

CROSSBAR SYSTEMS
NO. 3
INCOMING PLUG-ENDED TRUNK
CIRCUIT
DP OR MF PULSING
E AND M LEAD SUPERVISION
IN-BAND COIN CONTROL

CHANGES

was not formerly designated and is rated
Mfr Disc.

B. Changes in Apparatus

B.1 Superseded Superseded By
M - 18BM Resistor - M - 533A Diode -
Fig. 1, Option Q Fig. 1, Option P

D.2 In FS2 and CAD 2, reference to
"Transmission and Signaling Facil-
ities with Type I Interface" is added.

D. Description of Changes

D.3 Circuit Note 104 has been revised.

D.1 The FS2 has been revised to show
the addition of P option. Option Q

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-GFC

WE DEPT 25820-JRF-GWC-BT

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CHANGES

C. Changes in Circuit Requirements Other
Than Those Caused by Changes in
Apparatus

B. Changes in Apparatus

C.1 Blocking information and additional
timing requirements are added for
checking the TM timer.

B.1 Added

D. Description of Changes

TM - 446K Diode - App Fig. 1

D.1 In FS1 the TM diode has been inserted
in series between 4 of the CB relay
and the TC and TCA capacitors.

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit is used to complete calls from a distant toll or DSA switchboard to coin or noncoin customers, and is arranged to use E and M lead supervision. The coin and rering features provided are controlled by the use of ac tones.

2. GENERAL DESCRIPTION OF OPERATION

SEIZURE AND PULSING

2.01 When this circuit is seized from the distant switchboard, off-hook supervision is received over the E and M signaling facilities. The trunk transmits an off-hook supervisory signal to the distant switchboard.

2.02 Subsequently an incoming register is attached to this circuit and when it is prepared to receive pulses, it sends an on-hook toward the distant switchboard. After the called number has been registered, the incoming register requests a marker to complete the connection to the called line.

COMPLETION OF CONNECTION

2.03 The incoming register passes the called number and other information to the marker. The marker, from information received, will connect this circuit to the called line and ringing will be applied to the line. When the called customer answers, ringing is tripped, the talking path is cut through and answer supervision is returned

to the operator. This circuit is maintained in the busy state until the operator disconnects.

COIN CONTROL AND RERING

2.04 Whenever the operator desires to collect or return a coin, or rering the called customer, this circuit will receive a wink signal. This wink signal directs the trunk to connect the receiver circuit to the T and R leads. Shortly after the wink signal is received a combination of tones of 700 Hz and 1100 Hz or, 1700 Hz and 1100 Hz or, 1700 Hz and 700 Hz is received as a coin collect, or coin return, or rering code, respectively.

2.05 The coin collect code will cause coin collect potential to be connected to the called line, and the coin return code will cause coin return potential to be connected to the called line. The rering code will cause machine ringing or continuous 20-Hz ringing to be connected to the called line depending upon whether the called customer's receiver is on-hook or off-hook, respectively.

SECTION II - DETAILED DESCRIPTION

1. SEIZURE AND PULSING

1.01 When this circuit is seized from the distant switchboard, off-hook is received over lead E in the form of a ground to operate relay E.

1.02 Relay E, operated, functions to:

- (a) Operate relay El.
- (b) Remove the T1 idle circuit termination network from across the tip and ring toward the distant office.
- (c) (Option Y) - Connect resistance ground to lead R toward the incoming register link (IRL) circuit in preparation for repeating dial pulses.
- (d) (Option Z) - Partially closes a 4700-ohm bridge across the T and R to the register to simulate a loop while MF digits are being received.
- (e) Connect resistance battery on lead ST toward the IRL as a bid for an incoming register.
- (f) To establish control of TM timer by grounding the I lead through contact 2 make.

1.03 Relay El, operated, functions to:

- (a) Prepare a hold path for itself.
- (b) Transmit an off-hook signal to the distant switchboard by transferring the M lead from ground to resistance battery.
- (c) Prepare an operate path for relay ER.
- (d) Prepares to place the proper timing resistor in the TM timer circuit for timing disconnect.

1.04 When an IR is attached it will operate relay CO. Relay CO, operated, functions to:

- (a) Remove resistive battery from lead ST to the IRL.
- (b) Complete the lock path for relay El.
- (c) Prepare a hold path for relay RV.
- (d) Place timer TM under control of relay E when contact 2 break removes one of the control grounds.
- (e) Place ground on lead BL to the IR as a check that relay CO operated.
- (f) Prepare a hold path for itself when relay CT operates.

1.05 When the incoming register is prepared to receive the called number, it places ground on lead T to operate relay RV. Relay RV operated, functions to:

- (a) Prepare a hold path for relay CT.
- (b) Further opens the ST lead to the IRL.
- (c) Bridge resistor N across leads T and R to the IR when option Z, MF pulsing, is applied.
- (d) Place ground on lead M to the signaling facilities as a signal to out-pulse the called number.

1.06 The IR then receives the called number digits in the form of multifrequency pulses, option Z; or in the form of dial pulses, option Y. In the case of dial pulses, relay E follows the dial pulses to make and break resistance ground on lead R toward the IR. After digit registration of the called number is complete, the incoming register grounds lead CT to operate relay CT.

1.07 Relay CT, operated, functions to:

- (a) Hold itself operated under control of relay E, and relay TM.
- (b) Hold relay CO under control of relay S.
- (c) Prepare a lock path for relays DS, RC, R2, R3, TP, CCl, and CR1 when, and if, they operate.
- (d) Cuts the distant switchboard through toward the called end.
- (e) Prepare an operate path for relay E2.
- (f) Break the dial pulse repeating circuitry, option Y, or the multifrequency receiving loop, option Z, from the trunk T and R.
- (g) Prepare to ground lead S to the trunk switch and connector (TS and C) circuit.

2. MARKER OPERATION

2.01 The marker, upon being summoned by the register, seizes the trunk via the incoming register, the incoming register link circuit, and the trunk switch and connector circuit. The marker operates relay F by applying resistance battery to lead F. The IR passes the called number, class mark, and trunk switch and connector circuit number to the marker.

2.02 Relay F, operated, functions to:

- (a) Connect relays RC, R2, R3, and TP to the marker via the trunk switch and connector circuit.
- (b) Cut leads T, R, and S into the marker via leads T1, R1, and SL through the TS and C.
- (c) Prevent relay PU from operating.
- (d) Operate relay DS.
- (e) Grounds leads JC, SW, and TT1 to the marker via the TS and C.

2.03 The marker at this time determines whether the called party is busy or idle by looking at the T, R, and S leads

cut through by relay F. If the circuit is busy, busy tone is connected to the tip and ring and the marker disconnects. If the called party is idle, the marker sets up the proper ringing code as follows:

RINGING COMBINATION				
Called Party	Trunk Relays Oper	Ringing		Ringing Applied To
		Superimp	Coded	
1	-	Code 1-	Code 1-	Ring
2	TP	Code 1-	Code 1-	Tip
3	R2	Code 1+	Code 2-	Ring
4	R2,TP	Code 1+	Code 2-	Tip
5	R3	Code 2-	Code 3-	Ring
6	R3,TP	Code 2-	Code 3-	Tip
7	R2,R3	Code 2+	Code 4-	Ring
8	R2,R3,TP	Code 2+	Code 4-	Tip

2.04 The marker completes the ringing connection by grounding lead RC to operate relay RC. Relay RC, operated, functions to:

- (a) Prepare an operate path for relay PU.
- (b) Prepare a hold path for relay PU.
- (c) Prevent relay RO from operating.
- (d) Cut ringing toward the called customer.
- (e) Grounds lead RA to the marker via the TS and C as a check that its lock path is grounded.

2.05 When the marker is satisfied that the ringing connection is complete, it releases relay F. Relay F, released, functions to:

- (a) Complete a path from the PU relay to either ground or to the PU lead. The combination of transfer contacts on the R2 and R3 relays and options S and R provide that the PU relay will be operated immediately for CODE 1 ringing. For other than CODE 1 ringing the PU will be operated by the PU pulse on the PU lead.
- (b) Cut through the T and R to the called line.

(c) Cut through ground to the sleeve lead, through contacts of relays DS and CT, to hold the connection to the called line.

2.06 Relays DS and RC are all held over by relay CT. The operated ringing combination relays are locked for the duration of the call through 9 make CT and 3 break F to ground.

3. CALLED CUSTOMER ANSWERS

3.01 When the called customer answers, relay RT operates over the called customers loop and in return releases relay RC. Relay RC, released, removes ringing potential from the called line, releases relay PU and operates relay S. Relay S, operated, functions to:

- (a) Place battery on the M lead to the distant switchboard as an off-hook, answer supervision signal.
- (b) Release relay CO.
- (c) Prepare a hold path for itself should a rering occur with the called party off-hook.
- (d) Provide logic to determine whether 20-Hz ringing or machine ringing should be sent to the called party on rering.

Relay CO, released, readies the timer for timing the various intervals associated with winking, coin control, and rering. Conversation can now take place between calling and called customer.

4. THE CALLED CUSTOMER DISCONNECTS

4.01 When the called customer disconnects, relay S releases. Relay S released, sends on-hook, disconnect supervision, to the distant switchboard. At this time the operator may disconnect, collect, or return coins or rering. The connection to the called customer remains under control of the distant switchboard.

5. SIGNALING THE OPERATOR

5.01 When the call has been established to the called customer, the customer can signal the operator by depressing and releasing the switchhook. Relay S follows the switchhook flashes to alternately connect battery and ground on the M lead to the distant office, thus flashing the operators supervisory lamp.

6. OPERATOR GOES ON-HOOK

6.01 When the operator goes on-hook at the start of a wink or a disconnect, ground is removed from lead E of this circuit and relay E releases. Relay E, released, functions to:

- (a) Release relay E1.
- (b) Place the idle line termination T1 across tip and ring toward the distant switchboard.
- (c) Remove one of the lock paths of relay CT.
- (d) Remove one of the ground paths from the I lead to the timer TM.
- (e) Prepare to place the proper resistance, for the disconnect timing function, in the timer circuit.

6.02 Relay E1, released, operates relay E2. Relay E2, operated, functions to:

- (a) Complete the path for the proper timing resistance for timing disconnect.
- (b) Remove ground from the I lead to the timer TM to start the timer.
- (c) Prepare to recycle TM timer should relay F1 or F2 operate later.
- (d) Prepare an operate path for relay ER should this be the beginning of a wink.

Timer TM will time for a nominal time of 230 milliseconds. Should the operator send off-hook before the 230 milliseconds are up, the signal will be considered a wink. Should the operator not send off-hook, the signal will be considered a disconnect.

7. THE OPERATOR DISCONNECTS

7.01 After 230 milliseconds timer TM will time out and operate relay TM. Relay TM, operated, releases relay CT. Relay CT, released, functions to:

- (a) Release relays RV, E2, and DS.
- (b) Release, if operated, relays S, R2, R3, and TP.
- (c) Remove ground from lead S to drop the connection to the called end.

7.02 Relay E2, released, releases relay TM and recycles the timer by grounding its I lead. Relay RV released places ground on the M lead, as an on-hook supervisory signal to the switchboard.

8. THE OPERATOR COMPLETES THE WINK

8.01 The operator completes the wink by returning off-hook before timer TM operates relay TM. The signal places ground on lead E to reoperate relay E. Relay E, operated, functions to:

- (a) Remove the idle line termination T1 from across tip and ring.
- (b) Recycle TM timer by grounding its I lead.
- (c) Reoperate relay E1.
- (d) Provide an additional lock path to relay CT.
- (e) Remove the shunt from across resistor RFW in the timing circuit.

8.02 Relay E1, reoperated, functions to:

- (a) Operate relay ER.
- (b) Hold relay E2 operated under control of relays TM, F1, and F2.

8.03 Relay ER, operated, functions to:

- (a) Connect the dual channel receiver (DCR) to the tip and ring toward the distant switchboard.
- (b) Remove the shunt from across the input of the DCR to prepare for the reception of tones.
- (c) Connect relays F1 and F2 to the appropriate outputs of the DCR.
- (d) Start timer TM.
- (e) Should the called customer be on-hook, place the off-hook signal back to the distant switchboard.

8.04 At this time the TM timer is timing with the dual channel receiver connected to the tip and ring. The operator at the distant switchboard, by operating the appropriate key, can collect coins, return coins, or recall the customer. In the event that a hit on the line caused the wink signal, no operator signal can be expected to follow. To guard against this, a signal must be received on the line within the nominal time of 540 milliseconds after the wink signal is received or the wink will be disregarded ie, treated as a false wink.

9. FALSE WINK

9.01 If, after 540 milliseconds, neither relay F1 or F2 is operated, an indication that no operator controlled tones have been received, timer TM times out and operates relay TM. Relay TM, operated, releases relay E2. Relay E2, released, functions to:

- (a) Release relay ER.
- (b) Recycle timer TM.
- (c) Release relay TM.

9.02 Relay ER, released, disconnects the DCR from the line and reestablishes the transmission path.

10. THE OPERATOR COLLECTS COINS

10.01 Should the operator operate the coin collect key before the timer times out, 1100-Hz and 700-Hz tones will be transmitted to and detected by the DCR and will result in the DCR grounding its 5 and 9 terminals. Terminals 5 and 9 grounded, operate relays F1 and F2.

10.02 Relay F1, operated, functions to:

- (a) Release relay E2.
- (b) Recycle the TM timer.
- (c) Prepare to start the TM timer.
- (d) Provide an additional hold path for relay ER.
- (e) Prepare the operate path for coin collect relay CCl.

Relay F2, operated, functions to:

- (f) Release relay E2.
- (g) Recycle the TM timer.
- (h) Prepare to start the TM timer.
- (i) Provide an additional hold path for relay ER.
- (j) Prepare a path to operate relay CCl.
- (k) Prepare a lock path for the coin collect relay after it operates.
- (l) Prepare a path for the coin collect potential to be applied.

10.03 Relay E2, released, shunts resistors RDSC and RFW to provide the 85-millisecond timer delay before operating the required coin control relay; and starts the timer TM.

10.04 In approximately 85 milliseconds, timer TM operates relay TM. Relay TM, operated, completes the operate path of relay CCl operating it. Relay CCl, operated, locks itself to contact 12 make of relay F2; operates relay CB; and prepares the path to apply the coin collect potential.

10.05 Relay CB, operated, functions to:

- (a) Prevent the operator from reworking until all the coin control relays are normal.
- (b) Open the operate path to the coin control and recall relays.
- (c) Disconnect talking battery from and connects coin collect potential to the called line.
- (d) Recycle the timer.
- (e) Release relay TM.
- (f) Complete the coin potential to the line.
- (g) Prepare to start TM timer.
- (h) Connects a discharge network consisting of capacitor G and resistors G and H to the called line.

Relay TM, released, provides an additional hold path for relay CCl.

10.06 The coin collect potential remains on the line for as long as the operator holds the key operated. When the operator releases the coin collect key, the 1100-Hz and 700-Hz tones are removed from the line. This in turn causes the DCR to remove ground from its terminals 5 and 9 releasing relays F1 and F2.

10.07 Relay F1, released, starts timer TM and removes one of the hold paths of relay ER. Relay F2, released, functions to:

- (a) Remove the coin collect potential from the line.
- (b) Place the lock path of relay CCl under control of the TM timer.
- (c) Start the TM timer.
- (d) Release relay ER.

Relay ER, released, removes the DCR from across the line.

10.08 The timer will time for approximately 540 milliseconds to allow the discharge network to discharge the line. After 540 milliseconds relay TM operates, releasing relay CCl which in turn releases relay CB. Relay CB, released, functions to:

- (a) Recycle the timer.
- (b) Remove discharge network from the line.
- (c) Release relay TM.
- (d) Restore the transmission path between the operator and called line.

11. COIN RETURN

11.01 When the operator returns a coin a wink signal is received. When E1 releases, E2 operates, and when E1 reoperates ER operates. Shortly after E1 reoperates 1700- and 1100-Hz tones are received as a coin return code.

11.02 The subsequent circuit functions are the same as for coin collect with the following exceptions; only F2 operates, CRI operates instead of CCl, and coin return battery is connected to the customer line instead of coin collect potential.

12. RECALLING THE CUSTOMER

12.01 When the operator desires to rering a wink signal is received. When E1 releases, E2 operates, and when E1 reoperates ER operates. Shortly after E1 reoperates 1700- and 700-Hz tones are received as a rering code.

12.02 The operation of E1:

- (a) Partially closes the locking path for E2.
- (b) Provides an operating ground for ER.

12.03 The operation of ER:

- (a) Sends off-hook supervision to the switchboard.
- (b) Opens the transmission path toward the called customer and connects to the receiver circuit.
- (c) Removes the short circuit of lead TA to lead RA to receiver circuit.

12.04 The 700-Hz tone will cause F1 to operate.

12.05 Relay F1, operated, functions to:

- (a) Prepare to hold relay S operated if the customer is off-hook.
- (b) Release relay E2.
- (c) Prepare an additional lock path for relay ER.
- (d) Prepare a path to operate either relay RO or relay RC.
- (e) Recycle timer TM.
- (f) Prepare to start timer TM.

12.06 Relay E2, released, shunts resistors RDSC and RFW to give the proper time delay, 85 milliseconds, before operating the required recall relay; and starts timer TM.

12.07 In approximately 85 milliseconds, timer TM operates relay TM.

CALLED PARTY GOES ON-HOOK

12.08 Relay TM, operated, operates relay RC through nonoperated break-contacts of relays CB, F2, S, RC, and F and operated make-contacts of relays CT, TM, and F1. Relay RC operated either operates immediately or prepares PU for operating at the beginning of a ringing interval when the PRTD grounds lead PU. Relay PU applies ringing to the line, as stored on the ringing combination relays R2, R3, and TP.

12.09 When the operator releases the recall key the 700-Hz and 1700-Hz tones are removed from the line and the DCR removes ground from its terminal 5 to release relay F1. Relay F1, released, functions to:

- (a) Recycle timer TM.
- (b) Release relays TM and ER.

Relay ER, released, sends an on-hook signal to the distant switchboard via the M lead. The called customers station continues to ring. Part 3 of this description details the trunk circuit action when the called customer answers.

CALLED PARTY OFF-HOOK

12.10 Relay TM, operated, operates relay RO through nonoperated break-contacts of relays CB, F2, and RC and operated make-contacts of relays CT, F1, TM, and S. The 3 make of relay TM, also, holds relay S operated.

12.11 Relay RO, operated, functions to:

- (a) Provide an additional hold path for relay S through its 12 make-contact and C resistor.
- (b) Apply continuous 20-Hz ringing to the customer line.
- (c) Place a 4 microfarad, 100K-ohm termination across the line (B capacitor and D resistor).

12.12 The continuous 20-Hz ringing will be applied to the line for as long as the operators key remains operated.

12.13 When the operator releases the recall key, 1700-Hz and 700-Hz is removed from the line. The DCR in turn removes ground from its terminal 5 to release relay F1. Relay F1, released, functions to:

- (a) Release relay ER.
- (b) Recycle the timer.
- (c) Release relay TM.
- (d) Release relay RO.

Relay ER, released, places control of the M lead supervisory signaling under control of the S relay.

12.14 Relay RO, released, removes continuous 20-Hz ringing from the line and re-establishes the transmission path.

13. RINGING COIN SERVICE IMPROVED COIN LINES - OPTION V

13.01 During the initial ringing of coin improved lines, the operator operates the coin return key. Coin potential does not reach the called station but relay CR1 operating operates the PB relay. The PB removes negative 48 volts and ground from the S relay windings and applies positive 48 volts and PB ground to them. This prepares the trunk to supervise the coin line.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 See No. 3 crossbar keysheet.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designation</u>	<u>Meaning</u>
CB	Coin Battery

<u>Designation</u>	<u>Meaning</u>	
CC1	Coin Collect	3.05 To recognize when registration has been completed and trunk closure is required.
CO	Cutoff	3.06 To repeat dial pulses into the register, option Y.
CR1	Coin Return	3.07 To signal the attached register when trunk closure has been made by applying ground to lead CT.
CT	Cut Through	3.08 To provide a talking and pulsing path over leads T and R.
DS	Delay Start	3.09 To provide a memory as to the party and code of ringing required for the called customer as set up by the marker.
E	Traditional	3.10 To provide a ground over-lead RA to satisfy the marker.
E1	E Auxiliary	3.11 To provide means whereby the called customer may signal the distant operator after cut-through.
E2	E Auxiliary	3.12 To provide a pickup delay feature by receiving ground over lead PU.
ER	Enable Receiver	3.13 To provide for ringing back the called customer against either an on-hook or off-hook condition.
F	Traditional	3.14 To provide audible ringing tone to the distant office for all ringing other than operator controlled continuous ringing.
F1	Frequency 1	3.15 To trip ringing when the customer answers.
F2	Frequency 2	3.16 To provide line-busy tone to the distant office, if the marker finds the called line-busy and connects line-busy tone to the called end appearance of the trunk.
PU	Pickup	3.17 To provide overflow tone to the distant office if the marker encounters an overflow condition and connects overflow tone to the called end appearance of the trunk.
PB	Positive Battery	3.18 To provide for holding the connection under direct control of the originating office regardless of whether the called customer receiver is on- or off-hook.
RC	Ringing Control	3.19 To provide E and M lead supervision.
RO	Ringing Off-Hook	3.20 To send a disconnect signal to the originating end when the called end disconnects.
R2	Ringing Auxiliary	
R3	Ringing Auxiliary	
TP	Tip Party	
RT	Ringing Trip	
RV	Reverse	
S	Supervisory	
TM	Timer	

3. FUNCTIONS

- 3.01 To provide an off-hook or on-hook signal to the originating office while awaiting trunk seizure and during register seizure.
- 3.02 To provide for signaling a register link upon trunk seizure.
- 3.03 To provide for recognizing when a register is attached.
- 3.04 To signal the originating end when the register is ready to receive pulsing.

- 3.18 To provide for holding the connection under direct control of the originating office regardless of whether the called customer receiver is on- or off-hook.
- 3.19 To provide E and M lead supervision.
- 3.20 To send a disconnect signal to the originating end when the called end disconnects.

- 3.21 To provide an idle circuit termination for the repeaters.
- 3.22 To provide test jacks to permit the disconnection of the interoffice conductors and the connection of a test circuit.
- 3.23 To provide recognition of a wink signal as a signal that the receiver circuit is to be connected.
- 3.24 To collect coins, return coins, or re-ring when 1100- and 700-Hz, 1700- and 1100-Hz, or 1700- and 700-Hz tones are received, respectively.
- 3.25 To provide a means to remove talking battery from and connect coin battery to the customer line.
- 3.26 At the end of each operation of the coin control feature, to provide approximately a one-half second open interval during which the line is discharged. This interval also permits the coin magnet to restore to normal before the talking battery is again connected to the line. This is particularly necessary when large earth potentials are encountered.
- 3.27 To permit conversion between dial pulsing with E and M lead signaling (option Y) and MF pulsing with E and M lead signaling (option Z) by exchanging Y and Z wiring straps.
- 3.28 Provide a means of changing -48 volts to positive 48-volts when connecting to a coin station where coin-service-improvements are provided (option V).

4. CONNECTING CIRCUITS

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

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-LCB

WE DEPT 355-JRF-KLF-BA

- (a) Incoming Register Link Circuit - SD-26394-01.
- (b) Trunk Switch and Connector Circuit - SD-36383-01.
- (c) Power, Ringing, and Tone Distributing Circuit - SD-26414-01.
- (d) Composite Signaling Circuit, Type B - SD-95032-01 (Typical).
- (e) N1 Carrier Application Schematic - SD-95121-01 (Typical).
- (f) Line and Balancing Composite Set and Repeating Coil Circuit - SD-95004-01.
- (g) Four-Wire Terminating Circuit - SD-96463-01 (Typical).
- (h) Receiver Circuit - SD-26348-05 (Circuit Pack Schematic).

5. MANUFACTURING TESTING REQUIREMENTS

- 5.01 This circuit shall be capable of performing all the functions listed in this Circuit Description and meeting the requirements listed in the Circuit Requirements Tables.

6. TAKING EQUIPMENT OUT OF SERVICE

- 6.01 Test jacks T1 and T2 provide access to this circuit for test purposes. Insertion of a plug in the jacks disconnects the trunk circuit from the cable pair and from the signaling facilities.