connector multiple sleeve. This action makes the connector appearances busy to incoming calls.

4.12 When the line finder finds the line, a first selector is seized and ground is returned on the S and T leads. Dial tone is also returned but is ignored by the No. 101 ESS. The S relay is operated from the ground on the sleeve lead. The T relay operates from the ground on the T lead and extends off-hook supervision to the scan point at the switch unit.

4.13 The scan point change at the switch unit is transmitted to the control unit. Second dial tone is given immediately to the station directly

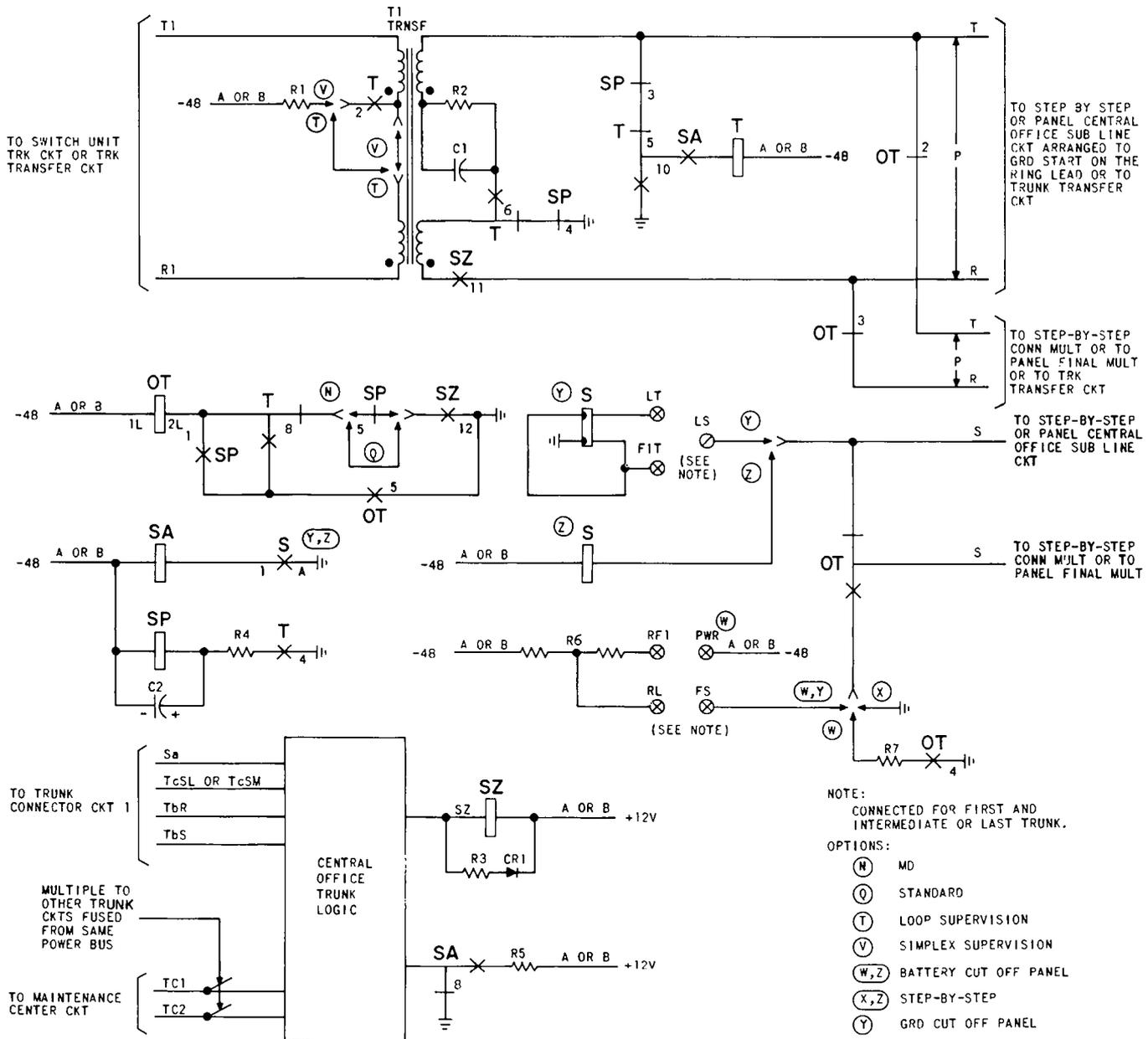


Fig. 5—Central Office Trunk Circuit for Use with Step-by-Step or Panel Central Office

from the control unit as an indication that dialing may proceed. Dial pulses through the control unit and the trunk logic circuit will cause the SZ relay to release and operate. The SZ relay will open and close the loop to the central office, thereby transmitting dial pulses to the central office at the rate of 10 pulses per second.

4.14 The operation of this trunk circuit with a panel central office is almost identical to its

operation with a step-by-step office. The difference is that a resistor network is used to indicate a busy condition to final selectors that attempt to terminate to this line. Ground on the T lead, which initiates second dial tone to the No. 101 ESS station, is returned from the subscriber-sender.

4.15 When dialing is completed in a step-by-step or panel central office, the No. 101 ESS

station will hear audible ring or busy-back depending on the condition of the called line.

4.16 If a No. 101 ESS station disconnects first, a release pulse will be sent through the trunk connector and the trunk logic circuit releasing the SZ relay. Release of the SZ relay opens the loop to the central office. This open will be recognized by the central office as a disconnect signal, and the central office equipment will return to normal.

4.17 The idle state of the sleeve lead is extended to the switch unit scan point, and the control unit will mark the trunk idle. Slow release of the SP relay prevents premature reseizure by the central office.

4.18 When the central office disconnects first, the sequence is identical to that described for a No. 101 ESS station, except that the release pulse occurs after the release of the T relay. The slow-release SP relay protects against seizure by the No. 101 ESS by isolating the ground on the R lead during disconnect.

4.19 When a step-by-step or panel central office originates a call to the No. 101 ESS via this trunk, the central office will seize the trunk and place ground on the LS lead. Ground on the sleeve will operate the S relay.

4.20 Superimposed 20-cps ringing voltage is now applied to the trunk. Ground on the tip lead operates the T relay to close the loop to the switch unit and partially close the loop to the central office.

4.21 The loop closure is detected by the switch unit and messages are sent between the switch unit and the control unit alerting the attendant of an incoming call. Ringback is returned to the calling party by the CO. When the attendant answers, a seize pulse is sent through the trunk connector and the trunk logic circuit operating the SZ relay. Operation of the SZ relay closes the loop to the central office which trips ringing and places the trunk in a talking condition.

C. Central Office Trunk Circuit for Use with No. 1 Crossbar or No. 5 Crossbar Central Office for Control Unit, Including Direct Access Direct Inward Dialing (DADID) (SD-1H077)

4.22 This central office trunk circuit provides 2-way central office service from a No. 101 ESS to a No. 1 crossbar or No. 5 crossbar central office. Originating calls from the No. 101 ESS are dial pulsed to the connecting central office. An incoming call will be routed to the No. 101 ESS attendant (Fig. 6) or to the station if the trunk is operating in association with direct access DID from a No. 1 or No. 5 crossbar office (Fig. 7).

4.23 For an outgoing call from a No. 101 ESS to a No. 1 or No. 5 crossbar (Fig. 6 or 7), a seize pulse is sent through the trunk connector circuit and the trunk logic circuit. This pulse operates the SZ relay, which places ground on the R lead to operate the central office line relay, causing a dial pulse register to be connected to the line.

4.24 A subscriber sender for No. 1 crossbar or an originating register for No. 5 crossbar is connected to the trunk. Ground on the S and T leads is extended as loop closure to the switch unit to indicate that a dial pulse register is attached to the trunk. The switch unit sends the off-hook message to the control unit.

4.25 Second dial tone is given immediately to the calling party indicating that dialing can proceed. The sender control sends seize and release pulses to the SZ relay corresponding to the dial pulses. The loop to the central office is opened and closed by the SZ relay, transmitting pulse signals to the central office dial pulse register. The central office will then complete the call. The calling party will hear the appropriate signals returned by the central office.

4.26 If the No. 101 ESS disconnects first, a release signal is sent through the trunk connector and the trunk logic circuit. This signal releases the SZ relay, opening the loop to the central office, and releases the central office equipment. The idle state of the S lead is extended to the switch unit scan point; the control unit then marks the trunk idle. Slow release of the SP relay prevents premature reseizure by the central office.

4.27 When a distant station disconnects first, a time-out feature in the central office goes into effect. If the No. 101 ESS party disconnects during this time-out cycle, the No. 101 ESS disconnects as described in 4.26. If the time-out is completed, the central office returns the T lead to open circuit and the R and S leads to battery. The open circuit state of the T lead is extended to the switch unit, and the No. 101 ESS disconnects as described in 4.26.

4.28 When a call comes into the No. 101 ESS office without direct access DID (Fig. 6), the trunk is made busy by a ground on the S lead in the central office. A double-seize protection circuit is provided by the V option, which is always furnished. Ringing power with ground on the T lead and negative battery on the R lead is applied from the central office. The 20-cycle ringing is ignored, but the T and R potential is converted to loop closure to the switch unit.

4.29 Closing the loop to the switch unit causes a data message (the off-hook scan point) to be sent from the switch unit to the control unit, which sends a data message back to the switch unit alerting the attendant to the incoming call. Ringback indication to the calling party provided by the CO. The attendant goes off-hook and a seize signal is sent to the trunk logic circuit, operating the SZ relay. The operated SZ relay closes the loop to the central office, trips the central office ringing, and completes the transmission path.

4.30 The operation of this trunk when used for direct access DID (S option, Fig. 7), is similar to an inward call to the attendant, except that silent level ringing is applied and the trunk is connected to the called station rather than to the attendant. Also double seize protection is not needed. The control unit obtains the called number from the central office via the direct access pretranslator circuit prior to seizure of the trunk by the central office. The trunk circuit trips the silent level ringing from the central office, and the switch unit applies ringing to the called station if it is idle. The calling station will hear an audible signal, busy tone, ringback, or recorded announcement indicating the condition of the called station. When from the 101 ESS the called station answers, a seize pulse is sent to the trunk circuit to return answer supervision to the central office.

4.31 This trunk may be tested from the master test frame (MTF) of a No. 5 crossbar office. The trunk is made busy and seized by the MTF. Test calls to the switch unit are directed to a test facility rather than an attendant or station. The No. 5 crossbar test circuit is considered the originating party. The call proceeds in the same way as a service call. When testing is completed, release of the make-busy ground causes the trunk to return to normal.

5. DIRECT INWARD DIALING TRUNKS

A. One-Way Direct Inward Dialing Trunk Circuit (SD-1H043)

5.01 Direct inward dialing without direct access (Fig. 8) is accomplished by means of a direct inward dialing (DID) trunk circuit. This trunk circuit provides the means for interconnecting the No. 101 ESS and a crossbar tandem office, or a No. 5 crossbar office arranged for line link pulsing. This is a one-way, incoming trunk circuit that permits the incoming call to connect directly to the switch unit station dialed.

5.02 The trunk circuit is seized by the connecting office, completing a dc path between the T and ring R leads. This causes the A relay to operate and extend the off-hook to the switch unit. The switch unit recognizes this change in scan point and informs the control unit. The control unit directs the connection of this trunk to a digit trunk at the switch unit and the digit trunk to a digit receiver at the control unit. The trunk is now ready to receive dial pulses, and a wink start signal (reverse battery on T and R leads for 200 milliseconds) is sent back to the connecting office. The wink start is accomplished in the following way: a seize signal sent to the trunk circuit logic activates a monopulser, which causes the RV relay to operate and reverse T and R leads for 200 milliseconds, after which RV releases.

5.03 The connecting office recognizes the wink start signal and begins dialing, causing the operation of the A relay, which repeats the dial pulses to the switch unit. The dial pulses are converted into a pair of TOUCH-TONE® frequencies at the switch unit digit trunk. The series of tones are received and counted by the digit receiver at the control unit to determine the digit being dialed.

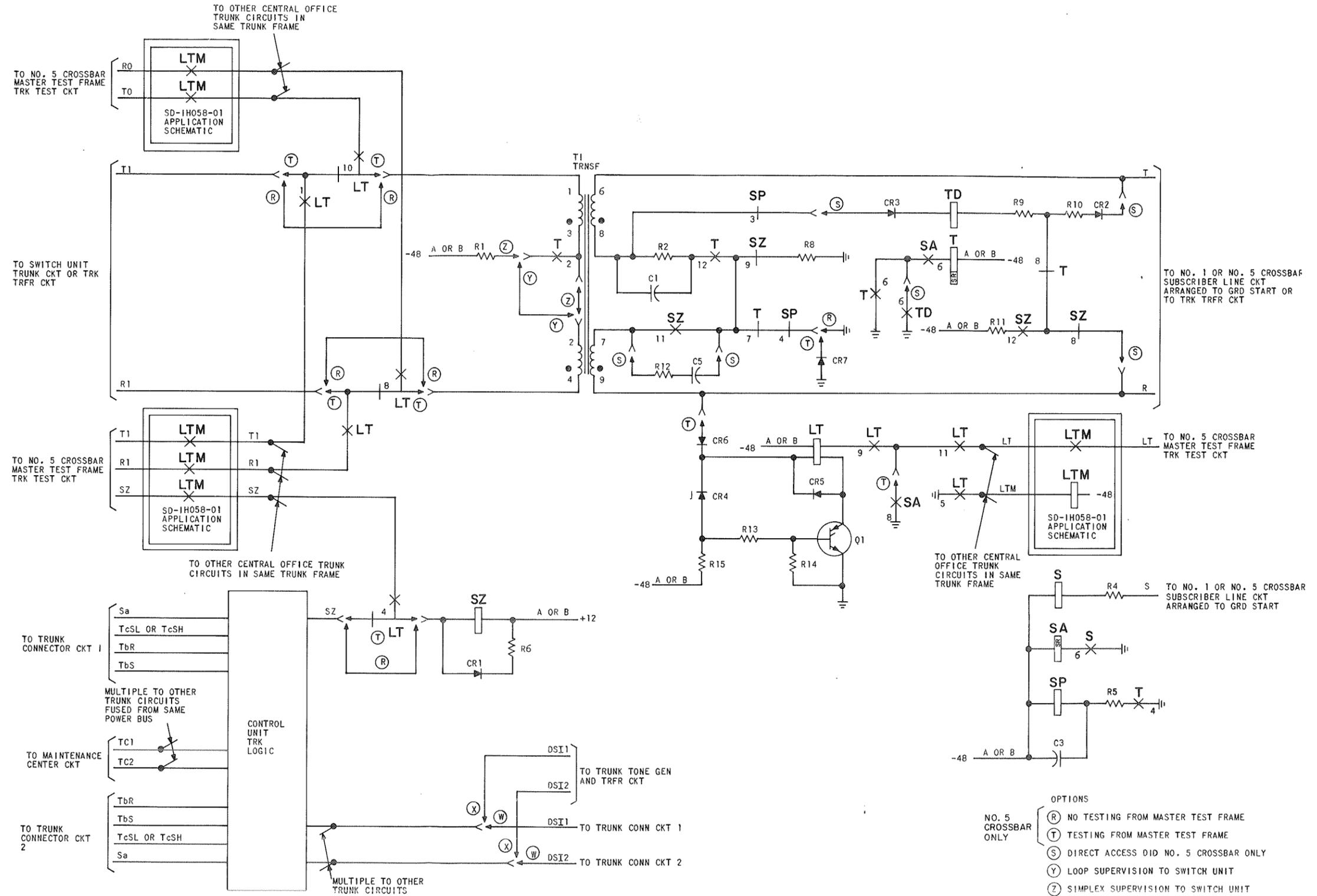


Fig. 7—Central Office Trunk Circuit for Use with No. 1 or No. 5 Crossbar Central Office Option S

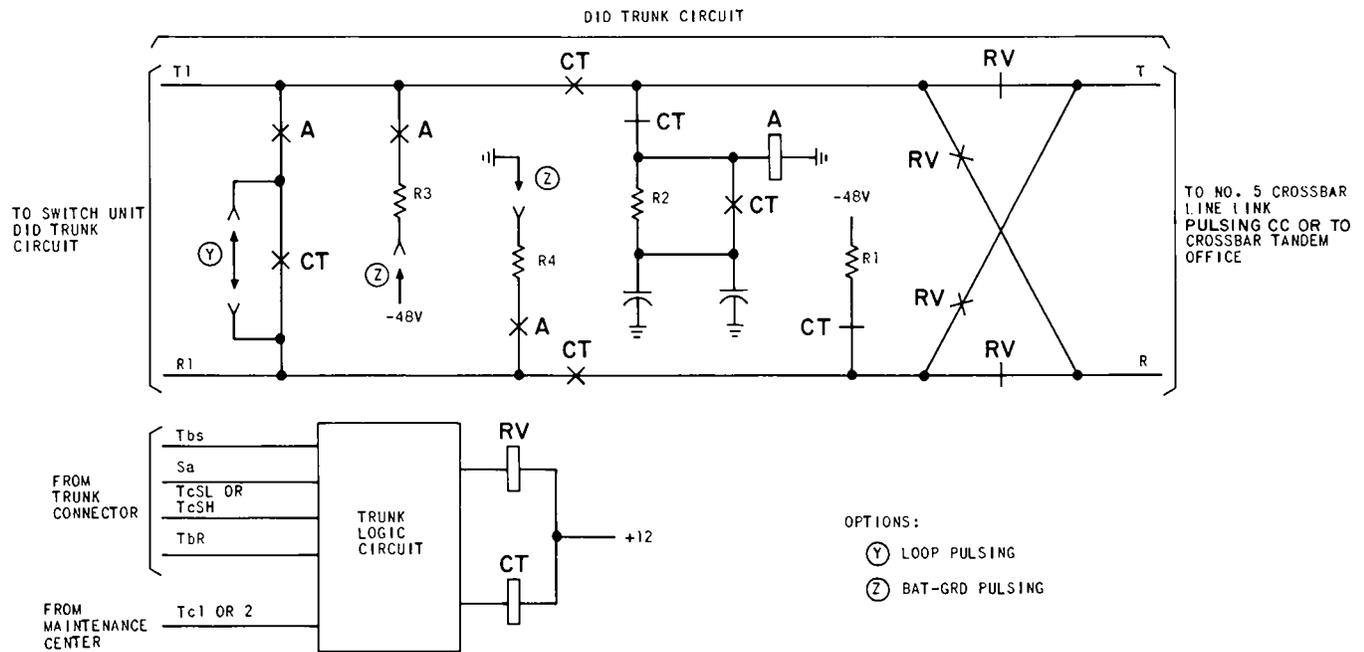


Fig. 8—One-Way Direct Inward Dialing Circuit

5.04 When dialing is completed, the control unit causes a second seize signal to be sent to the trunk circuit logic. This signal causes the cut-through (CT) relay to operate and cut through the T and R leads from the connecting office to the switch unit. A message is sent to the switch unit from the control unit, instructing the switch unit to apply ringing to the dialed station and ringback tone to the calling subscriber.

5.05 When the dialed extension goes off-hook, the switch unit scanner recognizes the change in scan point status and informs the control unit. The control unit responds by instructing the switch unit to connect the dialed extension to the DID trunk. The control unit also sends a third seize pulse to the trunk circuit logic, which reverses the T and R leads to the connecting office. The connecting office recognizes this reversal as an off-hook signal, and the trunk is in a talk and charge condition.

5.06 If the No. 101 ESS subscriber disconnects first, the change in scan point is recognized by the switch unit scanner and reported to the control unit. The control unit responds by sending a release pulse to the trunk circuit logic, which causes the RV relay to release and return the T and R leads to the connecting office to normal.

The connecting office recognizes this as an on-hook signal and disconnects. The disconnect is extended by the A relay to the switch unit. The switch unit informs the control unit, which marks the trunk idle.

5.07 If the connecting office disconnects first, the dc loop to the switch unit is opened. This causes a change in scan point. The switch unit informs the control unit of the change, and the control unit responds by sending a release signal to the trunk circuit logic. This release signal causes the trunk to be made idle and ready to accept new calls.

B. 2-Way Direct Inward Dialing Trunk Circuit for Use with No. 5 Crossbar Offices (SD-1H073)

5.08 This trunk circuit (Fig. 9) provides 2-way service, direct inward dialing (DID), and dial 9 outgoing central office service between a No. 101 ESS PBX and a No. 5 crossbar line link pulsing (LLP) central office. The dial 9 and DID operations are both similar to the operation of the CO and DID trunk circuits used in this system. In both cases, E and M lead supervision is used.

5.09 When one of these 2-way DID trunks is used with a No. 101 ESS office, there will

5.13 If an extension dials 9, the control unit gives the extension second dial tone, selects an idle trunk circuit and sends a seize pulse. This pulse through the trunk connector and the trunk logic circuits operates the E relay, sending ground on the E lead to the central office, which causes the dial tone marker to connect the line circuit in the central office to an originating register. When the register is attached, the central office line circuit places battery on the M lead, operating the M relay in the trunk circuit. The operated M relay extends the off-hook to the switch unit, which sends an off-hook signal to the control unit. The control unit then causes the sender circuit to dial pulse the number of the called party. A speed calling number will be converted to the number of the called party.

5.14 The sender generates dial pulses by sending a series of release and seize pulses to the trunk. The E and CT relays release and operate in response to these pulses.

5.15 When dialing is completed, a connection is established by the central office between the associated central office line circuit and the called party.

5.16 If the central office end disconnects first at the end of a call, the central office line circuit places ground on the M lead, releasing the M relay in the trunk circuit. The trunk circuit logic will cause an on-hook signal to be sent to the switch unit. The control unit recognizes the on-hook signal and sends a release pulse to the trunk. This pulse through the trunk logic circuit removes ground from the E lead and releases the line circuit in the central office. The LLP line circuit restores to normal after a 3/4-second timing interval.

5.17 When a No. 101 ESS extension disconnects first, the control unit sends a release pulse to the trunk. This pulse through the trunk logic circuit removes ground from the E lead, which releases the LLP line circuit. When the line circuit disconnects, ground is applied to the M lead, releasing the M relay. The released M relay sends an on-hook signal to the switch unit and the trunk returns to normal.

5.18 This trunk circuit has built-in double seize protection. Since it is a 2-way trunk, it may be seized simultaneously by the No. 101 ESS

for an outgoing call and by the distant end for an incoming call. If this condition occurs, the control unit will give preference to the incoming call by selecting another trunk for the outgoing call.

5.19 When an E-type repeater is used as a gain device for this trunk circuit, a method of enabling or disabling the repeater is provided via a make contact on the CT relay. When the transmission path is closed through, the CT relay is operated and the repeater is enabled. When the circuit is idle, the CT relay is released and the repeater is disabled.

C. One-Way Direct Inward Dialing Trunk Circuit for Use with Step-by-Step Central Offices (SD-1H075)

5.20 This trunk circuit (Fig. 10) is used to provide one-way direct inward dialing between a step-by-step central office and a No. 101 ESS switch unit. Supervision from the selectors is converted by the trunk circuit to loop supervision for the switch unit.

5.21 This trunk is designed to operate from two levels on the local and toll selectors in the central office. The telephone number of the No. 101 ESS station determines the selector levels. If the trunk is connected to the fifth selector, the two levels correspond to two hundreds groups of numbers. If the trunk is connected to the fourth selector, the two levels correspond to two thousands groups of numbers.

5.22 When a call is originated by a step-by-step subscriber to the lower hundreds level of a No. 101 ESS switch unit, the loop is closed to the trunk circuit, operating the A1 relay. The operated A1 relay closes the loop to the switch unit, and the switch unit scanner will inform the control unit of the off-hook condition. The control unit establishes a connection between a digit receiver and the step-by-step trunk. The operated A1 relay also operates the B1 relay.

5.23 Operation of the B1 relay holds the selectors operated and makes the trunk busy. It also cuts the tip and ring from the selector through to the tip and ring of the trunk, and applies +12 volts to lead 26 indicating the lower hundreds (or thousands) group digit of the dialed number to the control unit via the double seize (DSB) flip-flop in the program control. If, instead, the A2 and B2 relay had been operated by loop closure on

SECTION 240-107-101

the T and R leads to the upper level of SXS selector, ground on lead 26 would indicate the upper hundreds (or thousands) group digit via the DSB flip flop in the program control.

5.24 After the connection between the digit receiver and a trunk is established, a seize pulse sent by the control unit through the trunk connector and the trunk logic circuit keeps the loop to the switch unit closed.

5.25 The subscriber pulses the circuit by opening and closing the loop from the selector levels. The A1 relay (contact A-) follows the dial pulses, alternately grounding and opening the input to the dial pulse delay circuit.

5.26 The dial pulse delay circuit is built into the trunk in order to delay the arrival of all dial pulses at the switch unit digit trunk. This allows time for the control unit to attach a digit receiver; otherwise, the first digit or so might be lost. This circuit is necessary due to the amount of action that must take place while dialing. After a 600- or 180-millisecond delay, depending upon equipment used, the P relay will operate and release with the dial pulses. The P relay will open and close the loop to the switch unit, transmitting the make and break signals to the digit receiver.

5.27 After dialing is completed, a busy tone or audible ringback will be returned to the calling subscriber. The control unit will send a seize pulse to the trunk logic circuit, closing through an ac transmission path to allow the calling subscriber to hear the ringback or reorder tone from the 101 ESS.

5.28 When the called party answers, a third seize pulse through the trunk logic circuit will operate the SZ relay. The operated SZ relay reverses battery and ground to the step-by-step office to charge the call.

5.29 When a No. 101 ESS subscriber goes on-hook, a release pulse from the trunk connector through the trunk logic circuit releases the R and CT relays. The SZ relay remains operated and the released R relay opens the loop to the switch unit. The released CT relay opens the operate path for the A1 relay. The released A1 relay releases the B1 relay after a 350-millisecond delay. During this interval, the switch unit will recognize

the on-hook condition and the No. 101 ESS will mark the trunk idle.

5.30 The released B1 relay releases the step-by-step selectors. The K relay releases, keeping a false off-hook signal from being transmitted to the switch unit. The trunk is now returned to the idle condition.

5.31 When a step-by-step subscriber goes on-hook, the A1 relay releases, followed by B1, which releases the selectors by removing ground from the S lead. Release of the A1 relay also causes the loop to the switch unit to be opened. The S relay operates and regrounds the S lead to prevent reseizure during the interval the trunk is being idled by the No. 101 ESS system. The R, CT, S, and SZ relays will be released when a release pulse is sent from the trunk connector; the trunk is then marked idle.

5.32 The operation of the trunk for toll calls originating from the selector levels is identical to the local calls except for a ground placed on a signal lead that is removed by operation of the CT or T relay.

5.33 A preference circuit (not shown in Fig. 10) is built into the trunk circuit to prevent double seizure from the step-by-step selectors. Only one of two seized selector levels is allowed to transmit dial pulses to the delay circuit. If two selector levels are seized, the one not allowed access to the delay circuit will either be released by the trunk or by the step-by-step subscriber when ringback is not returned.

5.34 The order of preference in the double seize protection is as follows: toll lower selector level, local lower selector level, toll upper selector level, and local upper level.

5.35 A delayed dial tone protection circuit is also provided. This circuit consists of a protection relay, which returns overflow tone to the calling subscriber and an on-hook signal to the switch unit if the P relay operates before a seizure is given which indicates dialing may start.

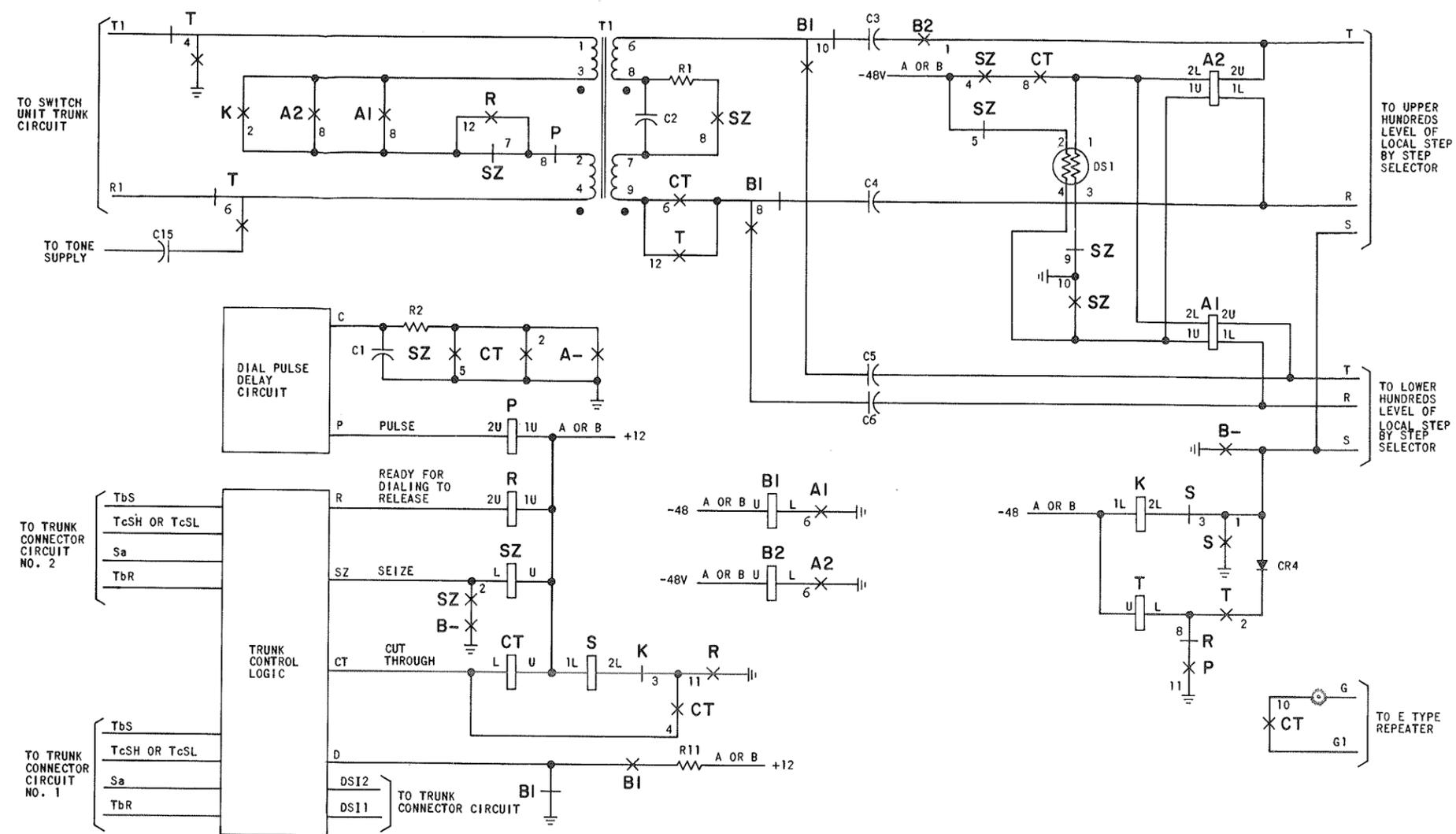


Fig. 10—One-Way Direct Inward Dialing Trunk
—Circuit for Use with Step-by-Step
Central Office

6. TIE TRUNKS

A. 2-Way Automatic Tie Trunk Circuit—High-Low Loop Supervision (SD-1H044)

6.01 This circuit (Fig. 11) is intended to provide between a No. 101 ESS PBX and a distant PBX. All calls incoming and outgoing are routed to an attendant. This trunk circuit is arranged for loop supervision to the distant PBX.

6.02 When a call is originated by the No. 101 ESS, the trunk connector sends a seize signal to the trunk circuit logic, which connects the L relay across the loop to the distant PBX, sending an off-hook signal (battery feed) over the T and R leads. When the attendant at the distant PBX goes off-hook, the T and R leads are closed through, causing the L relay to operate. The operated L relay closes the loop to the switch unit and sends an off-hook indication to the control unit.

6.03 If the No. 101 ESS disconnects first, the control unit will send a release pulse through the trunk connector to the trunk circuit logic, which disconnects the L relay from the loop, sending an

on-hook signal to the distant PBX. The L relay releases, opening the loop to the switch unit. This causes an on-hook signal to be sent to the control unit, which marks the trunk idle.

6.04 When the distant PBX disconnects first, the loop from the PBX is opened, causing the L relay to release. This opens the loop to the switch unit and signals an on-hook indication to the control unit. A release pulse is then sent through the trunk connector removing battery and ground, thereby informing the distant PBX that the trunk is idle.

6.05 On a call originated by the distant PBX, battery and ground will be applied over the T and R leads to the control unit, causing the S relay to extend the off-hook to the switch unit. An off-hook indications is sent to the control unit; this establishes a ringing connection between this trunk and the attendant at the switch unit. When the attendant answers, a seize pulse is sent through the trunk connector to the trunk circuit logic, which sends an off-hook signal (low-resistance loop) back to the distant PBX.

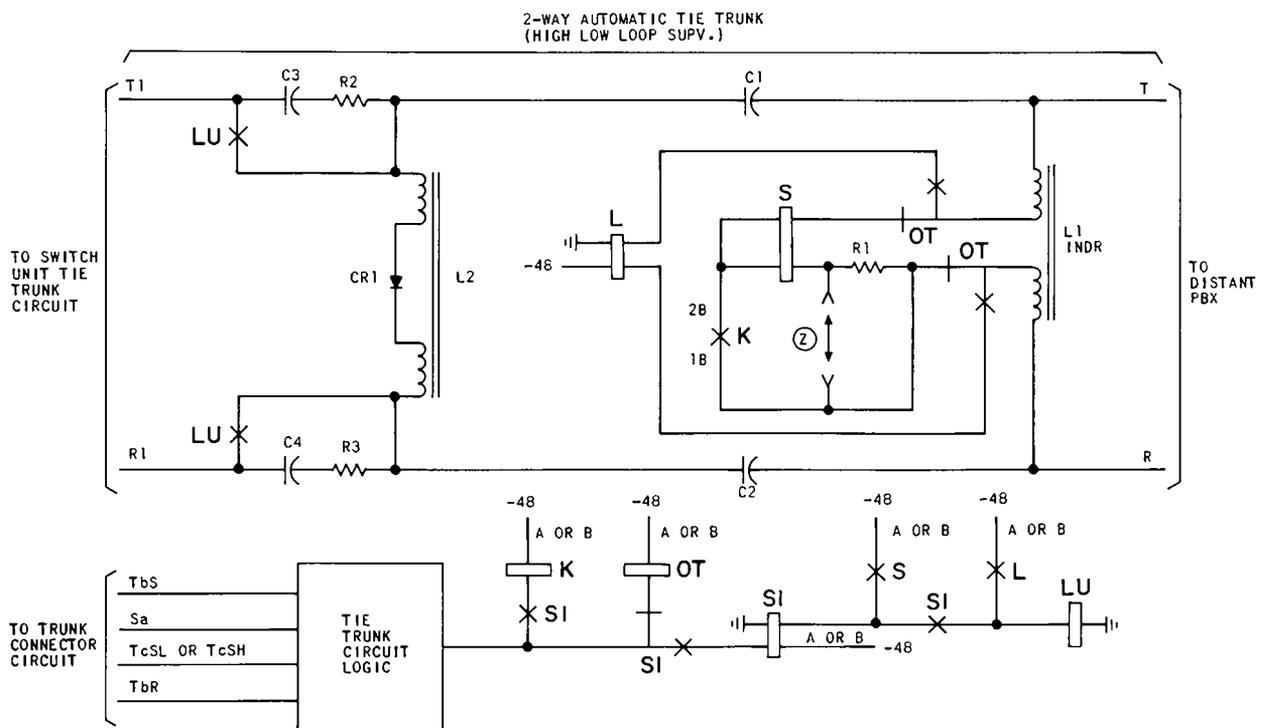


Fig. 11—2-Way Automatic Tie Trunk Circuit High-Low Loop Supervision

6.06 If the distant party disconnects first, the loop is opened to the switch unit, causing an on-hook indication to be sent to the control unit. A release pulse is then sent through the trunk connector and the trunk logic circuit.

6.07 When the No. 101 ESS station disconnects first, a release pulse is sent from the call processor through the trunk connector and trunk logic circuit, opening the loop to the distant PBX. When the distant PBX disconnects, battery is removed from the pair, opening the loop to the switch unit, which sends an on-hook indication to the control unit. The trunk is then marked idle.

B. 2-Way Dial Repeating Tie Trunk Circuit (SD-1H065, A and M Replaced by SD-1H083)

6.08 The 2-way dial repeating tie trunk is used to connect a switch unit with another PBX and uses E and M lead supervision. It has provisions for either 2- or 4-wire operation to the switch unit. Fig. 12 shows a block diagram of a typical application of this trunk circuit.

6.09 When this trunk is seized by a distant PBX for an incoming call, ground will be put on the E lead, causing a change in the scan point in the switch unit. The scanner recognizes the change in scan point and causes a message to be sent to the control unit. The control unit recognizes this as an off-hook signal and causes the switch unit to set up a connection between this trunk and a digit trunk. The control unit then sets up a connection between the digit trunk and a digit receiver. When the connection is established, the control unit sends seize pulses through the trunk connector to the trunk circuit. This pulse advances the circuit to the dial tone state (001). (See Fig. 12 and Table A.) This seize request causes dial tone on the trunk. The calling party then begins to dial, causing the E relay to operate and release in response to the dial pulses.

6.10 The first release of the E relay will cause the dial pulse detector (DETR) circuit to advance the trunk to the dialing state (101). The E relay continues to follow the dial pulses until dialing is completed. These pulses are detected by the digit trunk at the switch unit and converted into TOUCH-TONE frequencies which are passed to the digit receiver at the control unit. When the digit receiver has received a complete number, it passes this number to the control unit through

the dialing-completed register. When dialing is complete, the control unit causes a second seize pulse to be sent through the trunk connector to the trunk circuit. This pulse causes the trunk to advance to the cut-through state (110), closing an ac transmission path through to the switch unit. When the called number goes off-hook, the control unit sends a third seize pulse through the trunk connector to the trunk circuit. This pulse advances the trunk to the answer state (111) and causes the M relay to operate, which places battery on the M lead to the distant PBX as an answer signal.

6.11 When this trunk is seized for an outgoing call, a seize pulse is sent through the trunk connector to the trunk circuit. This seize pulse places the trunk in the connect state (111). As the station dials the number for the distant PBX, the sender in the control unit sends release and seize pulses to the trunk through the trunk connector. The first release pulse causes the trunk to go to the release (000) state. The next seize pulse places the trunk in the connected state (111), which reoperates the M and CT relays. This sequence is followed for each pulse of the dialed digit. The release and operation of the M relay changes the potential on the M lead which the distant PBX recognizes as dial pulses. When the called party goes off-hook, the ground will be returned on the E lead, which causes an off-hook signal to be sent to the switch unit. This signal is detected by the scanner and a message is sent to the control unit.

6.12 When the party at the distant PBX goes on-hook, ground is removed from the E lead, causing a change in scan point status which is detected by the switch unit scanner, and a message is sent to the control unit. The control unit times for 1-1/2 seconds to be sure this is not a flash signal and then responds by causing a release pulse to be sent through the trunk connector to the trunk circuit. This release pulse places the trunk in the release state (000). This state causes an on-hook signal to be sent to the distant PBX.

6.13 When the station of the No. 101 ESS goes on-hook, the control unit times for 1-1/2 seconds to be sure this is not a flash signal, and then responds by causing a release pulse to be sent through the trunk connector to the trunk circuit. This pulse sets the trunk in the flashing state (110). When the distant party goes on-hook,

TABLE A

STATE OF TRUNK	CHANGE STATE WITH SEIZE PLS AND E RELAY		CHANGE STATE WITH RLS PLS AND E RELAY		DIAL PULSE	RELAYS OPER	REG STATE NO.
	OPR	RLS	OPR	RLS			
RELEASED	001	111b	—	—	100	NONE	000
DIAL TONE	—	—	000	000	101	DT	001
FALSE DIAL	—	—	—	000	—	DT, CT	100
DIALING	110a	110a	000	000	—	NONE	101
CUT THRU	111a	*	000	*	000	CT	110a
FLASHING	111a	*	000	*	000	CT	110b
ANSWER	—	—	110b	000	—	CT, M	111a
CONNECT	—	—	110b	000	—	CT, M	111b

* THE CIRCUIT WILL NOT REMAIN IN THIS STATE WHEN THE E RELAY IS RELEASED, BUT WILL REVERT TO THE 000 STATE WITHOUT A SEIZE OR RELEASE PULSE.

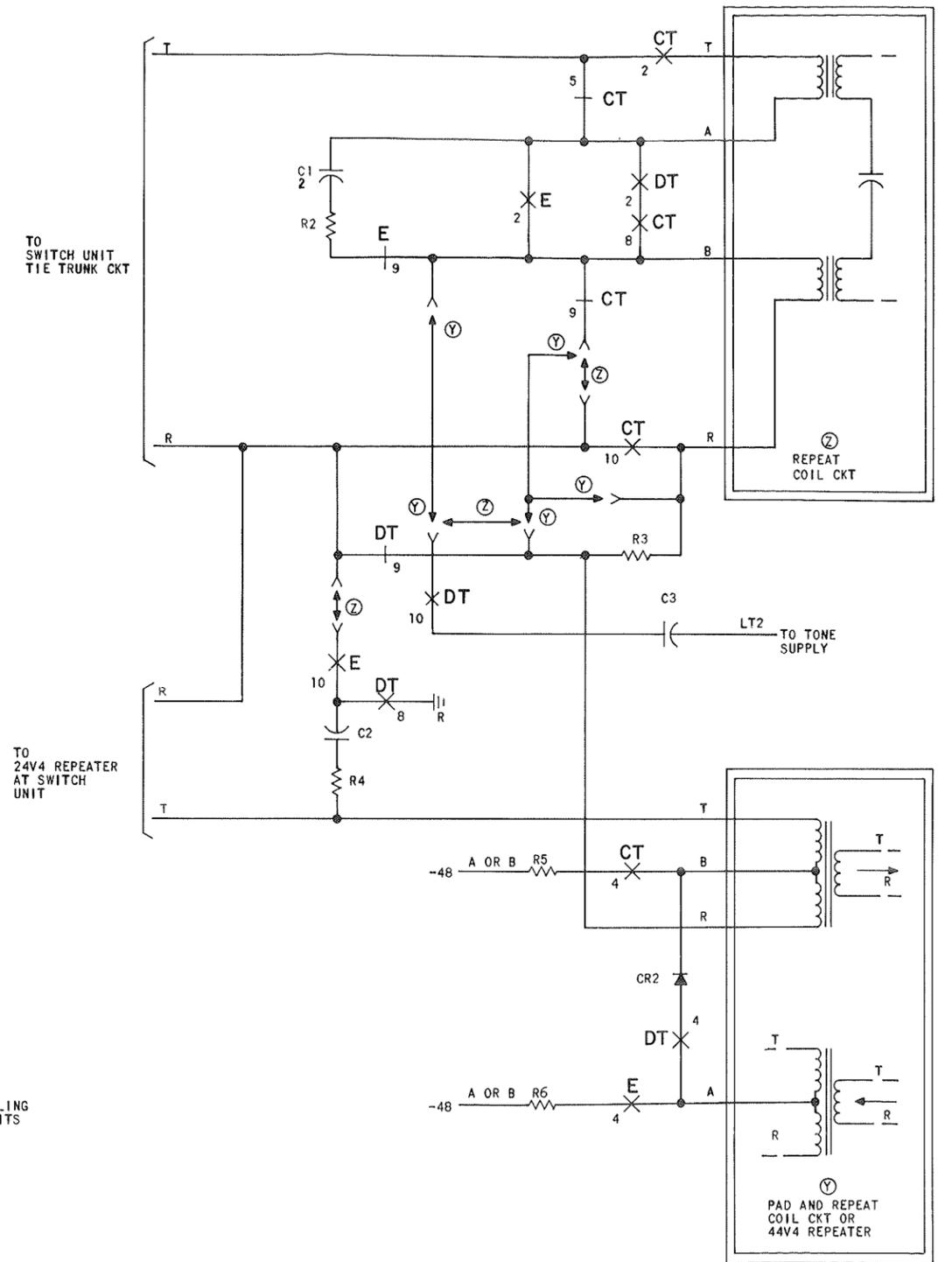
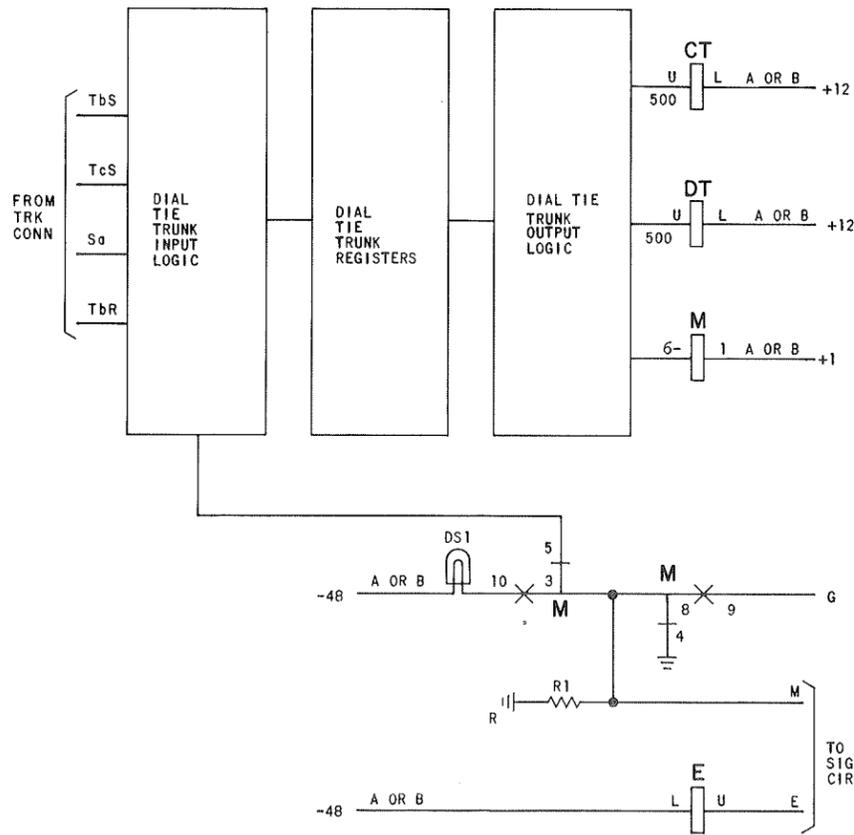


Fig. 12—2-Way Dial Repeating Tie Trunk Circuit Detail

ground is removed from the E lead and the trunk is released.

6.14 In the talking or answer state, flashing may be accomplished by either the No. 101 ESS or the distant PBX. If the distant PBX initiates the flash, the E lead will be opened briefly. This is detected at the switch unit by the scanner. If the open period is less than 1 second, the control unit recognizes this as a flash signal. Miscellaneous tie trunks are permitted to flash only when they are the outgoing party. If the tie trunk is the outgoing party and it is converted to a CO trunk or another tie trunk, then a flash will call in the attendant. If the tie trunk is connected to a station then the tie trunk is not permitted to flash, regardless of whether it is an incoming party (source) or an outgoing party (destination). The control unit then generates a message to connect the attendant to the call.

6.15 If the No. 101 ESS station initiates the flash, it is connected to dial tone. The No. 101 ESS station then dials the attendant and requests a flash to the distant PBX. When the attendant operates the signal destination key, the control unit sends a release pulse to the trunk through the trunk connector. This pulse places the trunk in the flashing state (110) and releases the M relay. To end the flash, the control unit sends a seize pulse to the trunk through the trunk connector, placing the trunk in the connect state (111). This causes the M relay to operate, placing battery on the M lead. The distant PBX recognizes this as a flash and signals the attendant.

C. 2-Way Automatic Tie Trunk Circuit—E and M Lead Signaling (SD-1H061, A and M Replaced by SD-1H084)

6.16 This 2-way tie trunk circuit (Fig. 13) is arranged to use E and M lead signaling between the No. 101 ESS control unit and the associated carrier facility. It has provisions for either 2- or 4-wire operation to the switch unit, and all calls are handled by the attendant.

6.17 When this trunk circuit is seized by the No. 101 ESS, the control unit causes a seize pulse to be sent to the trunk through the trunk connector, placing battery on the M lead to the distant PBX. This generates a seizure at the distant PBX. The response of the distant PBX (ground on E lead) causes a change in the scan

point either by placing battery on the T and R leads to the switch unit (4-wire operation), or by closing the loop to the switch unit (2-wire operation). The control unit recognizes this change as an answer signal from the distant PBX and places the call in a talking condition.

6.18 If the No. 101 ESS disconnects first, the control unit causes a release pulse to be sent to the trunk circuit through the trunk connector.

6.19 This pulse causes ground to be placed on the M lead as a disconnect signal to the distant PBX. The distant PBX goes on-hook, removing ground from the E lead and causing a change in scan point at the switch unit. The control unit recognizes this change as a disconnect signal from the distant PBX. When the E relay releases, the scan protection (SP) relay will operate, preventing a seizure from the distant end until the No.101 ESS has time to mark the trunk idle.

6.20 If the trunk circuit is seized by the distant PBX, ground is placed upon the E lead, causing a change in the scan point at the switch unit. The control unit recognizes this change as a seize signal from the distant PBX and signals the attendant. When the attendant answers, the control unit sends a seize pulse to the trunk control logic circuit through the trunk connector. This pulse places battery on the M lead, which the distant PBX recognizes as an answer signal. The trunk is now in a talking condition.

6.21 When the distant PBX goes on-hook, ground is removed from the E lead, causing a change in scan point at the switch unit. This change is recognized by the control unit as a disconnect signal from the distant PBX. The control unit sends a release signal to the trunk through the trunk connector, causing ground to be placed on the M lead and informing the distant end of the No. 101 ESS disconnect.

D. 2-Way Tie Trunk Circuit for Use with Dial PBX or No. 5 Crossbar Office Arranged for CCSA Service, E and M Lead Supervision (SD-1H083)

6.22 This trunk circuit (Fig. 14) is used to interconnect a No. 101 ESS switch unit and a No. 101 ESS control unit with either a No. 5 crossbar central office arranged for CCSA service or a tie trunk circuit to a distant PBX.

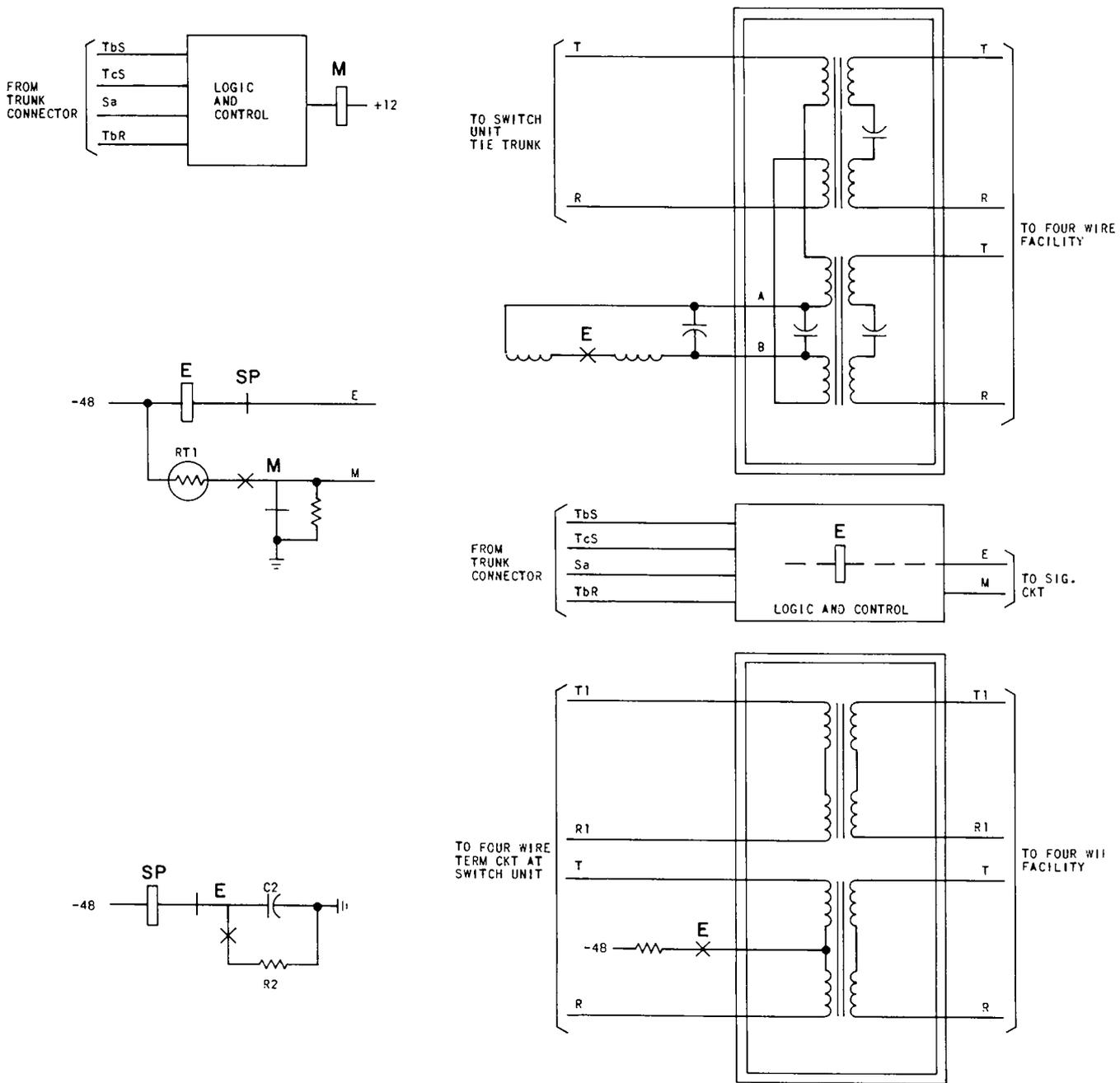
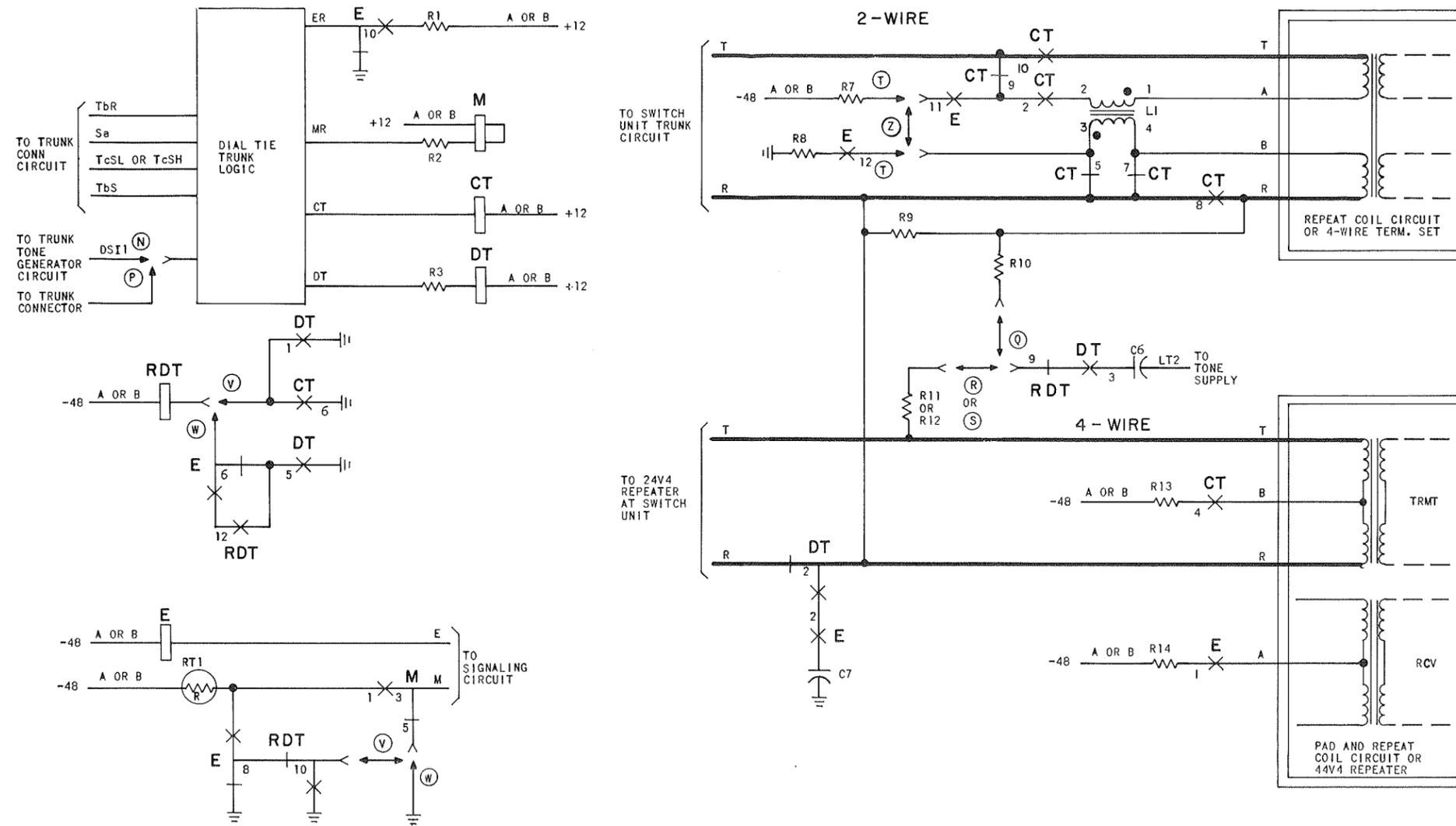


Fig. 13—2-Way Automatic Tie Trunk Circuit—E and M Lead Signaling

6.23 The circuit is designed to operate with two types of supervisory signals, depending on the supervision required in the connecting circuits. The first type occurs with CCSA operation and the second occurs when the connecting circuit is a tie trunk to a distant PBX. The connecting circuits for this trunk must be arranged for E and M lead supervision.

Incoming Calls with Start Dial Supervision (V Option)

6.24 An incoming call from the distant end seizes the trunk by operating the E relay, causing the off-hook information to be passed through the switch unit to the control unit. Operation of the E relay also causes an immediate off-hook (battery on the M lead) to be returned to the distant end.



FEATURE		OPTIONS
DELAYED DIAL SUPERVISION RETURNED TO DISTANT END FOR INCOMING CALLS		V
DIAL TONE RETURNED TO DISTANT END FOR INCOMING CALLS	2-WIRE TRANSMISSION TO SWITCH UNIT	W,Q
	4-WIRE TRANSMISSION TO SWITCH UNIT	600Ω LINE
1200Ω LINE		W,R
PULSING TYPE 2 WIRE TRANSMISSION TO SWITCH UNIT	LOOP	Z
	BATTERY AND GROUND	T
		N
		P

Fig. 14—2-Way Tie Trunk Circuit for Use with Dial PBX or No. 5 Crossbar Office

A circuit is then established between the tie trunk and a digit receiver in the control unit. In setting up this connection, a release pulse is sent to the trunk to ensure that the logic circuit is ready for the start of the call.

6.25 When the circuit connection is completed, a seize pulse is sent through the trunk connector circuit and the dial tie trunk logic circuit, sending a start dial signal (ground on the M lead) to the distant end; dial pulsing begins. The dial tie trunk logic circuit will not reset during dialing, even though the E relay releases and reoperates with the dial pulses.

6.26 When dialing is completed, the control unit sends a second seize pulse to the trunk circuit. This pulse causes the dial tie trunk logic circuit to establish a talking path through the trunk unit to the switch unit. This path allows ringback or reorder tones to be sent from the switch unit to the distant subscriber.

6.27 When the No. 101 ESS subscriber answers, a third seize pulse is sent from the trunk connector to the tie trunk. This pulse will set the circuit to the answer state. The operated M relay sends answer supervision (battery) to the distant end. The trunk logic circuit prevents any change in the state of the trunk by additional seize pulse occurring during call transfer.

Outgoing Calls with Start Dial Supervision (V Option)

6.28 When a No. 101 ESS station dials the tie trunk code, a trunk is selected by the control unit. A seize pulse through the dial tie trunk logic circuit causes battery to be applied to the M lead to seize the distant trunk circuit. The control unit gives second dial tone to the No. 101 ESS subscriber. This indicates to the control unit that outpulsing may start.

6.29 An off-hook signal (ground on the E lead) from the distant end will operate the E relay in the trunk circuit and close the loop to the switch unit. The switch unit detects the off-hook signal and in turn sends an off-hook signal to the control unit. When a register is attached to the distant end, a start dial signal (battery on the E lead) will be sent and the switch unit will send an on-hook signal to the control unit. As the subscriber dials, the sender outpulses a series of seize and release

pulses to the trunk control logic. The M relay pulses the called number to the distant end.

6.30 When dialing is completed, an ac transmission path to the switch unit is provided so that the No. 101 ESS party will hear ringback or the proper tone. When the called party goes off-hook, the E relay will operate and close the loop to the switch unit. The scanner will detect this and signal the control unit that the distant party has answered.

Distant End Disconnect (V Option)

6.31 When the distant end party disconnects first, the E lead is opened, and an on-hook signal is sent to the switch unit, which passes it to the control circuit. The control unit times for 1-1/2 seconds to be sure this is not a flash, and then sends a release pulse through the trunk connector to the trunk. An on-hook signal (ground on the M lead) is sent to the distant end, and the trunk is placed in an idle condition.

No. 101 ESS Station Disconnect

6.32 When the No. 101 ESS station goes on-hook, the control unit times to be sure this is not a flash. A release pulse is then sent through the trunk connector to the trunk logic circuit. Ground on the M lead acts as an on-hook signal to the distant end. When the distant subscriber goes on-hook, the E relay is released, opening the loop to the switch unit. This causes the trunk logic circuit to place the trunk in an idle condition.

Incoming Calls (W, Q Options)

6.33 An incoming call from a distant PBX operates the E relay, closing the loop to the switch unit. This is detected by the switch unit scanner, which sends an off-hook signal to the control unit. When the control unit has established a connection between the trunk at the switch unit and a digit receiver at the control unit, a seize pulse is sent to the dial tie trunk logic circuit. The seize pulse causes dial tone to be supplied to the distant end from a CO source.

6.34 When dialing is completed, the control unit sends a second seize pulse to the trunk control, establishing a transmission path for the distant subscriber to hear ringback or tones.

6.35 When the No. 101 ESS subscriber answers, a third seize pulse is sent to the trunk through the trunk logic circuit, sending answer supervision (battery on the M lead) to the distant end.

Outgoing Calls (W, Q Option)

6.36 When the No. 101 ESS station dials the tie trunk code, a seize pulse sent by the control unit causes battery to be placed on the M lead to seize the distant tie trunk. Second dial tone is returned by the control unit to the No. 101 ESS subscriber. The control unit will time for two seconds and then dial pulses will be passed by a sender in the control unit through the trunk to the trunk control logic. The M relay will pulse the called number to the distant end. When dialing is completed, the CT relay will close the transmission path to the switch unit, enabling the distant subscriber to hear the proper tones.

6.37 When the called party answers, the E relay will operate and close the loop to the switch unit. This will be detected by the scanner, which will send a signal to the control unit signifying a distant party answer.

6.38 Disconnect from the No. 101 ESS or the distant end is effected in the manner described in 6.31 and 6.32.

6.39 This tie trunk may be connected for 4-wire operation. In this case supervisory signals are sent by the E relay via the A lead, and cut-through signals by the CT relay via the B lead.

6.40 When dial tone is required for the distant PBX subscriber, the R or S option must also be provided. These options are dependent on the impedance of the transmission system.

E. 2-Way Tie Trunk Circuit Incoming Automatic, Outgoing Automatic, or Dial Repeating E and M Lead Supervision (SD-1H084)

6.41 This trunk circuit will repeat flashes in either direction. The trunk circuit also has double seize protection which will give preference to incoming calls.

6.42 This tie trunk circuit (Fig. 15) is used to connect a No. 101 ESS control unit, a No. 101 ESS switch unit, and a distant PBX. It can

be arranged for automatic incoming calls to the No. 101 ESS, and either automatic or dial repeating outgoing calls. Two- or four-wire transmission facilities may be provided by options in the trunk. E and M lead signaling is used between the trunk and the distant PBX.

Incoming Call (W or Z Option)

6.43 When the distant PBX goes off-hook, operating the E relay, the loop is closed to the switch unit which passes this off-hook indication to the control unit. The control unit establishes a connection between the trunk and the proper tone source (ringback tone), and alerts the attendant.

6.44 When the attendant answers the call and connects to the trunk, a seize pulse is sent through the trunk connector and the trunk logic circuit, causing battery to be applied to the M lead; this sends answer supervision to the distant end. The trunk is then in an answer state.

Outgoing Calls Automatic Operation (W Option)

6.45 When a No. 101 ESS subscriber dials the tie line code, the control unit will send a seize pulse to the trunk and direct the switch unit to connect the calling party to the trunk. The seize pulse will cause battery to be placed on the M lead to signal the distant PBX of the seizure. When the attendant at the distant end answers, ground placed on the E lead causes answer supervision to be sent to the No. 101 ESS by closing the loop to the switch unit.

Outgoing Calls Dial Repeating (Z Option)

6.46 When a No. 101 ESS dials the tie line, the control unit will send a seize pulse through the trunk connector and the trunk logic circuit. This pulse causes battery to be placed on the M lead, sending an off-hook signal to the distant PBX. The No. 101 ESS subscriber receives second dial tone and then dials the extension number at the distant PBX.

6.47 The control unit will time for 2 seconds and then start outpulsing from a sender in the control unit by applying release and seize pulses through the trunk connector to the trunk logic circuit. The M relay will operate and release in unison with these pulses, outpulsing the called number. The M relay alternately places battery

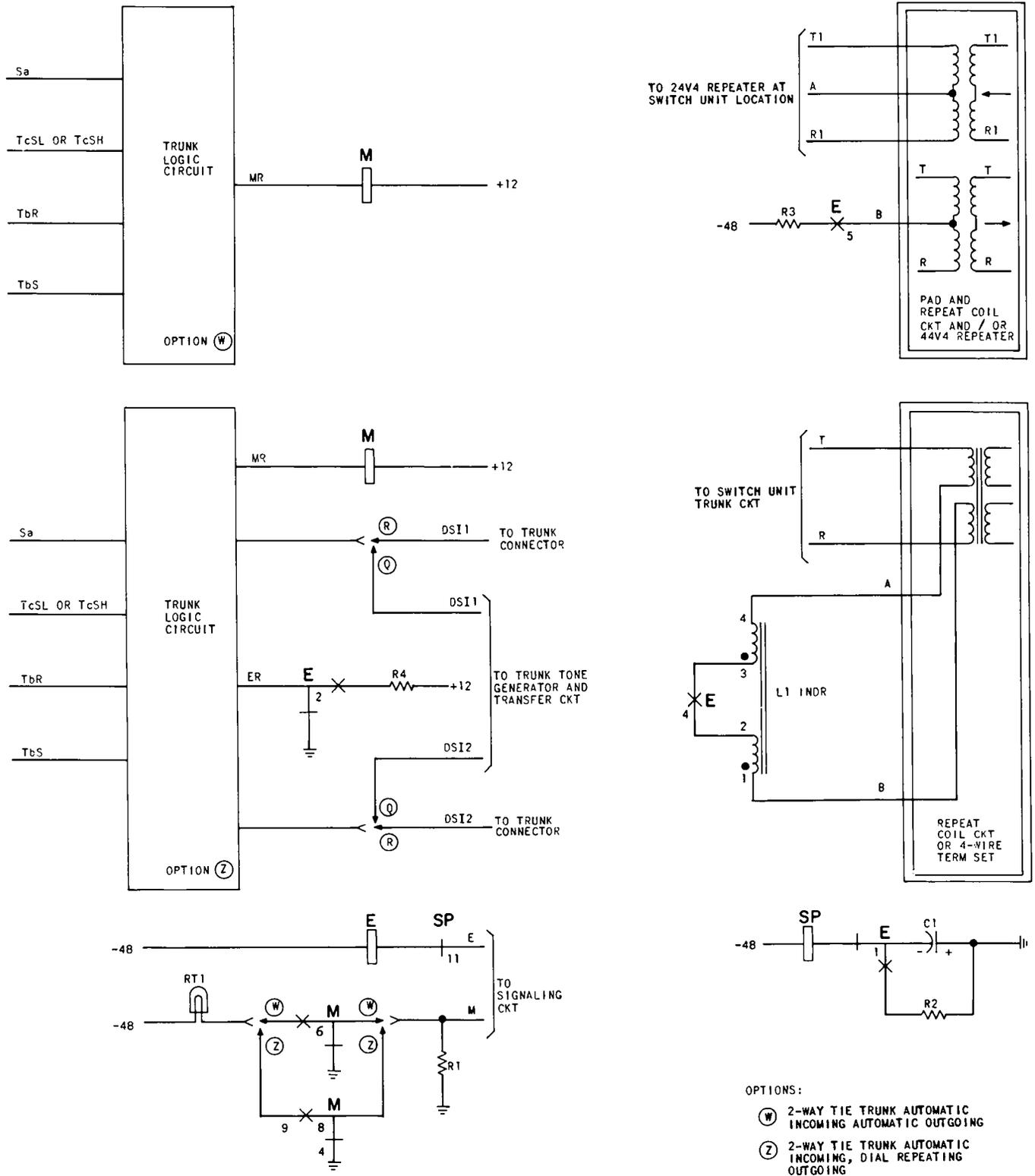


Fig. 15—2-Way Tie Trunk Circuit Incoming Automatic, Outgoing Automatic, or Dial Repeating E and M Lead Supervision

- OPTIONS:
- (W) 2-WAY TIE TRUNK AUTOMATIC INCOMING AUTOMATIC OUTGOING
 - (Z) 2-WAY TIE TRUNK AUTOMATIC INCOMING, DIAL REPEATING OUTGOING

and ground on the M lead, thus transmitting make and break signals to the distant end.

6.48 When the distant party answers, ground is placed on the E lead, which closes the loop, sending an answer signal to the switch unit.

Disconnection

6.49 When the No. 101 ESS station disconnects first, a release pulse is sent through the trunk logic circuit, releasing the M relay. The released M relay places ground on the M lead, signaling the distant PBX of the disconnect.

6.50 The distant PBX disconnects, removing ground from the E lead. This causes the E relay to release, opening the loop to the switch unit. An SP relay will operate and hold operated for approximately 200 milliseconds. This interval allows the open E lead to block any incoming calls, and gives the No. 101 ESS time to recognize the disconnect and mark the trunk idle.

6.51 If a distant PBX disconnects first, ground is removed from the E lead, causing the E relay to release. Release of the E relay opens the loop to the switch unit. When the No. 101 ESS recognizes the on-hook signal from the distant PBX, a release pulse is sent to the control unit. This pulse through the trunk logic circuit releases the M relay, which places ground on the M lead marking the trunk idle.

Flashing

6.52 Flashing may be originated only from the No. 101 ESS. If the distant end flashes, the control unit will treat the flash as a disconnect followed by an origination. If the No. 101 ESS is to flash, the attendant must be added to the circuit by dialing 0. The attendant can then flash the distant PBX. When the attendant flashes, release and seize pulses are sent by the control unit. These pulses cause the M relay to release and reoperate, transmitting flash signals to the distant PBX.

7. MISCELLANEOUS TRUNKS

A. Foreign Exchange Trunk Circuit (SD-1H042)

7.01 The foreign exchange (FX) trunk circuit (Fig. 16) is used to interconnect the No. 101 ESS and a central office which is remote from the

control unit. This trunk circuit is arranged for E and M lead supervision between the No. 101 ESS control unit and a 4-wire facility to the distant central office. It permits outgoing calls to be dialed directly from the No. 101 ESS station, but all incoming calls are routed to the attendant.

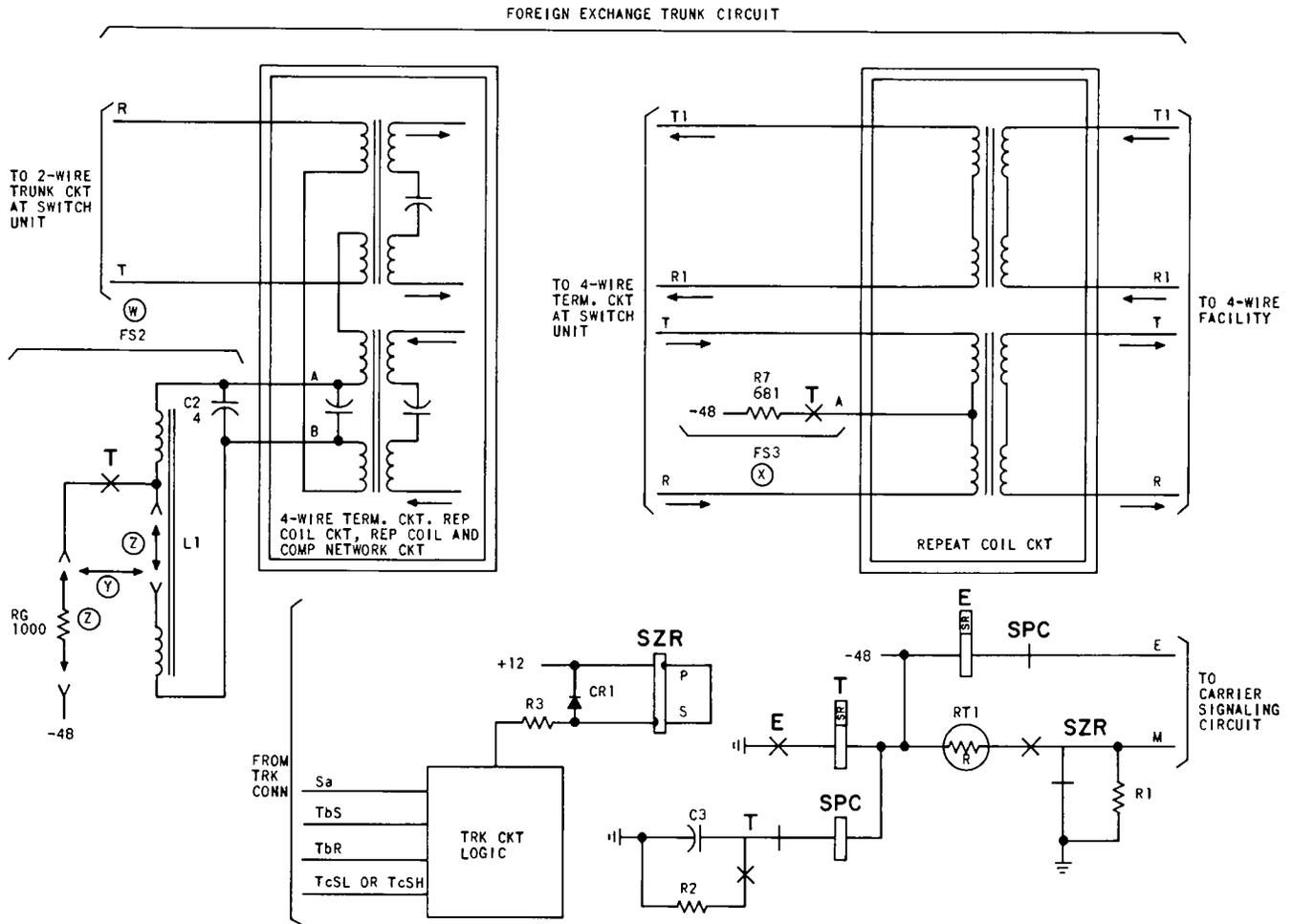
7.02 To originate a call, the No. 101 ESS station goes off-hook and dials the proper code to select an FX trunk. Immediate second dial tone is given to the calling party by the No. 101 ESS. A seize pulse is sent through the trunk connector to the trunk circuit logic. This operation is the same as for the trunk circuit logic for the central office trunk circuit which was previously described. The seize pulse through the logic causes the seize (SZR) relay to operate. When the SZR relay operates, the condition of the M lead is changed from ground to battery. The remote central office response to this signal places ground on the E lead when a dial pulse register has been attached to the trunk. This causes the dc supervision to be closed through to the T and R leads to the switch unit.

7.03 The switch unit scanner recognizes the change in scan point status and informs the control unit. The control unit then is permitted to start outpulsing.

7.04 Outpulsing is accomplished by release and seize signals from the trunk connector. These signals cause the SZR relay to release and operate. As the SZR relay releases and operates in response to these dial signals, it alternately applies ground and battery to the M lead via the transfer contact. When dialing is completed, the call will be cut through to the called party and the connection completed.

7.05 When the No. 101 ESS disconnects, a release pulse is sent through the trunk connector to the trunk circuit logic. This causes the SZR relay to release, which returns the ground condition to the M lead. This condition must be maintained for approximately 600 milliseconds in order to be recognized as a disconnect signal by the distant central office.

7.06 When the central office recognizes the disconnect signal, it releases the trunk, thereby returning the E lead to open circuit. This causes a change in the scan point status on T and R leads to the switch unit. The switch unit



OPTIONS:

- (W) 2-WIRE TRANSMISSION TO SWITCH UNIT
- (X) 4-WIRE TRANSMISSION TO SWITCH UNIT
- (#Y) LOOP SUPERVISION TO SWITCH UNIT
- (#Z) SIMPLEX SUPERVISION TO SWITCH UNIT

Fig. 16—Foreign Exchange Trunk Circuit

recognizes the change in scan point status and informs the control unit that the trunk is idle.

7.07 If the central office serving this trunk circuit is equipped to provide timed release disconnect signals and this central office disconnects first, a time-out cycle of approximately 25 seconds will be started. Moreover, if the dial long line circuit at the central office is equipped to provide disconnect supervision, the following sequence will be affected. If the No. 101 ESS does not disconnect and the time-out cycle is completed, the E lead is returned to open circuit. This causes a change of the dc supervision back to the switch unit on the T and

R leads. The switch unit scanner detects the change in dc supervision and informs the control unit. The No. 101 ESS station is disconnected from the trunk. A release pulse is sent through the trunk connector to the trunk circuit logic, which causes the SZR relay to release. When the SZR relay releases, the condition of the M lead is changed from battery to ground. This informs the distant central office that the No. 101 ESS station is disconnected from the trunk.

7.08 If the dial long line circuit at the central office is not equipped to provide disconnect supervision and the time-out cycle is completed,

the No. 101 ESS station will be connected to central office dial tone. The No. 101 ESS station cannot dial at this time, if a rotary station is being used or if the distant central office will not accept TT signals. Also if this station remains off-hook, the central office will connect the station to a permanent signal trunk after a timed interval.

7.09 When the call is originated at the distant central office, the signaling circuit makes the trunk busy by grounding the E lead, causing the dc supervision on the T and R leads to be changed back to the switch unit. The switch unit scanner recognizes this change and informs the control unit, which causes the attendant to be signaled. When the attendant goes off-hook, a seize signal is sent from the trunk connector to the trunk logic circuit, causing the SZR relay to operate. The M lead is transferred from ground to battery by SZR transfer contacts. The distant office recognizes this change and charges the call.

7.10 If the No. 101 ESS disconnects first, a release signal is sent to the trunk circuit logic, causing the SZR relay to release. Release of the SZR relay changes the condition of the M lead from battery to ground. Since the call was originated in the distant office, a time-out cycle of 25 seconds will be started at this point. When the calling party goes on-hook or the time-out cycle is completed, the call disconnect proceeds as previously described.

B. Code Call Trunk Circuit for Control Unit (SD-1H066)

7.11 This trunk (Fig. 17) is used to connect a No. 101 ESS control unit with a 3A code call circuit located on the customer premises. The circuit converts either TOUCH-TONE or dial pulses from the switch unit into dial pulses to the 3A code call unit.

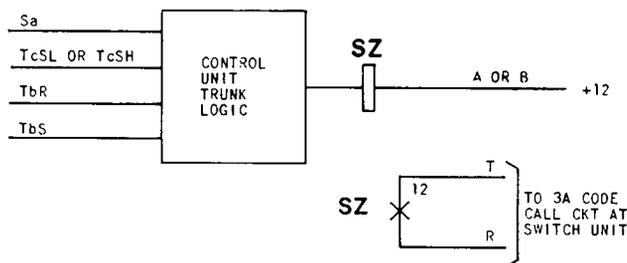


Fig. 17—Code Call Trunk Circuit

7.12 When the access code for a 3A code call has been dialed, a seize pulse is sent through the trunk connector and trunk logic circuit, causing the loop to close to the code call unit. The loop closure changes the scan point at the switch unit, which will notify the control unit of the change. The calling party will receive second dial tone and can dial the code of the party being called. Dial pulses of the code called are now transmitted in the form of release and seize pulses from the trunk connector. The pulses operate and release the SZ relay. This action opens and closes the loop, sending dial pulses to the 3A code call circuit.

7.13 When the correct number of digits (2 or 3) are received by the switch unit code call circuit, it will give an on-hook or flash signal. When the control unit receives this signal, it operates the SZ relay, which remains operated until the called party answers or the 3A code call circuit times out.

7.14 When the called party answers or the 3A code call circuit times out, the trunk connector transmits a release pulse through the trunk logic circuit. This causes the SZ relay to release, which in turn releases the 3A code call circuit. The switch unit scan point is changed and the trunk is then marked idle.

8. REFERENCES

8.01 The following SD drawings and associated circuit descriptions (CDs) give additional information. These are not attached.

SD-1H041	Two-Way Central Office Trunk, A and M (Replaced by SD-1H077)
SD-1H042	Foreign Exchange Trunk Circuit (E and M Lead Signaling)
SD-1H043	Direct Inward Dialing Trunk
SD-1H044	Two-Way Automatic Tie Trunk—High-Low Loop Supervision
SD-1H045	Trunk Connector Circuit
SD-1H053	Pad and Repeat Coil Circuit, A and M (Used Only with 1A Switch Unit)
SD-1H055	Trunk Tone Generator and Transfer, MD (Replaced by SD-1H079)

SD-1H061	Two-Way Automatic Tie Trunk Unit, A and M (Replaced by SD-1H084)	SD-1H077	Central Office Trunk for Use with No. 1 or No. 5 Crossbar Central Office for Control Unit
SD-1H065	Two-Way Dial Repeating Tie Trunk with E and M Lead Supervision, A and M (Replaced by SD-1H083)	SD-1H079	Trunk Transfer Circuit
SD-1H066	Code Call Trunk	SD-1H080	Trunks System Application Diagram
SD-1H073	Two-Way Direct Inward Dialing Trunk Unit	SD-1H083	Two-Way Tie Trunk for Use with Dial PBX or No. 5 Crossbar Offices Arranged for CCSA Service E and M Lead Supervision
SD-1H074	Central Office Trunk for Use with Step-by-Step or Panel Central Office	SD-1H084	Two-Way Tie Trunk Incoming Automatic, Outgoing Automatic, or Dial Repeating E and M Lead Supervision
SD-1H075	One-Way Direct Inward Dialing Trunk for Use with Step-by-Step Central Offices		