

BELL SYSTEM PRACTICES
Installation and Maintenance

SECTION C53.154
Issue 3, Nov., 1954
AT&T Co Provisional

KEY TELEPHONE SYSTEM 1A

MAINTENANCE

1. GENERAL

1.01 This section provides certain information (including an index and drawings) to assist in the maintenance of **key telephone units**, as they are more commonly employed in providing the various service features at 1A key telephone system installations.

1.02 Maintenance of telephone sets, keys, buzzers, power equipment, etc., used in this system is covered by other C sections pertaining directly to these various apparatus items.

1.03 Due to extensive revision, arrows indicating changes have been omitted.

2. TESTING AND ADJUSTMENT OF RELAYS

2.01 Relays shall be tested and adjusted in accordance with information contained in B460 sections to meet the readjust values given in the circuit requirement tables contained in the various SD drawings covering this system.

3. MODIFICATIONS

Thermistors and Varistors Used in Ringing Circuits

3.01 At the time thermistors and varistors are in a low resistance condition due to application of ringing current, high voltage surges may occur, severely damaging these devices. When this condition is found on **any** line in a system, **each** line in the system should be equipped with a 317A varistor, connected as shown in the various drawings included in this section or as shown on appropriate SD drawings. 317A varistors may be added to 50-type KTUs or, if system employs bent angle-type KTUs, 15A, B, or C KTUs may be replaced by 15D KTUs which are equipped with a 317A varistor.

Noise Suppression

3.02 At certain installations, objectionable noise (sometimes referred to as longitudinal noise) may be heard immediately upon answering an incoming call. Generally, this is a temporary line unbalance to ground situation, and applicable procedures for correcting this condition are authorized on page 29 of this section.

3.03 Battery feed filtering (or suppression) of objectionable noise on talking paths of intercom line circuits is discussed on page 9 and subject matter cross referenced and noted in the index below.

4. DRAWINGS

4.01 The drawings included in this section will assist in testing the more commonly found circuit arrangements of the 1A key telephone system. They should be used as a supplement to standard drawings and are not intended to replace them. Wherever practicable, individual service features are shown completely; and for the purpose of clarity, each circuit feature per illustration is shown in heavy black lines. Talking circuits are shown in their entirety by broad, dark gray lines.

4.02 All factual information unique to each particular drawing is found on the same page with the drawing.

5. INDEX

5.01 The index on pages 3, 4, 5, and 6 lists standard line circuit drawings used in the 1A key telephone system. Those drawings covering wiring and connecting of key boxes and key button telephone sets are **not** listed. Only those arrangements listed in **bold face** print are covered in this section.

INDEX

CENTRAL OFFICE AND PBX LINE CIRCUITS

CENTRAL OFFICE AND PBX LINE CIRCUITS (Contd)

Feature	Key Telephone Units Used	Circuit or Drawing Title	Figure Number	Page Number	Schematic Drawing Reference
Holding	1A	Operate Path Bridging Path Release Path	1A	7	SD-69091-01, Fig. 8
			1C	7	
			1D	7	
	1B	Operate Path Bridging Path Release Path	2A	8	SD-69091-01, Fig. 38
			2C	8	
	2D	8			
5A	Auxiliary Hold	—	—	SD-69091-01, Fig. 9	
51A or 52A	Operate Path Bridging Path Release Path	22A	24	SD-69136-01, Figs. 1, 51, 52	
		22C	24		
22D	24				
641B or 642B Subset	Holding Ckt	—	—	SD-69165-01, Fig. 2	
Hold- ing	With Wink	Holding Ckt	1A or 1B	—	SD-69091-01, Fig. 49
			51A or 52A	—	SD-69136-01, Fig. 1 Modified per SD-69242-01
Busy Lamps Only	6A	Line Busy Lamp	—	—	SD-69091-01, Fig. 6
	6B or C	Line Busy Lamp	9	11	SD-69091-01, Fig. 22
Line Lamps Only	9A	Line Lamp	—	—	SD-69091-01, Fig. 5
	6B or C, 14A, 17A or B, 30A	Line Lamp, Com Aud Sig, and Time-out	—	—	SD-69091-01, Figs. 42, 45
			15A, B, C, or D	8	10
	15C or D, 16A, 18D or E, 30A	Line Lamp, Com Aud Sig, and Time-out	—	—	SD-69091-01, Figs. 41, 45
	21A or B Indicator	Line (Lamp) Indicator	—	—	SD-69091-01, Fig. 17

Feature	Key Telephone Units Used	Circuit or Drawing Title	Figure Number	Page Number	Schematic Drawing Reference
Separate Line and Busy Lamps	6A, 9A	Separate Line and Busy Lamps and Com Aud Sig	—	—	SD-69091-01, Figs. 5, 6
	6B or C, 14A	Separate Line and Busy Lamps and Com Aud Sig	—	—	SD-69091-01, Fig. 22
	6B or C, 14A, 20A	Separate Line and Busy Lamps and Com Aud Sig	—	—	SD-69091-01, Fig. 24
	6B or C, 15A, B, C, or D	Ring and Com Aud Sig Separate Line and Busy Lamps	8 9	10 11	SD-69091-01, Fig. 22
	6B or C, 15A, or B, 16A	Separate Line and Busy Lamps and Com Aud Sig	—	—	SD-69091-01, Fig. 23
Combined Line and Busy Lamps	6B or C, 14A, 17A, 19A or B, 20A	Combined Line and Busy Lamps, Com Aud Sig, and Time-out	—	—	SD-69091-01, Fig. 26
	14A, 17A or B, 18D or E, 19A or B, 30A	Combined Line and Busy Lamps, Com Aud Sig, and Time-out	—	—	SD-69091-01, Figs. 44, 45, 46
	15A or B, 16A, 18A, B, or C, 19A or B	Ring and Com Aud Sig Combined Line and Busy Lamps Flashing Relays	10	12	SD-69091-01, Fig. 25
			11	13	
			12	14	
	15A or B, 16A, 18B or C, 19A or B, 30A	Combined Line and Busy Lamps, Com Aud Sig, and Time-out	—	—	SD-69091-01, Fig. 40
	15C or D, 16A, 18D or E, 19A or B, 30A	Ring and Com Aud Sig Combined Line and Busy Lamps Flashing Relays Time-out	13	15	SD-69091-01, Figs. 43, 45, 46
			14	16	
			15	17	
			16	18	
51A	Ring and Com Aud Sig Combined Line and Busy Lamps Flashing Relays Time-out	17	19	SD-69136-01, Figs. 1, 6, 7, 17, 51	
		18	20		
19	21				
20	22				
52A	Ring and Com Aud Sig Combined Line and Busy Lamps Flashing Relays Time-out	23	25	SD-69136-01, Figs. 1, 6, 7, 17, 51, 52	
		24	26		
		25	27		
		26	28		

INDEX (Contd)

CENTRAL OFFICE AND PBX LINE CIRCUITS (Contd)

Feature	Key Telephone Units Used	Circuit or Drawing Title		Figure Number	Page Number	Schematic Drawing Reference
Combined Line and Busy Lamps (Contd)	213A	CO or PBX line ckt for joint use with stations of other systems or equipments		—	—	SD-69230-01, Figs. 1, 51
Wink With Combined Line and Busy Signal and Holding	1A or B, 15C or D, 16A, 17B, 18D or E, 19A or B, 30A, 33A	Wink, Combined Line and Busy Signal, Com Aud Sig, Time-out, and Holding		—	—	SD-69091-01, Figs. 45, 46, 49, 50, 51
	17B, 18D, 33A, 51A or 52A	Wink, Combined Line and Busy Signal, Com Aud Sig, Time-out, and Holding		—	—	SD-69136-01, Figs. 1, 6, 7, 17 Modified per SD-69242-01
Automatic Cutoff	25A or B, 26A or B	Automatic Cutoff and Control Ckt	For Systems Using Bent Angle-type KTUs	—	—	SD-69091-01, Figs. 36, 39
			For Systems Using 50-type KTUs	—	—	SD-69136-01, Figs. 21, 22
Automatic Exclusion	10A	Automatic Exclusion		—	—	SD-69140-01, Fig. 1
Listening-in	5A Varistor	Listening-in Line Ckt		—	—	SD-69091-01, Fig. 16
	See Dwg	Listening-in Line Ckts		—	—	SD-69155-01
Noise Suppression	17B	Modification of 51A KTU Modification of 52A KTU		27	29	—
				28	29	—

INTERCOMMUNICATING LINE AND SIGNALING CIRCUITS

Type of Circuit	Key Telephone Units Used	Circuit or Drawing Title		Figure Number	Page Number	Schematic Dwg and/or BSP Sect Reference
Dial Selective	57A	Dialing and Line Busy Lamp Audible Signaling Release		29 30 31	30 31 32	SD-69199-01, Figs. 1, 51
		Line, Busy Lamp, and Cutoff		—	—	SD-69199-01, Figs. 1, 4, 5, 6, 51
	57A	Line and Combined Line and Busy Lamp		—	—	SD-69199-01, Figs. 1, 7, 51
		Line, Combined and Busy Lamp, and Cutoff		—	—	SD-69199-01, Figs. 1, 4, 5, 6, 51
Line and Signaling	2A	Battery Feed Coil		3	9	SD-69091-01, Fig. 11
	3A	Selective and Code Signaling	For Systems Using Bent Angle-type KTUs	—	—	SD-69091-01, Figs. 10, 21
			For Systems Using 50-type KTUs	—	—	SD-69136-01, Figs. 10, 11
	4A	Automatic Signaling		—	—	SD-69091-01, Fig. 12
	12A	Battery Feed Coil		4	9	SD-69091-01, Fig. 19
	13A	Battery Feed Relay and 2-way Automatic Signaling		—	—	SD-69091-01, Fig. 20
	13B	Battery Feed Relay, 2-way Automatic Sig, and Line Busy Lamp		—	—	SD-69091-01, Fig. 29
	13B, 17A or B, 19A or B	Battery Feed Relay, 2-way Automatic Sig and Comb Line and Busy Lamp		—	—	SD-69091-01, Figs. 32, 46
	31A	Battery Feed Relay and Line Busy Lamp		5	9	SD-69091-01, Fig. 47
	51A	Battery Feed Relay and Line Busy Lamp		21	23	SD-69136-01, Figs. 1, 5, 17, 51

INDEX (Contd)

INTERCOMMUNICATING LINE AND SIGNALING CIRCUITS (Contd)

Type of Circuit	Key Telephone Units Used	Circuit or Drawing Title	Figure Number	Page Number	Schematic Dwg and/or BSP Sect Reference
Line and Signaling (Contd)	641B or 642B Subset	Battery Feed Coil	—	—	SD-69165-01, Fig. 3
	J86205A, L1 Rectifier	Battery Supply and Feed	6	9	SD-80555-03, C53.513
	J86205H, L1 Rectifier	Battery Supply and Feed	7	9	SD-80672-01, C53.513
Noise Suppression	23A	Noise Suppression for Battery Supply	—	—	SD-69091-01, Fig. 34, C53.513
		For Systems Using Bent Angle-type KTUs	—	—	SD-69136-01, Fig. 23, C53.513
	KS-14136 Condenser	Noise Suppression for Battery Supply	—	—	SD-69136-01, Fig. 24, C53.513
	KS-8056 Condenser	Noise Suppression for Battery Supply	—	—	C53.513

PRIVATE LINE, TIE LINE, STATION LINE, ETC., CIRCUITS

Type of Line	Key Telephone Units Used	Circuit or Drawing Title	Figure Number	Page Number	Schematic Drawing Reference
Private Lines	7A	Private Line Ckt	—	—	SD-69091-01, Fig. 7
	7A, 15C or D, 16A, 19A or B, 30A, 31A	Private Line Signaling and Battery Feed Relay Ckt	—	—	SD-69091-01, Figs. 45, 46, 48
	56A	Private Line Ckt	—	—	SD-69105-01, Figs. 1, 51

PRIVATE LINE, TIE LINE, STATION LINE, ETC., CIRCUITS (Contd)

Type of Line	Key Telephone Units Used	Circuit or Drawing Title	Figure Number	Page Number	Schematic Drawing Reference
Tie Lines	53A	Automatic Tie Line Ckt	—	—	SD-69136-01, Figs. 2, 6, 7, 14, 17, 53
	54A	Ringdown Tie Line Ckt	—	—	SD-69136-01, Figs. 3, 6, 7, 14, 17, 54
Station Line	55A	Station Line Ckt	—	—	SD-69136-01, Figs. 4, 6, 7, 14, 17, 55

MISCELLANEOUS

Item	Code	Circuit or Use	Schematic Dwg and/or BSP Sect Reference	
Bent Angle-type KTUs	1-type thru 33-type KTUs	Schematic Wiring Dwgs showing Individual KTUs	SD-69243-01	
B buzzers	4-type Buzzers	Common Audible Signal	Connections C65.826 Maintenance B438.003	
		Common Audible Signal	For Systems Using Bent Angle-type KTUs	Connections SD-69091-01, Fig. 15 Maintenance C54.352
	Common Audible Signal		For Systems Using 50-type KTUs	Connections SD-69136-01, Fig. 13 Maintenance C54.352
		7-type Bells and Buzzers	Inter-com Signal	For Systems Using Bent Angle-type KTUs
	Inter-com Signal			For Systems Using 50-type KTUs
			Inter-com Signal	For Dial Selective Intercom Station Sig

INDEX (Contd)

MISCELLANEOUS (Contd)

Item	Code	Circuit or Use		Schematic Dwg and/or BSP Sect Reference
Lamps	A3, B2, G2, K2, 51A Lamp	Line Lamp, Busy Lamp, Comb Line and Busy Lamp or Sig Lamp	For Systems Using Bent Angle-type KTUs	SD-69091-01, Fig. 28
			For Systems Using 50-type KTUs	SD-69136-01, Fig. 15
			For Dial Selective Intercom Line	SD-69199-01, Fig. 9
	22-type KTU	Lamp Resistance Ckt	For Systems Using Bent Angle-type KTUs	SD-69091-01, Fig. 33
			For Systems Using 50-type KTUs	SD-69136-01, Fig. 20
			For Dial Selective Intercom Line Ckt	SD-69199-01, Fig. 10
ED-91929-01, G5 Equipment Unit	Lamp Resistance Ckt	For Dial Selective Intercom Line Ckt	SD-69199-01, Fig. 11	
Power	11A KTU	Ringing Feeder Lamp Ckt	For Systems Using Bent Angle-type KTUs	SD-69091-01, Fig. 18
			For Systems Using 50-type KTUs	SD-69136-01, Fig. 8
	16A KTU	Used with Dial Selective Intercom Line Ckt		SD-69199-01, Fig. 15
	17B KTU	Used with Dial Selective Intercom Line Ckt		SD-69199-01, Fig. 14
	393A or B Transformer	For Systems Using Bent Angle-type KTUs		SD-69091-01, Fig. 31
		For Systems Using 50-type KTUs		SD-69136-01, Fig. 19
	KS-5714, L1, 2, or 3 Transformer	For Systems Using Bent Angle-type KTUs		SD-69091-01, Fig. 30
		For Systems Using 50-type KTUs		SD-69136-01, Fig. 18

MISCELLANEOUS (Contd)

Item	Code	Circuit or Use		Schematic Dwg and/or BSP Sect Reference
Ringer (External to Set)	531A or 584DE Subset	Common Ringer	For Systems Using Bent Angle-type KTUs	SD-69091-01, Fig. 4
			For Systems Using 50-type KTUs	SD-69136-01, Fig. 16
		For Dial Selective Intercom Station Ringer		SD-69199-01, Fig. 3
		Line Ringer	For Systems Using Bent Angle-type or 50-type KTUs	SD-69091-01, Fig. 3
When 10A KTU is used (Auto Excl)			SD-69140-01, Fig. 2	
Signaling Keys	551A, 549A, B, C, or D Keys	Signaling Key Ckt		SD-69091-01, Fig. 14
Switching Relay	17A or B KTU	Switching Relay Ckt		SD-69091-01, Fig. 27
Range Charts	—	Range Charts for Systems Connected to PBXs		SD-69200-01

OPERATE, HOLD, AND RELEASE SEQUENCE

1. Operate and Hold—Figs. A, B, and C

1.01 With a call in progress, pickup key [Fig. B] depressed, and relay (L) [Fig. A] operated, operation of hold key [Fig. B] operates relay (H) and releases relay (L) [Fig. A]. Operation of relay (H) while relay (L) is released allows relay (H) to lock operated via its own contacts, putting bridging path [Fig. C] across the line. Release of hold key releases pickup key mechanically, which effects continued release of relay (L) which allows relay (H) to remain operated and locked, holding the call.

Notes

1. **Crosstalk:** "B" lead and one 85-ohm resistance are used to balance the line and prevent crosstalk.
2. **Condenser (B):** The 60-mf condenser is arranged to make relay (L) noninductive.

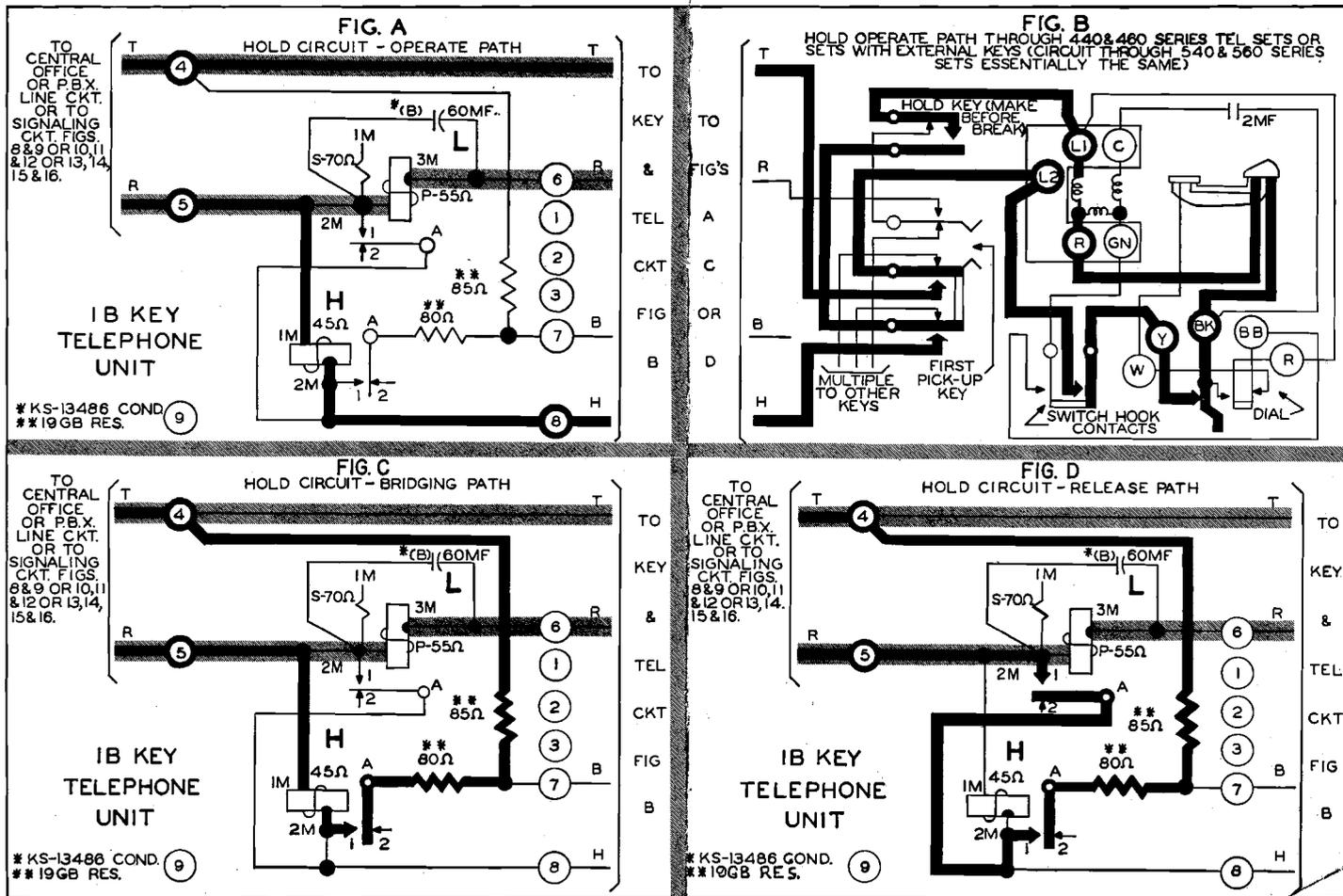
2. Release—Fig. D

2.01 When a held line is picked up, the station loop operates relay (L). Operation of relay (L) shorts out the winding of relay (H) [current bypasses relay (H) winding via contacts on relay (L)], allowing relay (H) to release, which removes holding bridge from across line.

Reference:
SD-69091-01,
Fig. 38

FIG. 2

1B-KTU HOLDING CIRCUIT



FIGS. 3, 4, 5, 6, 7

INTERCOMMUNICATING LINE CIRCUITS

INTERCOMMUNICATING LINE CIRCUITS

1. Operation

1.01 Figs. 3, 4, 5, 6, and 7 show the various battery feed coil arrangements for intercom line circuits furnished in conjunction with 1A key telephone systems employing bent angle-type KTUs.

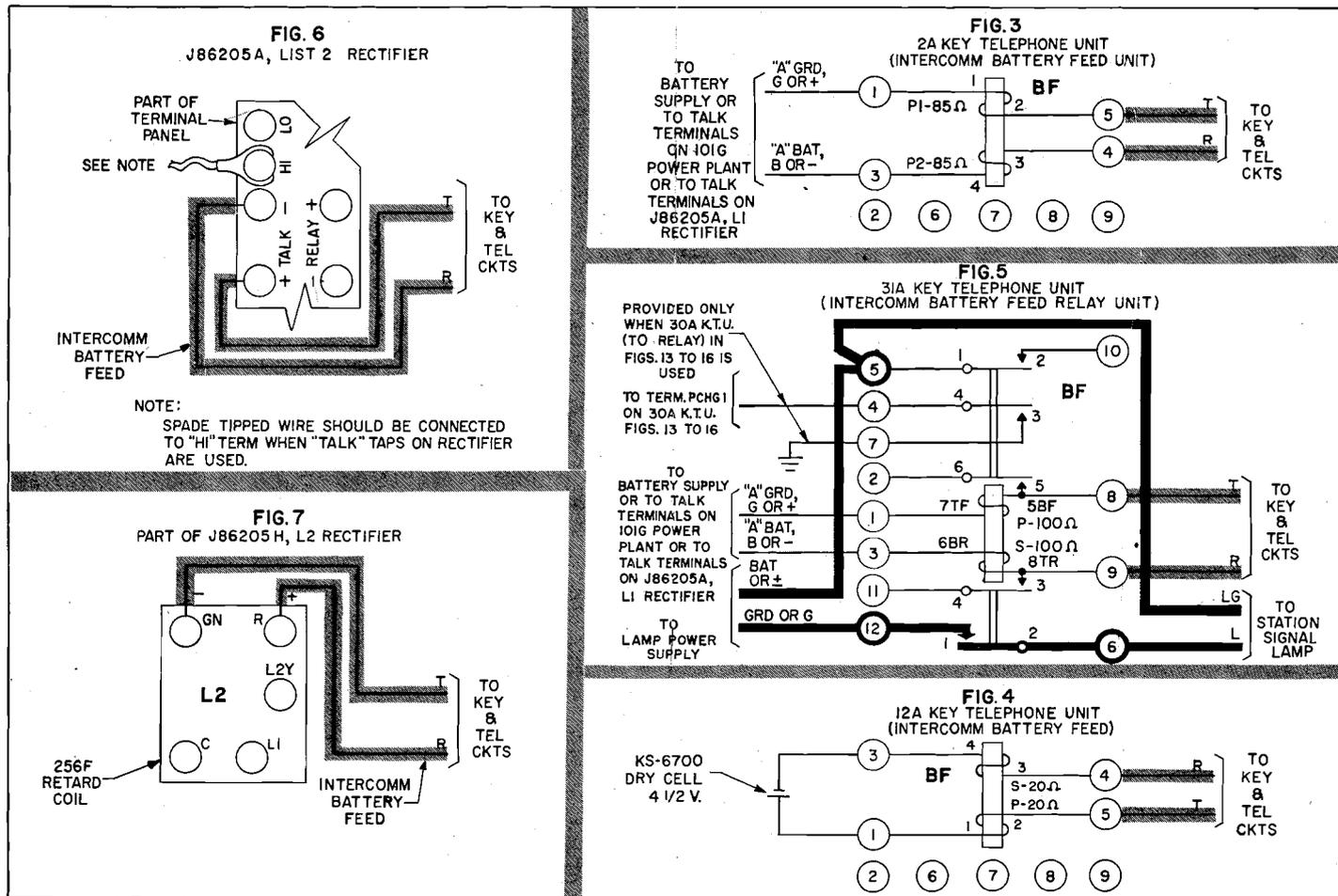
1.02 Figs. 3 and 4 each provide a battery feed coil to supply talking battery to all stations on one intercom line.

1.03 Fig. 5, in addition to providing a battery feed coil to supply talking battery for all stations on one intercom line, has provision for intercom line busy lamp as shown by heavy lines. Seizure of line by any station operates relay (BF). Operated relay (BF) lights station signal lamp steadily and, if provided, operates relay (TO). Disconnection by all stations releases relay (BF), which extinguishes signal lamp and releases relay (TO) if provided.

1.04 Figs. 6 and 7 each provide battery supply in addition to a battery feed coil to supply talking battery for all stations on one intercom line.

2. Noise Suppression

2.01 Where noise suppression of talking battery is necessary, proceed as outlined in Section C53.513, Power Supply Arrangements For Station Systems, Installation and Maintenance.



OPERATE SEQUENCE

1. Operation

1.01 Ground return ringing, usually over ring side of line, operates relay (R). Relay (R), operated only while ringing is applied, lights line lamp and operates common audible signal.

Notes

1. **Thermistors (R) and (T)** prevent false operation of relay (R). [As ringing is applied, thermistor resistance (about 50,000 ohms) is reduced by thermal action to about 3,000 ohms.]

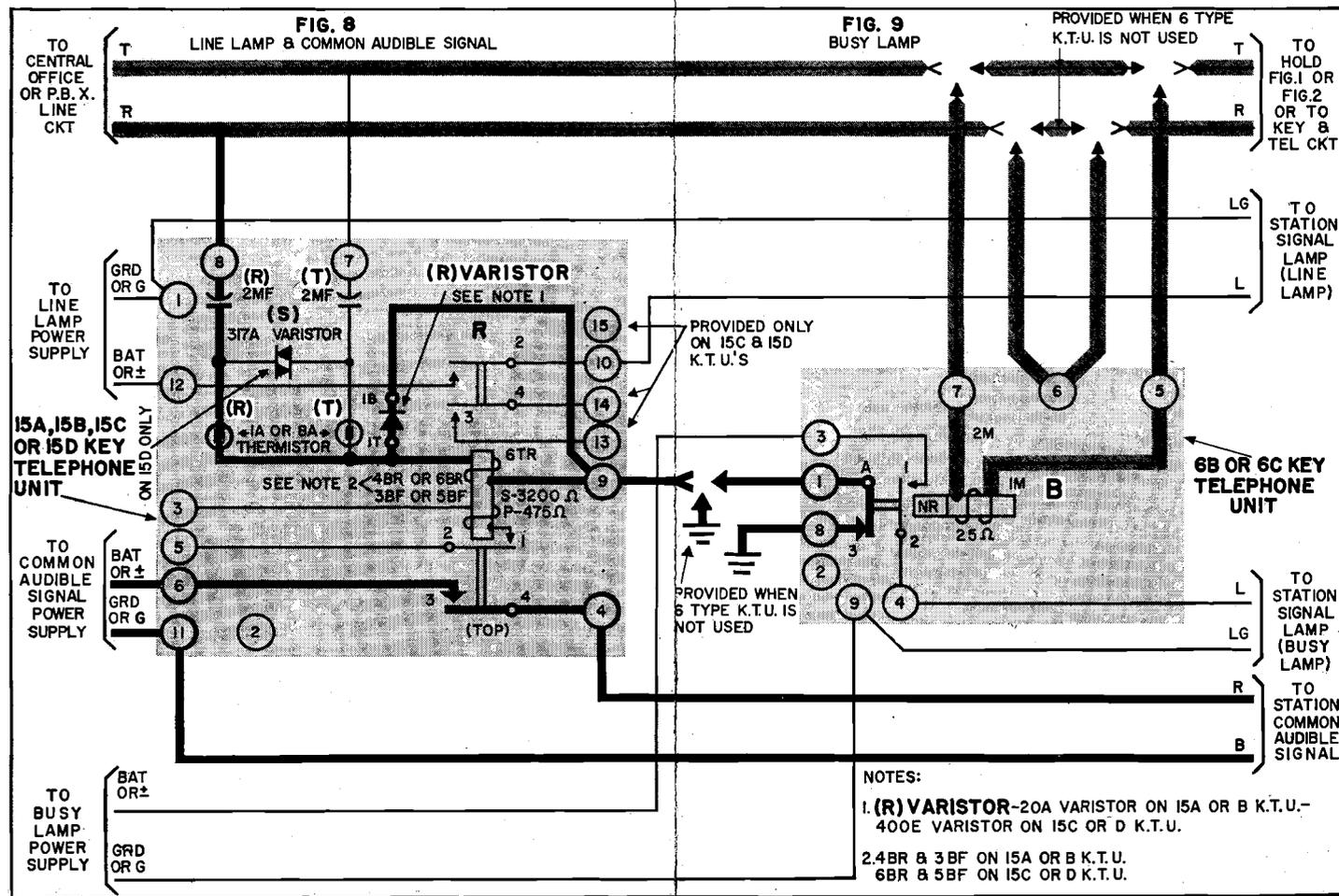
2. **Varistor (R)** converts ringing current to pulsating dc for operation of relay (R). [1/2 cycle passes through varistor (R) and the opposite 1/2 cycle, blocked by varistor (R), flows through secondary winding of relay (R).]

3. **Varistor (S)** protects thermistor (R) or (T) and varistor (R) by providing a shunt path for high voltage surges which may occur and damage thermistors and varistors while they are in a low resistance condition.

1.02 If line is equipped with 6B or C KTU [relay (B)], ringing lead to ground is opened at the time the call is answered by operation of relay (B) by station loop.

Reference:
SD-69091-01,
Fig. 22

FIG. 8 RINGING AND COMMON AUDIBLE SIGNALING CIRCUITS



OPERATE AND RELEASE SEQUENCE

1. Line Lamp

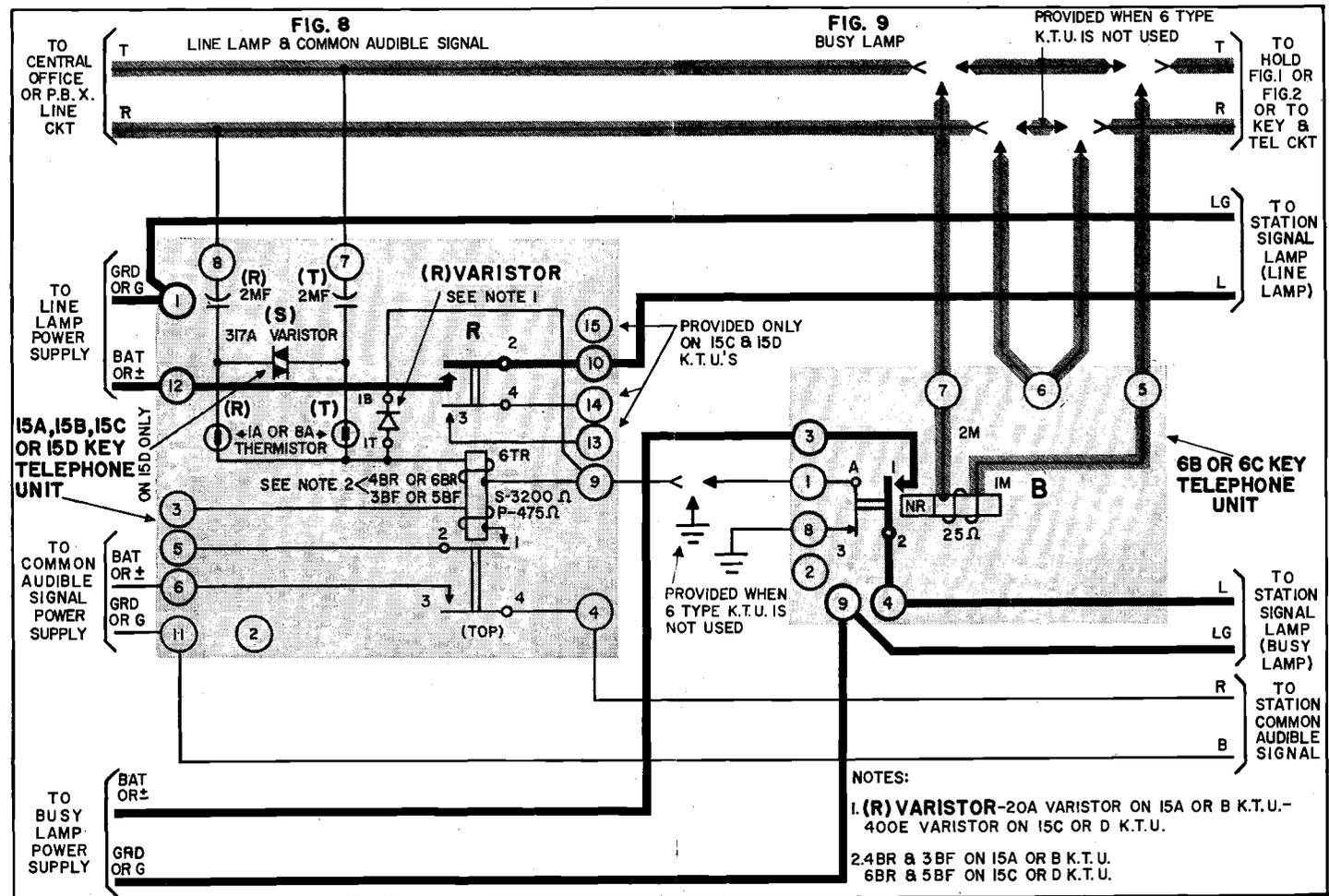
1.01 Ringing operates relay (R). Relay (R), operated only while ringing is applied, operates intermittent common audible signal and lights line lamp. Line lamp is lighted and extinguished as relay (R) operates and releases.

2. Busy Lamp

2.01 Answering or originating [or, if equipped, holding] a call operates relay (B). Relay (B) opens ringing lead to ground and lights busy lamp steadily. Termination of call releases relay (B) and relay (B) extinguishes busy lamp.

FIG. 9

SEPARATE LINE AND BUSY LAMP CIRCUITS



Reference:
SD-69091-01,
Fig. 22

OPERATE AND RELEASE SEQUENCE

1. Flashing Line Lamp

Operate

1.01 **System attended, battery cutoff key closed:** Ringing operates relay (R) which locks operated, operates steady common audible signal, and starts flashing circuit. Flashing relay (B) of 19-type KTU operates and releases alternately, flashing station signal lamp on and off.

1.02 **System unattended, battery cutoff key open:** Under this condition, relay (R) operates **only** while ringing is applied, causing lamp to flash and steady audible signal to sound **only** during ringing.

Release

1.03 **System attended, battery cutoff key closed:** Answering a call operates relay (B) of 18-type KTU. Relay (B) operates relay (SR). Relay (SR) causes station signal lamps to burn steadily and releases relay (R). Released relay (R) stops flashing circuit and steady common audible signal.

2. Line Busy Lamp

Operate

2.01 Answering or originating [or, if equipped, holding] a call operates relay (B) of 18-type KTU. Relay (B) operates relay (SR). Relay (SR) lights station signal lamp steadily.

Note: Due to slow release action of relay (SR), lamp should not flutter or extinguish during dialing.

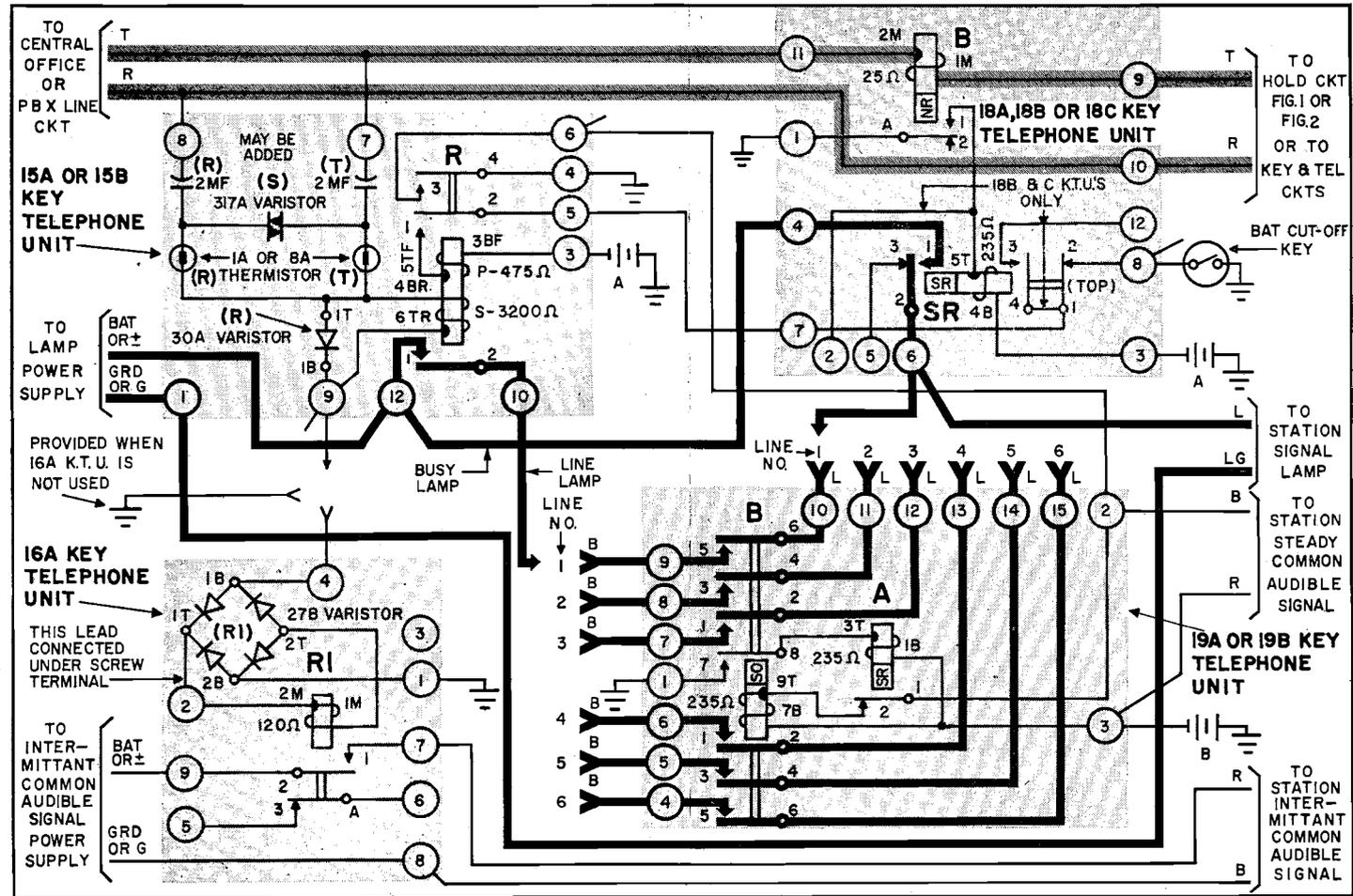
Release

2.02 Termination of a call releases relay (B) of 18-type KTU. Relay (B) releases relay (SR). Released relay (SR) extinguishes station signal lamp.

Reference:
SD-69091-01,
Fig. 25

FIG. 11

COMBINED LINE AND BUSY LAMP CIRCUITS



OPERATE AND RELEASE SEQUENCE

1. Operate

1.01 **System attended, battery cutoff key closed:** Ringing operates relay (R). Relay (R) locks operated, and operates steady common audible signal and flashing circuit relay (B) of 19-type KTU. Relay (B) lights station signal lamp and operates relay (A). Relay (A) releases relay (B) and relay (B) extinguishes station signal lamp and releases relay (A). Relays (B) and (A) continue to operate and release alternately [flashing lamp on and off] for duration of relay (R) lockup.

1.02 **System attended, battery cutoff key open:** Under this condition relay (R) operates **only** while ringing is applied, causing flashing circuit relays (B) and (A) to operate and release alternately, and steady audible signal to sound **only** during ringing.

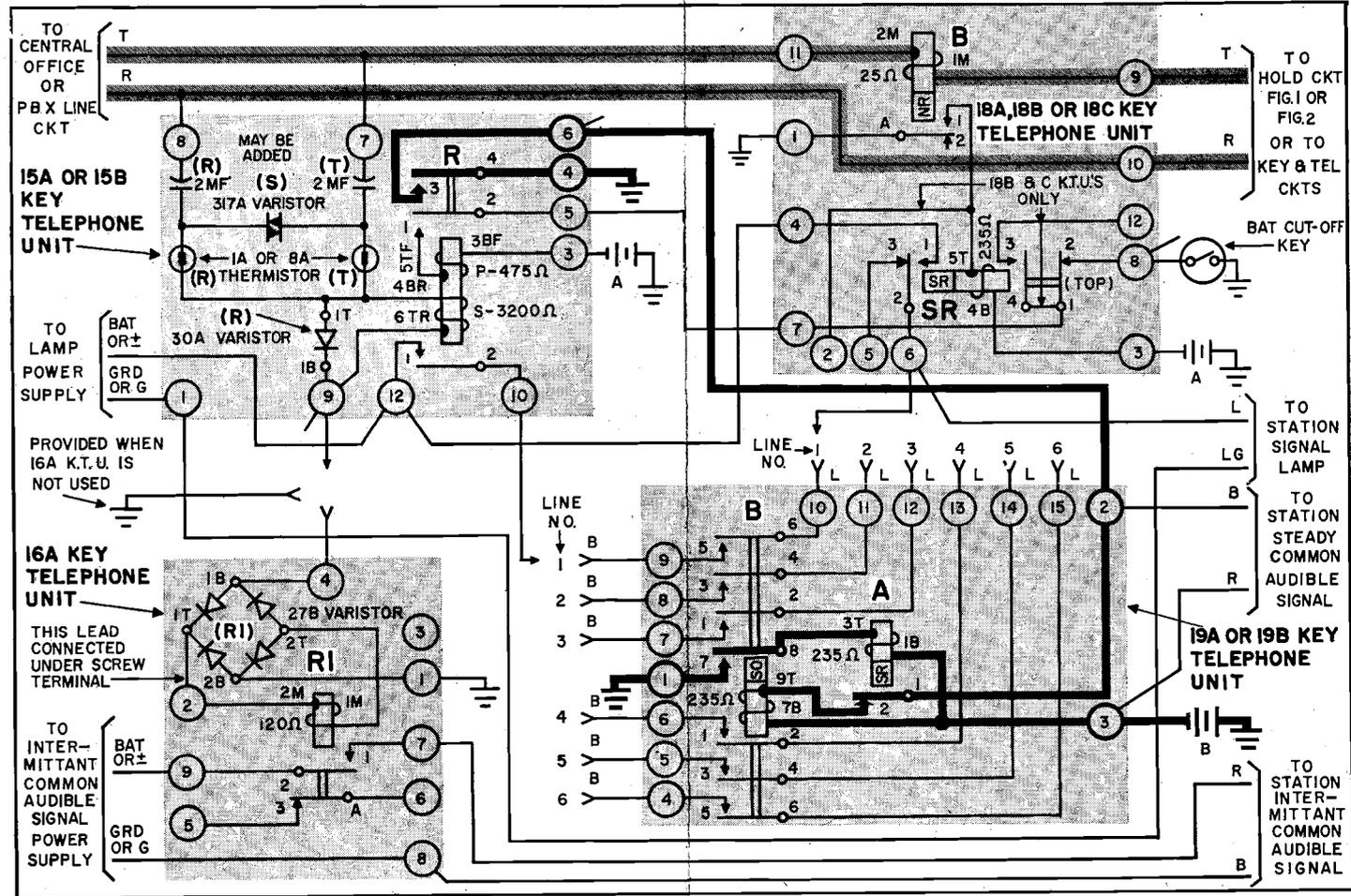
2. Release

2.01 **System attended, battery cutoff key closed:** Answering a call operates relay (B) of 18-type KTU. Relay (B) operates relay (SR). Relay (SR) causes station signal lamp to burn steadily and releases relay (R). Released relay (R) releases relay (B) of 19-type KTU [or does not allow relay (B) to operate again]. Released relay (B) releases relay (A).

Note: Release of flashing relays (B) and (A) may also be effected by opening battery cutoff key.

Reference:
SD-69091-01,
Fig. 25

FIG. 12 FLASHING CIRCUIT—RELAYS (B) AND (A) OF 19-TYPE KTU



OPERATE AND RELEASE SEQUENCE

1. Operate

1.01 Ground return ringing, usually over the ring side of a line, operates relays (R) and (R1). Relay (R) locks operated, starts flashing and time-out circuits, and operates steady common audible signal. Relay (R1) [operated only while ringing is applied] operates intermittent common audible signal.

Notes

1. **Thermistors (R) and (T)** prevent false operation of relays (R) and (R1). [As ringing is applied, thermistor resistance (about 50,000 ohms) is reduced by thermal action to about 3,000 ohms.]

2. **Varistor (R)** converts ringing current to pulsating dc for operation of relay (R). [1/2 cycle passes through varistor (R) and the opposite 1/2 cycle, blocked by varistor (R), flows through the secondary winding of relay (R).]

3. **Varistor Combination (R1)** converts ringing current in the same manner as varistor (R), but is arranged to cause **both** 1/2 cycles to flow in the **same direction** through the winding of relay (R1).

4. **Varistor (S)** protects thermistor (R) or (T) and varistors (R) and (R1) by providing a shunt path for high voltage surges which may occur and damage thermistors and varistors while they are in a low resistance condition.

2. Release

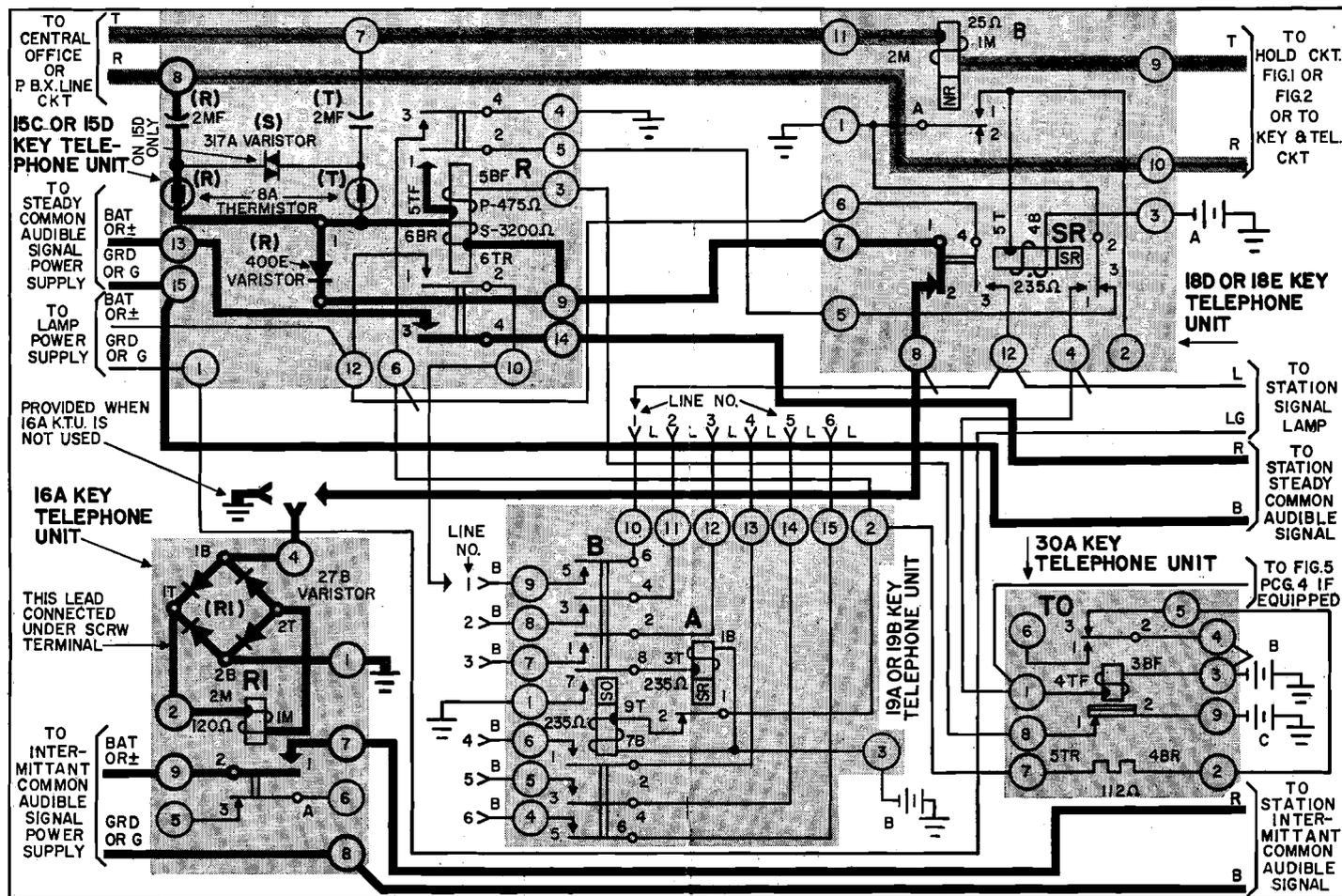
2.01 **System attended:** Answering a call operates relay (B) of 18-type KTU. Relay (B) operates relay (SR). Relay (SR) releases relay (R), operates relay (TO), causes station signal lamps to burn steadily and opens ringing lead to relay (R1) or ground. Released relay (R) stops flashing circuit and steady common audible signal.

2.02 **System unattended:** Relay (R) is released by time-out, and intermittent common audible signal silenced by calling party hangup. Released relay (R) stops flashing circuit and steady common audible signal.

Reference:
SD-69091-01,
Figs. 43, 45, 46

FIG. 13

RINGING AND COMMON AUDIBLE SIGNALING CIRCUITS



OPERATE AND RELEASE SEQUENCE

1. Flashing Line Lamp

Operate

1.01 Ringing operates relay (R) which locks operated, starts flashing and time-out circuits, and operates steady common audible signal. Flashing relay (B) of 19-type KTU operates and releases alternately, flashing station signal lamps on and off.

Release

1.02 **System attended:** Answering a call operates relay (B) of 18-type KTU. Relay (B) operates relay (SR). Relay (SR) causes station signal lamps to burn steadily, operates relay (TO), opens ringing lead to relay (R1) or ground, and releases relay (R). Released relay (R) stops flashing circuit and steady common audible signal.

1.03 **System unattended:** Relay (R) is released by time-out. Released relay (R) stops flashing circuit and steady common audible signal.

2. Line Busy Lamps

Operate

2.01 Answering or originating [or, if equipped, holding] a call operates relay (B) of 18-type KTU. Relay (B) operates relay (SR). Relay (SR) lights station signal lamp steadily and operates relay (TO).

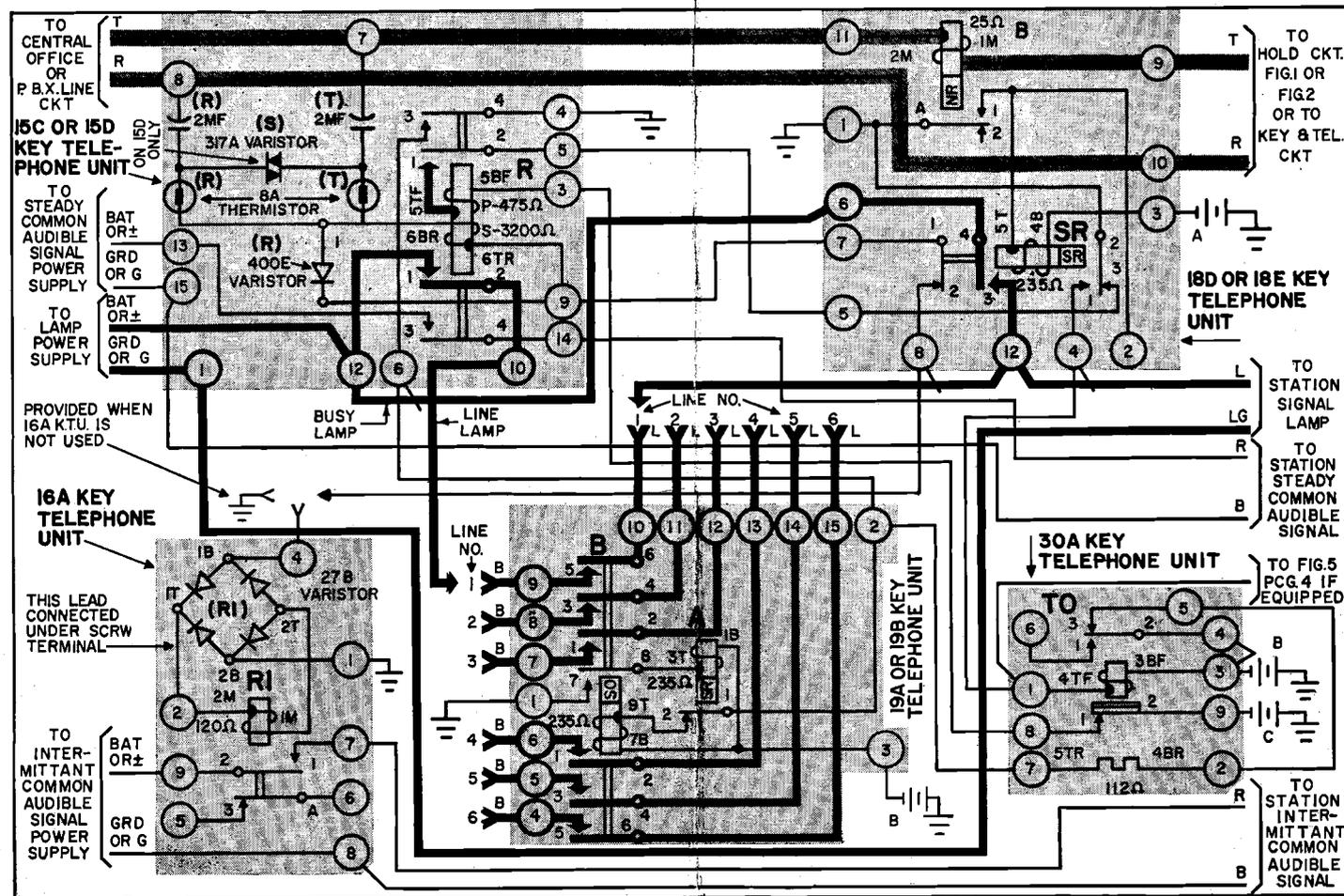
Note: Due to slow release action of relay (SR), lamp should not flutter or extinguish during dialing.

Release

2.02 Termination of a call releases relay (B) of 18-type KTU. Relay (B) releases relay (SR). Relay (SR) extinguishes station signal lamp and releases relay (TO).

Reference:
SD-69091-01,
Figs. 43, 45, 46

FIG. 14 COMBINED LINE AND BUSY LAMP CIRCUITS



OPERATE AND RELEASE SEQUENCE

1. Operate

1.01 Ringing operates relay (R). Relay (R) locks operated, starts time-out circuit, and operates steady common audible signal and flashing circuit relay (B) of 19-type KTU. Relay (B) lights station signal lamp and operates relay (A). Relay (A) releases relay (B), and relay (B) extinguishes station signal lamp and releases relay (A). Relays (B) and (A) continue to operate and release alternately [flashing lamp on and off] for duration of relay (R) lockup.

2. Release

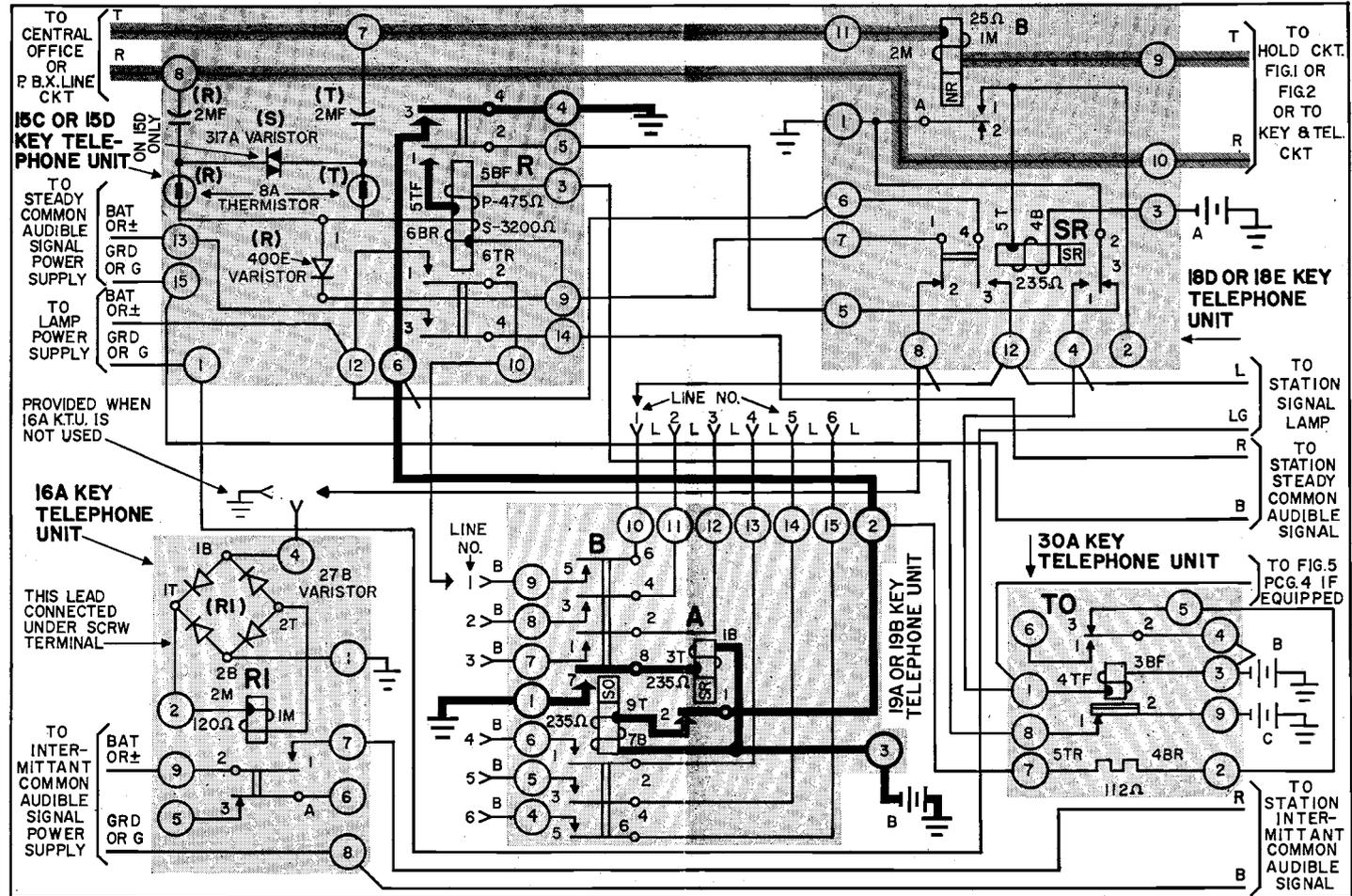
2.01 **System attended:** Answering a call operates relay (B) of 18-type KTU. Relay (B) operates relay (SR). Relay (SR) causes station signal lamp to burn steadily, operates relay (TO), opens ringing lead to relay (R1) or ground, and releases relay (R). Released relay (R) stops steady common audible signal and releases relay (B) of 19-type KTU [or does not allow relay (B) to operate again]. Released relay (B) releases relay (A).

2.02 **System unattended:** Relay (R) is released by time-out. Released relay (R) extinguishes station signal lamp, stops steady common audible signal, and releases relay (B) of 19-type KTU [or does not allow relay (B) to operate again]. Released relay (B) releases relay (A).

Reference:
SD-69091-01,
Figs. 43, 45, 46

FIG. 15

FLASHING CIRCUIT—RELAYS (B) AND (A) OF 19-TYPE KTU



OPERATE SEQUENCE

1. Operation

1.01 **System unattended:** Relay (R), operated by ringing, locks operated through thermal contacts on relay (TO). Operated relay (R) starts flashing circuit, operates steady common audible signal, and puts ground to heater winding of relay (TO). Heat discharge from heater winding causes thermal contacts to open in about 30 seconds. Open thermal contacts release relay (R). Released relay (R) stops flashing circuit and steady common audible signal.

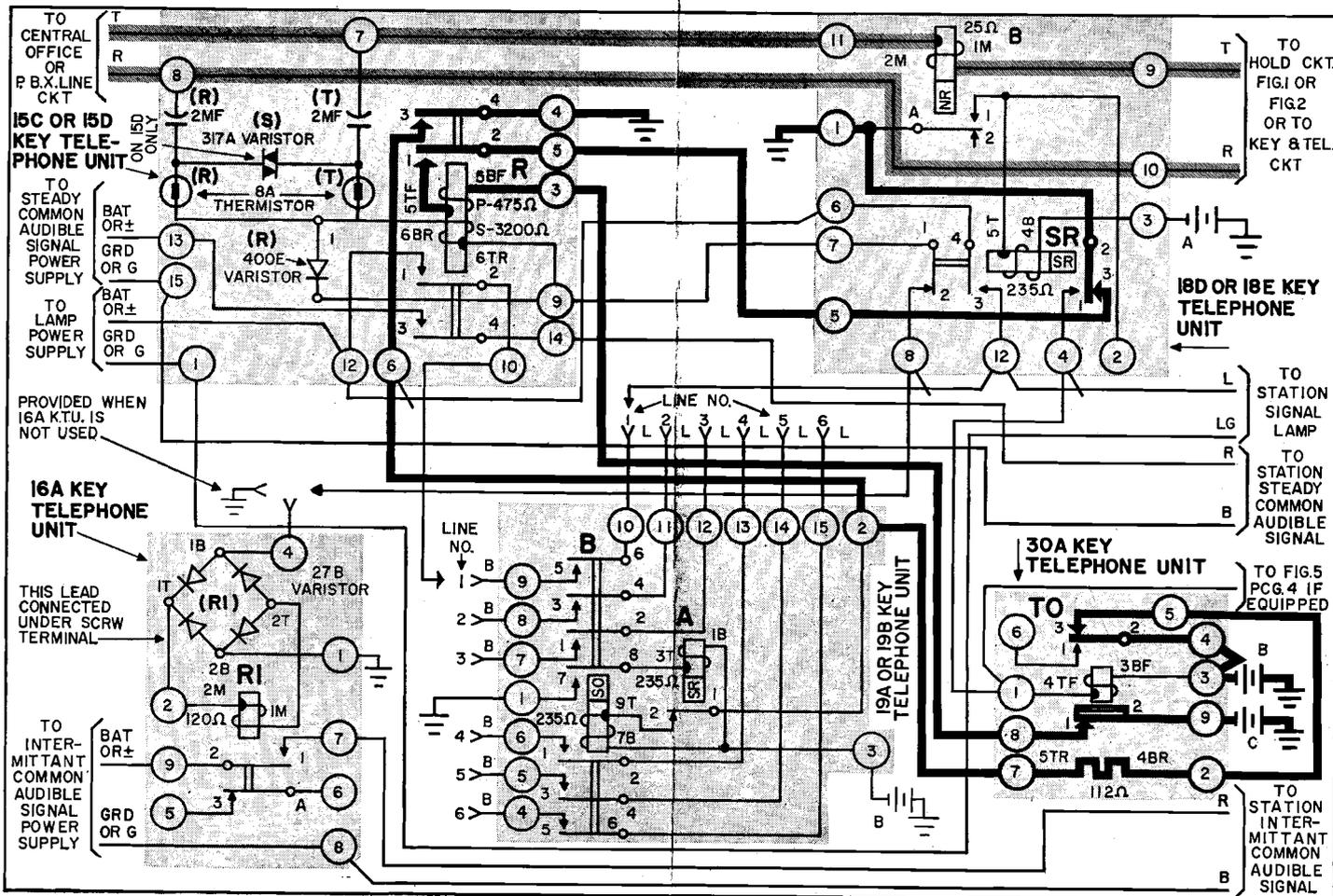
Note: Thermal contacts cool and remake in about 1 to 3 minutes. If, during this cooling period, ringing continues, relay (R) does not lock up but operates only while ringing is applied.

1.02 **System attended:** If no lines are in use and an incoming call goes unanswered, time-out will occur as in 1.01 above. If one or more lines [including intercom line if equipped with 31A KTU] are in use and an incoming call goes unanswered, time-out will **not** occur until all busy lines are released.

Note: With one or more lines in use, relay (TO) will be operated and its heater winding will be open.

Reference:
SD-69091-01,
Figs. 43, 45, 46

FIG. 16 TIME-OUT CIRCUIT



OPERATE AND RELEASE SEQUENCE

1. Flashing Line Lamp

Operate

1.01 Ringing operates relay (R) which locks operated and starts flashing and time-out circuits. Flashing circuit relay (B) operates and releases alternately, flashing station signal lamp on and off.

Release

1.02 **System attended:** Answering a call operates relays (L) and (L1). Relay (L1) operates relay (SR). Relay (SR) causes station signal lamps to burn steadily, operates relay (TO), and releases relay (R). Released relay (R) stops flashing circuit.

1.03 **System unattended:** Relay (R) is released by time-out. Released relay (R) stops flashing circuit.

2. Line Busy Lamps

Operate

2.01 Answering, originating, or holding a call operates relay (L1). Relay (L1) operates relay (SR). Relay (SR) lights station signal lamp steadily and operates relay (TO).

Note: Due to slow release action of relay (SR), lamp should not flutter or extinguish during dialing.

Release

2.02 Termination of a call releases relays (L) and (L1). Relay (L1) releases relay (SR). Released relay (SR) extinguishes station signal lamps and releases relay (TO).

Reference:
SD-69136-01,
Figs. 1, 6, 7, 17, 51

FIG. 18

51A KTU—COMBINED LINE AND BUSY LAMP CIRCUITS

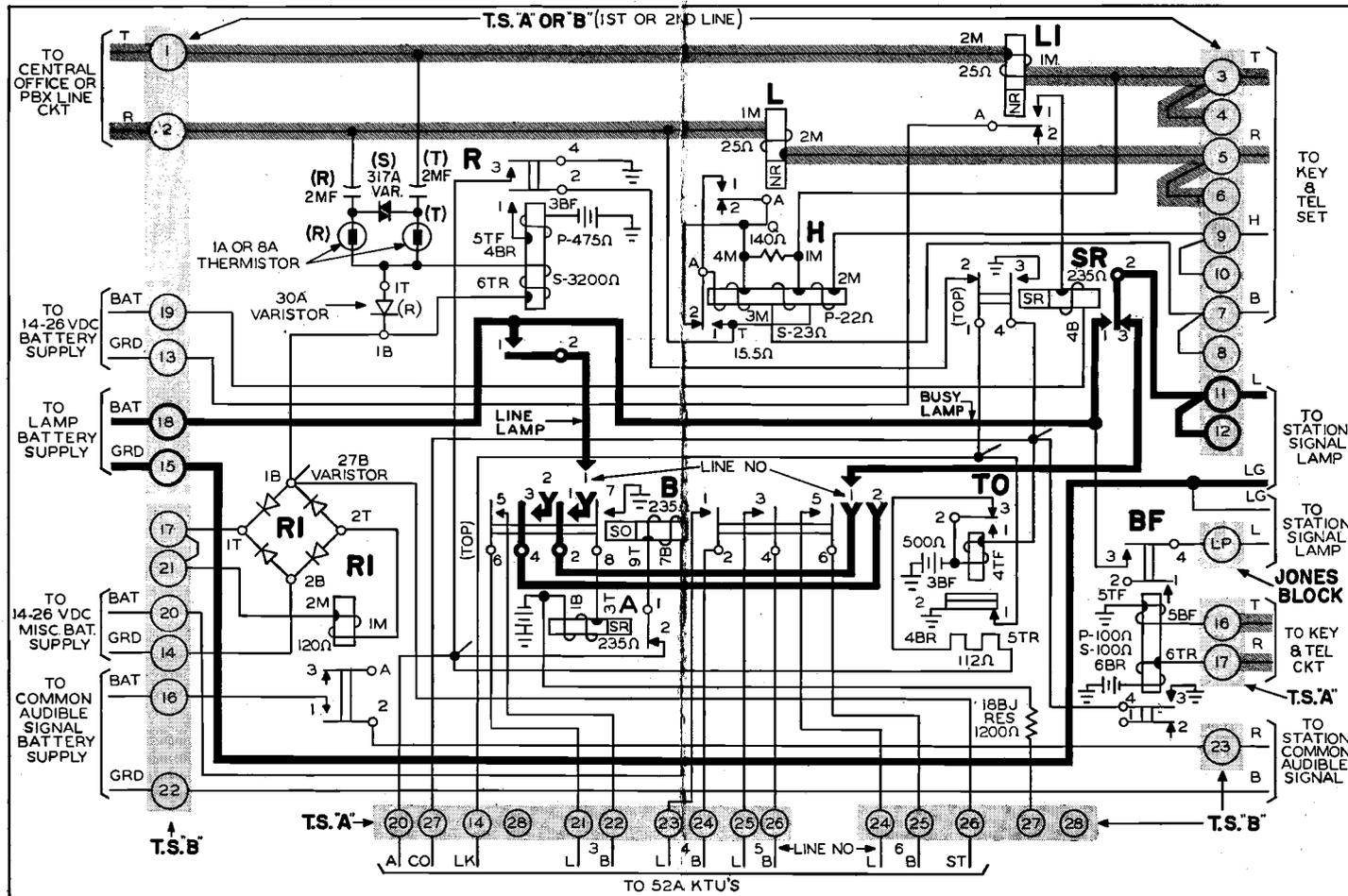


FIG. 19

51A KTU—FLASHING CIRCUIT—RELAYS (B) AND (A)

OPERATE AND RELEASE SEQUENCE

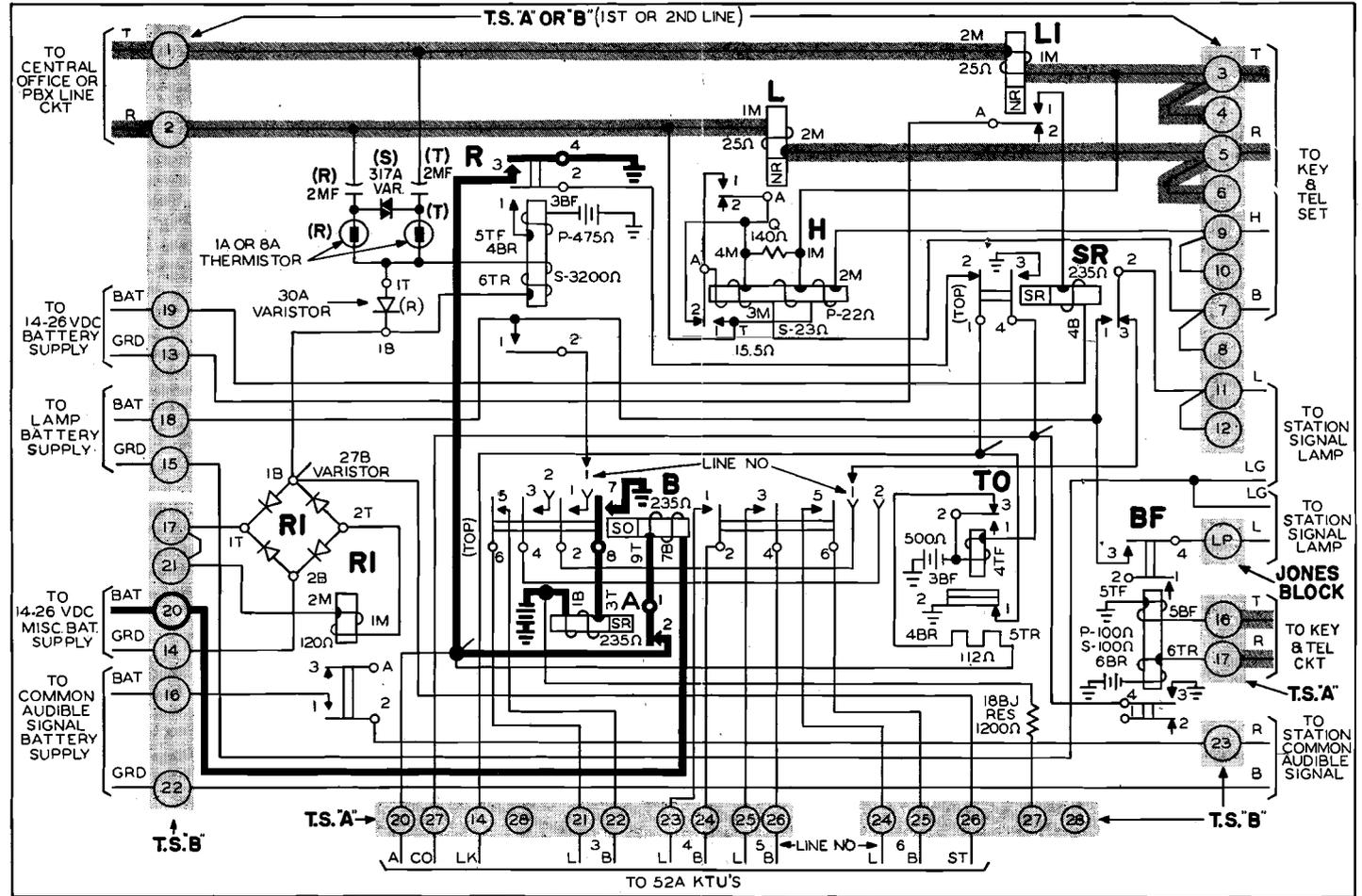
1. Operate

1.01 Ringing operates relay (R). Relay (R) locks operated, starts time-out circuit, and operates flashing circuit relay (B). Relay (B) lights station signal lamp and operates relay (A). Relay (A) releases relay (B), and relay (B) extinguishes station signal lamp and releases relay (A). Relays (B) and (A) continue to operate and release alternately [flashing lamp on and off] for duration of relay (R) lockup.

2. Release

2.01 **System attended:** Answering a call operates relays (L) and (L1). Relay (L1) operates relay (SR). Relay (SR) causes station signal lamp to burn steadily, operates relay (TO), and releases relay (R). Released relay (R) releases relay (B) [or does not allow relay (B) to operate again]. Released relay (B) releases relay (A).

2.02 **System unattended:** Relay (R) is released by time-out. Released relay (R) extinguishes station signal lamps and releases relay (B) [or does not allow relay (B) to operate again]. Released relay (B) releases relay (A).



Reference:
SD-69136-01,
Figs. 1, 6, 7, 17, 51

OPERATE SEQUENCE

1. Operation

1.01 **System unattended:** Relay (R), operated by ringing, locks operated through thermal contacts on relay (TO). Operated relay (R) puts ground to relay (TO) heater winding and starts flashing circuit. Heat discharge from heater winding causes thermal contacts to open in about 30 seconds. Open thermal contacts release relay (R). Released relay (R) stops flashing circuit.

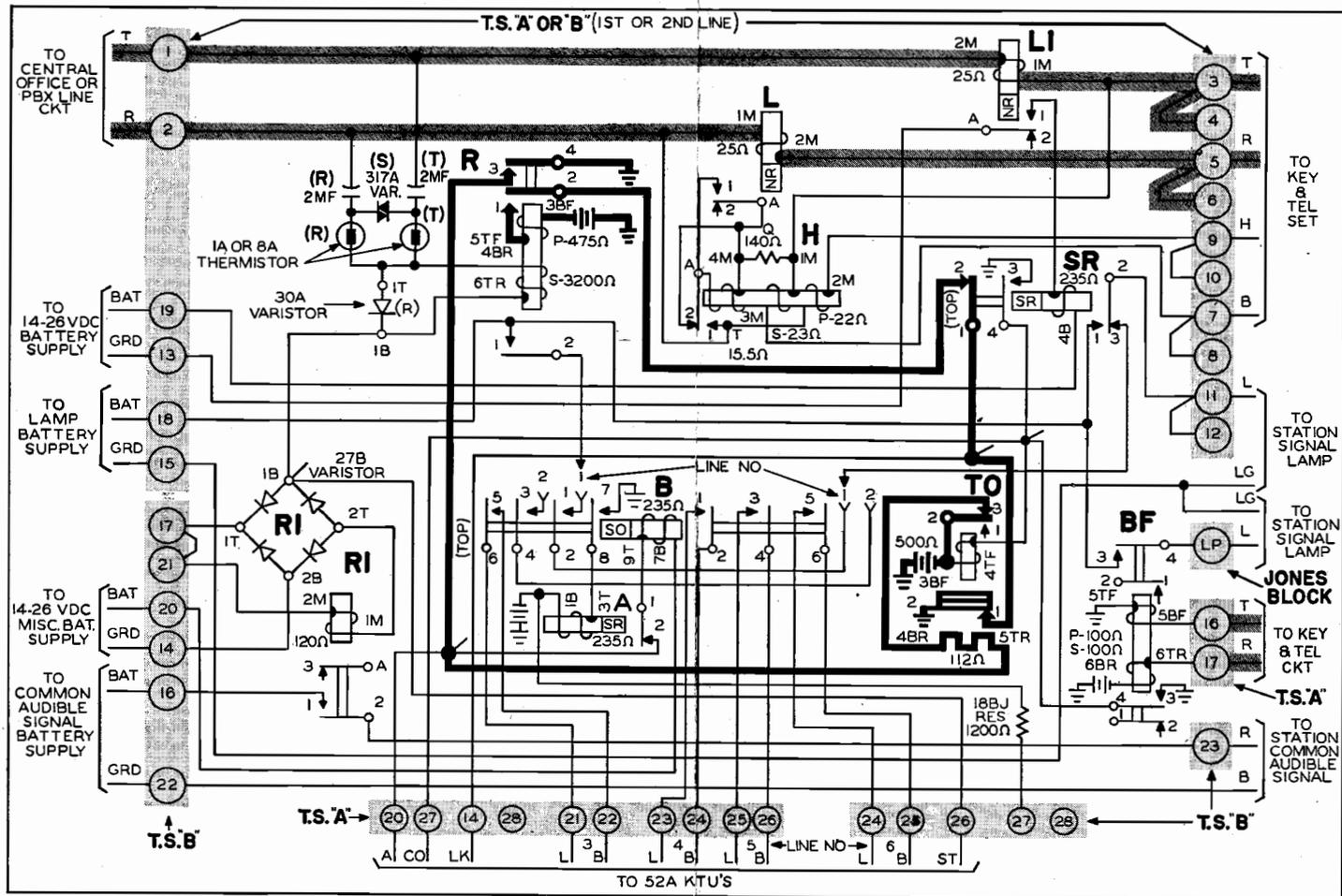
Note: Thermal contacts cool and remake in about 1 to 3 minutes. If, during this cooling period, ringing continues, relay (R) does not lock up but operates **only** while ringing is applied.

1.02 **System attended:** If no lines are in use and an incoming call goes unanswered, time-out will occur as in 1.01 above. If one or more lines, including intercom, are in use and an incoming call goes unanswered, time-out will **not** occur until all busy lines are released.

Note: With one or more lines in use, relay (TO) will be operated and its heater winding will be open.

FIG. 20

51A KTU-TIME-OUT CIRCUIT



Reference:
SD-69136-01,
Figs. 1, 6, 7, 17, 51

OPERATE, HOLD, AND RELEASE SEQUENCE

1. Operate and Hold—Figs. A, B, and C

1.01 With a call in progress, pickup key [Fig. B] depressed, and relay (L) [Fig. A] operated, operation of hold key [Fig. B] operates relay (H) and releases relay (L) [Fig. A]. Operation of relay (H), while relay (L) is released, allows relay (H) to lock operated on its own tertiary winding, putting the bridging path [Fig. C] across the line. Release of hold key releases pickup key mechanically, which effects the continued release of relay (L) which allows relay (H) to remain operated and locked, holding the call.

Note: Crosstalk: "B" lead and secondary winding of relay (H) are used to balance the line and prevent crosstalk.

2. Release—Fig. D

2.01 When a held line is picked up, the station loop operates relay (L). Operation of relay (L) shorts out the tertiary winding of relay (H) [current bypasses locking (or tertiary) winding via contacts on relay (L)], allowing relay (H) to release, which removes holding bridge from across line.

Reference:
SD-69136-01,
Figs. 1 and 51 or 52

FIG. 22 51A OR 52A KTU—HOLDING CIRCUIT

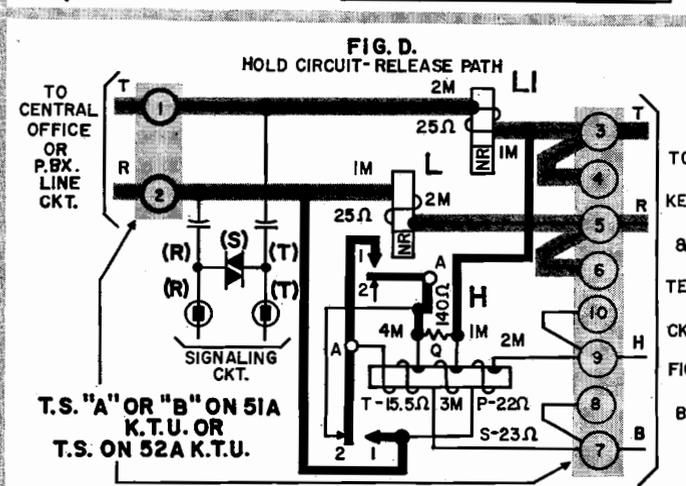
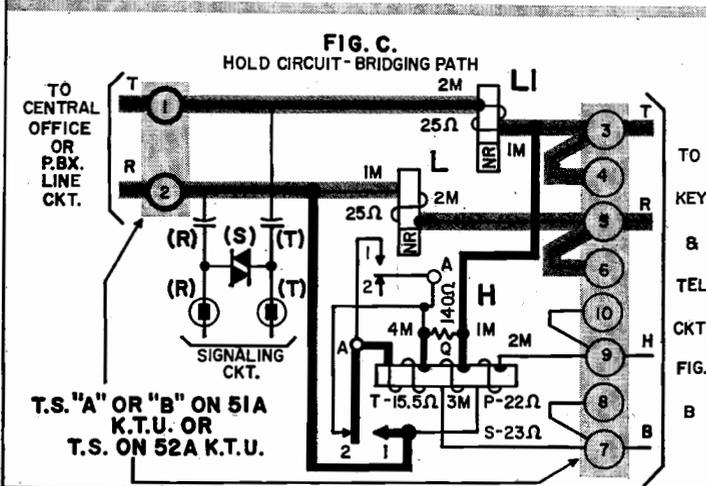
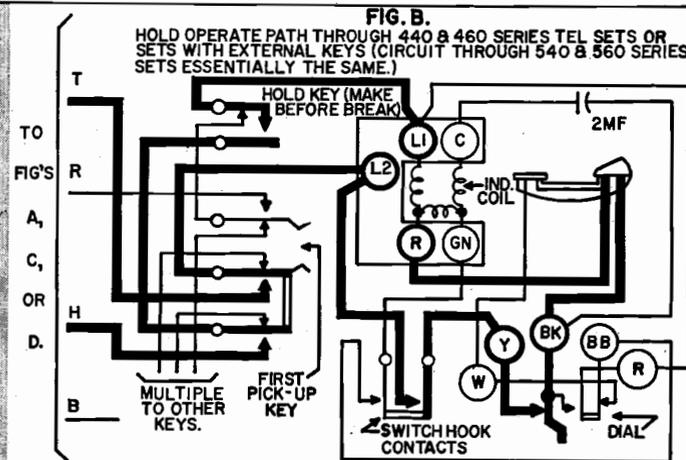
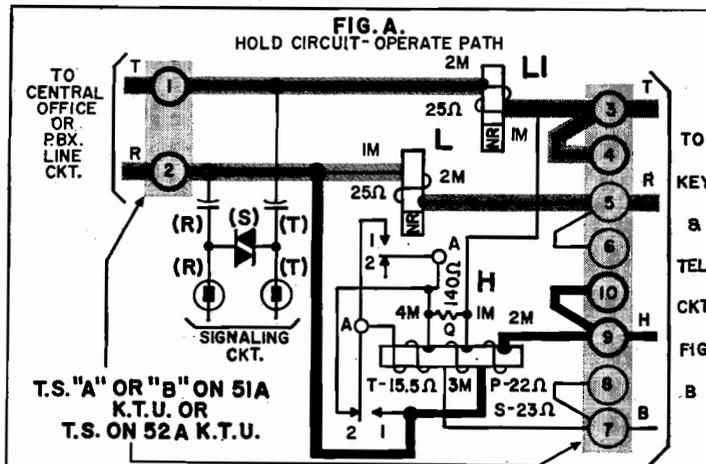


FIG. 23

52A KTU—RINGING AND COMMON AUDIBLE SIGNALING CIRCUITS

OPERATE AND RELEASE SEQUENCE

1. Operate

1.01 Ground return ringing, usually over ring side of line, operates relays (R) and (R1). Relay (R) locks operated and starts flashing and time-out circuits. Relay (R1) [operated only while ringing is applied] operates common audible signal.

Notes

1. **Thermistors (R) and (T)** prevent false operation of relays (R) and (R1). [As ringing is applied, thermistor resistance (about 50,000 ohms) is reduced by thermal action to about 3,000 ohms.]

2. **Varistor (R)** converts ringing current to pulsating dc for operation of relay (R). [1/2 cycle passes through varistor (R), and the opposite 1/2 cycle, blocked by varistor (R), flows through secondary winding of relay (R).]

3. **Varistor Combination (R1)** converts ringing current in same manner as varistor (R), but is arranged to cause both 1/2 cycles to flow in the same direction through winding of relay (R1).

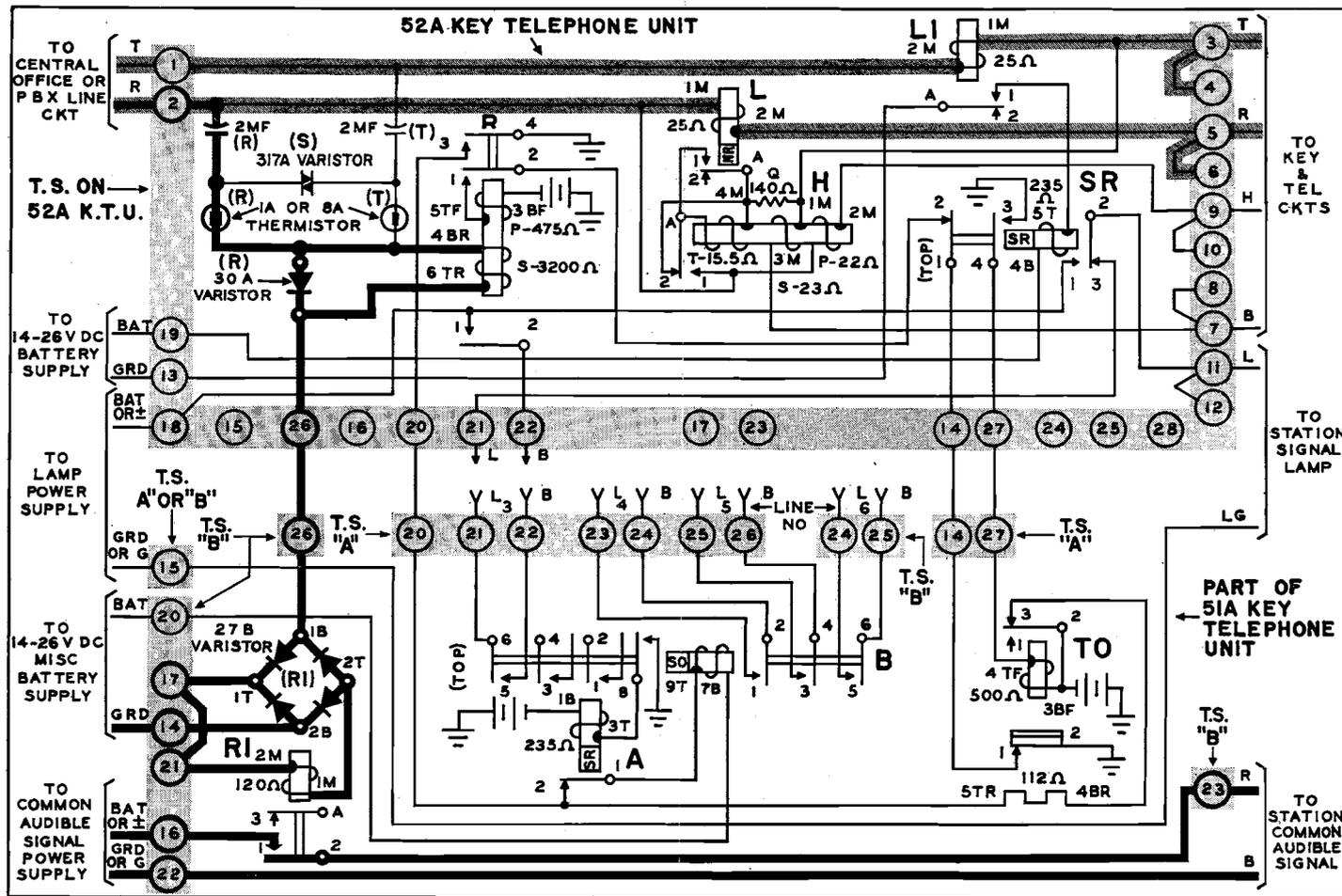
4. **Varistor (S)** provides protection for thermistor (R) or (T) and varistors (R) and (R1) by providing a shunt path for high voltage surges which may occur and damage thermistors and varistors while they are in a low resistance condition.

2. Release

2.01 **System attended:** Answering a call operates relays (L) and (L1). Relay (L1) operates relay (SR). Operated relay (SR) lights station signal lamp steadily, operates relay (TO), and releases relay (R). Released relay (R) stops flashing circuit.

2.02 **System unattended:** Relay (R) is released by time-out and audible signaling is silenced by calling party hangup. Released relay (R) stops flashing circuit.

Reference:
SD-69136-01,
Figs. 1, 6, 7, 17, 51, 52



OPERATE SEQUENCE

1. Operation

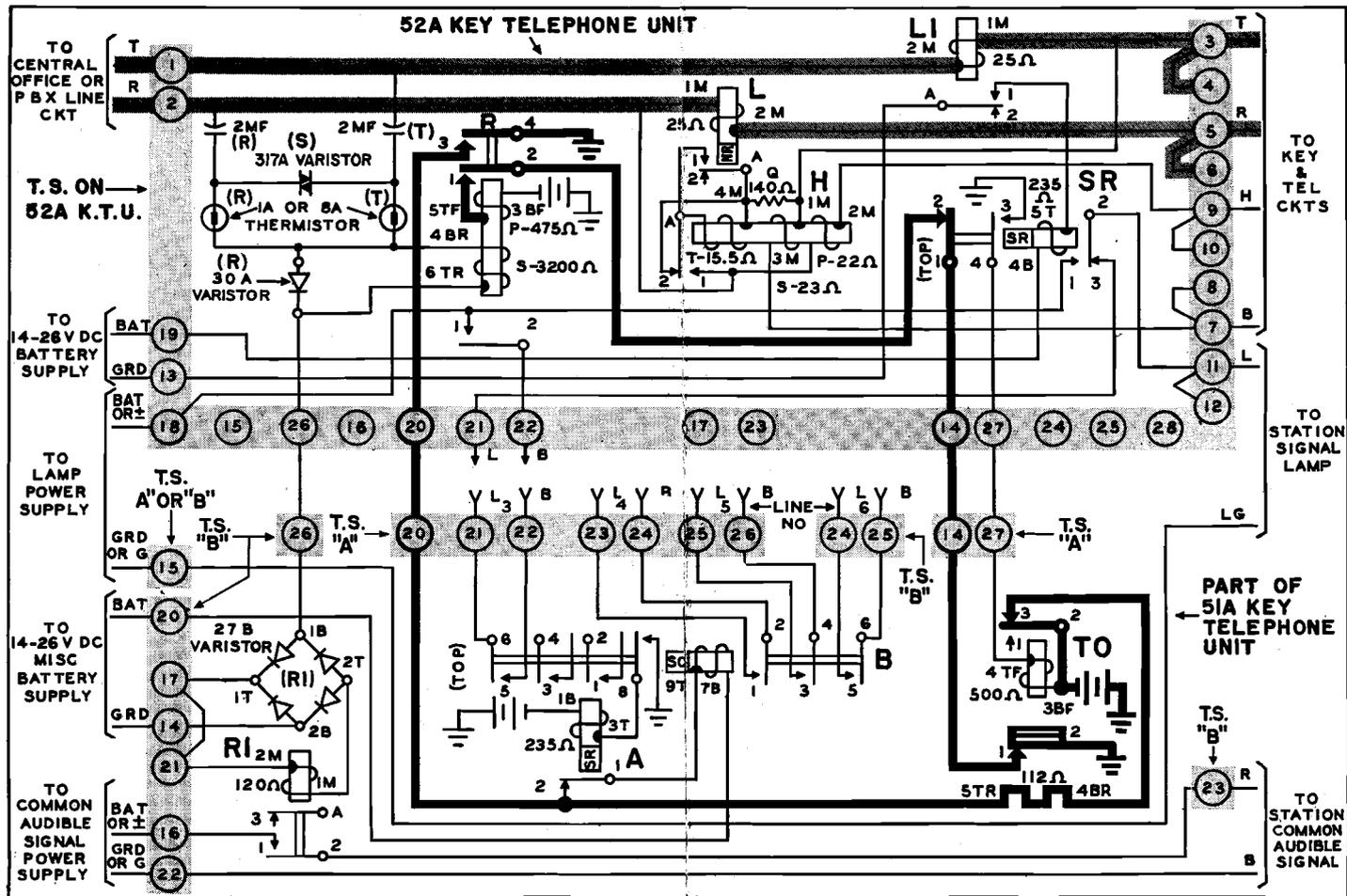
1.01 **System unattended:** Relay (R), operated by ringing, locks operated through thermal contacts on relay (TO). Operated relay (R) puts ground to relay (TO) heater winding and starts flashing circuit. Heat discharge from heater winding causes thermal contacts to open in about 30 seconds. Open thermal contacts release relay (R). Released relay (R) stops flashing circuit.

Note: Thermal contacts cool and remake in about 1 to 3 minutes. If, during this cooling period, ringing continues, relay (R) does not lock up but operates **only** while ringing is applied.

1.02 **System attended:** If no lines are in use and an incoming call goes unanswered, time-out will occur as in 1.01 above. If one or more lines, including intercom, are in use and an incoming call goes unanswered, time-out will **not** occur until all busy lines are released.

Note: With one or more lines in use, relay (TO) will be operated and its heater winding will be open.

FIG. 26 52A KTU-TIME-OUT CIRCUIT



Reference:
SD-69136-01,
Figs. 1, 6, 7, 17, 51, 52

NOISE SUPPRESSION

1. Longitudinal Noise

1.01 When ringing is applied to a line connected to either a 51A or 52A KTU, (R) or (T) thermistor resistance becomes low, causing the line to become temporarily unbalanced to ground. After ringing stops [due to call being answered], thermistor should cool rapidly, raising resistance and balancing line. In some areas where an ac ground potential is present, a diminishing longitudinal noise may be heard during thermistor cooling period. In some extreme cases, ground potential may be high enough to keep thermistors in a low resistance condition throughout the call, causing severe noise.

1.02 Where the trouble described in 1.01 above is to be corrected, all of the lines in the system should be equipped or modified per one of the following: 50-type KTUs should be replaced by bent angle-type KTUs per SD-69091-01, Fig. 43 (dial) or Fig. 44 (manual), or system should be changed to a 1A1 key telephone system using 200-type KTUs per SD-692023-01, Fig. 1 (see note below), or, **if replacement or change is not practical**, 51A and 52A KTUs should be modified per Figs. 27 and 28. Any of these three methods will result in opening of the "ST" lead at the time a call is answered, thereby removing ground from the line.

Note: If system is to be changed to a 1A1 key telephone system and telephone sets are of the type **not** suitable for 1A1 application, line circuit per SD-69230-01, Fig. 1 may be used together with 1A key telephone system stations.

2. Ringing Circuit Operation for Fig. 17 or 23 Modified Per Fig. 27 or 28

2.01 On incoming calls, flashing, time-out, and common audible signals operate in the normal manner. Answering the call operates relay (L1). Relay (L1) operates relay (SR). Relay (SR) releases relay (R) and operates relay (SW) shown in Figs. 27 and 28. Relay (SW) operates relay (TO) and opens "ST" lead (see Fig. A, opposite page).

Notes (See Figs. 27 and 28)

1. **Add** one 17B KTU per line.

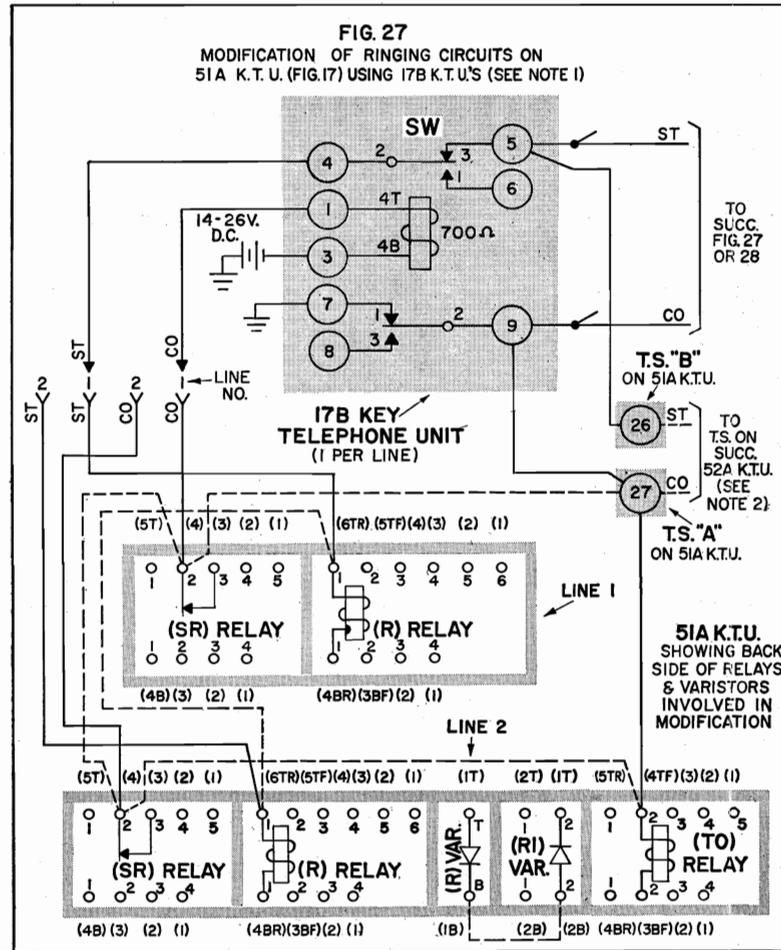
Add strapping as shown by solid lines.

Remove strapping as shown by dotted lines.

2. **If system is equipped with 53A, 54A, or 55A KTU**, connect straps from pchg 26 and 27 on terminal strip of 53A, 54A, or 55A KTU directly to pchg 26 on terminal strip "B" and pchg 27 on terminal strip "A" of 51A KTU, respectively.

FIGS. 27, 28

MODIFICATION OF 51A AND 52A KTUs



OPERATE SEQUENCE

1. Line Busy Lamp

1.01 Seizure of line by any station operates relay (A). Relay (A) operates relay (B). Operated relay (B) prepares circuit for stepping selector (A) and lights station signal lamps steadily.

Note: Talking battery for all stations is supplied through winding of relay (A).

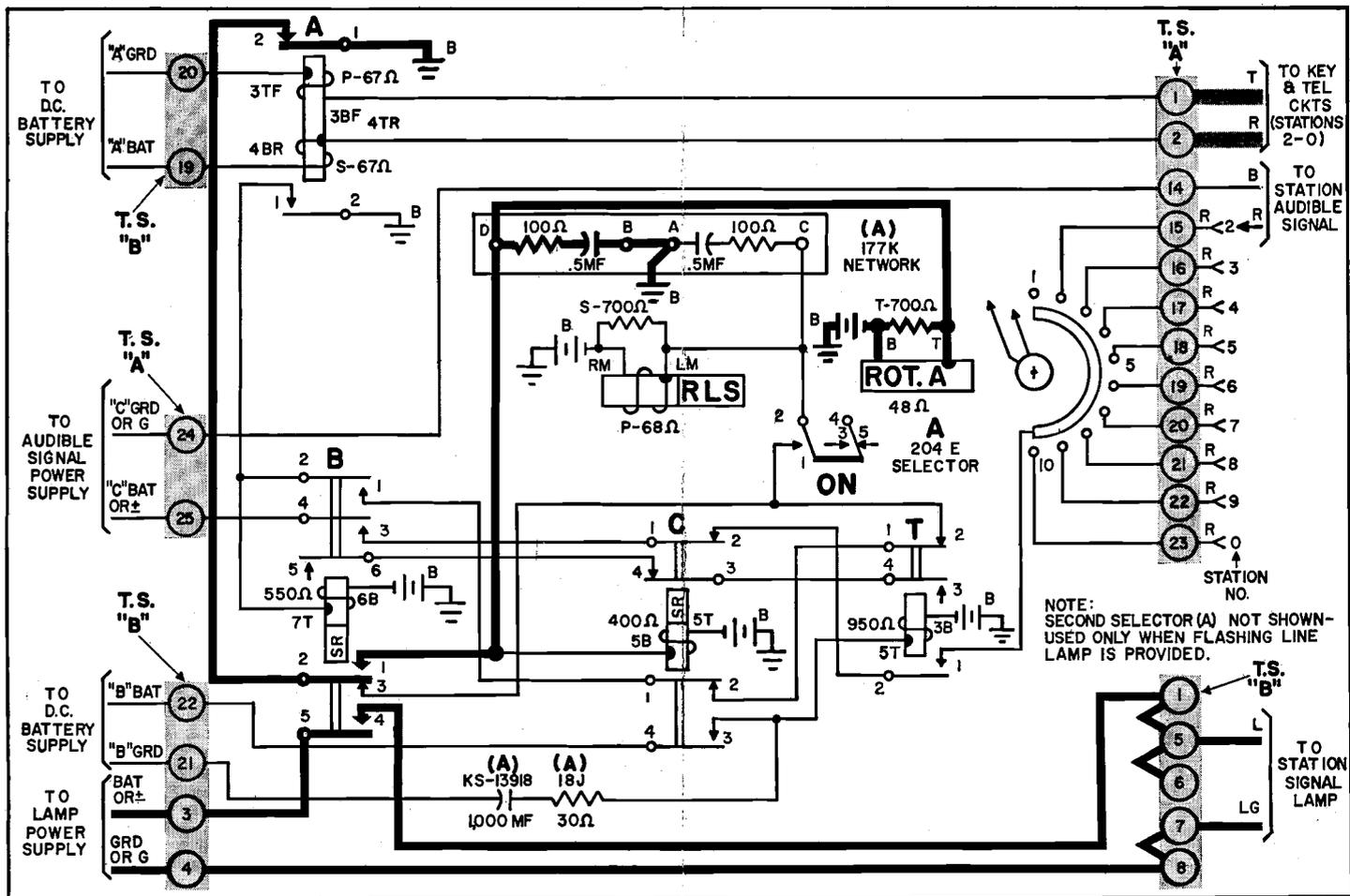
2. Dialing

2.01 Relay (A) follows dial pulses as number is dialed. On first release of relay (A), relay (C) operates and selector (A) steps [during set of dial pulses, slow release relays (B) and (C) remain operated]. Operated relay (C) puts ground to condenser (A) and winding of relay (T), charging condenser (A) and operating relay (T). As pulsing continues, alternate release and reoperate of relay (A) operates and releases rotary magnet (A) which causes selector (A) to step in a rotary direction in unison with dial pulses. On the first step of selector (A), "ON" contacts close, preparing circuit for release of selector (A).

Note: "D"—"B" part of network (A) prevents excessive arcing at upper contacts of relay (A) during dialing.

Reference:
SD-69199-01,
Figs. 1, 51

FIG. 29 57A KTU—DIAL SELECTIVE INTERCOMMUNICATING LINE CIRCUIT—DIALING AND BUSY LAMP CIRCUITS



57A KTU—DIAL SELECTIVE INTERCOMMUNICATING LINE CIRCUIT—AUDIBLE SIGNALING

FIG. 30

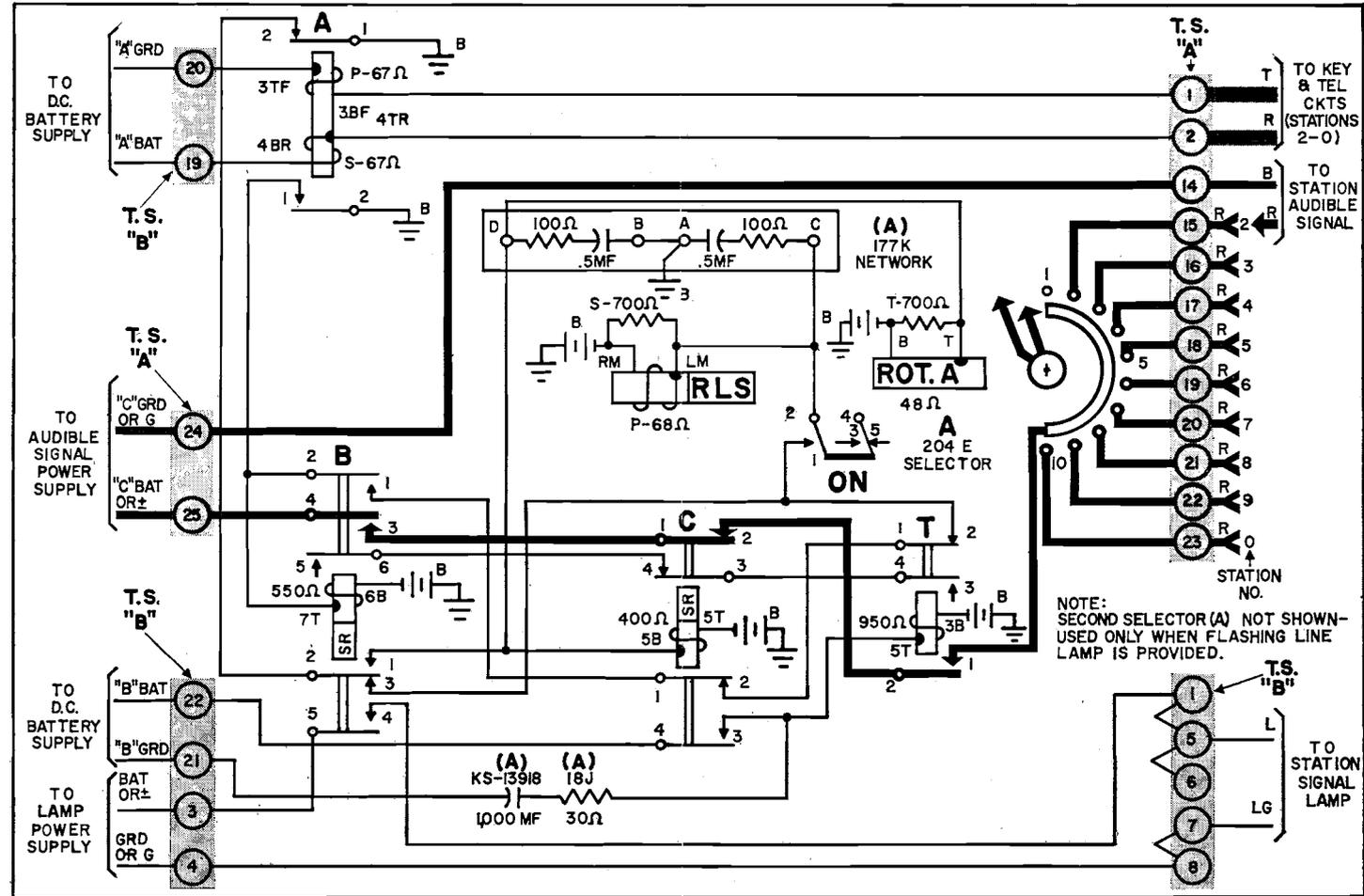
OPERATE SEQUENCE

1. Signaling

1.01 Upon completion of dialing, rotary selector (A) stops at "R" lead to called station's audible signal, and relay (A) remains operated. Operated relay (A) releases relay (C). Release of relay (C) starts operation of called station's audible signal and opens ground lead to condenser (A) and winding of relay (T). Removal of ground from condenser (A) and winding of relay (T) allows previously charged condenser (A) to discharge through winding of relay (T), holding relay (T) operated for 1 to 3 seconds after relay (C) is released [or until discharging current reaches a value which permits release of relay (T)]. Called station's audible signal operates **only** during discharge period of condenser (A) or until relay (T) releases.

Note: If call is not answered, calling station may resignal without intervening hangup by redialing called station's number.

Reference:
SD-69199-01,
Figs. 1, 51



RELEASE SEQUENCE

1. Rotary Selector (A)

1.01 **Circuit condition:** Dialing ended, relays (A) and (B) operated, relay (C) released, and relay (T) releasing.

1.02 Release of relay (T) silences audible signal and operates release (RLS) magnet. Operation of release magnet returns rotary selector (A) to normal. Return to normal of selector (A) causes "ON" contacts to open. Open "ON" contacts effect the release of release (RLS) magnet.

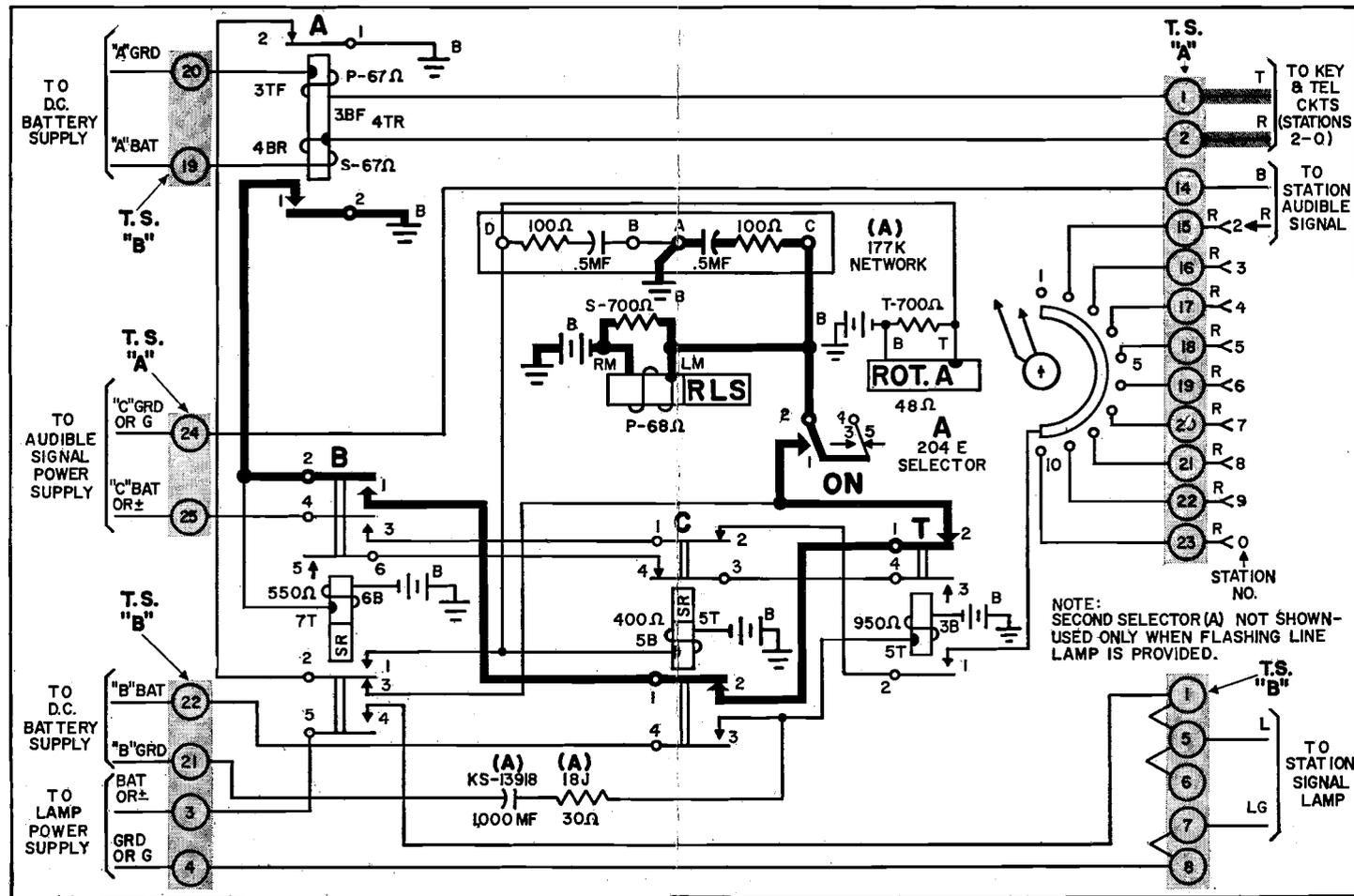
Note: "A"—"C" part of network (A) prevents excessive arcing at "ON" contacts.

2. Disconnection

2.01 Answering by called station effects no further change in circuit. Disconnection by **both** stations releases relay (A). Relay (A) releases relay (B). Released relay (B) extinguishes station signal lamp.

FIG. 31

57A KTU—DIAL SELECTIVE INTERCOMMUNICATING LINE CIRCUIT—RELEASE



Reference:
SD-69199-01,
Figs. 1, 51

BELL SYSTEM PRACTICES
Station Installation and Maintenance

ADDENDUM C53.154
Issue 1, Aug., 1955
AT&T Co Provisional

KEY TELEPHONE SYSTEM 1A

MAINTENANCE

1. GENERAL

1.01 This addendum supplements Section C53.154, Issue 3.
It is issued to replace Figs. 27, 28, 29, 30, and 31 of
this section with corrected drawings.

Revised Figs. 27 and 28 replace Figs. 27 and 28 in Section.

Revised Fig. 29 replaces Fig. 29 in Section.

Revised Fig. 30 replaces Fig. 30 in Section.

Revised Fig. 31 replaces Fig. 31 in Section.

NOISE SUPPRESSION

1. Longitudinal Noise

1.01 When ringing is applied to a line connected to either a 51A or 52A KTU, (R) or (T) thermistor resistance becomes low, causing the line to become temporarily unbalanced to ground. After ringing stops (due to call being answered), thermistor should cool rapidly, raising resistance and balancing line. In some areas where an ac ground potential is present, a diminishing longitudinal noise may be heard during thermistor cooling period. In some extreme cases, ground potential may be high enough to keep thermistors in a low resistance condition throughout the call, causing severe noise.

1.02 Where the trouble described in 1.01 above is to be corrected, all of the lines in the system should be equipped or modified per one of the following: 50-type KTUs should be replaced by bent angle-type KTUs per SD-69091-01, Fig. 43 (dial) or Fig. 44 (manual), or system should be changed to a 1A1 key telephone system using 200-type KTUs per SD-69203-01, Fig. 1 (see note below), or if replacement or change is not practical, 51A and 52A KTUs should be modified per Figs. 27 and 28. Any of these three methods will result in opening of the "ST" lead at the time a call is answered, thereby removing ground from the line.

Note: If system is to be changed to a 1A1 key telephone system and telephone sets are of the type not suitable for 1A1 application, line circuit per SD-69230-01, Fig. 1 may be used together with 1A key telephone system stations.

2. Ringing Circuit Operation for Fig. 17 or 23 Modified Per Fig. 27 or 28

2.01 On incoming calls, flashing, time-out, and common audible signals operate in the normal manner. Answering the call operates relay (L1). Relay (L1) operates relay (SR). Relay (SR) releases relay (R) and operates relay (SW) shown in Figs. 27 and 28. Relay (SW) operates relay (TO) and opens "ST" lead (see Fig. A, opposite page).

Notes (See Figs. 27 and 28)

1. Add one 17B KTU per line.

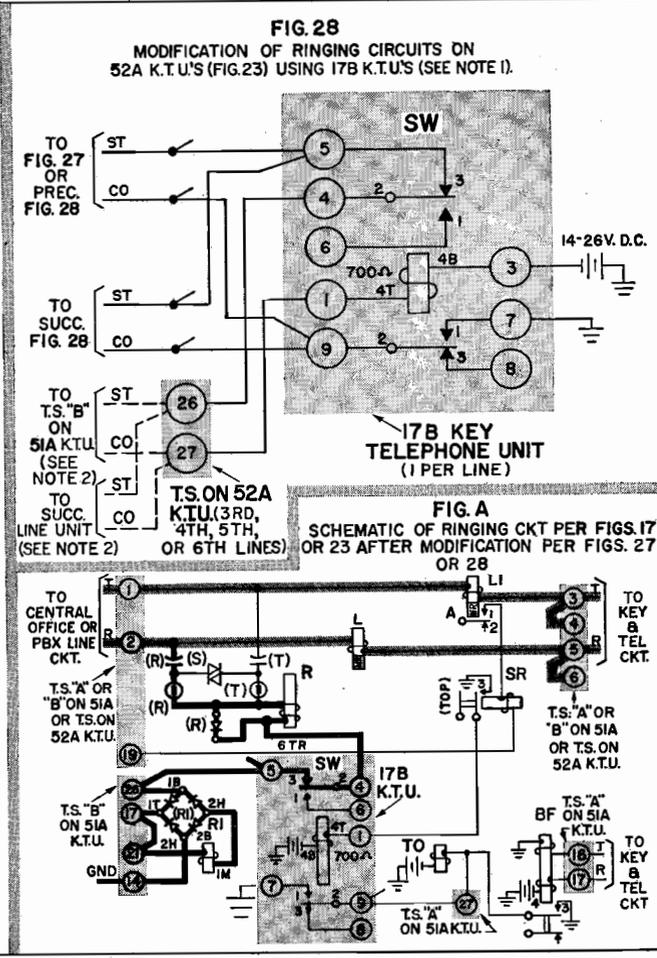
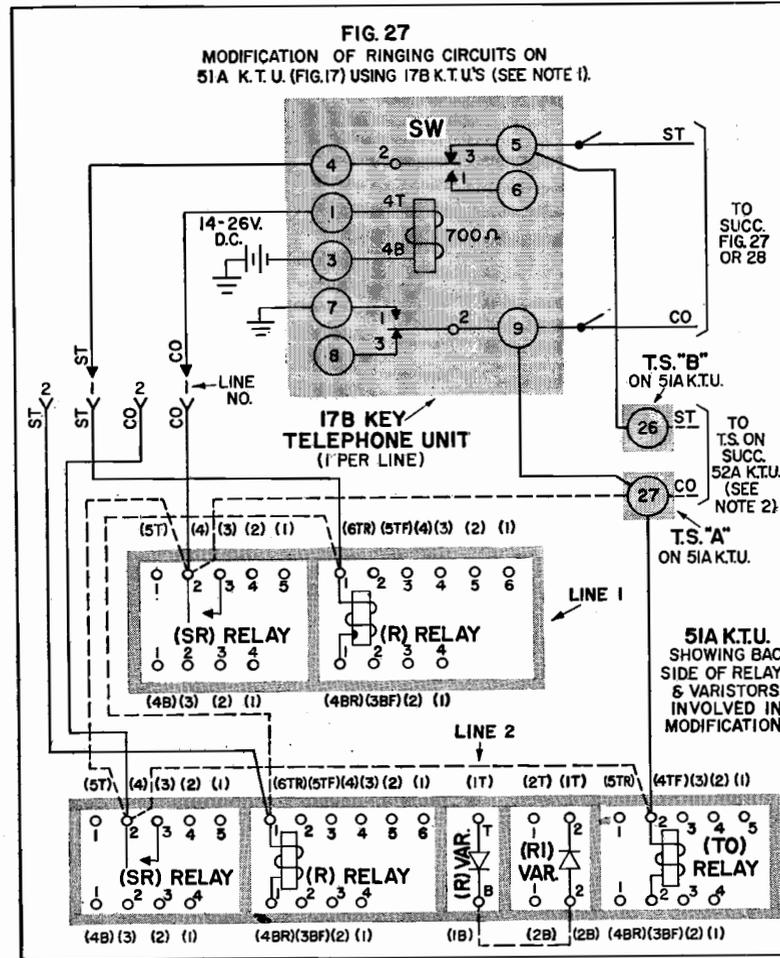
Add strapping as shown by solid lines.

Remove strapping as shown by dotted lines.

2. If system is equipped with 53A, 54A, or 55A KTU, connect straps from punchings 26 and 27 on terminal strip of 53A, 54A, or 55A KTU directly to punching 26 on terminal strip "B" and punching 27 on terminal strip "A" of 51A KTU, respectively.

FIGS. 27, 28

MODIFICATION OF 51A AND 52A KTUs



OPERATE SEQUENCE

1. Line Busy Lamp

1.01 Seizure of line by any station operates relay (A). Relay (A) operates relay (B). Operated relay (B) prepares circuit for stepping selector (A) and lights station signal lamps steadily.

Note: Talking battery for all stations is supplied through winding of relay (A).

2. Dialing

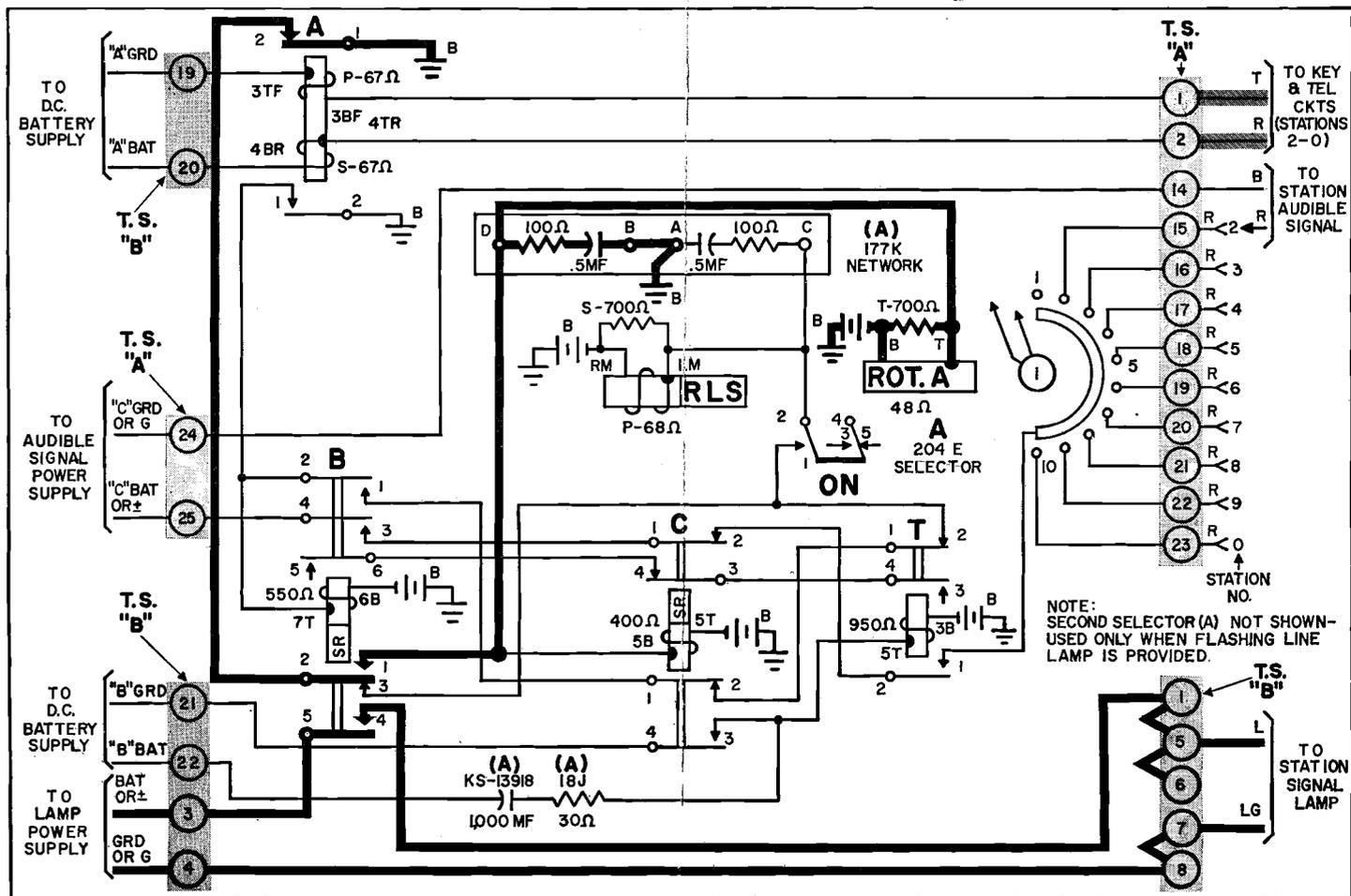
2.01 Relay (A) follows dial pulses as number is dialed. On first release of relay (A), relay (C) operates and selector (A) steps (during set of dial pulses, slow release relays (B) and (C) remain operated). Operated relay (C) puts ground to condenser (A) and winding of relay (T), charging condenser (A) and operating relay (T). As pulsing continues, alternate release and reoperate of relay (A) operates and releases rotary magnate (A) which causes selector (A) to step in a rotary direction in unison with dial pulses. On the first step of selector (A), "ON" contacts close, preparing circuit for release of selector (A).

Note: "D"—"B" part of network (A) prevents excessive arcing at upper contacts of relay (A) during dialing.

Reference:
SD-69199-01,
Figs. 1, 51

FIG. 29

57A KTU-DIAL SELECTIVE INTERCOMMUNICATING LINE CIRCUIT-DIALING AND BUSY LAMP CIRCUITS



OPERATE SEQUENCE

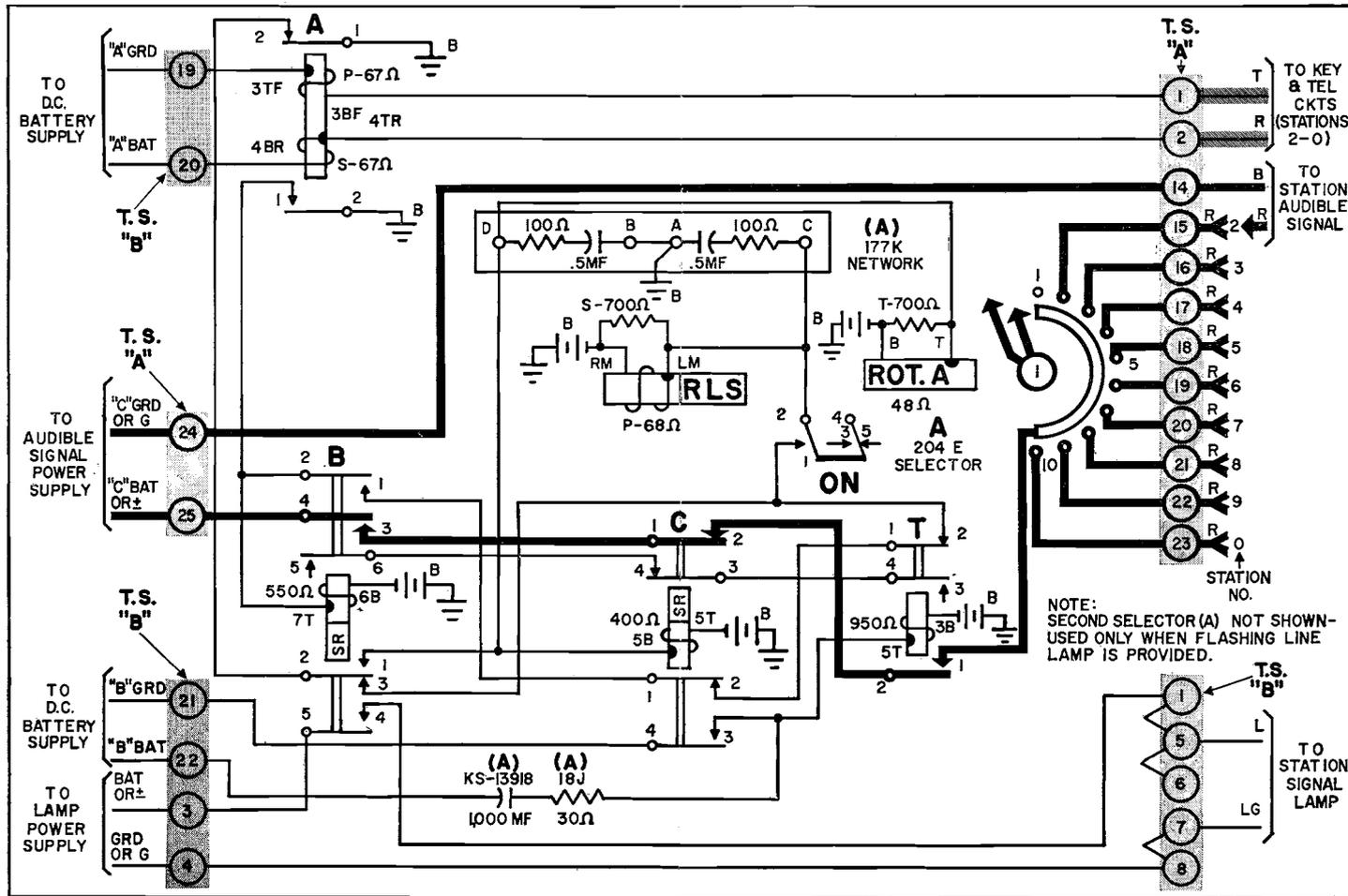
1. Signaling

1.01 Upon completion of dialing, rotary selector (A) stops at "R" lead to called station's audible signal, and relay (A) remains operated. Operated relay (A) releases relay (C). Release of relay (C) starts operation of called station's audible signal and opens ground lead to condenser (A) and winding of relay (T). Removal of ground from condenser (A) and winding of relay (T) allows previously charged condenser (A) to discharge through winding of relay (T), holding relay (T) operated for 1 to 3 seconds after relay (C) is released [or until discharging current reaches a value which permits release of relay (T)]. Called station's audible signal operates **only** during discharge period of condenser (A) or until relay (T) releases.

Note: If call is not answered, calling station may re-signal without intervening hangup by redialing called station's number.

FIG. 30

57A KTU-DIAL SELECTIVE INTERCOMMUNICATING LINE CIRCUIT-AUDIBLE SIGNALING



Reference:
SD-69199-01,
Figs. 1, 51

RELEASE SEQUENCE

1. Rotary Selector (A)

1.01 **Circuit condition:** Dialing ended, relays (A) and (B) operated, relay (C) released, and relay (T) releasing.

1.02 Release of relay (T) silences audible signal and operates release (RLS) magnet. Operation of release magnet returns rotary selector (A) to normal. Return to normal of selector (A) causes "ON" contacts to open. Open "ON" contacts effect the release of release (RLS) magnet.

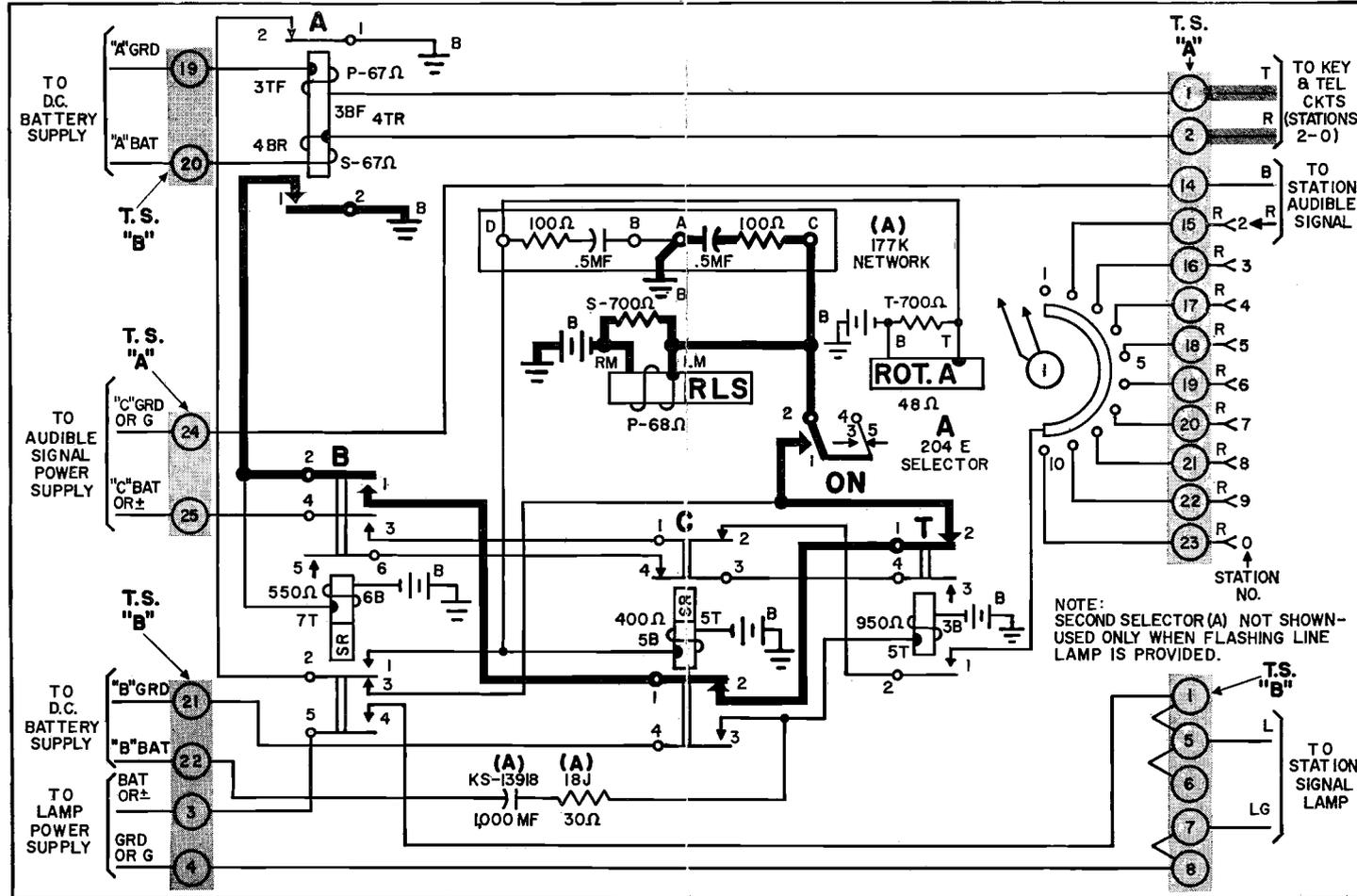
Note: "A"—"C" part of network (A) prevents excessive arcing at "ON" contacts.

2. Disconnection

2.01 Answering by called station effects no further change in circuit. Disconnection by **both** stations releases relay (A). Relay (A) releases relay (B). Released relay (B) extinguishes station signal lamp.

FIG. 31

57A KTU—DIAL SELECTIVE INTERCOMMUNICATING LINE CIRCUIT—RELEASE



Reference:
SD-69199-01,
Figs. 1, 51