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PBX SYSTEMS
TRUNK CIRCUIT TO CENTRAL OFFICE
FOR NO. 701A, 701B, 701PK, 702A,
711A, 711B, 711PK OR 740E
OR
TWO-WAY - MANUAL AND DIAL SELECTED
FOR NO. 701A, 701B, 701PK OR 740E
OR
TWO-WAY - MANUAL SELECTED
FOR NO. 800A

CHANGES

B. Changes in Apparatus

B.1 Added:

A Diode 446F, Option YZ, Figs. 1 and 2

D. Description of Changes

D.1 Notes 102 and 104 are revised.

D.2 Option YY is designated and option YZ is added, providing diode A to prevent a momentary ground on the ring causing a premature ring-trip of the ELS signaling equipment.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-AEK-WHK)
DEPT 5337-LAH

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PEX SYSTEMS
TRUNK CIRCUIT TO CENTRAL OFFICE
ONE-WAY OUTGOING - DIAL SELECTED
FOR NO. 701A, 701B, 701PK, 702A,
711A, 711B, 711PK OR 740E
OR
TWO-WAY - MANUAL AND DIAL SELECTED
FOR NO. 701A, 701B, 701PK OR 740E
OR
TWO-WAY MANUAL SELECTED
FOR NO. 800A

CHANGES

(a) The 800A PBX one-way trunk circuit is added to the references for:

A. Changed and Added Functions

A.1 To function as a two-way, manual selected, auxiliary trunk for the one-way outgoing trunk circuit of the 800A PBX.

(1) Leads T and R of FS1 and FS2.

A.2 To function with Intra-PBX Protection of Service.

(2) Leads T, R, S, S1 or S1 and IND of FS3.

A.3 To function with the line or trunk access circuit for TOUCH-TONE calling.

(3) Lead L of FS9.

(b) Lead S and TR, FS1 and FS2, are added connecting to the 800A PBX one-way trunk circuit.

B. Changes in ApparatusB.1 SupersededSuperseded ByS Relay B1175
YW Option,
Figs. 1 and 2S Relay B1190
YX Option,
Figs. 1 and 2E Capacitor
KS-13486,
YW Option,
Figs. 1 and 2E Capacitor
KS-19524,L9
YX Option,
Figs. 1 and 2

D.3 In FS1 and FS2, option YS is designated and rated Mfr. Disc. and option YT is added to provide ground on the S1 resistor through a normally open contact of the CT relay. This provides a 3790 ohm ground on the sleeve lead to the right jack only when the trunk is in use. The resistance ground is required by 608-type switchboards.

D.4 In CAD Figure 2, T or T1, R or R1, and S or S1 leads to selector or selector connector bank multiple, etc. are changed to agree with SD when long line circuits are used.

D. Description of Changes

D.1 In FS1 and FS2, reference is added to T and R leads to permit connecting to line or trunk access circuit for TOUCH-TONE calling. In FS3 and FS10, option YQ is added providing an additional lead, TR, to the line or trunk access circuit for TOUCH-TONE calling.

D.5 In FS1 and FS2, option YL is shown and in CADs 1, 2, 3, 5 and 26, reference to 701A, 701B, 711A, or 711B PBX is added for PBX-ANI connections.

D.2 Connecting information is added to permit the use of this circuit as a two-way manual selected, auxiliary trunk to the 800A PBX one-way outgoing trunk circuit, SD-1E013-01, when the 800A is equipped with a 608A switchboard:

D.6 In FS1 and FS2, option YU is designated and YV is added to provide leads T1, R1, and S1 connecting to the Intra-PBX Protection of Service Circuit.

D.7 In FS1 and FS2, multiple connections are added to lead M to the ringing leads circuit. Equipment note 202 is added.

D.8 In FS1, FS2 and FS3 and associated CAD figures and notes, reference is added to permit connecting to the 608D switchboard.

D.9 Option YW is designated and rated Mfr. Disc. and option YX is added. This changes the codes of relay S from B1175 to B1190 and capacitor E from KS-13486 to KS-19524,L9.

D.10 The title is changed to include reference to the 800A PBX.

D.11 Connecting information for Rotary Out Trunk Switches is added.

D.12 CADs 28 and 29 have been added.

F. Changes in CD Sections

F.1 In SECTION III, Part 4. CONNECTING CIRCUITS, add:

4.30 Line or Trunk Access Circuit - SD-1E045-01.

4.31 No. 800A One-Way Outgoing Central Office Trunk Circuit - SD-1E013-01.

4.32 Intra-PBX Protection of Service - SD-1E031-01.

4.33 No. 608D Auxiliary Signal, Fuse Alarm, Battery Cut-Off and Miscellaneous Circuit - SD-67039-01.

4.34 Rotary Out Trunk Switch Circuit - SD-30868-01.

4.35 Rotary Out Trunk Switch Circuit - SD-30891-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-AEK-WHK)
DEPT 5337-LAH

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PBX SYSTEMS
NO. 701A, 701B, 701PK, 702A, 711A, 711B, 711PK
OR 740E
ONE-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE
OUTGOING DIAL SELECTED
OR
NO. 701A, 701B, 701PK OR 740E
2-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE
MANUAL AND DIAL SELECTED

CHANGESA. Changed and Added Functions

A.1 Automatic number identification service is provided.

B. Changes in Apparatus

B.1 Added
N relay AK23, YP option, App. Fig. 12

D. Description of Changes

D.1 Various indexes and notes 102 and 104 are revised.

D.2 On sheets B1, B2, and B5, option YL is designated and options YL and ZK are rated Mfr. Disc. to provide for automatic number identification.

D.3 On sheets B1, B2, B3 and B5, option YM is designated and option YN is added providing leads A, B, S1 and S2 to the automatic number identification circuit required for either one-way or two-way trunk operation and lead P1 required for two-way trunk operation.

D.4 On sheet B5, FSI4 is added as part of YP option.

D.5 On sheets B1, B2, B3, B4 and B5, option YD is designated and option YP is added to prevent shorting of the identification pulses and to provide listed number billing when night jacks are used for night operation.

D.6 On sheet C2, App Fig. 12 is added.

D.7 Relay N requirements are added to the Circuit Requirements Table.

D.8 CADS 1, 2, 3 and 5 are revised and CADS 26 and 27 are added.

F. Changes in CD Sections

F.1 Under TABLE OF CONTENTS, SECTION II, add:

13. AUTOMATIC NUMBER IDENTIFICATIONA. SeizureB. IdentificationC. Night Operation

F.2 Under SECTION II - DETAILED DESCRIPTION, add the following after paragraph 12.01:

13. AUTOMATIC NUMBER IDENTIFICATIONA. Seizure

13.01 The automatic number identification circuit determines the direction of a call through a trunk by detecting the sequence in which ground is applied to control leads A and B by the trunk. The seizure of the trunk by a station making a dail "9" call or by an attendant inserting a cord plug into the trunk jack results in the operation of relay S1. Relay S1 operated grounds lead A. The operation of central office equipment results in the operation of relay CT which grounds lead B.

31.02 This order of operation (A before B) turns on a pnpn transistor in the trunk sensing circuit causing a capacitor discharge which sets the trunk location core associated with the seized trunk and starts the identification cycle.

B. Identification

13.03 The automatic number identification equipment functions to open the sleeve via leads S1 and S2 and provides a metallic path from the outpulser to the sleeve via the trunk connector. The outpulser sends a 150 to 200 volt positive 30 microsecond pulse (Write, WRP1) over this path and the sleeve of the switchtrain to the station line circuit to set the proper station number cores on station originated calls. The outpulser provides a holding ground on the sleeve during periods that the trunk connector is operated.

13.04 Outgoing calls from a manual appearance results in the operation of relay JK which completes a metallic path from the trunk sleeve to the operator billing cross-connect field via lead P1. This completes a path to set listed number cores with write pulse WRP1 on attendant-originated or attendant-assisted calls to the central office.

C. Night Operation

13.05 Inserting a cord plug into a night jack grounds lead S or SL operating relay N. Relay N operated:

(a) Grounds the selector banks to make the trunk busy to the selector circuit.

(b) Opens the sleeve to prevent shorting the identification pulses.

(c) Transfers the sleeve to lead P1 providing listed number billing on all calls during night operation.

F.3 Under Part 4. CONNECTING CIRCUITS, add:

4.29 Automatic Number Identification Circuit - SD-1E007-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 7760HW-AELK-JGW)
DEPT 5337-LAH

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PBX SYSTEMS
NO. 701A, 701B, 701PK, 702A, 711A, 711B, 711PK
OR 740E
ONE-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE
OUTGOING DIAL SELECTED
OR
NO. 701A, 701B, 701PK OR 740E
2-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE
MANUAL AND DIAL SELECTED

CHANGESA. Changed and Added Functions

A.1 Provision is made to permit the use of this trunk with the 701A, 702A and 711A PBX.

D. Description of Changes

D.1 701A, 702A and 711A PBX is added to titles on all sheets and to titles and notes of all applicable drawing figures.

D.2 Wiring on CAD 1, B terminal strip, terminal 2 to 9M CT relay is added to bring drawing into agreement with manufacturing information.

F. Changes in CD Sections

F.1 Change TABLE OF CONTENTS, SECTION II, 11A and heading, SECTION II, 11A to read:

A. The 701A, 702A, 711A or 740E PBX used with 552 Type or a 608A Switchboard Selection with Night Jacks

F.2 Change SECTION III, 4. CONNECTING CIRCUITS 4.06 and 4.25 to read:

4.06 Selector Connector Circuits 701A, 711A or 740E - SD-65721-01.

4.26 PBX No. 552A, 552B, 552D, 552E, 605A 701A, 711A or 740E Ringing Leads Circuit - SD-66330-01.

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(WECO 7760HW-RFS-JGW)
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PBX SYSTEMS
NO. 701B, 701PK, 711B, 711PK
OR 740E
ONE-WAY TRUNK CIRCUIT
TO CENTRAL OFFICE
OUTGOING DIAL SELECTED
OR
NO. 701B, 701PK OR 740E
2 WAY TRUNK CIRCUIT
TO CENTRAL OFFICE
MANUAL AND DIAL SELECTED

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SECTION I - GENERAL DESCRIPTION1. PURPOSE OF CIRCUIT

1.01 This circuit provides for one-way service from a dial station to a manual or dial central office or two-way service between a dial station or PBX attendant and a manual or dial central office.

2. GENERAL DESCRIPTION OF OPERATIONA. Incoming Call from Central Office

2.01 The central office is connected to the PBX through the trunk. The trunk may be seized by the central office during the silent or ringing interval. In either case, seizure results in the operation of the H relay. A ringing audible or lighted trunk lamp signals the attendant who answers by inserting the cord plug into the trunk jack. The trunk is then made busy. When the station disconnects, the central office is held until the attendant removes the plug from the trunk jack.

B. Outgoing Call to Central Office from Station

2.02 The central office is signaled by the station when it is off-hook. The central office functions and operates the H relay. When the trunk is cut through to the tip and ring of the central office, dial tone or the operators challenge is heard by the station. When the station disconnects, the slow release characteristic of the trunk permits the central office to release before the H relay is reapplied to the trunk.

C. Outgoing Call to Central Office by Attendant

2.03 The attendant starts the call by inserting the trunk plug of a cord circuit into the trunk jack. This causes the operation of the JK relay which in

turn closes the tip and ring circuit. The closed tip and ring starts the central office as described above. The call is extended to the station in the usual manner for the manual PBX.

D. Rering When Connection is Established

2.04 It is possible for the central office operator to recall the PBX attendant with a call in progress. Ringing current from the central office operates a relay in the cord circuit, lighting a lamp associated with the cord. If the cord circuit is not equipped with a rering relay, relay R operates which lights the I lamp as a rering signal.

E. Toll Diverting

2.05 Stations may dial the central office to reach a toll operator. However, if toll service is not authorized, such calls may be diverted. This feature is called toll diverting and requires the addition of FS11 in the trunk. This circuit is only for use with a central office which reverses the battery after dialing but before the connection is answered. When provided, toll diverting disconnects the station from the central office and transfers it to the attendant or a toll diverting tone circuit.

F. Other Features

- 2.06 A traffic register may be operated through connections to the trunk.
- 2.07 Optional connectors of a long line circuit between the selector bank and jack appearance may be made.
- 2.08 Tandem operation - calls from distant PBX's may be made over a tie trunk through the central office trunk to the central office. The tie trunk connection is made via the selector circuits.
- 2.09 Night connections are set up through the manual section of the PBX. Both incoming and outgoing calls may be handled.

SECTION II - DETAILED DESCRIPTION

1. OUTGOING CALLS TO CENTRAL OFFICES FROM STATION

A. Start of Call FS1 or 2

1.01 When the trunk is idle, battery through the 1200-ohm resistance D FS1 or B FS2, G wiring, or the winding of the T relay FS10 is standing on the sleeve. The resistance is provided only in PBX's having selector-connectors where the 1200-ohm battery is required to operate the selector-connector cut-through relay. When a hunting selector stops on the trunk, the selector places ground on the sleeve.

1.02 Relay S operates over the station loop from battery through resistance J to ground on a normal contact of relay CT or SR. The operation of relay S causes the operation of relay S1.

FS1

1.03 Relay S1 operated:

- (a) Connects a ground on the ring side of the trunk toward the central office.
- (b) Opens a parallel path of battery through resistance B and the winding of relay H to the tip side of the central office trunk.
- (c) Closes ground to the S lead to hold the selector and to the SL lead to operate the T relay in FS10 to extinguish the idle indicating lamps with ZG wiring or lights the busy lamp with ZH wiring.
- (d) Disconnects ground from lead K or BR to traffic register circuit.
- (e) Closes a ground to DD lead to FS3 or 10 to operate relay DD.
- (f) Provides a lockup ground on the DL2 lead for relay DD in FS3.

FS2

1.04 Relay S1 operated:

- (a) Connects a ground on the ring side of the trunk toward the central office. This ground is connected through the L resistor.
- (b) With W wiring battery through resistance B is disconnected through a contact of S1 and reconnected through a contact of SR and a contact of S1 through the winding of H to the tip side of the central office trunk. With X wiring, the ring side of the line is connected through the secondary winding of relay H through the contact of S1 and the primary winding of H to the tip of the trunk. Operation of S1 removes this bridge and battery is

supplied through resistance B and the contact of SR through the winding of H to the tip side of the trunk waiting for ground from the central office to indicate that the circuit at the central office is ready to receive dial pulses.

- (c) Closes ground to the S lead to hold the selector and to the SL lead to operate the T relay in FS10 to extinguish the idle indicating lamps with ZG wiring or lights the busy lamp with ZH wiring.
- (d) Closes through the ring of the trunk to central office to a contact of CT thereby short circuiting resistance H.
- (e) Disconnects ground from lead K or BR to traffic register circuit.
- (f) Closes ground to DD lead to FS3 or 10 to operate relay DD.
- (g) Provides a lockup ground on the DL2 lead to relay DD in FS3.

1.05 Relay DD in operating locks through its contacts to ground on the DL2 lead and connects battery from resistance A, option ZV, with FS3 or ground with FS10 to the jack sleeve to make it test busy. With FS3, relay DD also lights the trunk busy lamps.

B. Cut Through

FS1

1.06 When the equipment in the central office functions, relay H operates from central office ground on the tip side of the trunk and closes the circuit to relay CT which operates. Relay CT cuts the station through to the tip and ring of the central office trunk, connects ground in multiple with the ground on the S1 relay to hold the selector over the S lead, and closes a circuit to relay SR which operates. Relay S now holds from battery and ground at the central office.

1.07 Relay SR:

- (a) Removes the battery through resistance B from the tip side of the trunk thereby releasing relay H.
- (b) Closes a locking circuit for relay CT.
- (c) Disconnects the ground from the ring side of the trunk.
- (d) Provides an additional ground for holding the selector.
- (e) Provides a supplementary lockup circuit for holding relay DD operated.

- (f) Closes a supplementary circuit for lighting the busy lamps with FS3.
- (g) Closes a supplementary circuit for operating relay T in FS10 to extinguish the idle indicating lamp with ZG wiring or lights the busy lamp with ZH wiring. The station now hears dial tone from the central office in the case of a dial office or the challenge of the operator in the manual office and may dial the central office or pass the call to the central office operator in the usual manner.

FS2

- 1.08 When the H relay operates from ground on the tip side of the trunk, it causes relay R1 to operate which in turn operates relay CT. From here on, the operation proceeds as described in paragraph 1.06 except that relay CT also shorts the secondary winding of relay H and when relay H releases, relay R1 also releases.
- 1.09 The DL diode prevents the DD relay supplementary lockup ground provided by relay SR from falsely locking up relay CT.

FS1 or 2 Connected to Toll Subscribers Line Circuit

- 1.10 A ringing audible signal is furnished in FS1 and 2 for the calling station or attendant with option ZS. A ground from the answering toll operators jack circuit operates the H relay which operates the CT relay. Operation of the CT relay removes the ringing audible and cuts through the talking path from the PBX to the toll operator. The remaining operations are as described in 1.06 and 1.07.

C. Dialing and Talking

- 1.11 When the station dials, relay S follows dial pulses opening and closing the circuit to relay S1. Relay S1 is slow to release and holds over the dial pulses so that this circuit remains in the cut-through position while the station is dialing and during the talking interval.

D. Disconnection

- 1.12 When the station disconnects, relay S releases in turn releasing relay S1 and the central office equipment because the loop is opened at the station. The slow release characteristic of relay S1 gives the central office equipment time to start releasing before relay H is applied to the trunk.

FS1

- 1.13 The release of relay S1 opens the locking circuit of relay CT permitting it to release. The release of relay CT removes the ground from resistance B which

permits relay H to operate from battery through resistance B to ground on the tip from the central office if the central office has not yet released. Relay H causes relay CT to operate and stay operated until the central office equipment releases and removes ground from the tip.

FS2

- 1.14 The release of relay S1 opens the locking circuit of relay CT permitting it to release. The release of relay CT connects the two windings of relay H in series across the tip and ring of the trunk. If the central office has not yet released, relay H operates causing relay R1 to operate. Relay R1 causes relay CT to operate and stay operated until the central office equipment releases.

- 1.15 When the central office equipment has released, relay H releases causing the release of relays R1, CT and SR. With these relays normal, ground is removed from the S lead to the switches releasing all operated switches and relay T if FS10 is specified. The release of relay SR removes the ground from the DL2 lead to release relay DD. With these relays released, the circuit is available for receiving new calls from the switches, the manual section, if equipped, or the central office.

- 1.16 When this trunk is connected to a dial central office, provision is made to insure the release of the PBX selector after a call in case the station reoriginates quickly.

2. RECALL ON A DIAL SELECTED CALL

A. General

- 2.01 Provision is made in this trunk for allowing a central office operator such as a toll operator, special service operator, or a manual central office operator to recall the station after the station has hung up.
- 2.02 When the station hangs up, a disconnect signal is transmitted to the central office; and the trunk circuit starts to release but holds under control of the central office, which does not release, as described in paragraph 1.12.
- 2.03 When the central office operator re-rings, relay CT remains operated during the ringing period.

FS2

- 2.04 Relay H operates intermittently on its primary winding from the ringing current and operates relay R1 which holds relay CT. The ringing current is connected through the contacts of relay CT to the station.

FS1 or W Wiring, FS2

2.05 In manual, panel, and crossbar areas, relay H operates to the ringing ground on the tip side of the trunk in turn holding relay CT operated. The ringing current is connected through the contacts of relay CT to the station.

Station Answers

2.06 The station bell is rung in the usual manner; and when the station answers, relay S operates in turn operating relay S1 which disconnects relay H from the trunk circuit but relay CT remains operated under control of relays S1 and SR. Relay R, in the case of the 2-way trunk, will operate after ringing has been connected to the trunk for a short period but performs no useful function under this condition.

3. INCOMING CALL FROM CENTRAL OFFICE

A. Seizure

3.01 When this trunk circuit is normal, relay H is connected to the trunk to recognize when a connection is set up at the central office end of the trunk. With FS1 or W wiring, FS2, relay H is connected from the tip side to battery. With X wiring, FS2, relay H is bridged across the tip and ring of the trunk because in the step-by-step areas, the battery polarity may be in either direction depending on whether or not the trunk is seized by a local or a toll connector.

Seizure During Silent Interval FS1 or FS2, W Wiring

3.02 When the trunk is seized at the central office during the silent interval, ground on the tip operates relay H which in turn operates relay CT. In the case of FS2, W wiring, relay H operates relay R1 which in turn operates relay CT. In either case, the operation of the CT relay will be delayed with YK option during surcharge registration of the previous call. Relay CT operated:

- (a) Connects the trunk through relay S to the jack circuit.
- (b) Connects ground on lead S toward the selector multiple.
- (c) Prepares its own locking circuit to relay SR.
- (d) Closes the circuit to relay SR which operates and lights the trunk busy lamps or extinguishes the idle indicating lamp.

3.03 When ringing current is applied at the central office, it causes the operation of relay R of FS9 or 13 as described later. Relay H remains operated under this condition

to ground on the tip of the trunk at the central office. Relay R operated locks up through a contact on relays JK and DD keeping the L or TRK lamp lighted steadily until the PBX attendant answers.

Seizure During Silent Interval FS2, X Wiring

3.04 When the trunk is seized at the central office during the silent interval, battery may be either on the ring or tip of the trunk and ground on the tip or ring lead. Relay H operates under either condition.

3.05 The H relay operates relay R1 which in turn operates relay CT which shorts the secondary winding of relay H and also performs the functions described in paragraph 3.02. After a short interval, relay R operates as described in paragraph 3.02 and lights the L or TRK lamp.

Seizure During Ringing Interval With FS1 or W Wiring, FS2

3.06 Relay H operates under this condition as ground is on the tip side of the trunk at the central office under all conditions where this circuit is seized in manual, panel, or crossbar central offices. The circuit functions as described in paragraph 3.02.

Seizure During Ringing Interval With X Wiring, FS2

3.07 Relay H operates on the central office ringing current and causes relay R1 to operate.

3.08 Relay R1 operated operates relay CT which functions as described in paragraph 3.04 and 3.05 to make the circuit busy at the manual section and also to the selector multiple. When the thermistor in series with relay R functions, relay R of FS9 operates and locks up lighting the L or TRK lamp as described in paragraph 3.02.

B. PBX Attendant Answers

FS3 and 7

3.09 The PBX attendant inserts the cord plug in jack T to answer the call. The operation of the front contacts of jack T operates relay JK in series with a relay in the cord circuit. The operation of relay JK:

- (a) Extinguishes the line lamp.
- (b) Opens the locking circuit for relay R in FS9.
- (c) Provides a supplementary circuit for the busy lamps.

(d) Provides a supplementary ground to the sleeve of the selector multiple to indicate that the circuit is busy.

(e) Cuts through the T and R leads to Jack T.

3.10 The cord circuits have a bridge normally across the cord when the operator inserts the plug into a trunk jack. The bridge trips the central office ringing; and in this circuit, causes relay S to operate in turn operating relay S1 which removes relay H from the trunk.

FS4 and 6 or 10

3.11 When the attendant answers, closure of the ring of the plug causes a partial operation of relay JK. Relay JS then operates over the sleeve and causes relay JK to fully operate. Relay JK disconnects its primary winding from the ring, closes through the tip and ring, provides a supplementary ground for the sleeves of the selector bank, releases R in FS13 which retires the trunk lamps. Relay S operates from battery and ground in the central office through the cord bridge causing the operation of relay S1 which removes relay H from the trunk and closes a locking circuit for relay CT.

FS3 Used With a 608A PBX

3.12 The PBX attendant inserts a trunk cord plug into the jack to answer the call. Ground from the operated jack contacts operates relay JK which:

(a) Cuts the tip and ring leads from the central office through to the PBX attendants circuit operating relay S in series with the tip side of the line.

(b) Furnishes a ground through the SL resistor to the jack sleeve for the PBX cord circuit.

(c) Provides battery on the IND lead to operate the busy lamps.

(d) Opens the locking path for the R relay removing battery from the I and NA leads to extinguish the trunk lamp and auxiliary signals. The remaining operations are as described in 3.09, 3.10, and 3.11.

C. Disconnection on Incoming Calls

3.13 When the station disconnects, a bridge is connected across the cord circuit to hold the central office until the PBX attendant removes the plug from the trunk jack, relay S releases sending a disconnect signal to the central office and causing the trunk circuit to release as described in paragraphs 1.12, 1.13, 1.14, 1.15, and 1.16.

4. OUTGOING CALL FROM MANUAL APPEARANCE

4.01 When the PBX attendant makes an outgoing call, she observes that the busy lamps are dark or that the idle indicating lamp is lighted and inserts the trunk plug of a cord circuit in the trunk jack, FS4, 6 or 7.

A. FS3 and 7

4.02 Operation of the auxiliary contacts on the tip spring of the jack closes the circuit to the JK relay in FS3. Relay JK operates in series with a relay in the cord circuit. Relay JK is made slow operated to delay the tip and ring closure until the cord circuit relays have functioned in order to reduce the acoustic shock to a station connected to the station end of the cord circuit. Relay JK operated:

(a) Closes through the tip and ring leads to FS1 or 2.

(b) Opens the line lamp circuit when F option is not specified.

(c) Opens the circuit for relay DD.

(d) Places ground on the sleeve of the selector multiple to make the circuit test busy.

(e) Connects battery direct or through the E and F resistances to the busy lamps.

(f) Opens the locking circuit for relay R in FS9.

B. FS3 Used With 608A PBX

4.03 The PBX attendant inserts a cord plug into the trunk jack to originate a call. The operated jack contacts provide a ground on the S1 lead to operate relay JK. The operated JK relay:

(a) Provides a ground through resistor SL on the S lead, option ZW, causing the cord circuit to function to provide a bridge for the operation of relays in FS1 or 2.

(b) Connects battery to the IND lead to operate the busy lamps.

(c) Opens the trunk lamp and auxiliary signal circuits. The remainder of the operations are as described in 4.02.

4.04 Diode S, option ZW, prevents relays other than relay JK from falsely providing a high resistance ground sleeve condition for the 608A PBX cord circuit.

C. FS4 and 6 or 10

4.05 When the PBX attendant makes an outgoing call, she observes that the idle indicating lamp is lighted and inserts the front plug of a cord circuit in the trunk jack, FS4 or 6. When the ring closes, JK operates partially. JS operates and fully operates JK on its secondary winding. JK closes through the tip and ring, opens the circuit through the winding of relay DD, places a ground on the sleeve of the selector multiple to make the circuit teasy busy, operates relay T which extinguishes the (INDICATING) lamp with ZG wiring or lights the busy lamp with ZH wiring.

D. Dialing and Talking

4.06 The cord circuit closure on the tip and ring leads causes the trunk to start the central office in the same manner described in paragraph 1. The call is extended to the station in the usual manner in the manual PBX; that is, the station may have stayed in on the connection when the attendant was dialing or may have disconnected and the attendant recalled the station after dialing was completed or the attendant may have established a through dial connection in which case the station dialed in the usual manner. The operation of the trunk circuit is the same in all cases.

5. RERING WHEN CONNECTION IS ESTABLISHED AT MANUAL POSITION

A. General

5.01 On attendant dialed calls to DSA and toll operators, it is necessary sometimes for the central office operator to recall the PBX attendant when the attendant is not on the connection. The incoming ringing current from the central office operates a relay in the cord circuit lighting the lamp in the particular cord circuit. Relay S in series with the cord bridge or long line circuit operates and follows the 20-cycle ringing current holding relays S1 and CT operated. Relay R in FS3, A option, operates after the thermistor resistance is reduced by the ringing current but performs no useful function.

5.02 Relay CT holds from relay S1 so that ringing current will pass from the central office leads through to the PBX cord circuit or long line circuit.

B. FS3, F Wiring

5.03 When the cord circuit has no rering feature, the circuit performs as in paragraph 5.01 with the exception that the operation of relay R in FS9 lights lamp L as a rering signal. Since the locking circuit for relay R is open at the JK relay, relay R will follow the ringing current from the central office.

6. RINGING RELAY CIRCUIT

6.01 FS9 and 13 cover the ring relay circuit which employs a thermistor-varistor combination which prevents false line signals from operating relay R. The 8A thermistor normally has a high resistance (over 50,000 ohms) but when ringing current is applied for approximately half a second or longer, the resistance is reduced giving an operating path for relay R. Diode R is provided for two purposes:

- (a) To provide a low resistance operating path for the thermistor.
- (b) To shunt relay R on one half of the ringing cycle so that relay R will operate steadily during the other half cycle.

6.02 Varistor D is provided for two purposes:

- (a) The shunt reduces the effective (heating) current through the thermistor due to dialing transients to such an extent that false relay operation is eliminated.

- (b) Protects diode R and thermistor R by offering a very high resistance on normal ringing and dialing voltages; but on very high transients and surges, its resistance becomes very low so as to shunt the high voltage around the varistor and thermistor. Relay R operated locks and connects battery on ground over the L lead to light the L or TRK lamps.

6.03 Option YC is added in parallel with capacitor R of Figure B to provide 3 mf of capacitance to allow relay R to operate on toll rering. (Toll rering with minimum voltage of 95 volts through a 13C resistance lamp.)

6.04 The locking path of relay R is extended through break contacts of relay DD so that relay DD will release relay R when the call is answered at an auxiliary trunk circuit.

7. TOLL DIVERTING FS11

7.01 Ordinarily the station or tie trunk can dial the central office to reach a toll operator. Provision has been made for diverting the connection when unauthorized stations or tie trunks dial codes which provide for toll service. This feature is called toll diverting and is for use with a central office which reverses the battery after dialing is completed but before the connection is answered by the toll of DSA operator. FS11 is provided in the central office trunk to recognize this reversal. Relay TS is in series with the ring side of the line and when battery is on the ring side of the line, it does not operate. With battery on the tip side of the line, relay TS operates and closes the circuit through its secondary winding to the OP relay. Relay OP transfers the station from the central office trunk to the toll diverting trunk or the toll diverting tone circuit according to which arrangement is provided at the particular PBX. When relay OP breaks the connection from the station to the central office, the operating circuit for relay S is removed causing it to release and release relay S1. Opening the T and R leads to the central office causes it to release and causes the release of relays H, CT and SR. The release of relays SR removes the operating ground for relay OP; but in the meantime, the toll diverting tone circuit or the attendant trunk has supplied ground on lead S to hold relay OP. Relay OP remains operated until the station is dismissed by the attendant. While relay OP is operated, the circuit is made busy to the selector multiple by means of ground on lead S1 from the toll diverting trunk or tone circuit. The central office connection is released immediately when relay OP operates in order to avoid tying up the central office equipment. FS11 provides toll diverting for all stations of the PBX.

7.02 Ground from operated night jack, feeding through operated toll diversion circuit, is prevented from reaching group multiple and falsely locking up diverted dial selected trunks by diode S.

8. TRAFFIC REGISTER

8.01 A circuit for operating a traffic register is provided. This circuit is normally grounded but the ground is removed when all the trunks in the group are busy.

9. LONG LINE CIRCUITS

9.01 Provision is shown for optional connection of a long line circuit between the selector bank and jack appearances and the signaling relays of this circuit. The use of a long line circuit at this point will furnish talking battery at the PBX where so desired because of long central office trunks and will also permit the use of station and trunk loops whose combined

resistance exceeds the central office working range.

10. TANDEM OPERATION

10.01 Calls from distant PBX's may be established over a tie trunk through the central office trunk to the central office without the attention of the PBX attendant at this PBX. The tie trunk connection is established to the central office trunk via the selector circuits. The central office trunk circuit functions in the same manner as on a call established from a station via the selectors. However, when the long lines circuit is not provided, some tie trunks may cancel pulsing after a battery reversal is received from the central office if a toll code is dialed into a central office where the operators trunks are arranged to reverse the battery.

11. NIGHT CONNECTIONS

A. The 740E PBX Used With 552 Type or A 608A Switchboard Selection With Night Jacks

11.01 Night connections are established through the manual section associated with this PBX. With the cord circuit keys operated for night operation, there is no dc bridge across the cord and the trunk end of the cord is connected to the night jack in FS8 or 12. The tip and ring of the cord will then connect the station through to battery and ground at the contacts of relay CT or to the long line circuits. The trunk is made busy to the selector circuits by the auxiliary contact on the ring spring of the jack which grounds the sleeve.

11.02 A ground feedback from a night connected outgoing trunk is prevented from falsely locking up a diverted dial selected trunk through the multiple wiring by diode S.

Outgoing Calls

11.03 If the station desires to make an outgoing call, the receiver is removed from the switchhook in the usual manner. The calls proceed in the manner described in part 1 for outgoing calls from a station.

Incoming Calls

11.04 When seized at the central office, the trunk functions as described in part 3, except that the station bell rings and no PBX attendant answers. The presence of resistance H, FS2 limits the amount of ringing current and prevents false operation of the central office tripping relay. When the station answers, relay S and S1 operate. The operation of relay S1 places a short on resistance H, FS2 so as not to introduce a transmission loss. Relay R which operates on the ringing current stays operated until relay SR releases at the end of the call.

B. 740E PBX Used With a 556A Switchboard Section or With a 552 Type Switchboard Section Without Night Jacks

11.05 Night connections are established through the manual section associated with the PBX. With the cord circuit keys operated for night operation, there is no dc bridge across the cord and the trunk end of the cord is connected to jack T in FS7. Relay JK operates and performs the functions described in paragraph 4.02. However, the busy lamps will not light during periods when the switchboard is unattended since battery designated B, YA wiring is supplied through the battery cut-off key.

Outgoing Calls

11.06 When the receiver at the station is removed from the switchhook, the trunk is started and functions as described in part 1.

Incoming Calls

11.07 When seized at the central office, the trunk functions as described in part 3. Relay R may operate but will not lock since relay JK is operated. The station bells ring from ringing current at the central office upon the operation of relay CT.

12. RELAY FUNCTIONS

A. FS1 or 2

12.01 CT is a relay which provides the cut-through condition in the trunk circuit.

12.02 H is a high resistance relay which is connected to the tip side of the line in manual, panel, and crossbar offices and connected across the line in step-by-step offices to recognize when the central office disconnects or seizes the line.

12.03 S is the supervisory relay. It may be used with its two windings in multiple for short loops or with its inductive winding shunted with a 60 mf capacitor for long loops.

12.04 S1 is an auxiliary supervisory relay under control of relay S. It connects the outgoing signaling circuit when a call is originated by the station or an attendant. It is slow release to hold over the dial pulses through relay S.

12.05 SR is a slow release relay in combination with relay CT to provide a sufficient open interval after the station or the PBX attendant disconnects to permit the central office equipment to release

before reconnecting relay H across the line. On the operate condition, it provides time for relay CT to fully operate before relay SR disconnects relay H on an outgoing call.

B. FS2

12.06 R1 is auxiliary to relay H and holds while relay H follows ringing current on the seizure of the trunk by the central office.

C. FS3

12.07 DD operates and locks on an outdial call and opens the lockup circuit to the ring up relay R and the trunk lamp.

12.08 JK is a jack auxiliary relay to provide for making the jack test busy, lighting the busy lamps, opening the lockup circuit to ring up relay R and closing the tip ring and sleeve leads when the jack is occupied.

D. FS11

12.09 OP is the transfer relay for diverting the station from the central office trunk to the toll diverting attendant trunk or tone circuit.

12.10 TS is a polarized relay to recognize reverse battery in order to divert stations to the toll diverting circuit in combination with relay OP.

E. FS10

12.11 DD operates and locks on an outdial call and opens the circuit to the ring up relay R.

12.12 JK is a jack auxiliary relay to provide for making the jack test busy, opening the lockup circuit to ring up relay R and closing the tip, ring, and sleeve leads when the jack is occupied.

12.13 JS recognizes closure of the plug sleeve to the jack sleeve.

12.14 T extinguishes the indicating lamps and advances battery to light idle lamps of the next idle circuit if ZG wiring is furnished or lights the busy lamp if ZH wiring is furnished.

F. FS9 or 13

12.15 R operates on incoming ringing signals and lights the L or trunk lamp.

SECTION III - REFERENCE DATA

1. WORKING LIMITS**

1.01 Signaling Ranges

	<u>Max. Ext. Ckt. Res. to Grd.</u>	<u>Max. Ext. Ckt. Loop at</u>	<u>Min. Ins. Res.</u>	<u>Earth Potential</u>
		45V 47.5V		
H Relay		1800 2590	30,000	
X Option		2170 3120	50,000	
		2570 3670	100,000	
H Relay	4265		*	0V., +20V.
W or X Option	2365		*	-5V., +20V.
	990		*	-10V., +20V.
	140		*	-13V., +20V.

* Panel, Manual, or Crossbar 20,000; step by Step 30,000
Without long line equipment, the combined trunk and station minimum insulation resistance should not be less than these figures.

**Without long line equipment, the combined loop of maximum extension station and maximum trunk conductor loop plus the series resistance of the cord circuit when FS3 is used shall not exceed the subscriber loop range of connecting central office less:

82 Ohms With FS11
58 Ohms Without FS11

2. FUNCTIONAL DESIGNATIONS

2.01 The functional meanings of the designations of the relays of the central office trunk circuit are listed below:

<u>Designation</u>	<u>Meaning</u>
CT	Cut Through
H	High Resistance
S	Supervisory
S1	Supervisory Auxiliary
SR	Slow Release
R1	High Resistance Auxiliary
DD	Outdial
JK	Jack Auxiliary
R	Ring Up
JS	Jack Sleeve
T	Transfer
OP	Toll Diversion Transfer
TS	Toll Diversion Supervisory

3.02 To signal the central office

3.03 To connect the calling station to the central office when the central office answers in the case of a manual central office or when the dial equipment functions and is ready to receive pulses in the case of a dial central office.

3.04 To hold the trunk circuit in the cut-through condition while the station is dialing to a central office.

3.05 To give a disconnect signal to the central office when the PBX station disconnects.

3.06 To hold the PBX end of the trunk busy when the PBX station disconnects until the central office end of the trunk is released.

3. FUNCTIONS

A. Outgoing Calls From Stations

3.01 To light the trunk busy lamps or extinguish the indicating lamps and cause the jack sleeve to test busy.

3.07 To provide for reringing the station when the central office operator rings on the trunk circuit on night connections or on connections dialed by the station.

3.08 To disconnect the station from the central office trunk and connect it to a toll diverting attendant trunk circuit when the central office trunk is arranged to recognize reverse battery from a CLR trunk or a special operator trunk circuit when the PBX is equipped with a manual section. If the PBX is not equipped with a manual section, the station will, under this traffic condition, be connected to a toll diverting tone circuit to indicate that outgoing toll service has been denied.

3.09 To receive an incoming call or to permit the attendant or nontoll diverting stations to make an outgoing call while a toll diverted station is being held by the attendant.

3.10 To provide a ringing audible signal for the station until the toll switchboard operator answers.

3.11 Station message register pulse service and station message register surcharge service are provided for outgoing central office trunks.

B. Outgoing Calls Originated by PBX Attendant

3.12 To light the trunk busy lamps or extinguish the indicating lamps and to make the circuit busy to the PBX selector circuits when the attendant inserts a plug in the jack.

3.13 To signal the central office.

3.14 To connect the PBX cord circuit through to the central office when the operator answers in the manual central office or when the dial central office is ready to receive dial pulses.

3.15 To hold the trunk circuit in the cut-through condition while the attendant is dialing to a central office.

3.16 To give a disconnect signal to the central office when the station disconnects, provided the cord circuits are arranged for through supervision, or when the PBX attendant removes the plug from the trunk jack when the cord circuits are arranged for non-through supervision.

3.17 To provide means for passing ringing current to the cord circuit on a rering from central office or to provide line lamp rering when cord circuit has no rering feature.

3.18 To start the ringing machine when associated with a long line circuit which uses ringing current furnished by an intermittently operated ringing machine.

3.19 To provide a ringing audible signal for the PBX attendant until the toll

switchboard operator answers.

C. Incoming Calls

3.20 To make the PBX end of the trunk busy to the selector circuits and to light the trunk busy lamps or extinguish the indicating lamps when the central office end is seized.

3.21 To light the trunk lamp when ringing current is applied in the central office.

3.22 To cut the trunk through the PBX cord circuit when the attendant answers.

3.23 To start the ringing machine when associated with a long line circuit which uses ringing current furnished by an intermittently operated ringing machine.

3.24 To provide means for passing ringing current to the cord circuit on a rering from central office or to provide line lamp rering when cord circuit has no rering feature.

D. Tandem Operation

3.25 To provide for tandem operation from a tie trunk which is arranged for tandem dial operation.

E. Night Service

3.26 To provide for incoming and outgoing night service to a specified station via a manual PBX cord circuit and an optional night jack on both outgoing and two-way trunk circuits.

4. CONNECTING CIRCUITS

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

4.02 Manual, Panel, Step-by-Step, or Crossbar Central Office Subscribers Line and Long Line Circuits which are arranged for ground signaling on the Ring Conductor - SD-25003-01 (Typical).

4.03 552A, 552D or 605A PBX Cord Circuits - SD-66198-01 (Typical).

4.04 552A, 552D or 605A PBX Auxiliary Buzzer or Night Alarm Circuit - SD-66467-01.

4.05 Selector Circuits - SD-66359-01, SD-30200-01 (Typical).

4.06 Selector Connector Circuits 740E - SD-6572-01.

- 4.07 Toll Diverting Attendant Trunk Circuit - SD-66450-01.
- 4.08 Toll Diverting Tone Circuit - SD-66446-01.
- 4.09 Long Trunk Circuit - SD-66474-01 (Typical).
- 4.10 Long Line Circuit - SD-66060-01 (Typical).
- 4.11 Toll Diverting Trunk Circuit - SD-32067-01.
- 4.12 556 Cord, Telephone Dial, Buzzer, Ringing, and Battery Circuit - SD-65658-01.
- 4.13 Traffic Register Circuit - SD-65771-01 (Typical).
- 4.14 Power Ringing Circuit - SD-80946-01 (Typical).
- 4.15 Emergency Transfer Key Circuit - SD-66451-01.
- 4.16 Idle Trunk Indicating Circuit - SD-66657-01.
- 4.17 Cord Circuits 607A, SD-66707-01, 607B, SD-65670-01.
- 4.18 Night Alarm Circuit - SD-66653-01.
- 4.19 Power Supply for ac Busy and Idle Line Indicating Lamps - SD-80770-01.
- 4.20 Auxiliary Trunk Circuit - SD-65725-01.
- 4.21 No. 552A, 552B, 552D, 552E, 605A, 607A,

- 607B, or 608A Jack Circuit for Attendant Switchboard Positions - SD-65778-01.
- 4.22 No. 608A Auxiliary Signal, Fuse Alarm, Battery Cut-Off and Miscellaneous Circuit - SD-66722-01.
- 4.23 Night Transfer Circuit - SD-65837-01.
- 4.24 Traffic Usage Recorder Circuit 100 and 200 Terminal Capacity - SD-96549-01.
- 4.25 PBX No. 552A, 552B, 552D, 552E, 605A, or 740E Ringing Leads Circuit - SD-66330-01.
- 4.26 No. 552A, 552B, 552D, 552E, 605A, 607A, 607B, 701B or 711B Ringing Leads Circuit - SD-65771-01.
- 4.27 Station Message Register Pulse Circuit - SD-66915-01.
- 4.28 Station Message Register Surcharge Circuit - SD-66922-01.

5. MANUFACTURING TEST REQUIREMENTS

- 5.01 The central office trunk shall be capable of performing all of the functions specified in this circuit description and meeting all of the requirements of the circuit requirements table.

6. TAKING EQUIPMENT OUT OF SERVICE

- 6.01 The central office trunk can be taken out of service by grounding the sleeve terminal. This busies the trunk at the selector bank. To prevent incoming calls, the central office trunk should be made busy at the central office.

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