

STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
CABLING DIAGRAM

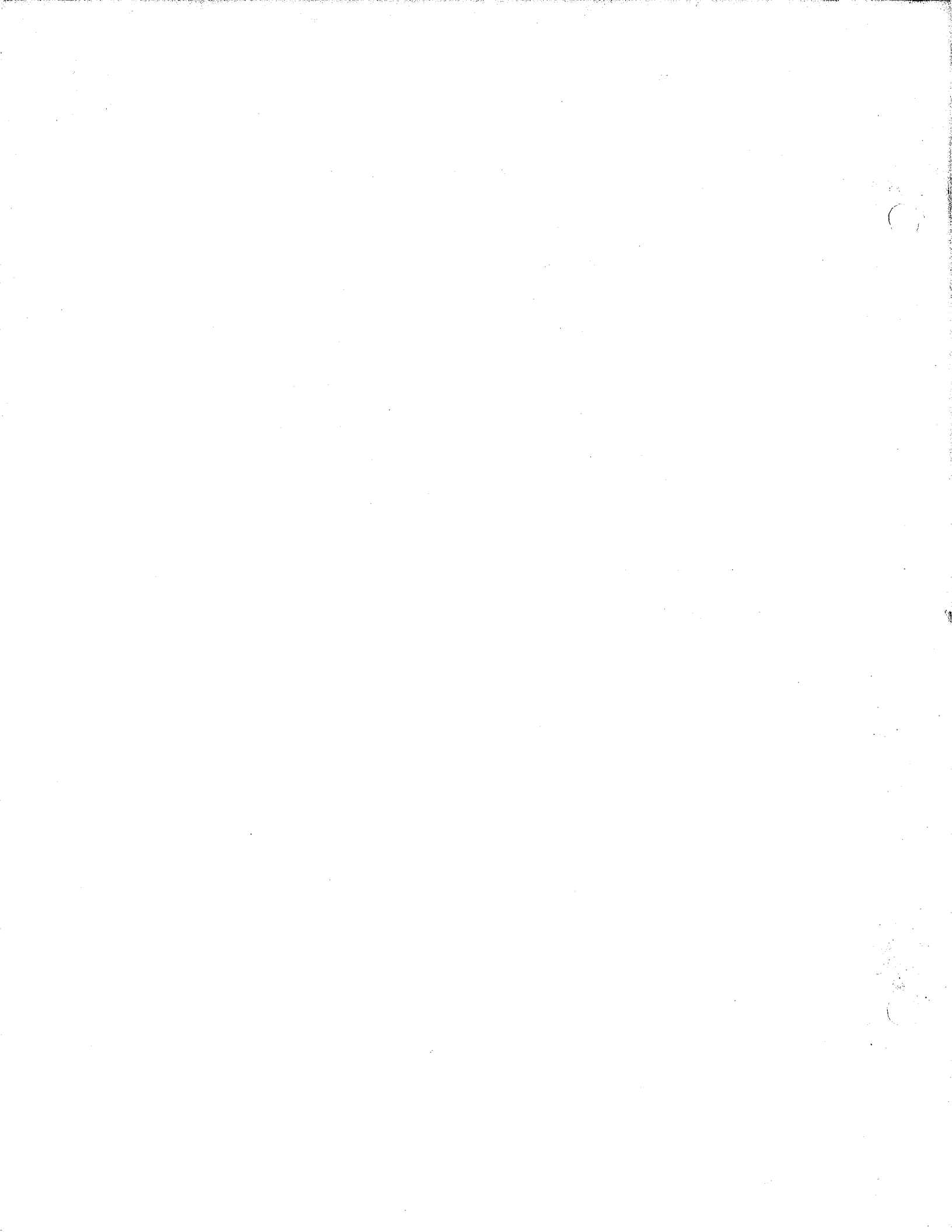
CHANGES

D. Description of Changes

- D.1 On sheet A1, the sheet index is brought up to date.
- D.2 On sheets A2 and A3 the lead index is brought up to date.
- D.3 On sheet D-1 option ED for recorded telephone dictation trunk is added.
- D.4 On sheets G4, 5 and G8-10 additional cross-reference information is added.
- D.5 On sheet G7, lead DT required for recorded telephone dictation trunk, and cross-reference information are added.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 2120HW-RHO-WHK)  
DEPT. 5337-LAH



STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
CABLING DIAGRAM

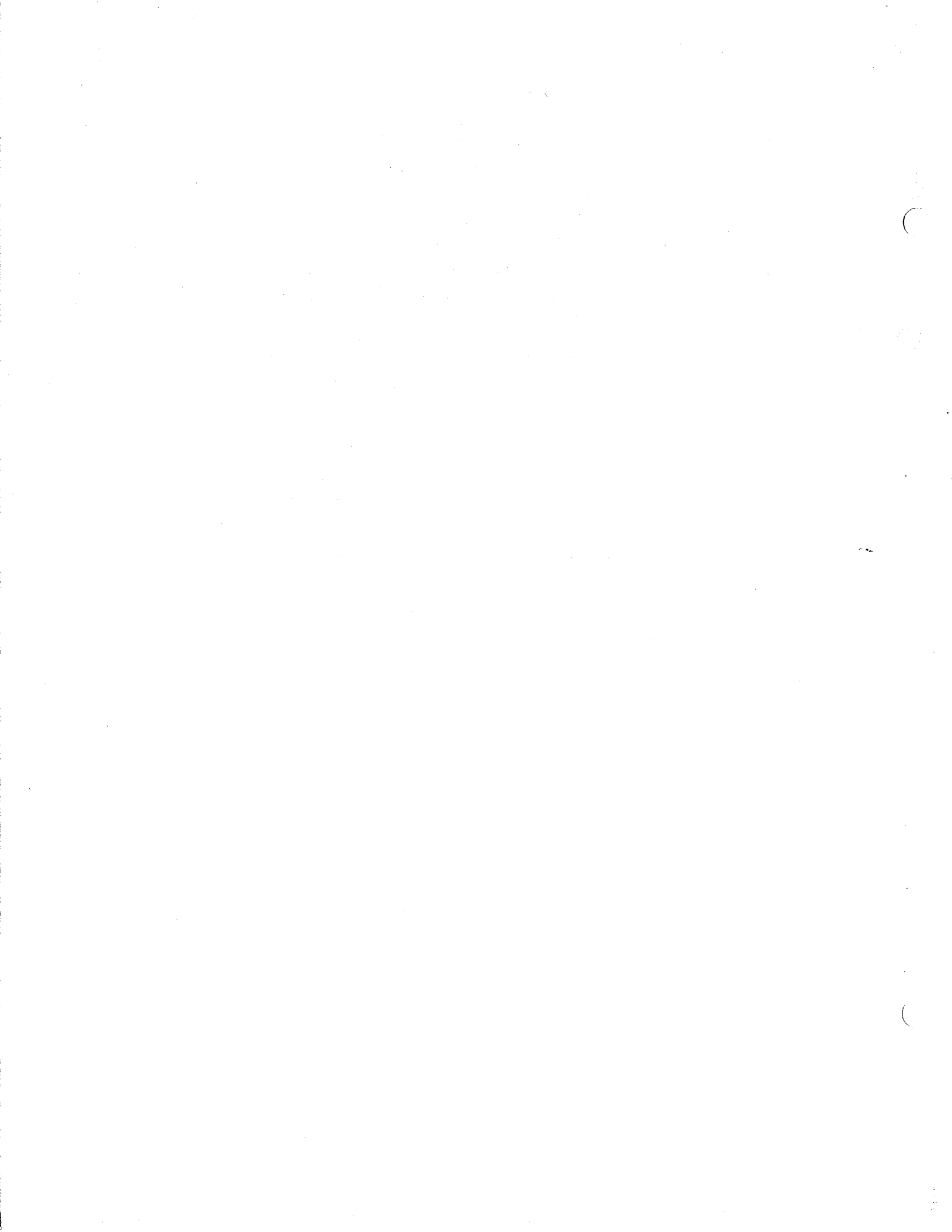
CHANGES

D. Description of Changes

- D.1 All changes are made on a Class D -  
No Record basis per agreement with  
WECO for station make busy and TOUCH-TONE  
calling.
- D.2 On sheet A1, the sheet index is  
brought up to date.
- D.3 On sheet G4, G5 and G7 drafting  
errors are corrected on CAD's 4,  
5, 6, 11 and 12.
- D.4 On sheet G8, "B" option is added  
to TO straps on TS (PWR SUP) on  
CAD 15.
- D.5 On sheet G9, CAD 16 is rated "Mfr  
Disc", CAD 17 is revised, and CAD  
19 is added.
- D.6 On sheet G10, CAD 18 is added.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 7120HW-RHO-JGW)  
DEPT 5337-LAH



STATION SYSTEMS  
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CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 CAD 2 is revised to redesignate lead "DT" as "DT(TT1 or LT2)".
- D.2 CAD 17 is added for the application of TOUCH-TONE calling.

F. Changes in Sections

- F.1 In SECTION III - CONNECTING CIRCUITS,

Add:

- (2) TOUCH-TONE Calling Receiver  
Applique Circuit - SD-66888-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECo 7760HW-RAB-JGW)  
DEPT 5337RAV



STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
CABLING DIAGRAMCHANGESD. Description of Changes

- D.1 On sheet A1, the sheet index is brought up to date.
- D.2 On sheet A2, the MB lead is added to the lead index.
- D.3 On sheet G2, portions of the leads are rated from A & M only to Mfr Disc on CAD 2.
- D.4 On sheet G3, portions of the leads are rated from A & M only to Mfr Disc on CAD 3.
- D.5 On sheet G4, "E" and "G" options are added to CAD 5; leads A0 to A17 and L are added to CAD 4; CAD 4 and 5 are rated from A & M only to Mfr Disc; a sheet note is added.
- D.6 On sheet G5, TO or MBO to MB17 leads are added to CAD 6; "E" and "G" options are added; CAD 6 is rated from A & M only to Mfr Disc.
- D.7 On sheet G6, portions of the leads are rated from A & M only to Mfr Disc on CAD 8; CAD 9 is rated from A & M only to Mfr Disc.
- D.8 On sheet G7, A0 to A17 and L leads and "E" option are added to CAD 11; MBO to MB17 and TO leads and "E" and "G" options are added to CAD 12; a sheet note is added.
- D.9 On sheet G8, "E" and "G" options and TO and LW leads are added to CAD 15.
- D.10 Sheet G10 is added and CAD 13 is relocated from sheet G7.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECO 7760HW-PFD-JGW)  
DEPT 5337-RAV

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STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 CAD 1 is changed to rate wires to test post on slide 3 "Mfr. Disc." and to show new frame ground.
- D.2 CAD 3 is changed to remove unused -48V FT lead and to show new frame ground.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WEC 7760HW-EWS-JGW)  
DEPT 5337-RAV



STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
CABLING DIAGRAMSECTION I - GENERAL DESCRIPTION1. GENERAL METHOD OF OPERATION

1.01 This cabling drawing shows the inter-connection of each of the three equipment slides to (a) the other slides, (b) the Cabinet Crown cross-connecting terminal strips, and (c) the Call Progress Indicating Circuit.

SECTION II - DETAILED DESCRIPTION

None.

SECTION III - REFERENCE DATA1. WORKING LIMITS

None.

2. FUNCTIONAL DESIGNATIONS

None.

3. FUNCTIONS

None.

4. CONNECTING CIRCUITS

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

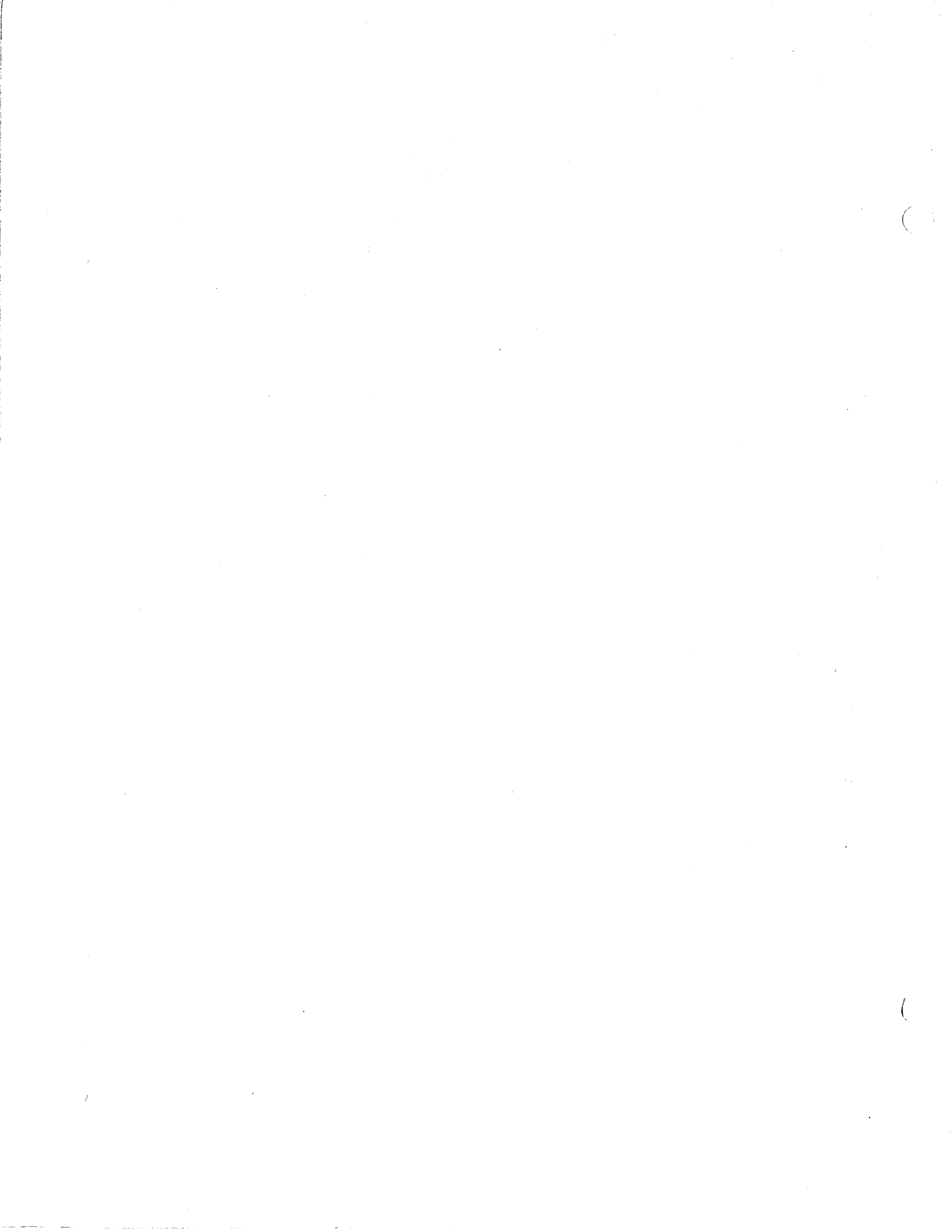
- (a) Marker Circuit - SD-69468-01.
- (b) Line, Link, and Connector Circuit - SD-69469-01.
- (c) Dial Pulse Register Circuit - SD-69470-01.
- (d) Alarm and Test Circuit - SD-69471-01.
- (e) Junctor Circuit - SD-69464-01.
- (f) Busy Tone Trunk Circuit - SD-69465-01.
- (g) Key Telephone and Add-On Line Circuit - SD-69466-01.
- (h) Auxiliary Relay Circuit for Direct Station Selection by Stations - SD-69467-01.
- (i) Power Supply Circuit - SD-81577-01.
- (j) Call Progress Indicating Circuit - SD-69472-01.
- (k) TOUCH-TONE Calling Receiving Circuit - SD-67027-01.

SECTION IV - REASONS FOR REISSUED. Description of Changes

- D.1 Add CAD 16 for the application of TOUCH-TONE calling.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5338-CRG-RVL



STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
JUNCTOR CIRCUIT

TABLE OF CONTENTS	PAGE	<u>SECTION I - GENERAL DESCRIPTION</u>
<u>SECTION I - GENERAL DESCRIPTION</u>	1	1. GENERAL METHOD OF OPERATION
1. GENERAL METHOD OF OPERATION	1	1.1 The Junctor circuit is used to supply talking battery, and provide ringing and supervision on station-to-station and Dial Repeating Tie Trunk-to-station calls.
<u>SECTION II - DETAILED DESCRIPTION</u>	1	
1. SEIZURE	1	When the Marker is signaled by the register to set up a connection from a station or Incoming Dial Repeating Tie Trunk to another station it does so by connecting a link from the terminating end of the Junctor to the called station and another link from the calling station or Tie Trunk to the originating end of the Junctor.
1.1 Operation of A Relay and Holding Connection	1	
1.2 Start of Ringing	2	
2. RINGING TRIP AND CUT THROUGH	2	
3. RELEASE	2	
3.1 Called Party Does Not Answer	2	When a register circuit signals the Marker to establish a connection using a junctor, it does so by connecting a link from the called station to the terminating end of a junctor and connecting the originating end of the Junctor to the link already connecting the calling station to the register.
3.2 Calling Party Disconnects First	2	
3.3 Called Party Disconnects First	2	
4. USE OF JUNCTOR WITH KEY TELEPHONE ADD-ON CIRCUIT	2	
<u>SECTION III - REFERENCE DATA</u>	3	
1. WORKING LIMITS	3	Upon seizure the Junctor supplies a holding ground to hold the originating and terminating Hold Magnets as well as the originating and terminating Junctor Hold Magnets in the Link circuit. The Junctor also connects ringing current to the called line via the terminating link. When the called line answers, the Junctor trips the ringing and cuts through the transmission path. When the calling line disconnects the Junctor releases the originating link and calling Hold Magnet, and when the called line disconnects, the Junctor releases the terminating line and terminating Hold Magnet.
1.1 Lines	3	
1.2 Voltage Limits	3	
2. FUNCTIONS	3	
3. CONNECTING CIRCUITS	3	
4. MANUFACTURING TEST REQUIREMENTS	3	
5. TAKING EQUIPMENT OUT OF SERVICE	3	
6. ALARM INFORMATION	3	
<u>SECTION IV - REASONS FOR REISSUE</u>	3	If the originating line disconnects but the terminating line fails to disconnect the Junctor will remain busy to the Marker even though the originating end of the connection is released. This feature is provided because the Marker tests the terminating end of the Junctor for a busy condition.
		The Junctor furnishes reverse battery supervision in both directions.
		<u>SECTION II - DETAILED DESCRIPTION</u>
		1. SEIZURE
		1.1 Operation of A Relay and Holding Connection

The Marker having received information from the register as to the called line number for a station-to-station or tie trunk-to-station call, proceeds to set up a connection to that line on a "Juncture Class" basis. A "Juncture Class" call requires a Junctor circuit to supply transmission battery to both parties.

The Marker tests the terminating hold magnets of the Junctors. Having found an idle Junctor the Marker SMT relay operates the terminating hold magnet for the Junctor and the hold magnet of the called line to connect them together over an idle link which has already been selected. Having established a connection to the called line, the Marker proceeds to operate the originating hold magnet of the Junctor which connects the Junctor to the same link used to connect the originating station or trunk to the Register. The Register then drops off the link. When the Junctor originating hold magnet operates to connect the calling line to the Junctor, the calling station loop is extended through crosspoints to the winding of relay A to battery and ground, and relay A operates. Relay A operates relay B. Relay B operated (1) closes ground through both sections of resistance A to the terminating link sleeve and to the originating link sleeve to hold the calling and called hold magnets and (2) closes holding ground to the originating and terminating Junctor hold magnets over leads OHM and THM respectively, to hold these operated after the Marker releases. Relay B is slow releasing in order to guard against momentary opens in the loop that would falsely drop the connection.

1.2 Start of Ringing

Ringling current, over Lead R1, through a make contact of A, through the primary winding and a break contact of tripping relay TP is applied to the ring conductor of the Junctor toward the called line. Ringling ground is connected and extended over lead Ring G through a break contact of Relay TP to the tip conductor of the Junctor toward the called line. Condenser A is providing to furnish audible ringling tone to the calling line.

2. RINGING TRIP AND CUT THROUGH

When the called party answers, the terminating loop operates relay TP. Relay TP operated, locks to ground through a make contact of B and transfers the terminating T and R leads from the ringling current supply to the windings of Relay D which operates. Relay D in operating reverses the originating and end T and R leads. This battery and ground reversal is of consequence on calls to local station lines from

Tie Trunks, and on Key Telephone and Add-On Line Circuits, (See Paragraph 4) which require reversed battery type supervision. Relay D operated provides supplementary holding ground for the terminating link sleeve, the Junctor terminating hold magnet and relay TP. The Junctor supplies talking battery through relay A to the calling line or Tie Trunk, and through Relay D to the called line. The voice current path is complete through capacitors T and R.

3. RELEASE

3.1 Called Party Does Not Answer

When the calling line or tie trunk disconnects, Relay A releases. Relay A released, removes ringing current from the terminating T and R leads and releases Relay B. The release of Relay B removes ground from leads SO, ST, OHM and THM which releases the originating and terminating hold magnets of the Junctor and the hold magnets of the associated line.

3.2 Calling Party Disconnects First

Relays A and B release as described in Paragraph 3.1 but Relay D is held operated over the called station loop and only the originating end of the Junctor will release. This condition will prevail until the called party hangs up at which time, the release of Relay D releases Relay TP, opens up the terminating ST lead and also opens up the THM lead thereby releasing the terminating hold magnet, restoring the Junctor to normal.

3.3 Called Party Disconnects First

Relay D releases as described in Paragraph 3.2 but the Junctor terminating hold magnet, and Relay TP cannot release until the supplementary holding grounds supplied by operated Relay B are removed. When the calling party hangs up Relays A and B release and the Junctor restores to normal as described in Paragraph 3.1.

4. USE OF JUNCTOR WITH KEY TELEPHONE ADD-ON CIRCUIT

When a junctor is used on an incoming call from a central office line which was extended to a local station via a Key Telephone Add-On circuit, the called party hanging up releases the D relay causing a reversal of the battery and ground toward the Add-On circuit. This causes a relay in the Add-On circuit to function, releasing the circuit. When a junctor is used on an outgoing call from a station the calling party in hanging up releases the A relay which reverses battery and ground toward the Add-On circuit to release a relay and restore that circuit to normal.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

- 1.1 Maximum external circuit loop is 1410 ohms.
- 1.2 Voltage limits are: 45 to 52 volts dc.  
75 to 110 volts ac.

2. FUNCTIONS

- 2.1 To respond to seizure and supply holding ground for the originating hold magnet and the terminating hold magnet under control of the calling station loop.
- 2.2 To supply ringing to the called station and audible ringing tone to the calling station.
- 2.3 To recognize that the called station has answered and to cut through the transmission path supplying transmission battery to both lines.
- 2.4 To reverse the battery and ground toward the calling end as an answered signal to Tie Trunks requiring reverse battery supervision.
- 2.5 To reverse the battery and ground toward the calling and called end to provide for the release of the Add-On circuit upon completion of a call.
- 2.6 To recognize when either party disconnects, and to hold itself busy to the Marker circuit until both parties hang up.

3. CONNECTING CIRCUITS

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

- 3.1 Marker SD-69468-01

- 3.2 Line, Link and Connector Circuit, SD-69469-01

- 3.3 Power Supply Circuit, SD-81577-01

4. MANUFACTURING TEST REQUIREMENTS

- 4.1 The Junctor Circuit shall be capable of performing all the service functions specified in this circuit description and meeting all the requirements in the Circuit Requirements tables.

5. TAKING EQUIPMENT OUT OF SERVICE

- 5.1 To make the Junctor busy, it is necessary to ground the (THM) lead toward the Marker Circuit. This can be accomplished as follows: Ascertain that no select magnet is operated and block the D relay operated.

6. ALARM INFORMATION

6.1 Fuse Alarm

An operated fuse supplying the Junctor circuit is indicated by an alarm at the Plant Service Center, if alarm transmitting features are provided and, in any case, by a visual signal locally. Replace the operated fuse to silence the alarm and extinguish the visual alarm signal.

SECTION IV - REASONS FOR REISSUE

CHANGES

B. CHANGES IN APPARATUS

- B.1. Removed

D-Diode - KS-15724, L1

D. DESCRIPTION OF CIRCUIT CHANGES

- D.1. The D diode is removed to correct an inoperative condition. The wiring around the T and R capacitors has also been changed.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5332-PB-HFH-DDT





STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
BUSY TONE TRUNK CIRCUIT

TABLE OF CONTENTS	PAGE	<u>SECTION I - GENERAL DESCRIPTION</u>
<u>SECTION I - GENERAL DESCRIPTION</u>	1	1. GENERAL METHOD OF OPERATION
1. GENERAL METHOD OF OPERATION	1	1.1 When a station line or trunk originates a call to another station line or trunk and the called station line or trunk is tested busy, the marker will route the call to the Busy Tone Trunk circuit.
<u>SECTION II - DETAILED DESCRIPTION</u>	1	When the Busy Tone Trunk is seized, it provides a ground to hold the station or trunk hold magnet and the Busy Tone Trunk hold magnet operated under control of the calling station loop or trunk.
1. SEIZURE	1	
2. RELEASE OF BUSY TONE TRUNK	1	
<u>SECTION III - REFERENCE DATA</u>	2	<u>SECTION II - DETAILED DESCRIPTION</u>
1. WORKING LIMITS	2	1. SEIZURE
1.1 Lines	2	When a station line or trunk originates a call to another station line or trunk and the marker finds it busy, the marker will function to establish a connection between the falling station or trunk and the Busy Tone Trunk. When the marker completes this connection, the A relay in the Busy Tone Trunk circuit will operate over the loop from the station or trunk bridge. Operation of the A relay operates the RA relay, which connects ground to the link sleeve to hold the originating hold magnet operated, and provides direct ground to the Busy Tone Trunk hold magnet HM in the link circuit.
1.2 Voltage	2	
2. FUNCTIONS	2	Relay RA is made slow to release to prevent the release of the connection should the calling station continue to dial. This release could occur if the calling station dialed a 2-way dial repeating tie trunk and assumed it was idle and, without listening for the dial tone, continued to dial. Since the RA is slow to release the station would only pulse the A relay.
3. CONNECTING CIRCUITS	2	The tone generator in the power supply circuit supplies busy tone over lead BT to condenser A of this trunk. Busy tone is passed through this condenser to the ring conductor of the trunk.
4. MANUFACTURING TEST INFORMATION	2	
5. TAKING EQUIPMENT OUT OF SERVICE	2	2. RELEASE OF BUSY TONE TRUNK
		When the calling station line or trunk disconnects in response to the busy tone signal, the originating station loop or trunk bridge is opened and relay A releases. Relay A releasing causes relay RA to release which removes the locking ground from

the link sleeve to release the calling line hold magnet and removes ground from the Busy Tone Trunk magnet restoring the circuit to normal.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.1 Maximum external circuit loop is 2370 ohms.

1.2 Voltage limits are 45 to 52 volts.

2. FUNCTIONS

2.1 To respond to a seizure and provide a holding ground for the calling station or trunk hold magnet and the Busy Tone Trunk hold magnet.

2.2 To return Busy Tone to the calling station or trunk.

2.3 To release the calling station line or trunk line hold magnet and Busy Tone Trunk hold magnet when the calling line or trunk disconnects, and to return to normal.

3. CONNECTING CIRCUITS

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

3.1 Marker Circuit - SD-69468-01.

3.2 Line, Link, and Connector Circuit - SD-69469-01.

4. MANUFACTURING TEST INFORMATION

4.1 The Busy Tone Trunk shall be capable of performing all the functions specified in this circuit description and meeting all the requirements of the Circuit Requirements table.

5. TAKING EQUIPMENT OUT OF SERVICE

5.1 In order to take the Busy Tone Trunk out of service it is necessary to ground the HM lead toward the marker circuit. The following procedure shall be followed. Verify that no select magnet is operated than block relay RA operated.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5332-PB-HFH-LF

STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
KEY TELEPHONE LINE AND  
ADD-ON CIRCUITCHANGESD. Description of Changes

- D.1 On sheet 1, the sheet index is brought up to date.
- D.2 On sheet 2, circuit notes 102, 104, equipment note 202 and information note 305 are corrected.
- D.3 On sheet 5 App. Fig. 7 M designation changed to M or MB.
- D.4 On sheets 8 and 9, ratings on CAD's 1, 2, 6 and 7 are changed from "Mfr. Disc." to A&M Only.
- D.5 On sheet 13, CAD 12, leads 1U and 1L to relay MB are reversed.
- D.6 On sheet 14, CAD 14, leads S and S1 designations are assigned to leads from relays MB.
- D.7 Above changes (D.2-D.6) are made on a class D - No Record basis per agreement with WECo.
- D.8 On sheet 2, Information Note 308 is added.
- D.9 On sheet 11, cross-reference information is added to CAD 9.
- D.10 On sheet 12, option 7 on CAD 10 and sheet note 1 are added.
- D.11 On sheet 13, cross-reference information is added on CAD 12.
- D.12 On new sheet 15, CAD 15 is added for installer information.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECo 2120HW-RHO-WHK)  
DEPT 5337-LAH



STATION SYSTEMS  
SWITCHING SYSTEM NO. 400  
CABLING DIAGRAM

CHANGES

D. Description of Changes

- D.1 All changes are made on a Class D - No Record basis per agreement with WECo.
- D.2 On sheet 2, Note 306 is revised and Notes 204 and 307 are added.
- D.3 On sheet 5, App. Fig. 6 was part of App. Fig. 5 and App. Fig. 7 is added.
- D.4 On sheets 4, 9 and 10 drafting errors are corrected.
- D.5 On sheet 8, CAD's 1 and 2 are rated "Mfr Disc".
- D.6 On sheet 9, CAD's 6 and 7 are rated "Mfr Disc".
- D.7 On sheet 10, G-G1 cross-connect information is removed.
- D.8 CAD's 8 through 13 are revised.
- D.9 CAD 14 is added for station make busy cross-connect information.
- D.10 Sheets 13 and 14 are added.

BELL TELEPHONE LABORATORIES, INCORPORATED

(WECo 7120HW-RHO-JGW)  
DEPT 5337-LAH



STATION SYSTEMS  
 SWITCHING SYSTEM NO. 400  
 KEY TELEPHONE LINE AND  
 ADD-ON CIRCUIT

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<u>SECTION I - GENERAL DESCRIPTION.</u>	1	<u>1. PURPOSE OF CIRCUIT</u>
1. <u>PURPOSE OF CIRCUIT.</u>	1	1.01 This add-on circuit with two line circuits provides a means of connecting a central office line to a local station at a key telephone set where the central office line appears.
2. <u>GENERAL METHOD OF OPERATION.</u>	1	1.02 Line circuits not required for association with add-on circuits can be used as part of a 1A1 key telephone system installation.
<u>SECTION II - DETAILED DESCRIPTION</u>	1	<u>2. GENERAL METHOD OF OPERATION</u>
1. <u>INCOMING CENTRAL OFFICE OR STATION CALL TO KEY TELEPHONE SET</u>	1	2.01 An incoming call produces a 60-ipm flashing line lamp and audible signal at the key telephone set.
A. <u>Ring-Up Circuit.</u>	1	2.02 With the receiver off hook, operation of the pick-up key associated with the visual signal silences the audible signal and connects the key telephone station of the calling party. The line lamp is transferred from 60-ipm to steady.
B. <u>Answering an Incoming Call</u>	2	2.03 A line circuit may be placed on hold by the operation of the HOLD key on the key telephone set. The line lamp is transferred from steady to 120-ipm wink.
2. <u>OUTGOING CALL FROM A KEY TELEPHONE STATION</u>	2	2.04 A central office line and station line may be capacitive coupled via the add-on circuit by the operation of a transfer (TR) key on the key telephone set when one line circuit is on hold and ringing induction is heard or the called party has answered on the other line. A ringing local station is indicated by a 30-ipm flashing line lamp.
3. <u>HOLDING</u>	2	2.06 If an incoming call is not answered at a key telephone set, a time-out circuit will release the R relay in about 30 to 45 seconds. After time out, the R relay will follow incoming ringing.
A. <u>Key Telephone Station Holds Call</u>	2	<u>SECTION II - DETAILED DESCRIPTION</u>
B. <u>Release of Holding Bridge</u>	3	1. <u>INCOMING CENTRAL OFFICE OR STATION CALL TO KEY TELEPHONE SET</u>
4. <u>DISCONNECTION</u>	3	A. <u>Ring-Up Circuit</u>
5. <u>OPERATION OF THE ADD-ON CIRCUIT</u>	3	<u>Ground Ringing - V Option</u>
A. <u>Bridging the Station and Central Office Lines.</u>	3	1.01 Ringing current applied to the ring of the line flows through a break contact of relay AH, capacitor R, thermistor R and on one-half cycle through diode R to ground. The other half-cycle is blocked by diode R causing current to flow through the secondary of relay R to ground.
B. <u>Key Telephone Station Disconnects.</u>	4	
C. <u>Disconnection of Extended Call.</u>	4	
6. <u>TIME OUT</u>	5	
7. <u>MISCELLANEOUS</u>	5	
A. <u>Station Busy Lamp</u>	5	
B. <u>Station Make Busy</u>	5	
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1. <u>WORKING LIMITS</u>	5	
2. <u>FUNCTIONAL DESIGNATIONS</u>	5	
3. <u>FUNCTIONS.</u>	5	
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6. <u>MANUFACTURING TEST REQUIREMENTS</u>	6	
7. <u>ALARM INFORMATION</u>	6	
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A. <u>Changed and Added Functions.</u>	6	
B. <u>Changes in Apparatus</u>	6	
D. <u>Description of Changes</u>	6	

1.02 Contacts of relays A and AH shunt relay H and varistor H to bypass ringing current preventing the establishment of a false hold condition which might otherwise occur when a number of ringers are bridged across the station side of the line.

1.03 Thermistor R has a cold resistance of approximately 50,000 ohms to prevent false line signals from operating relay R. Ringing current heats thermistor R reducing its resistance to approximately 3,000 ohms in about 1/2 second. This permits a sufficient current flow to operate relay R on the half-wave rectified current.

1.04 Relay R operated:

- (a) Locks operated on its primary winding under control of relay AH and the time-out circuit.
- (b) Grounds lead TO starting time-out timing.
- (c) Connects 60-1pm lamp supply to flash line lamp.
- (d) Connects ringing supply to the common ringer of the key telephone set, if provided.

1.05 Varistor R1 protects diode R and thermistor R by providing a shunt path for transient currents.

Metallic Ringing - X Option

1.06 Operation of the circuit using metallic ringing return is the same as for grounded ringing except that ringing is returned to the tip of the line instead of to ground. This arrangement is designed to reduce noise due to cooling of thermistor R and/or potential differences.

B. Answering an Incoming Call

1.07 An incoming call is answered by operating the pickup key associated with the line being rung and removing the handset from its on-hook condition. The operated telephone switchhook and pickup key extends the A1 ground via lead A operating relay A.

1.08 Relay A operated:

- (a) Operates relay AH.
- (b) Transfers the line lamp from 60 ipm to steady.
- (c) Opens the operating path of relay H.
- (d) Prepares a path to operate relay W via lead SG if the line circuit is used as an add-on circuit adjunct.

1.09 Relay AH operated:

- (a) Disconnects the ring-up circuit from the ring of the line.
- (b) Releases relay R silencing audible ringing.
- (c) Grounds lead CO operating relay TO to stop time-out timing.
- (d) Prepares a path to transfer line lamp from steady to 120-1pm wink (H option).

1.10 With the handset off-hook and the pickup key operated, tip and ring connections between the key telephone station and the calling party are completed.

2. OUTGOING CALL FROM A KEY TELEPHONE STATION

2.01 Operation of a central office or station line pickup key and removing the handset from its on-hook condition extends the A1 ground to the associated line circuit via lead A operating relay A.

2.02 Relay A operated:

- (a) Operates relay AH.
- (b) Lights station line lamp steadily.
- (c) Opens the operating path of hold relay H.

2.03 Relay AH operated:

- (a) Operates relay TO preventing time-out timing.
- (b) Opens the operating and locking path of relay R.
- (c) Prepares a path to transfer line lamp from steady to 120-1pm wink.

2.04 With the handset off-hook, central office dial tone will be returned to the key telephone station with a central office line pickup key operated or switching system 400 dial tone with a station line pickup key operated.

3. HOLDING

A. Key Telephone Station Holds Call

3.01 An incoming or outgoing call may be held by operating the HOLD key in the telephone set. This removes the ground from lead A releasing relay A.

3.02 Relay A released:

- (a) Inserts relay H in the ring side of the loop causing it to operate on line current.
- (b) Removes battery from the slow releasing AH relay.



- (c) Transfers line lamp from steady to 120-1pm wink (H option).
  - (d) Opens lead SG to add-on circuit, if provided.
- 3.03 Relay H operated:
- (a) Reconnect battery to relay AH prior to its release.
  - (b) Places a holding bridge across the line.
- 3.04 Release of the HOLD key mechanically releases the operated pickup key. The key telephone station is disconnected from the held line.
- 3.05 Varistor H stabilizes the sensitivity of the H relay circuit when subjected to varying voltages.

B. Release of Holding Bridge

- 3.06 With the receiver off hook, re-operation of the line pickup key reoperates relay A.
- 3.07 Relay A operated:
- (a) Transfers line lamp from 120-1pm wink to steady.
  - (b) Removes relay H from the ring of the line releasing it.
- 3.08 Relay H released removes the holding bridge from the line restoring the talking path.

4. DISCONNECTION

- 4.01 When a key telephone station disconnects on an incoming or outgoing call, relay A releases releasing relay AH which restores the circuit to normal.

5. OPERATION OF THE ADD-ON CIRCUIT

- 5.01 A talking connection can be established between the central office and a local station by a key telephone station when the central office and station line circuits are used as add-on circuit adjuncts.
- 5.02 After placing the central office line (or station line) on hold and operating the pickup key of the associated station line (or central office line), the desired number is dialed. Transfer may be completed immediately upon hearing ringing induction or after the called station answers.

A. Bridging the Station and Central Office Lines

- 5.03 Operation of the transfer (TR) key on the key telephone set grounds lead SG operating relay W via lead SG1 (with relay A of the line circuit used for dialing operated). The operated TR key provides a shunting ground for relay Z upon the operation of relay W.

- 5.04 Relay W operated:
- (a) Locks operated on its secondary winding.
  - (b) Prepares its release path over the primary winding.
  - (c) Prepares an operating path for relay Z.
  - (d) Prepares a locking path for relay S1.
  - (e) Prepares a path to cut through the central office line tip and ring to the 1-2 winding of inductor TR upon the release of relay H (incoming).
  - (f) Cuts through the central office line tip and ring to the 1-2 winding of inductor TR and capacitors T and R (outgoing).
  - (g) Shunts central office line relay H releasing it (incoming).
  - (h) Transfers central office line lamp from 120-1pm wink to steady (incoming - option H).
  - (i) Provides an alternate lamp supply upon the release of central office line relay A (outgoing).
- 5.05 Central office line relay H released (incoming):
- (a) Releases relay AH.
  - (b) Removes the central office line holding bridge cutting through the tip and ring to inductor TR and capacitors T and R.
- 5.06 The release of key TR removes the shunting ground from relay Z via lead SG1 permitting its operation.
- 5.07 Relay Z operated:
- (a) Prepares a release path for relay W under control of the key telephone station.
  - (b) Cuts through the station line tip and ring to capacitors T and R (incoming).
  - (c) Prepares a path to cut through the station line tip and ring to capacitors T and R upon the release of relay H (outgoing).
  - (d) Shunts station line relay H releasing it (outgoing).
- 5.08 Station line relay H released (outgoing):
- (a) Releases relay AH.