

PBX SYSTEMS
NO. 551A,B, 552B,D,E, 555, 556A, 605A, 608A,B,D
MANUAL PBX ACCESS LINE
WITH E AND M LEAD SIGNALING

A. Changed and Added Functions

- A.1 Leads have been added to operate a night alarm in the PBX and to turn on an associated echo suppressor.

D. Description of Changes

- D.1 Option N has been added to provide night alarm and echo-suppressor leads.
- D.2 CAD 1 has been changed to agree with WECO manufacturing drawings.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5336-EEM-FNR

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MANUAL PBX ACCESS LINE
WITH E&M LEAD SIGNALING

CHANGES

A. Changed and Added Functions

- A.1 Diode CR8 has been changed to improve the ringing intervals.
- A.2 Corrections have been made to the sequence charts.
- A.3 Lead designations have been corrected in CAD1.
- A.4 The audible ringing feature has been made optional.
- A.5 Connecting information has been added for the access line transfer circuit.
- A.6 Resistor R15 and diode CR12 have been added to protect transistor Q1 from thermal run away and voltage transients.

B. Changes in ApparatusB.1 ADDEDR15 KS-13490 L1, 1500 Ω - APP Fig. 1

CR12 420G - APP Fig. 1

REMOVED

R8 Resistor,
KS-13491 L1, 4700 Ω -
APP Fig. 1
CR8 Diode, 420N -
APP Fig. 1

REPLACED BY

KS-13491 L, 2000 Ω -
APP Fig. 1
420K - APP Fig.1

D. Description of Changes

- D.1 Option S has been added to include the new code for CR8. Better control of the ringing interval times has been attained and more reliable transistor operation. Option T covers the original codes.
- D.2 In CAD1 the lead from terminal 27 which had been incorrectly routed to 4M of relay D1 has been changed to +C8 CAP. The lead at terminal 36 previously routed to 10 of relay D1 has been changed to +C7 CAP.
- D.3 The audible ringing feature, previously always supplied has been made optional. Option R includes it. Option Q omits it.
- D.4 Connecting information for an associated access line transfer circuit has been added at the following points: Sheet B1, locations F0 and B6; Sheet G1, locations F1 and G1.
- D.5 Explanatory note 106 has been added and references to it shown at Sheet B1, location F4, and Sheet G1, location D1.
- D.6 The rating has been changed to AT&TCo. Std.
- D.7 Under 4. CONNECTING CIRCUITS add:
(m) 4 Wire Access Line Transfer Circuit - SD-1E064-01.

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit is used at a manual PBX switchboard to convert the cord circuit voice and signaling functions for transmission to a switching center. It also indicates when a call from the switching center requires attention and whether it is a regular or priority call.

2. GENERAL DESCRIPTION OF OPERATION

SWITCHBOARD APPEARANCES

2.01 Two jacks are required for each appearance of this circuit. The first jack, designated TALK, will be used for a majority of the connections. The other jack, designated NIGHT & ROTARY, is used for night and through-dial connections and when it is necessary to use a rotary dial in calling the switching center.

2.02 One or two lamps will be used at each appearance. The LINE lamp, when lit, indicates an incoming call requiring attention. The BSY lamp, if used, will be lit whenever the circuit is in use.

INCOMING CALLS

2.03 An incoming routine call from the switching center will cause the LINE lamp to light. The attendant will insert the EXT or BACK cord plug into the TALK jack to answer the call. The LINE lamp will then be extinguished and the BSY lamp, if used, will light. The attendant then completes the call with the other cord.

2.04 An incoming priority call will be indicated by a winking of the LINE lamp where it is lit for 1.6 seconds and off for 0.345 second. This on-off sequence is repeated until the call is answered as described above.

OUTGOING CALLS

2.05 An outgoing call, whether regular or priority, will be made by inserting the TRK or FRONT cord plug into the TALK jack and dialing toward the switching center with the TOUCH-TONE dial. With this connection double-lamp keyshelf supervision is obtained.

2.06 Should it be necessary to use a rotary dial, connection must be made to the NIGHT & ROTARY jack and single-lamp supervision only is obtained.

2.07 In case a call originating at a central office must be extended to the switching center, the attendant will have to insert the EXT or BACK cord into the TALK jack. In all boards except the 608, the attendant will then have to use a second cord circuit, inserting the TRK cord plug into the NIGHT & ROTARY jack. The call may then be completed with either the rotary or TOUCH-TONE dial. After dialing, the second cord is removed. With the 608 PBX, this type of call can be completed by using the DIAL BACK key on the original cord, with no second cord being required.

NIGHT AND THROUGH-DIAL CALLS

2.08 When this circuit is used for night or through-dial operation, the attendant will use the TRK cord in the NIGHT & ROTARY jack and the EXT cord in the jack of the extension required. The circuit then functions without the attention of the attendant. Regular incoming calls generate central office interval, immediate ringing signals to the extension phone (2 seconds ring and 4 seconds off). An incoming priority call generates ringing signals that are on for 1.6 seconds and off for 0.345 second.

2.09 Outgoing calls in this connection may be either rotary or TOUCH-TONE dialed.

SLEEVE CONNECTIONS

2.10 The TALK jack sleeve is grounded when the circuit is in use, thus indicating to the cord circuits that talking battery is required from the cord.

2.11 The NIGHT & ROTARY jack sleeve, however, when in use is connected to battery which indicates to the cord that the access circuit will provide talking battery.

SECTION II - DETAILED DESCRIPTION

1. REGULAR INCOMING CALL FROM SWITCHING CENTER

1.01 The off-hook condition at the switching center is indicated to this circuit by the application of ground to the E lead from the associated signaling circuit. This operates relay E which (a) lights the LINE lamp, (b) operates the E1 relay, (c) connects resistor R3 across the tip and ring of the TALK jack, and (d) connects fully-charged capacitor C4 to the base of transistor Q1 through zener diode CR8 and resistor R8. Transistor Q1 is turned on and operates relay R. Relay R connects 90-volt, 20-cycle current to the voice channel through capacitors C1 and C2 as an audible signal to the calling party that action is taking place.

Relay R operated opens the charging path of C4 and bypasses the zener diode CR8 permitting C4 to continue feeding current to the transistor for about 2 seconds. After this, Q1 turns off, R releases, and C4 is recharged through R10. In about 4 seconds, the charge is great enough to break down CR8 and the operation is repeated until the attendant plugs into the TALK jack. As the tip of the plug engages the tip spring of the jack, the auxiliary contact is made grounding lead 2 and operating relay T. Relay T operated:

- (a) Lights the BSY lamp.
- (b) Extinguishes the LINE lamp.
- (c) Removes ground and connects battery to the M lead indicating to the switching center that the call has been answered.
- (d) Grounds the TALK jack sleeve.
- (e) Connects battery to the NIGHT & ROTARY jack sleeve.
- (f) Operates the L relay.
- (g) Releases the R relay shutting off the audible ringing tone.

1.02 The attendant completes the call and the 4 contact of the E relay controls the A lamp on the keyshelf. If the switching center terminates the call, the E lead ground is removed releasing the E relay and opening the R3 resistor connection across the tip and ring, causing the A lamp to light on the keyshelf. The attendant then removes the cord releasing relays T and L.

1.03 Should the extension hang up before the switching center party, the C supervisory lamp lights and the attendant removes the cord. The T relay releasing in this case does not release the L relay as E1 is still operated, holding L operated. Relay L keeps the BSY lamp on and the LINE lamp off and the R relay released until the switching center goes on-hook releasing E, E1, and L.

2. PRIORITY INCOMING CALL FROM SWITCHING CENTER

2.01 When the switching center has a priority call for the PBX access circuit, the off-hook signal is interrupted periodically by an 0.345-second, on-hook signal. The short on-hook intervals occur every 1.945 seconds. In this access circuit, the first time the short on-hook signal is received the E relay releases but relay E1, being slow in releasing because of capacitors C3 and C5 and resistor R7, holds up over the short interval. The combination of E released and E1 operated pulls up relay P which locks to relay E1. Control of transistor Q1 is now transferred to the E relay contact 10 and the audible ringing tone is returned to

the switching center as a pattern of the priority signal. The LINE lamp will also follow this pattern and indicates by its periodic off intervals that a priority call is awaiting answer. After the attendant plugs into the TALK jack, operation is the same as described in 1.02 and 1.03.

3. OUTGOING CALL, "TOUCH-TONE" DIALED

3.01 The TRK or FRONT cord plug will be inserted into the TALK jack. When the tip spring of the jack has been operated, the auxiliary contact grounds the lead to relay T, pulling it up. Relay T operated:

- (a) Grounds the sleeve of the TALK jack.
- (b) Connects battery to the sleeve of the NIGHT & ROTARY jack.
- (c) Grounds the A lead to the traffic usage recorder.
- (d) Shifts the M lead to the signaling circuit from ground to battery.
- (e) Lights the BSY lamp.

3.02 The M lead signals the switching center that service is required. Dial tone will then be returned to the attendant who completes the call with the TOUCH-TONE dial. When the called party answers the signaling circuit, E lead is grounded operating relays E and E1. The operation of E connects resistor R3 across the line causing the cord lamp in the PBX to extinguish. The priority of outgoing calls is indicated by the use of special buttons on the TOUCH-TONE dial. No priority information can be transmitted from a rotary dial.

4. OUTGOING CALL, ROTARY DIALED

4.01 Rotary dialed calls from the PBX must use the NIGHT & ROTARY jack and require the use of the TRK cord. The TRK cord is not required with 608 PBX where either cord could be used, the DIAL BACK key being operated when the back cord is used.

4.02 The plug inserted in the NIGHT & ROTARY jack causes operation of relay N which:

- (a) Connects battery to the jack sleeve to operate the T relay in the cord circuits (with the 608 PBX, 3760 ohms is connected in series with the sleeve to indicate that dialing battery will be supplied).
- (b) Grounds the TALK jack sleeve.
- (c) Lights the BSY lamp.
- (d) Disconnects the TALK jack tip and ring leads.
- (e) Connects the DP and D relays through the terminating set to the NIGHT & ROTARY tip and ring leads.

4.03 A circuit is now established to control the DP and D relays through the PBX cord and dial. Operation of relay D causes D2 to operate which (a) operates N1 and (b) grounds lead A to the traffic usage recorder. Relay N1 operated transfers control of the M lead from relay T to relay DP which is now operated and sends the off-hook signal to the switching center.

4.04 When dial tone has been received, the attendant may start dialing. When the dial breaks the circuit the first time, D and DP release. The release of D causes D1 to operate. Both D1 and D2 are slow-release and remain operated over the individual pulses. D2 may release during the inter-digital interval. Relay D1 reconnects the leads to the terminating set to reduce the effects of transients caused by the dial pulses.

5. OUTGOING CALL ORIGINATED AT A CENTRAL OFFICE TRUNK

ALL SWITCHBOARDS BUT NO. 608

5.01 This call is answered by using the TRK cord plug in the central office trunk jack. The EXT plug will then be put into the access circuit TALK jack, but it will not be possible to dial toward the switching center since the PBX dial is directed toward the TRK plug. It is necessary, therefore, to use the TRK plug of a second cord circuit, inserting it into the NIGHT & ROTARY jack.

5.02 This causes operation of the N relay which opens the connections from the TALK jack and sets the access circuit up for dialing, as described in 4.02 and 4.03, although TOUCH-TONE dialing may be used. In case the opening of the TALK jack leads by the N relay causes loss of central office holding current in the first cord, option Z should be connected which provides an inductive bridge. Upon completion of dialing, the plug is removed from the NIGHT & ROTARY jack.

NO. 608 PBX

5.03 With the 608 PBX, the use of a second cord, as described in 5.01 and 5.02, is not required as the DIAL BACK key enables the dial circuit to face the other plug.

6. NIGHT AND THROUGH-DIAL OPERATION

CONNECTION

6.01 The TRK or rear cord of a cord circuit will be put into the NIGHT & ROTARY jack and the EXT or front cord into the jack of the extension selected for night service. The NIGHT & THRU DIAL key of the PBX cord will then be operated. Relay N will be operated and the BSY lamp lit.

INCOMING CALL FROM SWITCHING CENTER

6.02 Operation will be the same as described in 1.01, except that the LINE lamp will

not be lit and that ringing current will be applied to the extension. Each time the R relay releases, relay R1 will apply resistance battery and ground to the line for the short interval during its release. This charges the line and ringer capacitance in such a direction that when the D and DP relays are connected to the line, no charging current transient will falsely operate them.

6.03 Should the extension answer the call during a ringing interval, the increased current in the L2 resistor lamp and resistor R4 causes enough voltage to be applied to relay RT through the full-wave bridge to operate it. RT causes relay L to operate and lock up to the E1 relay. Relay L, by means of its 5 contact, releases R and R1 cutting off the ringing.

6.04 If the extension answers during the silent interval, relays DP and D pull up. DP brings up N1, if it is not already up from a previous call, and puts an off-hook signal on the M lead. Relay D operates D2 which operates L to prevent further ringing.

6.05 A priority call from the switching center will be indicated to the extension by a different type of ringing, on for 1.6 seconds and off for 0.345 second. This code is generated by the transistor Q1, as described in 2.01.

OUTGOING CALLS

6.06 An outgoing call may be rotary or TOUCH-TONE dialed. The off-hook signal is transmitted to the switching center by the DP relay.

7. PRE-EMPTION OF A CALL

7.01 The switching center may pre-empt a line that is required for a higher priority call. In this case, the switching center transmits a single 0.345-second on-hook pulse to the access circuit, then applies a 3-second tone (440 plus 620 cycles), and then a continuous on-hook signal terminating the call.

7.02 When the access circuit receives the on-hook pulse, the supervisory lamp on the keyshelf winks on and off but the attendant may not notice it. However, the extension will hear the pre-empt tone and presumably hand up. Even if this is not done, the regular disconnect signal will then be received and the attendant will disconnect and await the new call.

8. TRAFFIC USAGE RECORDER SCORING

8.01 Two leads are provided for the traffic usage recorder. Lead A is grounded for any call completed or not. Lead B is grounded only on incoming calls from the switching center, whether completed or not. Ground to the B lead is applied by operation of relay IC which operates from E1 operated if T and D2 are normal. Relay IC operated then

bypasses the T and D2 contacts so as to prevent double scoring in case the PBX disconnects first.

9. RING TRIPPING - W OPTION

9.01 When this circuit is used with a 608 PBX, W option must be provided as a means to trip the automatic ringing applied by the calling cord when it is connected to the TALK jack. When the cord plug is put into the jack, the tip and ring conductors are shunted by the coil of relay TR which is of low enough resistance to cause operation of the tripping relay in the cord. Relay TR operates and pulls up TR1. TR1 operated connects the coil of TR to battery and ground through resistors R11 and R12 to hold it up, disconnects it from the talking line, and cuts through the tip and ring conductors the line. TR1 remains locked up to the auxiliary contact until the plug is removed. The combined operate time of relays TR and TR1 is longer than the operate time of the cord circuit tripping relay to assure that the latter has time to operate.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

- 1.01 Extension pulsing and supervision - maximum conductor loop resistance 1500 ohms.
- 1.02 Extension pulsing and supervision - minimum insulation resistance 15,000 ohms.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

<u>Designation</u>	<u>Meaning</u>
D	Supervisory Relay
D1	Supervisory Auxiliary Relay
D2	Transient Blocking Relay
DP	Dial Pulse Repeating Relay
E	Incoming Off-Hook Relay
E1	Slow-Release Incoming Off-Hook Relay
IC	Incoming Traffic Usage Recorder
L	Ringing Lockout Relay
N	Night Jack Relay
N1	Night Jack Auxiliary Rel.
P	Priority Relay
R	Ringing Relay
R1	Ringing Auxiliary Relay
RT	Ring Trip Relay
T	Talk Jack Relay

3. FUNCTIONS

- 3.01 To permit an incoming call from the switching center to be answered by the PBX attendant.
- 3.02 To indicate whether an incoming call is regular or priority.
- 3.03 To provide the attendant with a disconnect signal when an established connection is pre-empted by the switching center.
- 3.04 To permit the attendant to call the switching center using TOUCH-TONE calling or rotary dial pulsing.
- 3.05 To permit night and through-dial connections to the access circuit from an extension telephone.
- 3.06 When using the night and through-dial connection, to indicate by distinctive ringing whether an incoming call is routine or priority.
- 3.07 To operate with an E and M lead signaling circuit.
- 3.08 To provide signals to a traffic usage recorder indicating the total of all calls and also the total of all incoming calls.
- 3.09 To extend a call from a central office to the switching center and vice versa.
- 3.10 To light a busy lamp at each appearance, if required.

4. CONNECTING CIRCUITS

- 4.01 The following are typical connecting circuits.
- (a) Single-Frequency Signaling Circuit - SD-98124-02.
- (b) V4 Telephone Repeater Circuit - SD-97047-01.
- (c) DX Signaling Circuit - SD-95487-01.
- (d) Cord Circuit No. 551 PBX - SD-66179-01.
- (e) Cord Circuit No. 552 PBX - SD-66198-01.
- (f) Cord Circuit No. 555 PBX - SD-66520-01.
- (g) Cord Circuit No. 556 PBX - SD-65658-01.
- (h) Cord Circuit No. 605 PBX - SD-66198-01.
- (i) Cord Circuit No. 608A PBX - SD-66720-01.
- (j) Cord Circuit No. 608B PBX - SD-65832-01.
- (k) Cord Circuit No. 608D PBX - SD-67034-01.
- (l) Cord Circuit No. 608D PBX - SD-67035-01.

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