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CROSSBAR SYSTEMS  
NO. 3  
INCOMING PLUG-ENDED TRUNK  
CIRCUIT  
DP OR MF PULSING  
REVERSE BATTERY SUPERVISION  
IN BAND COIN CONTROL

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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 reverse-battery 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 relay A operates over the trunk loop. Subsequently, an incoming register is attached to this circuit, and when it is prepared to receive pulses from the distant switchboard it will change the supervision toward the switchboard to on-hook. After the called number has been registered the incoming register requests a marker to complete the connection to the called customer line.

COMPLETION OF CONNECTION

2.02 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 customer line, and machine ringing will be applied to the called customer line. When the called customer answers, ringing is tripped and relay S will operate over the called customer loop. Relay S operates T which transmits an off-hook to the originating office. This circuit is maintained in the busy condition until the operator disconnects.

COIN CONTROL AND RERING

2.03 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 will direct this circuit to connect the receiver circuit. Shortly after the wink signal is received 700- and 1100-, 1700- and 1100-, or 1700- and 700- Hz tones are received as a coin collect code, coin return code, or rering code, respectively.

2.04 The coin collect code will cause coin collect potential to be connected to the customer line, and the coin return code will cause coin return potential to be connected to the customer line. The rering code will cause machine ringing or continuous 20- Hz ringing to be connected to the customer line depending upon whether the called customer supervision 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, relay A operates which operates relay E1. Relay E1 connects battery to the incoming register link ST lead. When the register is attached it will operate relay CO.

1.02 The operation of relay CO:

- (a) disconnects relay A from the tip and ring providing a clear pulsing path to the incoming register
- (b) operates relay G
- (c) removes battery from lead ST to the incoming register link,
- (d) connects ground to lead BL to the incoming register as a check that CO has operated, and
- (e) Prepares a locking path for relay CT.

1.03 When the register is prepared to receive the called number it will transmit an on-hook to the distant switchboard as an indication to spill the called number forward. The incoming register receives this number in the form of dial or MF pulsing. After the register has stored the complete number it will operate CT and request a marker.

1.04 The operation of relay CT:

- (a) locks relay CT operated under control of relay E1,
- (b) holds relay CO operated under control of relay CO,

- (c) operates relay A which operates relay E1,
- (d) prepares the operating path of relays CRL, CCL, TD, and E2,
- (e) prepares a ground to hold the terminating connection, and
- (f) prepares a holding path for relays R2, R3, and TP.

1.05 Relay G is slow to release to prevent the false operation of relays E2 and TD during the interval that E1 is released and CT is operated.

2. MARKER OPERATION

2.01 The marker, upon being summoned by the register, associates itself with the trunk via the incoming register, the incoming register link circuit and the trunk switch circuit. The marker operates relay F via lead F from the IR. The IR passes the called number, class mark and trunk unit 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 circuit (TSC),
- (b) cut leads T, R, and S into the marker via the TSC,
- (c) prevent relay PU from operating,
- (d) operate relay DS, and
- (e) ground leads JC, SW, and TTL to the marker via the TSC.

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

- (a) The marker grounds lead TPR to operate relay TP if the called customer is a tip party.

(b) The code of the ringing is determined by the operation of relays R2 and R3 by the marker as follows:

- (1) neither relay operated places code 1 gen toward the called party,
- (2) relay R2 operated only places code 1 plus toward the called party,
- (3) relay R3 operated only places code 2 plus ringing toward the called party, and
- (4) relays R2 and R3, both operated place code 2 gen ringing toward the called party.

(c) The marker completes the ringing connection by grounding lead RC to operate relay RC. Relay RC operated functions to:

- (1) prepare an operate path for relay PU,
- (2) prepare a hold path for relay PU,
- (3) prevent relay RO from operating,
- (4) cut ringing through toward the called subscriber (code 1 only), and
- (5) ground lead RA to the marker via the TSC as a check.

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

- (a) operate relay PU when the power, ringing, and tone distribution circuit (PRTD) grounds leads PU,
- (b) complete ground to the sleeve lead to hold the connection through contacts of relays DS and CT operated, and
- (c) ring the called subscriber on code 1 ringing or ring the called subscriber on other than code 1 ringing after relay PU operates.

2.05 Relays DS, RC, and, if operated, TP, R2 and R3 are all held over relay CT.

### 3. CALLED CUSTOMER ANSWERS

3.01 When the called customer answers, relay RT operates over the called subscribers loop and in turn 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) operate relay T which in turn, reverses the battery and ground on the tip and ring to the distant switchboard as an off-hook indication,
- (b) release relay CO,
- (c) prepare a hold path for itself should a rering occur with the called party off hook, and
- (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 is taking place between calling and called customer.

### 4. HOLDING AND DISCONNECT

4.01 When the called customer disconnects, relay S releases, releasing relay T.

4.02 The release of relay T reverses the battery and ground on the tip and ring to the distant switchboard as an on-hook signal thus, lighting a supervisory lamp as a disconnect signal.

4.03 The connection to the called customer line is maintained under the originating operator disconnects. When the operator disconnects an on-hook is received by this circuit releasing relay A which releases relay E1 which operates relay E2 which in turn operates relay TD. The E1 relay released also begins the slow release of relay CT.

4.04 The release of relay CT:

- (a) releases relays E2 and TD,

- (b) releases the links to the customer line,
- (c) releases relays R2, R3 and TP, if operated,
- (d) releases relay DS, and
- (e) removes ground from the sleeve lead to the marker via the TSC for an idle trunk indication.

#### 5. SIGNALING THE OPERATOR

5.01 When the connection has been established to the customer, the customer can signal the distant operator by depressing and releasing the switchhook. Relay S follows the switchhook and in turn operates and releases T. Relay T reverses the tip and ring to the distant switchboard flashing the supervisory lamp.

#### 6. COIN CONTROL

##### COIN COLLECT

6.01 When the operator collects a coin a wink signal is received. When relay E1 releases, relay E2 operates, and when relay E1 reoperates, relay ER operates. Shortly after relay E1 reoperates, 1100- and 700-Hz tones are received as a coin collect code.

6.02 The operation of relay E2:

- (a) partially closes the locking path for E2,
- (b) operates relay TD,
- (c) provides an operating ground for relay ER, and
- (d) partially opens the circuit to start the timer TM.

6.03 The operation of ER:

- (a) locks relay T operated, if operated,
- (b) opens the transmission path toward the called customer, connects the trunk to the receiver circuit and removes the short circuit between leads TA and RA,
- (c) starts timer TM, and
- (d) prepares an operate path for relays TM, F1 and F2.

6.04 The 1100- and 700-Hz tones causes relay F2 and relay F1 to operate respectively.

6.05 The operation of relay F2:

- (a) holds relay ER operated,
- (b) partially closes the operating path for relay CN1, and
- (c) releases relay TD.

6.06 The operation of relay F1:

- (a) holds relay ER operated,
- (b) partially closes the operating path for relay CCl, and
- (c) insures the release of relay TD.

6.07 The release of relay TD:

- (a) operates relay TM,
- (b) releases relay E2, and
- (c) operates relay CN1.

6.08 The operation of relay CN1:

- (a) operates relay CCl,
- (b) provides a locking ground for relay CCl, and
- (c) prepares a path to apply coin collect potential to the customer line.

6.09 The operation of relay CCl:

- (a) opens the operating path for relay CR1 and relay RC,
- (b) locks relay CCl operated under control of relay CN1,
- (c) connects coin collect potential to a make-contact of relay CB,
- (d) operates relay CB, and
- (e) operates relay PB, when coin service improvement is provided, and locks under control of relay CT. Relay PB operated, connects positive battery to relay S for dial tone first service.

## 6.10 The operation of relay CB:

- (a) disconnects talking battery from and connects coin collect potential to the customer line, and
- (b) connects a discharge network consisting of capacitor G, and resistors G and H to the customer line.

6.11 When the operator releases the coin collect key relays F1 and F2 release, releasing relays ER and CN1.

## 6.12 The release of relay ER:

- (a) disconnects the receiver and cuts the transmission path through to the called customer,
- (b) releases relay TM,
- (c) recycles timer TM, and
- (d) opens the lock path of relay T.

## 6.13 The release of relay CN1:

- (a) disconnects coin collect potential from the customer line, and
- (b) releases relay CCl which releases relay CB.

6.14 The release of relay CB disconnects the discharge network from and connects talking battery to the customer line.

## COIN RETURN

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

6.16 The subsequent circuit functions are the same as for coin collect with the following exceptions: only relay F2 operates, relay CR1 operates instead of CCl, and coin return battery is connected to the customer line instead of coin collect potential.

7. RECALLING THE CUSTOMER

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

## 7.02 The operation of relay E2:

- (a) partially closes the locking path for relay E2,
- (b) operates relay TD,
- (c) provides an operating ground for relay ER, and
- (d) partially opens the circuit to start the timer TM.

## 7.03 The operation of relay ER:

- (a) locks relay T operated if operated,
- (b) opens the transmission path toward the called customer, connects to the receiver circuit and removes the short circuit between leads TA and RA.
- (c) starts timer TM, and
- (d) prepares an operate path for relay TM.

7.04 The 700- Hz tone will cause relay F1 to operate.

## CUSTOMER RECEIVER ON-HOOK

7.05 With the customer receiver on-hook relays S and T will be normal and machine ringing will be applied to the customer line.

## 7.06 The operation of relay F1:

- (a) partially closes the operating path of relays RC, CCl, and TM,
- (b) holds relay ER operated, and
- (c) releases relay TD.

7.07 The release of relay TD:

- (a) operates relay TM,
- (b) releases relay E2, and
- (c) operates relay RC.

7.08 The operation of relay RC:

- (a) disconnects talking battery from and connects machine ringing to the customer line if code 1 ringing is to be applied,
- (b) provides an operating path for relay PU to lead PU. When relay PU operates it will connect machine ringing to the customer line if other than code 1 ringing is to be applied, and
- (c) opens the operating path of RO.

CUSTOMER RECEIVER OFF-HOOK

7.09 With the customer receiver off-hook relays S and T will be operated and continuous 20- Hz ringing will be applied to the customer line.

7.10 The operation of relay F1:

- (a) partially closes the operating path of relay TM,
- (b) holds relay ER operated,
- (c) releases relay TD, and
- (d) operates relay RO.

7.11 The release of relay TD:

- (a) operates relay TM, and
- (b) releases relay E2.

7.12 The operation of relay RO:

- (a) disconnects talking battery from the customer line and connects continuous 20- Hz ringing to the line,
- (b) holds relay S operated, and
- (c) connects resistor D and capacitor B across tip and ring for click reduction.

8. FALSE WINKS

8.01 Due to possible false wink signals, a circuit function has been designed to check this hazard. When relay E1 releases, it operates relay E2, and if relay E1 re-operates before relay CT releases, the signal is recognized as a wink signal. Relay E1 in reoperating operates relay ER which starts the TM timer. The TM timer will time for approximately 500-590 milliseconds. If tones are not received before this time elapses, timer TM will operate, operating relay TM. Relay TM in operating releases relay E2, which in turn releases relay ER, reestablishing the transmission path between the customer and operator.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 Customer Loop - See Keysheet.

1.02 Trunk Selection

	<u>Resistance</u>	<u>Cable</u>
Max Ext Ckt Loop	45V Min	48V Min
Dial or MF Pulsing	6400 ohms	6800 ohms 60MI
Min Ins Res.	30,000 ohms	

- 3.11 To provide means whereby the called customer may signal the distant operator after cut-through.
- 3.12 To provide a pickup delay feature by receiving ground over lead PU.
- 3.13 To provide for ringing back the called customer against either an on-hook or off-hook condition.
- 3.14 To provide audible ringing tone to the distant office for all ringing other than operator controlled continuous ringing.
- 3.15 To trip ringing when the customer answers.
- 3.16 To provide positive battery to the supervisory relay on coin collect, when coin service improvement is provided.
- 3.17 To provide positive battery to the supervisory relay on coin return, when coin service improvement is provided.
- 3.18 To provide for holding the connection under direct control of the originating office regardless of whether the called customer receiver is on-hook or off-hook.
- 3.19 To provide reverse-battery supervision.
- 3.20 To send a disconnect signal to the originating end when the called end disconnects.
- 3.21 To provide a test jack to permit the disconnection of the interoffice conductors and the connection of a test circuit.
- 3.22 To provide recognition of a wink signal as a signal that the receiver circuit is to be connected.
- 3.23 To collect coins, return coins, or rering when 1100 and 700 Hz, 1700 and 1100 Hz, or 1700- and 700-Hz tones are received, respectively.
- 3.24 To provide a means to remove talking battery from, and connect coin battery to, the customer line.

3.25 At the end of each operation of the coin control feature, to provide approximately a 1/2-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 where large earth potentials are encountered.

#### 4. CONNECTING CIRCUITS

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

- (a) Incoming Register Link Circuit - SD-26394-01.
- (b) Trunk Switch - SD-36283-01.
- (c) Power, Ringing, and Tone Distributing Circuit - SD-26414-01.
- (d) Traffic Usage Recorder Circuit - SD-96494-01.
- (e) Receiver Circuit - SD-26348-05 (Circuit Pack Schematic).
- (f) Time Delay Control Circuit - SD-94820-01.

#### 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 Jack T is provided for connecting test circuit to this trunk. A normally opened sleeve of test jack T is grounded when the circuit is busy if relay CO is operated.

6.02 The trunk at the originating end should be made busy when testing this trunk so as to prevent calls from interfering with the testing of this circuit and vice versa.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-GFC

WE DEPT 25820-JRF-GWC-VK

1.03 Trunk Supervision

	<u>Resistance</u>	<u>Cable</u>	<u>Designation</u>	<u>Meaning</u>
Relay A			R2	Ringling Auxiliary
Max Ext			R3	Ringling Auxiliary
Ckt Loop	45V Min 48V Min		RT	Ring Trip
Dial or MF	6400 ohms 68 ohms	60MI	S	Supervisory
Min Ins			T	Traditional
Res	30,000 ohms		TD	Time Delay

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designation</u>	<u>Meaning</u>
A	Traditional
CB	Coin Battery
CC1	Coin Collect
CN1	Coin
CO	Cutoff
CR1	Coin Return
CT	Cut Through
DS	Delay Start
E1	Traditional Auxiliary
E2	Traditional Auxiliary
ER	Enter Receiver
F	Traditional
F1	Frequency 1
F2	Frequency 2
G	Guard
PB	Positive Battery
PU	Pick Up
RC	Ring Control
RO	Ringling On

TM	Timer
TP	Tip Party

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 the operation of relay CO as a signal that the register is attached.
- 3.04 To signal the attached register when relay CO has operated, by applying ground to lead BL.
- 3.05 To signal the originating end when the register is ready to receive pulsing.
- 3.06 To recognize when registration has been completed and trunk closure is required.
- 3.07 To signal the attached register when trunk closure has been made by applying ground to lead CT.
- 3.08 To provide a talking and pulsing path over leads T and R.
- 3.09 To store the code of ringling required for the called party as set up by the marker.
- 3.10 To provide a ground over lead RA to satisfy the marker.