

KS-21102 BUSINESS PHONE TRAINER

DESCRIPTION AND MAINTENANCE

1. GENERAL

1.01 This section covers the description and maintenance of the KS-21102 Business Phone Trainer.

1.02 The Business Phone Trainer was developed to simulate a standard Key Telephone System and is to be used in training people in the proper use of key telephones.

1.03 This issue of the section is based on the following drawing:

SD-69649-01, Issue 1.

If this section is to be used with equipment or apparatus reflecting later issue(s) of the drawing(s), reference should be made to the SDs and CDs to determine the extent of the changes and the manner in which the section may be affected.

1.04 The Business Phone Trainer provides the following:

- Communication between rotary dial and/or TOUCH-TONE® key telephone sets
- Two simulated central office or PBX lines
- Individual ringing at all key telephone sets
- Dial tone, busy tone, and ringback tone
- Visual supervisory lamp signals, steady lamp signals for talking and dialing, wink signals for hold, and flashing signals for incoming ringing
- Intercommunication with signal buttons and buzzers for interoffice use
- A loudspeaker with amplification for instructor use, or monitoring student usage for classroom demonstrations

- An output jack available for connecting to a public address or recording device.

1.05 The Business Phone Trainer is packaged in three carrying cases. One contains the control, logic circuits, and loudspeaker. The other two cases contain the key telephone sets, two per carrying case.

2. DESCRIPTION

2.01 The KS-21102 control and logic circuit consists of an interrupter, frequency generator, loudspeaker, power supply, and five plug in circuit boards assembled in a prewired carrier.

2.02 The KS-21102 control and logic circuit is shown in Fig. 1.

2.03 Power for operation is obtained from a 115-volt 60-Hz power source.

2.04 The KS-21101 carrying cases are shown in Fig. 2.

- Carrying cases are gray polyethylene-molded containers provided with special molded inserts.

- KS-21101, List 1 carrying case is molded to contain the control, logic, power cord, and loudspeaker units. See Fig. 3.

- KS-21101, List 2 carrying case is molded to contain two key telephone sets and extension cords. See Fig. 4.

2.05 The complete Business Phone Trainer is made available in two options.

- (a) KS-21102, List 1 Business Phone Trainer consists of:

- Control and logic units, loudspeaker, and power cord, housed in a KS-21101, List 1 carrying case

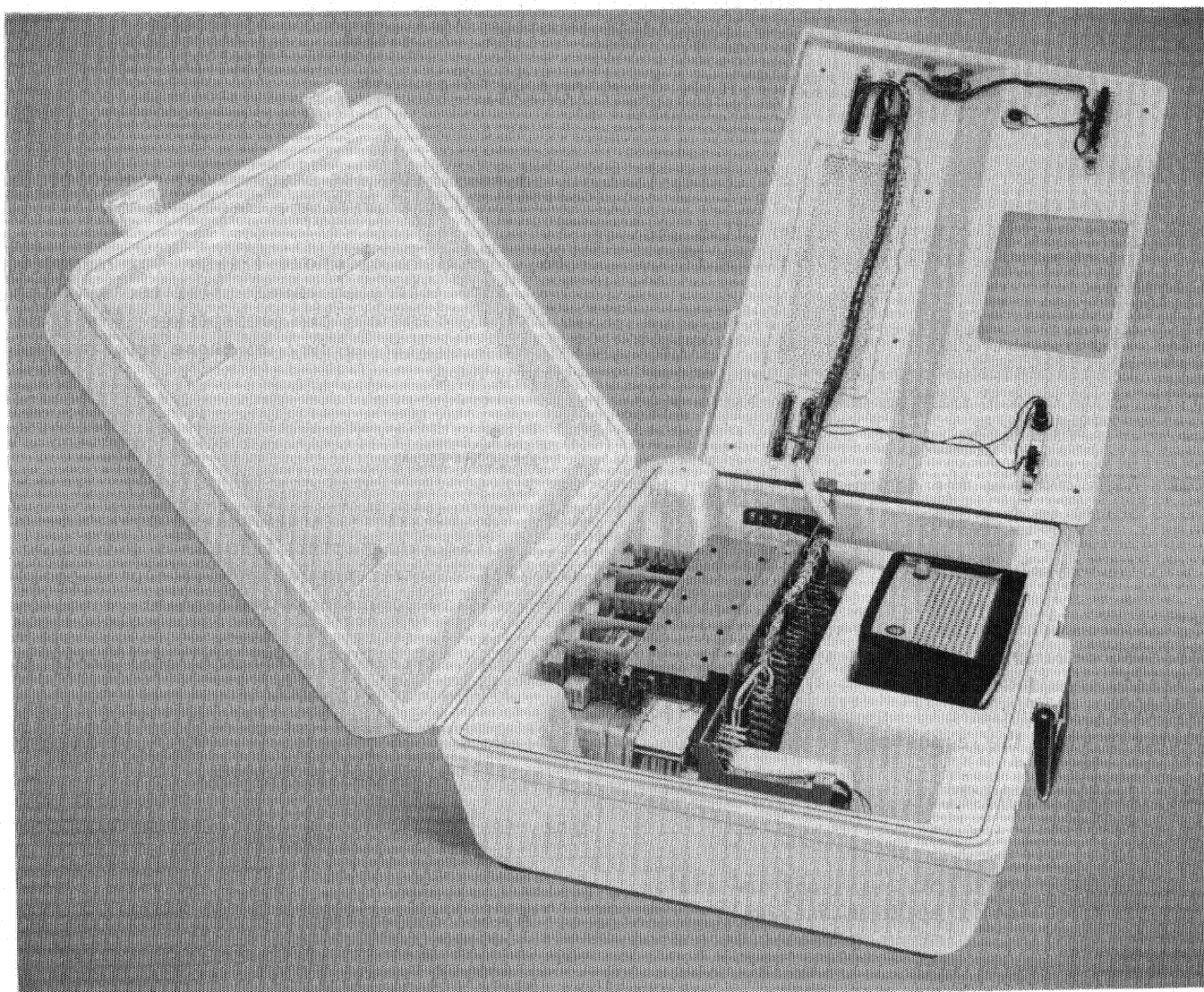


Fig. 1—KS-21102 Control and Logic Circuit With Loudspeaker (Shown Open for Clarity)

- Two modified 565HK-51, green rotary dial key telephone sets, equipped with a 25-foot extension cord, housed in a KS-21101, List 2 carrying case
- Two modified 565HK-53, red rotary dial key telephone sets, equipped with a 25-foot extension cord, housed in a KS-21101, List 2 carrying case.

(b) KS-21102, List 2 Business Phone Trainer consists of:

- Control and logic units, loudspeaker, and power cord, housed in a KS-21101, List 1 carrying case
- Two modified 565HK-51, green rotary dial key telephone sets, equipped with a 25-foot



Fig. 2—KS-21101 Carrying Cases

extension cord, housed in a KS-21101, List 2 carrying case

- Two modified 2565HK-53, red TOUCH-TONE key telephone sets, equipped with a 25-foot extension cord, housed in a KS-21101, List 2 carrying case.

3. OPERATION

3.01 The Business Phone Trainer provides control for four students. Telephone set 1 can be used to represent a secretary, with telephone set 2 being the boss or employer. Telephone set 3, student 3, represents an outside station which could call or be called by sets 1 and 2. Telephone set 4, student 4, could also be representative of another outside location. Telephone set 4 is also used by the instructor and the set is provided a special access to the intercom to monitor or use for announcements. Each telephone is individually

identified by a set number located in the number plate holder of the dial. The telephone set cord should be plugged into the jack connector on the control unit corresponding to that telephone set number to function properly.

3.02 The loudspeaker is used to monitor the audible signals and answering techniques of the students. Monitoring of one or more telephone talking circuits is selected by the loudspeaker selection switch.

3.03 The KS-21102 Business Phone Trainer assembled for operation is shown in Fig. 5.

3.04 Five of the six keys on the telephones are used. The red key on the left is the hold key. The pickup keys number one through five to the right of the hold key. The first pickup key is the line 1 key; the seven digit telephone number assigned is printed in the designation strip above



Fig. 3—KS-21101, List 1 Carrying Case (With Control Unit Mounted)

the key. The second pickup key is the line 2 key; the seven digit telephone number assigned is printed in the designation strip above the key. The third pickup key is the intercom line, designated ICM and appears at telephone sets 1, 2, and 4. The fourth pickup key is converted to a nonlocking signal key, designated SIG and operates at telephone sets 1 and 2 only. The fifth pickup key is not used.

3.05 All telephone sets are wired alike to permit the exchange of rotary dial and TOUCH-TONE for training.

3.06 The key modifications of the four sets are identical.

3.07 The wiring at each of the four telephone set jack connectors J1 thru J4 in the control and logic unit determines the functions of the four telephone sets. See Fig. 8 and 9.

3.08 The intercommunication (INTERCOM) circuit, along with lamp signals and buzzers, operates between student 1 and 2 (telephone sets 1 and 2). The intercom circuit is available to the instructor on telephone set 4 along with the busy lamp signal,



Fig. 4—KS-21101, List 2 Carrying Case (With Sets)

but the buzzer and signal key functions are not available at that position.

3.09 All standard basic audible and visual key telephone signals are provided for both lines 1 and 2 which simulate two central office or PBX lines.

3.10 The Business Phone Trainer is designed to simulate key telephone service in its *method* of operation.



The circuit operation (dialing, ringing, audible tones, and talking paths) is unique, and is not encountered with Key Telephone Systems.

3.11 Dialing, ringing, and talk paths to the called telephone set and which line the ringer of the called telephone is bridged across are determined by the calling telephone set (station 1 thru 4), line (1 or 2). Four telephone sets, each simulating an individual station, share the two common lines. See Fig. 13 for ringer terminations and ringing circuits.



Fig. 5—KS-21102 Business Phone Trainer Assembled for Operation

Note: The ringer for telephone set 1 is connected directly to line 2, and bridged to line 1 by a diode. The ringers for telephone sets 2 and 3 ring on line 1, and telephone set 4 rings on line 2.

Example 1: Telephone sets 1 and 2 can dial (seven digits) on line 1 and cause set 3 to ring. Dialing on line 2 will cause set 4 to ring. A talking path will be established when the called telephone answers. See Fig. 12 for ringing and talking paths between telephone sets 1 and 3.

Example 2: Both telephone set 3 (student 3) and telephone set 4 (student 4) can dial

telephone set 1 (secretary) on line 2 and be answered by set 1. When telephone set 3 or set 4 dials telephone set 2 (boss) on line 1, both set 1 and set 2 will ring (diode bridge) and can be answered at either set.

Note: Telephone sets 1 and 2 cannot dial each other nor can telephone sets 3 or 4 dial each other. However, telephone sets 1 and 2 can signal each other, and talk on the intercom line.

3.12 Ringing is accompanied by flashing lamp indications. Both lines may ring independently or simultaneously and ringing is initiated as soon

as seven digits (any seven numbers) have been dialed.

3.13 Both lines can be put on hold by any one of the four telephone sets. The line key will release and the steady lamp signal will be changed to a winking signal.

4. INSTALLATION AND MAINTENANCE

4.01 In order to simplify the design of the control and logic circuits, standard telephone transmission parameters are not followed, and the telephone set circuits are modified accordingly. For example, the tip side of the line, generally considered as a part of the transmission path, is used for dialing only.

4.02 Modified key telephone sets are illustrated in Fig. 6 for the 565HK and Fig. 7 for the 2565HK telephone sets. Modifications are necessary if maintenance replacements are made. These changes are shown on Table A.

4.03 To aid in the sectionalization of faults or trouble that may occur, simplified schematics representing operating functions and wiring are illustrated in Fig. 8 through 15 and a circuit description is presented.

5. CIRCUIT DESCRIPTION

5.01 The operation of the power switch to the ON position energizes the power supply for the DC supply, AC supply, frequency generator, and interrupter.

5.02 The "B" battery supply is a conventional full-wave rectifier providing voltage for relay operation and the loudspeaker. The circuit is protected by the F2 fuse.

5.03 The "A" battery supply is derived from the "B" battery supply through additional filtering providing a smooth DC for talk battery. The circuit is protected by the F2 fuse.

5.04 The 10-volt AC lamp supply is derived from the T1 transformer and overload protected by fuse F3.

5.05 The frequency generator is supplied directly from the AC power source through the line fuse and OFF and ON switch. It supplies:

- A 30-Hz sine wave ringing signal
- A reasonable simulation of dial tone for lines 1 and 2
- Ringback tone
- Busy tone.

5.06 AC and DC power distribution jack appearances are shown on Fig. 10.

Line Seizure

5.07 The L (A or B) relays control the associated busy lamps, busy tone, talk battery, and inhibit other L relays, enable and reset the counter circuit, open the ringer circuit, and control the hold circuit. The LA relay is controlled by telephone sets 1 and 2 and the LB relay by telephone sets 3 and 4. The first CP3(1) is associated with line 1 and the second CP3(2) is associated with line 2. A condensed functional schematic of line seizure with simulated visual and audible signals is shown on Fig. 11.

5.08 When either student 1 or 2 goes off-hook on line 1, the LA relay operates and:

- Lights steady the line 1 busy lamp on telephone sets 1 and 2
- Inhibits the LB relay
- Enables the line 1 counter circuit
- Enables the line 1 hold circuit for telephone sets 1 and 2
- Provides dial tone
- Connects talk battery to line 1.

5.09 When either student 3 or 4 goes off-hook on line 1, the LB relay operates and:

- Lights steady the line 1 busy lamp on telephone sets 3 and 4
- Inhibits the LA relay

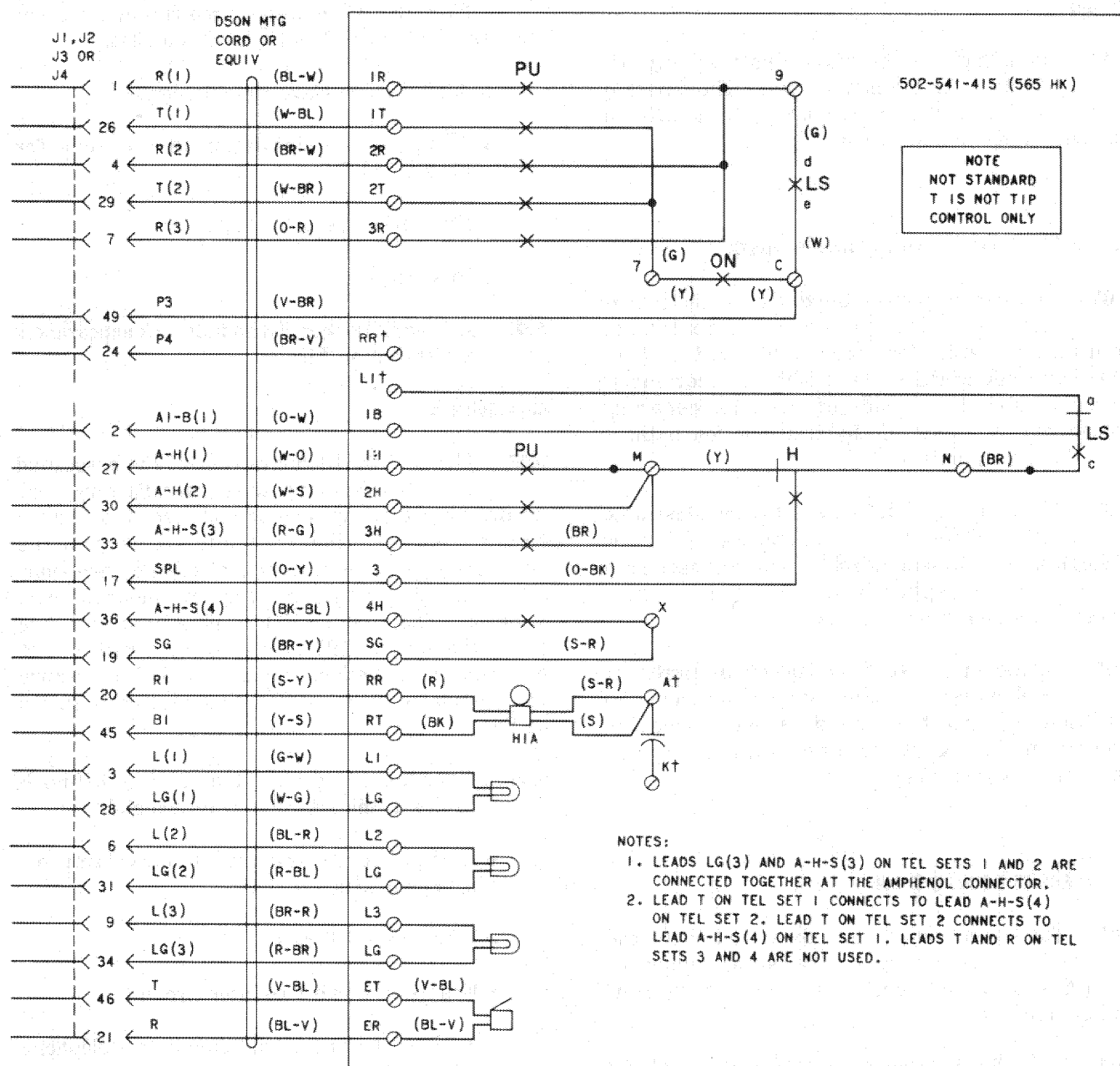


Fig. 6—Modified 565HK Telephone Set

- Enables the line 1 counter circuit
- Enables the line 1 hold circuit for telephone sets 3 and 4
- Provides dial tone
- Connects talk battery to line 1.

- 5.10** The LA and LB relays on the second CP3(2) perform the same functions for line 2.
- 5.11** The HA and HB relays on the first CP3(1) make up the hold circuit for line 1 and the HA and HB on the second CP3(2) make up the hold circuit for line 2. The HA relay is operated by the hold key of telephone sets 1 and 2 and

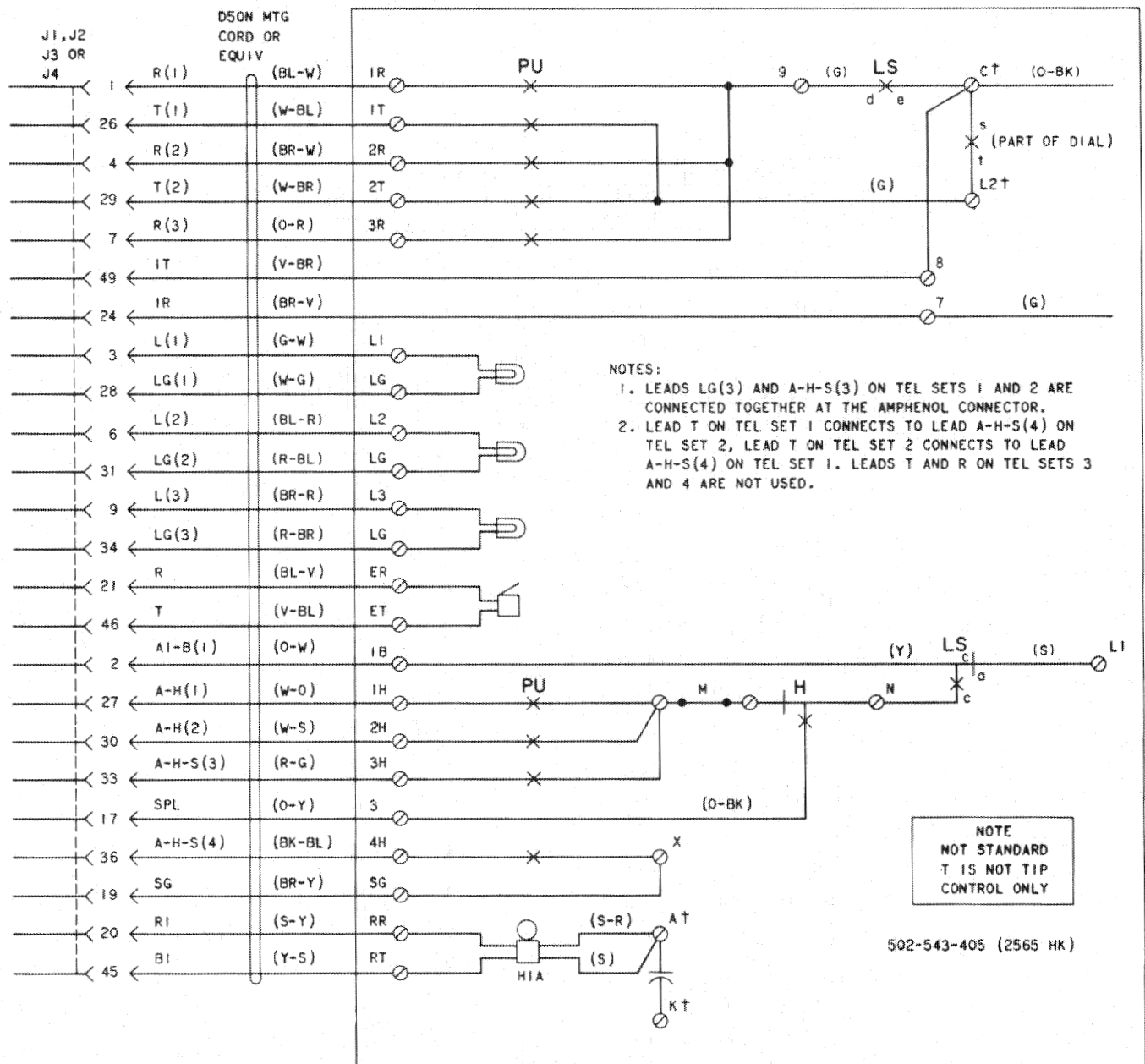


Fig. 7—Modified 2565HK Telephone Set

the HB relay is operated by the hold key of telephone sets 3 and 4.

5.12 When the LA relay is operated and the hold key on telephone set 1 or 2 is momentarily depressed:

- The associated line pickup key releases.

- HA relay operates.
- LA relay releases.
- HA relay locks.

5.13 Diode CR1 across the coil of the LA relay prevents a race condition by slowing down

JACK CONNECTOR NO. 1			JACK CONNECTOR NO. 2		
TELEPHONE SET 1	PIN NO.	CONNECTING EQUIPMENT	TELEPHONE SET 2	PIN NO.	CONNECTING EQUIPMENT
R (1)	1	J9-36	R (1)	1	J9-37
T (1)	26	J2-26	T (1)	26	J3-26 J1-26
R (2)	4	J9-33	R (2)	4	J9-32
T (2)	29	J2-29	T (2)	29	J3-29 J1-29
R (3)	7	J9-29	R (3)	7	J9-28
P4 OR IR	24	J5-21	P4 OR IR	24	J5-21
P3 OR IT	49	SW2-1	P3 OR IT	49	SW2-2
A1-B (1)	2	J2-2	A1-B (1)	2	J1-2 J3-2
A-H (1)	27	J6-26	A-H (1)	27	J6-26
A-H (2)	30	J8-26	A-H (2)	30	J8-26
A-H-S (3)	33	J2-33 J1-34	A-H-S (3)	33	J1-33 J2-34
SPL	17	J6-20	SPL	17	J8-20
A-H-S (4)	36	J2-46	A-H-S (4)	36	J1-46
SG	19	J1-28	SG	19	J3-31 J2-28
RI	20	J9-12 J8-28	RI	20	J9-13 J6-28
BI	45	J2-45	BI	45	J1-45 J3-45
L (1)	3	J6-25	L (1)	3	J6-25
LG (1)	28	J1-19 J2-28 J1-31	LG (1)	28	J2-19 J1-28 J2-31
L (2)	6	J8-25	L (2)	6	J8-25
LG (2)	31	J1-28	LG (2)	31	J2-28
L (3)	9	J2-9 J1-21	L (3)	9	J1-9 J2-21 J4-9
LG 3	34	J1-33	LG (3)	34	J2-33 J4-34
T	46	J2-26	T	46	J1-36
R	21	J1-9 J2-21	R	21	J2-9 J1-21

Fig. 8—Jack Connector Wiring 1 and 2—Telephone Sets 1 and 2

JACK CONNECTOR NO. 3			JACK CONNECTOR NO. 4		
TELEPHONE SET 3	PIN NO.	CONNECTING EQUIPMENT	TELEPHONE SET 4	PIN NO.	CONNECTING EQUIPMENT
R (1)	1	J9-31	R (1)	1	J9-38
T (1)	26	J4-26 J2-26	T (1)	26	J5-1 J3-26
R (2)	4	J9-34	R (2)	4	J9-35
T (2)	29	J4-29 J2-29	T (2)	29	J7-1 J3-29
P4 OR IR	24	J5-20	R (3)	7	J9-30
A1-B (1)	2	J2-2 J4-2	P4 OR IR	24	J5-20
A-H (1)	27	J6-34	P3 OR IT	49	SW2-4
A-H (2)	30	J8-34	A1-B (1)	2	J3-2 J5-29
SPL	17	J8-14	A-H (1)	27	J6-34
RI	20	J6-27	A-H (2)	30	J8-34
BI	45	J2-45 J4-45	SPL	17	J6-14
L (1)	3	J6-35	RI	20	J8-27
LG (1)	28	J4-28 J3-31	BI	45	J3-45 J5-30
L (2)	6	J8-35	L (1)	3	J6-35
LG (2)	31	J3-28 J2-19	LG (1)	28	J3-28 J4-31
			L (2)	6	J8-35
			LG (2)	31	J4-28 J3-31
			L (3)	9	J2-9 J10-10
			LG (3)	34	J2-34

Fig. 9—Jack Connector Wiring 3 and 4—Telephone Sets 3 and 4

the release of the LA relay. This insures operation of relay HA before relay LA releases.

5.14 The operated HA relay:

- Inhibits the LB relay
- Provides a partial operating path for the LA relay
- Provides a winking lamp for line 1 at telephone sets 1 and 2
- Opens the busy tone circuit to line 1.

5.15 When the line 1 pickup key is reoperated, the LA relay reoperates, locks up through its own contact, and releases the HA relay.

5.16 When the LB relay is operated and the hold key on either telephone set 3 or 4 is momentarily depressed:

- The associated line pickup key releases.
- The HB relay operates.
- The LB relay releases.
- The HB relay locks up.

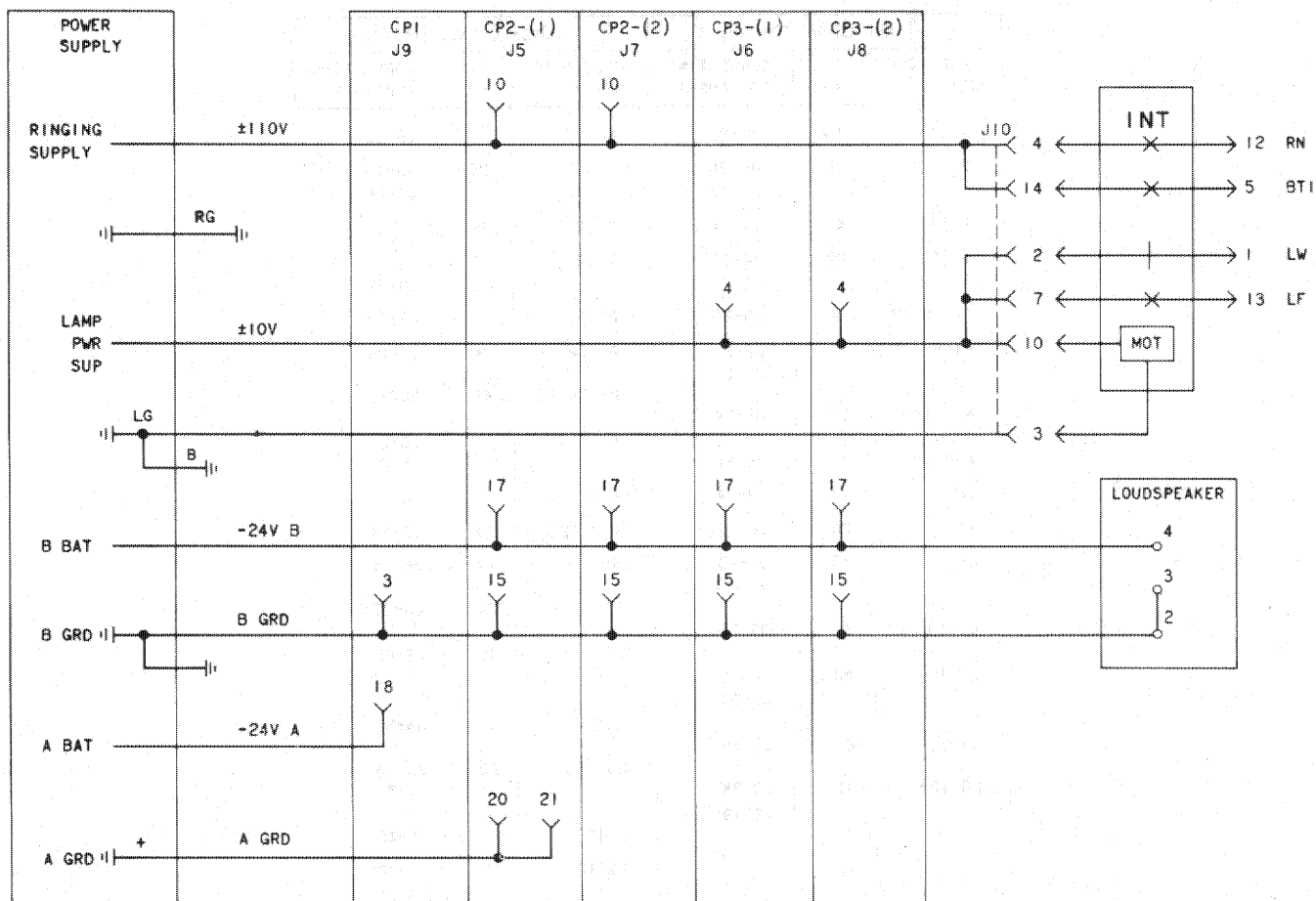


Fig. 10—AC and DC Power Distribution—Jack Appearances

5.17 Diode CR2 across the coil of the LB relay prevents a race condition by slowing down the release of the LB relay. This insures the operation of the HB relay before the LB relay releases.

5.18 The operated HB relay:

- Inhibits the LA relay
- Provides a partial operating path for the LB relay
- Provides a winking lamp for line 1 at telephone sets 3 and 4
- Opens the busy tone circuit to line 1.

5.19 When the line 1 pickup key is reoperated, the LB relay reoperates, locks up through its own contacts, and releases the HB relay.

5.20 The HA and HB relays on the second CP3(2) form the same functions for line 2.

5.21 If telephone sets 1 or 2 attempt to initiate a call and the line is in use by either telephone set 3 or 4, the LA relay could not operate. This provides a path from the busy tone supply to the telephone set attempting to make a call. If telephone set 1 or 2 were in the act of dialing and either telephone set 3 or 4 tried to initiate a call, the LB relay could not operate and busy tone would be received by set 3 or 4.

Dialing

5.22 A functional schematic of the dialing circuit, ringing circuit, and transmission path between the calling and called telephone sets is shown in Fig. 12.

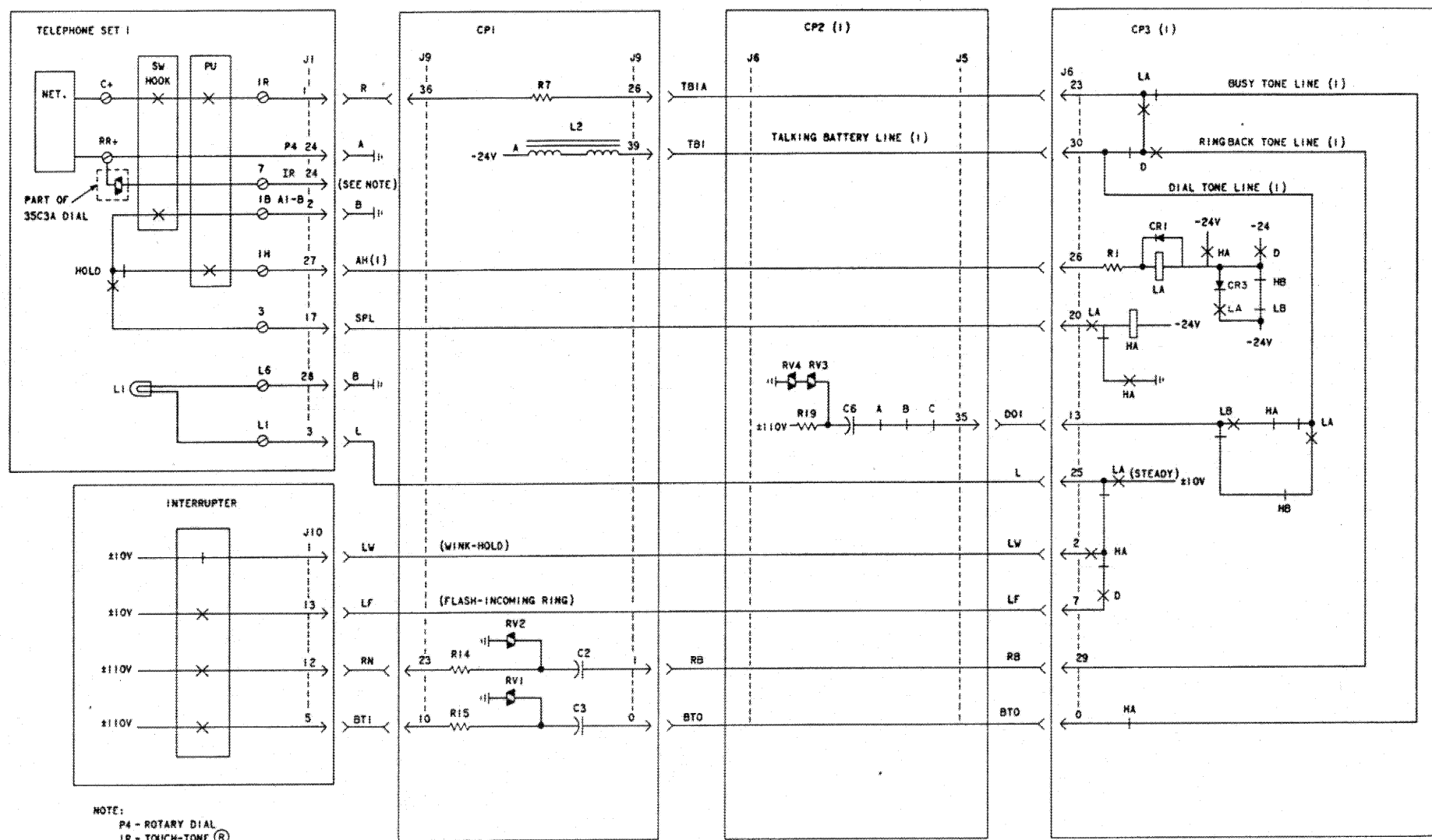


Fig. 11—Condensed Functional Schematic of Line Seizure With Simulated Visual and Audible Signals

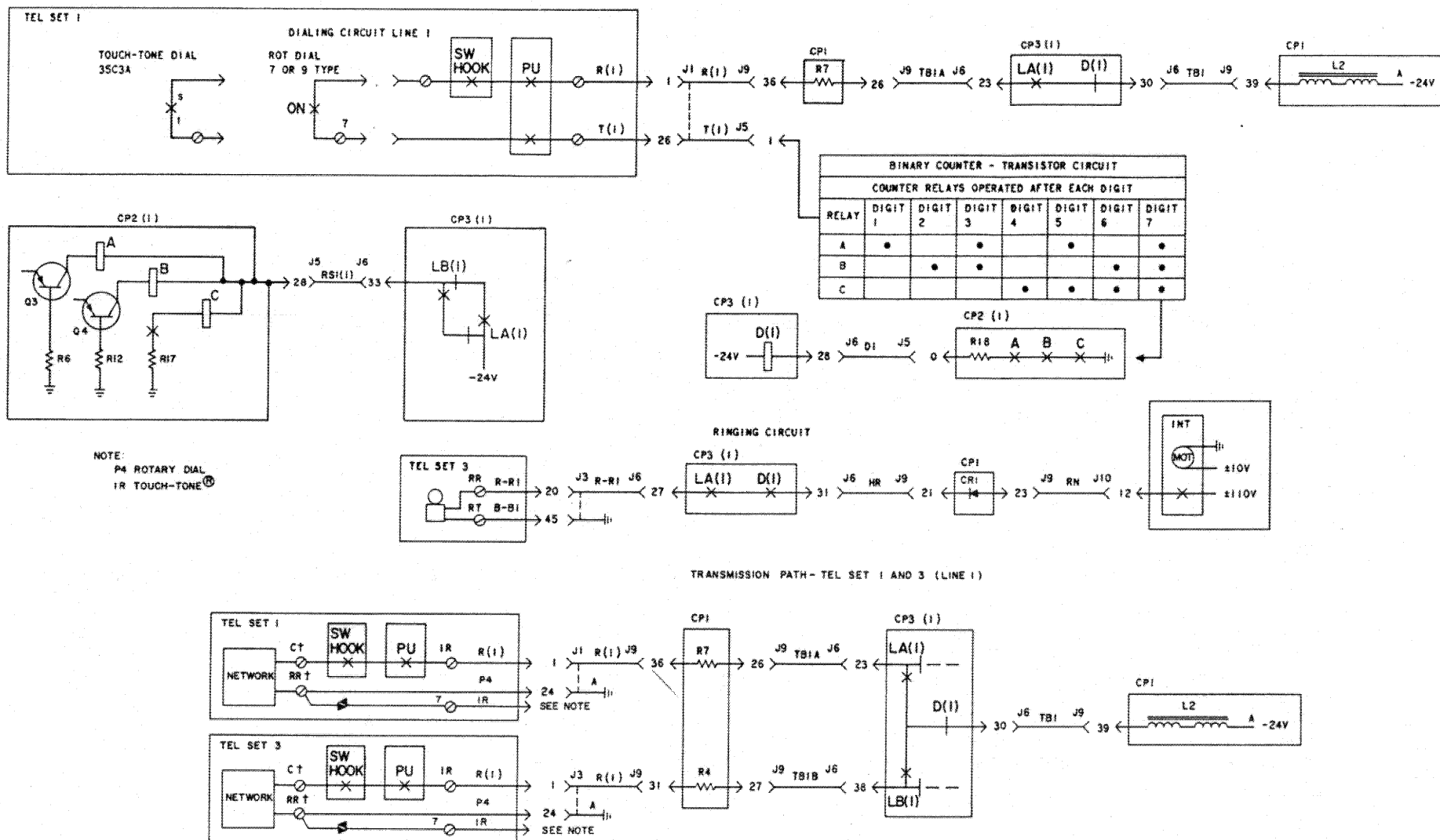


Fig. 12—Condensed Functional Schematic of the Dialing Cycle and Transmission Path Between the Calling and Called Telephone Sets

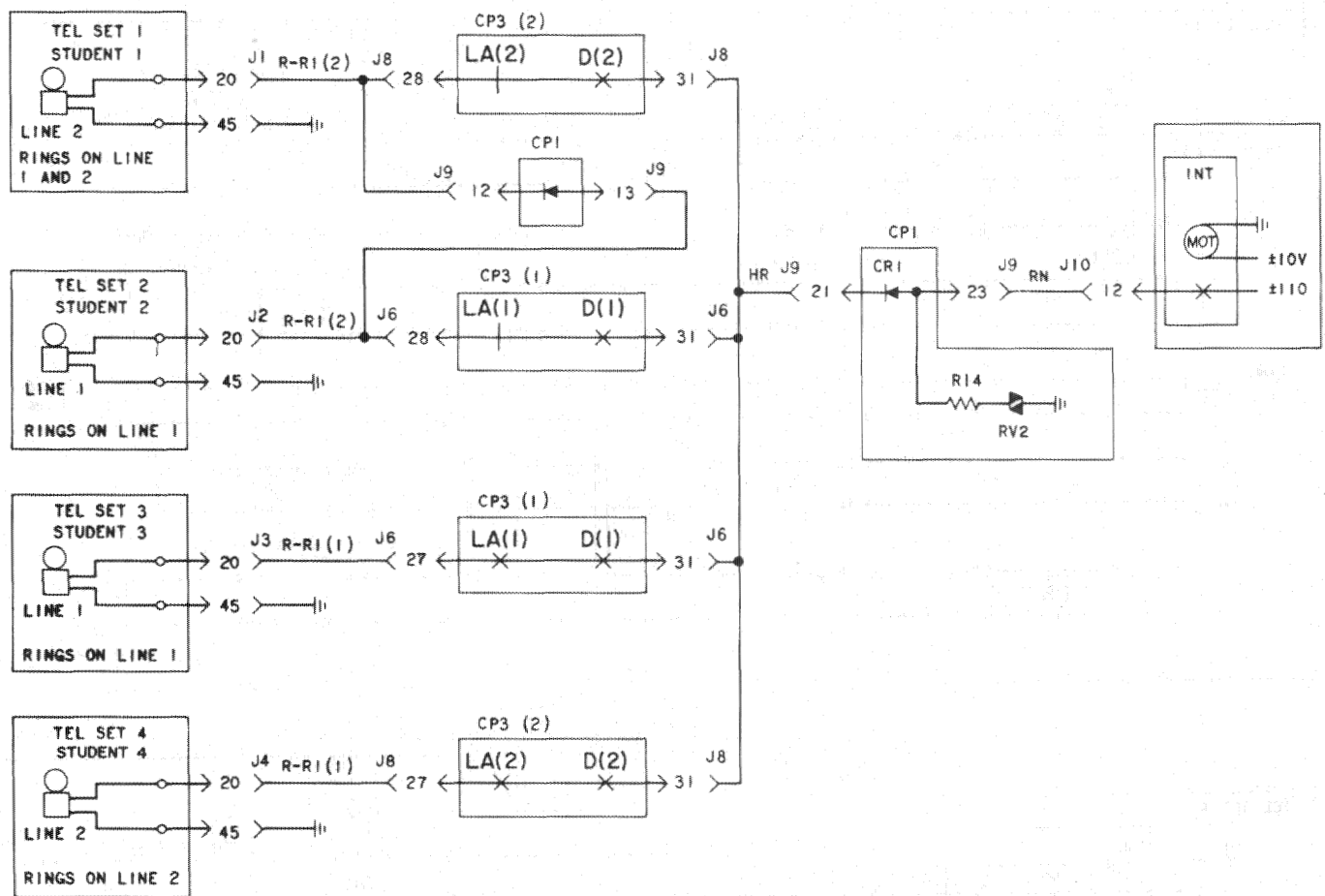


Fig. 13—Dialing and Ringing Combinations Possible Between Telephone Sets 1, 2, 3, and 4

5.23 The dialing circuit consists of a transistor circuit which is a binary counter and will operate or release a combination of three relays until seven digits have been dialed.

5.24 In the idle condition the RS1 CP3(1) (line 1) and RS2 CP3(2) (line 2) are open; in the seized condition, these leads are controlled by the LA or LB relays in CP3(1) or CP3(2). The RS1 or RS2 provides the operate path for the A, B, and C relays in CP2(1) (line 1) or CP2(2) (line 2).

5.25 There are two CP2 (1 and 2) counter circuits; each is associated with a CP3. The input to each counter is determined by the line 1 or 2 pickup key at each telephone set. All four telephone sets have access determined by the respective operated LA or LB relays.

5.26 The binary counter circuit counts only digits, not pulses. The dials are arranged to close a path when off-normal, from the talk battery supply to the input of the counter circuit. Operation of counter circuit is as follows:

- On the first digit, the A relay operates and holds through its own contacts.
- On the second digit, the A relay releases and the B relay operates and holds through its own contacts.
- On the third digit, the A relay reoperates.
- On the fourth digit, the A relay releases, the B relay releases, and the C relay operates and locks operated through its contacts.
- On the fifth digit, the A relay reoperates.

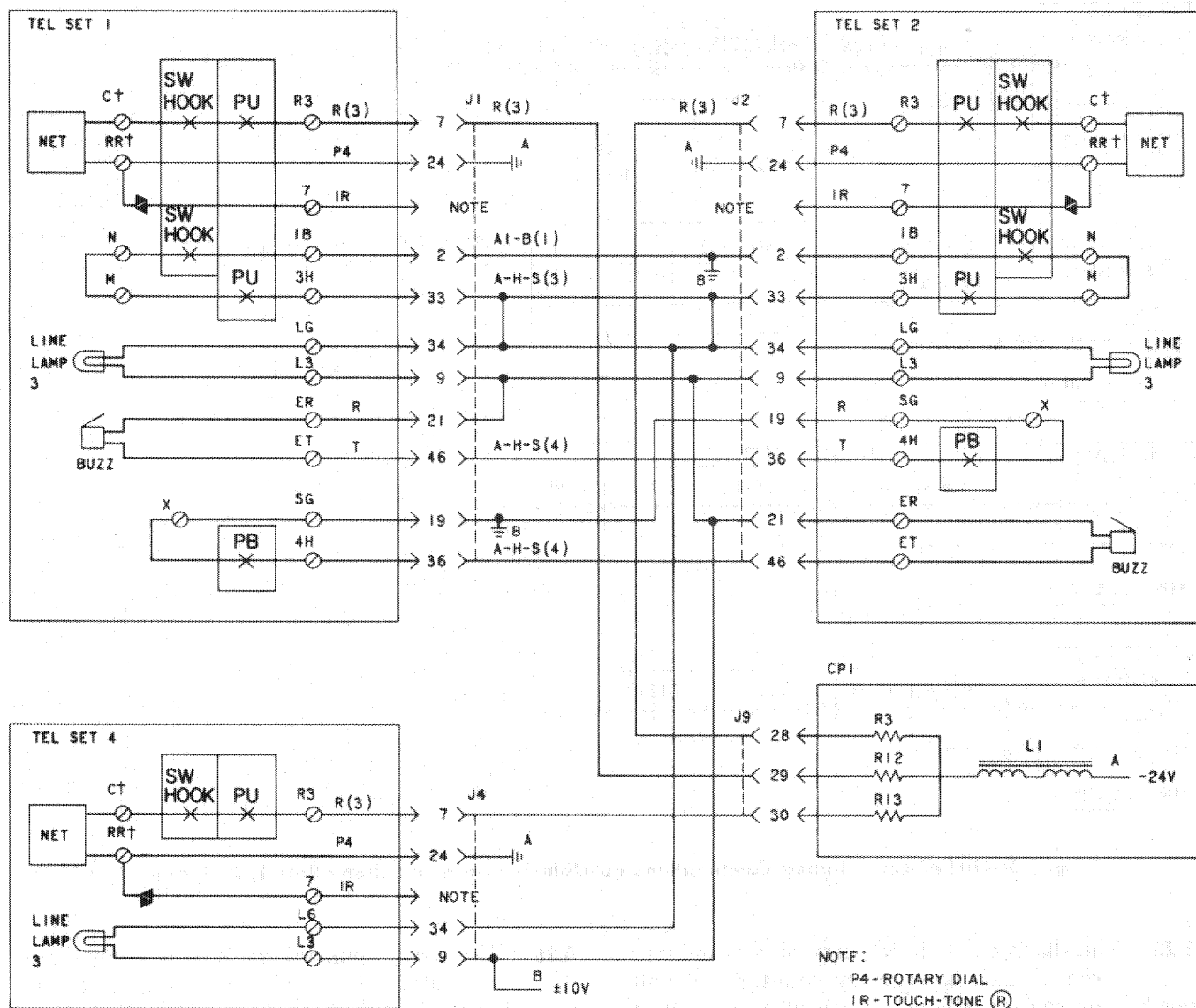


Fig. 14—Condensed Functional Schematic of the Intercommunication Circuit and Signal Arrangement Between Telephone Sets 1, 2, and 4

- On the sixth digit, the A relay releases and the B relay operates and locks operated through its contacts.
- On the seventh digit, the A relay reoperates and locks through its contacts.

At this point, relays A, B, and C are now operated via the RS1 or RS2 lead through either an operated LA or LB relay contact (Fig. 12).

Ringling

5.27 The D relay on the first CP3 operates whenever the line 1 CP2 counter circuit has counted seven digits. The operated A, B, and C relays provide the operate path for the D relay. A, B, and C relays will remain operated until the called party answers or the call is abandoned. The D relay closes the ringing current to telephone sets 2 and 3 and ringback tone to 1 and 4. See

Fig. 11 for the functional circuit of the ringback tone.

5.28 When the called telephone answers, the off-hook condition operates either the LA or LB relay as determined by the telephone set.

- The operate path for the A, B, and C relays is the RS1 or RS2 leads controlled by the LA and LB relays. With both the LA and LB relays operated, the D relay releases.
- The release of the D relay removes ringing current.
- The operated LA and LB relays connect the telephone sets to the talk battery supplied for line 1 or 2 through the resistor associated with indicators L2 and L3.

5.29 The ringing paths are shown on Fig. 13.

Intercom

5.30 The intercom circuit and signals are illustrated on Fig. 14.

5.31 Telephone sets 1 and 2 are interconnected for the intercom circuit. The intercom circuit

is also extended to the instructor telephone, set 4.

5.32 Telephone sets 1 and 2 can signal each other through nonlocking signal keys and buzzers via the A-H-S(4) and T and R leads.

5.33 The signal lamps at telephone sets 1, 2, and 4 are controlled by the pickup keys and the A-H-S(3) lead.

5.34 Talk battery is supplied through indicator L1 and distributed through resistors to the line 3 pickup key.

Monitoring

5.35 The audible signals and voice transmission can be monitored by the 107A loudspeaker unit and/or a tape recorder or public address system. A 3-position switch is used to connect the input of the loudspeaker or recorder to the talking circuit (Ring) of telephone sets 1, 2, or 4 via the P3 or 1T leads. The loudspeaker is controlled by its own off-on volume control. It is possible to monitor telephone sets 1 and 2 by depressing both set 1 and 2 loudspeaker selection keys.

5.36 The monitor circuit is illustrated on Fig. 15.

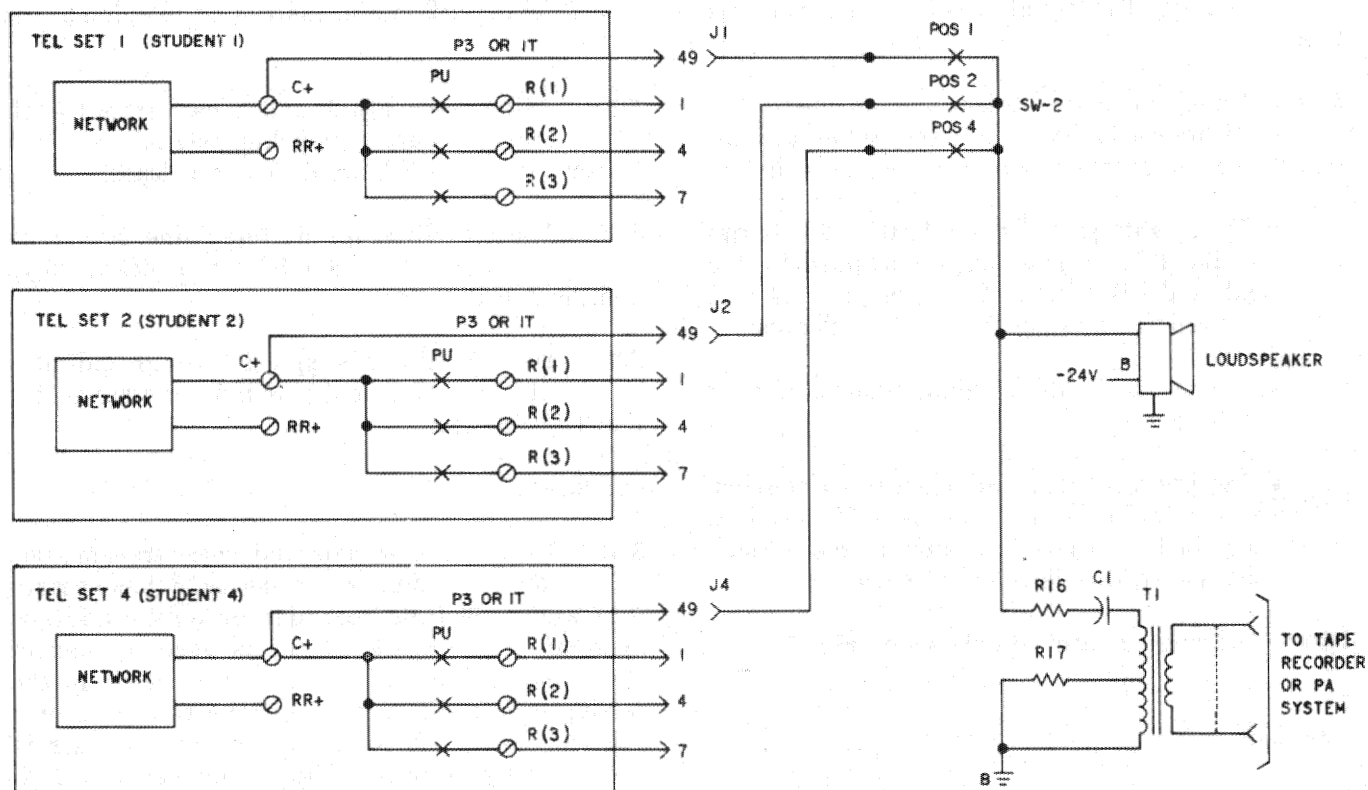


Fig. 15—Monitor Circuit—Telephone Sets 1, 2, and 4

TABLE A
TELEPHONE SET MODIFICATIONS

565HK				2565HK			
TERMINATION	COLOR	FROM	TO	TERMINATION	COLOR	FROM	TO
Pickup Key	G	F+	7	Dial	V	7	L2+
Cord	BR-V	7	RR+	Dial	G	L2+	7
Cord	V-BR	8	C+	Cord	V-BR	8	C+
Dial	Y	8	C+	Hold Key	O-BK	N	3
Hold Key	O-BK	N	3	Signal Key	S-R	M	SG
Signal Key	S-R	M	SG	Ringer Cap	S	K+	A+
Ringer Cap	S	K+	A+	Pickup Key 5	BR-BK	X	5H
Pickup Key 5	BR-BK	X	5H				

Note: All convertible key positions are supplied as pickup keys. To convert from pickup (locking) to signaling (nonlocking), remove the P-12A892 screw detail from key position involved.