

**PRIVATE LINE SERVICE TERMINATIONS  
STATION ENGINEERING INFORMATION  
ENGINEERING SKETCHES AND SIGNALING DEVICES**

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**1. GENERAL**

**1.01** This section provides information for miscellaneous standard circuit arrangements of a special nature. These arrangements are not available on schematic drawings (SDs) or in other Sections.



*Comments concerning contents, usability, and adequacy of this practice will be welcome. Mail comments directly to the Bell System Practices Organization.*

Mail to:  
 Bell System  
 Data Design Engineering Manager  
 2400 Reynolda Road  
 Winston-Salem, N.C. 27106

**1.02** This section is reissued to provide current reference information.

**1.03** This section will serve as an aid to those who are engaged in the provision of these arrangements by providing:

- Associated uniform service order codes (USOC), (where applicable)

- Detail schematics
- Circuit descriptions
- Apparatus requirements.

**1.04** General notes for all figures appear on a foldout on the last page of this section.

**1.05** For general information for the entire Private Line Service Terminations series, refer to Section 812-002-200.

**1.06** Section 812-002-201, uniform service order code (USOC) index of definitions and applications, complements this section with additional information and references. It provides coordination for the entire Private Line Service Terminations series, and will be maintained to reflect changes in the related sections.

**2. PRIVATE LINE SERVICE TERMINATIONS SERIES**

**2.01** The following sections constitute the Private Line Service Terminations series. All of these are related sections.

SECTION	TITLE
812-002-200	General Information
812-002-201	Uniform Service Order Code (USOC) Index of Definitions and Applications
812-002-210	PBX Terminations (Tie Trunk and SS-3)
812-002-211	PBX Terminations (Foreign Exchange and Wide Area Telephone Service)
812-002-215	Telephoto Station Arrangements
812-002-221	Station Equipment (Voice)
812-002-230	Station Equipment (Data Voiceband)
812-002-231	Station Equipment (Data Wideband)
812-002-250	Alternate Arrangements
812-002-270	Engineering Sketches and Signaling Devices

SECTION	TITLE
812-002-290	V4 Repeater Mountings and Components

### 3. INDEX OF USOC REFERENCE TABLES

**3.01** The following is an index of tables that provide a reference to related sections requiring the use of the associated arrangement:

Table A—Index for Arrangements With an Associated USOC

Table B—Index for Arrangements Without an Associated USOC.

### 4. TRANSFER CIRCUITS (USOC 1YXKA) (FIG. 1, 2, 3, 4, 5, AND 6)

**4.01** Uniform Service Order Code (USOC) 1YXKA specifies a transfer arrangement to permit transferring a 2-wire or 4-wire facility from one termination to another on the same premises, e.g., from a PBX termination to a data termination.

**4.02** This section provides the following 2-wire and 4-wire transfer arrangements to fulfill the requirements of USOC 1YXKA:

- Fig. 1 (2-wire) and Fig. 2 (4-wire)—locally controlled (transfer is effected by contacts of a 6017AP key modified).
- Fig. 3 (2-wire) and Fig. 4 (4-wire)—remotely controlled by locking key (transfer is effected by relay contacts of a 229B KTU).

**TABLE A**  
**INDEX FOR ARRANGEMENTS WITH AN ASSOCIATED USOC**

USOC	ARRANGEMENT DESCRIPTION	REFERENCE (THIS SECTION)	RELATED SECTION
1YXKA	Transfer Circuits	Part 4	812-002-210 812-002-211 812-002-221 812-002-230 812-002-231 812-002-250
27M	Automatic Ringing Circuit	Part 6	812-002-221
BCA	Steady Signal Without Time-out		
BCB	Intermittent Signal With-out Time-out		
UU5	Signal Control	Part 7	812-002-221
7FW	.5 to 200 sec Interval		
F4F	2400 and 2600 Hz Filter	Part 8	812-002-221
28S	Key Control for Switching Arrangements	Part 9	
29A			
29B			
29C			
9BX	Lamp Indicator		
27S	Voice-Operated Busy Circuit	Part 16	812-002-221

**TABLE B**  
**INDEX FOR ARRANGEMENTS WITHOUT AN ASSOCIATED USOC**

ARRANGEMENT DESCRIPTION	REFERENCE (THIS SECTION)	RELATED SECTION
Range Extension Circuit	Part 5	
Idle Circuit Termination	Part 10	812-002-210 812-002-211
Modification Loop-to- Loop Dial Long Line Circuit	Part 11	812-002-211 812-002-221
Repeat Coil Duplex Signaling Arrangement	Part 12	812-002-211
Repeat Coil Arrangements Using 219A KTU	Part 13	
Wet Loop Control Circuit	Part 14	
Dial Pulse Suppression Circuit	Part 15	
Make Busy Arrangements	Part 17	

- Fig. 5 (2-wire) and Fig. 6 (4-wire)—remotely controlled by non-locking key (transfer is effected by relay contacts of the W-Z circuit arrangement of the 241B KTU).
- 4.03** In selecting one of the above arrangements for a specific installation, the following should be considered.
- Economics
  - Equipment arrangements (availability of cable pairs in house cable or inside wiring plan cable, etc)
  - Customer requirements:
    - (a) More than one location required to control transfer
    - (b) Office decor (customer does not want external keys mounted on furniture)
    - (c) Specific request to use spare non-locking key in key sets, CALL DIRECTOR® sets, etc.
- 4.04** Each of the transfer circuits (Fig. 1 through 6) are arranged to:
- Transfer the transmission path from the regular termination to the alternate termination.
  - Illuminate a lamp to provide visual status of the transfer circuit (provides leads for controlling separate lamps, one each at the regular and alternate location, if required).
  - Control make-busy arrangements to provide busy indications for regular and alternate terminations, as required.
- 4.05** The 4-wire transfer circuits (Fig. 2, 4, 6) provide an additional lead to activate the not-in-data indication feature of the 828 Data Auxiliary Set, as required.
- 4.06** The not-in-data indication provides an off-normal indication to the modem of the data set to turn off the data set ready (DSR) lead to the customer-provided terminal equipment. This indicates to the terminal equipment that the data set is not ready to send or receive. This, in effect, provides a make-busy condition to the data terminal.

**4.07** Section 812-002-250 provides typical applications of transfer circuits depicted in this section.

**Circuit Description (Fig. 1 and 2)**

**4.08** Fig. 1 and 2 provide a 2-wire and a 4-wire transfer circuit, respectively, to switch from a regular to an alternate termination.

**4.09** In the normal condition (circuit unoperated):

- The 2-wire or 4-wire facility is connected to the regular termination.
- Lamp ground is applied to lead L to illuminate the lamp associated with the regular termination.
- Ground is applied to the MB lead to activate the make-busy feature associated with the alternate termination.
- With the 4-wire arrangement, battery is applied to the B lead to activate the not-in-data indication at the data terminal.

**4.10** In the transferred condition (circuit operated):

- The 2-wire or 4-wire facility is connected to the alternate termination.
- Lamp ground is applied to lead L to illuminate the lamp associated with the alternate termination.
- Ground is applied to the MB lead to activate the make-busy feature associated with the regular termination.

**4.11** Modification of the 6017AP key for use with Fig. 1 and 2 must be made as follows:

- Remove resistors between terminals 6 and 9, 4 and 18, 12 and 17, 13 and 18, and 10 and 15.
- Remove strap between terminals 7 and 12.
- Place a strap between terminal 16 and the upper right spring, number 3, of the key.

**4.12** Apparatus requirements:

- Key 6017AP (modified)

- Indicator (as required).

**Circuit Description (Fig. 3 and 4)**

**4.13** Fig. 3 and 4 provide a 2-wire and a 4-wire transfer circuit, respectively, to switch from a regular to an alternate termination.

**4.14** Operation of the locking key of Fig. 8 operates the relay of Fig. 3 or 4. All other functions are as described for Fig. 1 and 2, in 4.09 through 4.10.

**4.15** Apparatus requirements:

- Key telephone unit, 229B
- Control key (as required)
- Indicator (as required).

**Circuit Description (Fig. 5 and 6)**

**4.16** Fig. 5 and 6 provide a 2-wire and a 4-wire transfer circuit, respectively, to switch from a regular termination to an alternate termination.

**4.17** Operation of the non-locking key of Fig. 8 connects ground to the S lead of Fig. 5 or 6. Ground on the S lead operates Relay AW which locks operated via its operated contacts EMB6. Relay AZ is held de-energized by applied ground through its released contacts EBM6.

**4.18** When the key is released, ground is removed from the S lead. This function removes the shunt from relay AZ which operates in parallel with relay AW.

**4.19** When the non-locking key of Fig. 8 is again operated, ground is applied to lead S which causes relay AW to release due to the shunt applied through operated contacts EBM6 of the AZ relay. Relay AZ releases when the non-locking key of Fig. 8 is released, restoring this circuit to normal.

**4.20** Relay AW operated (4.17) operates relay AT, and relay AW released releases relay AT.

**4.21** The operation and release of relay AT performs the same functions as described in 4.09 and 4.10 for Fig. 1 and 2.

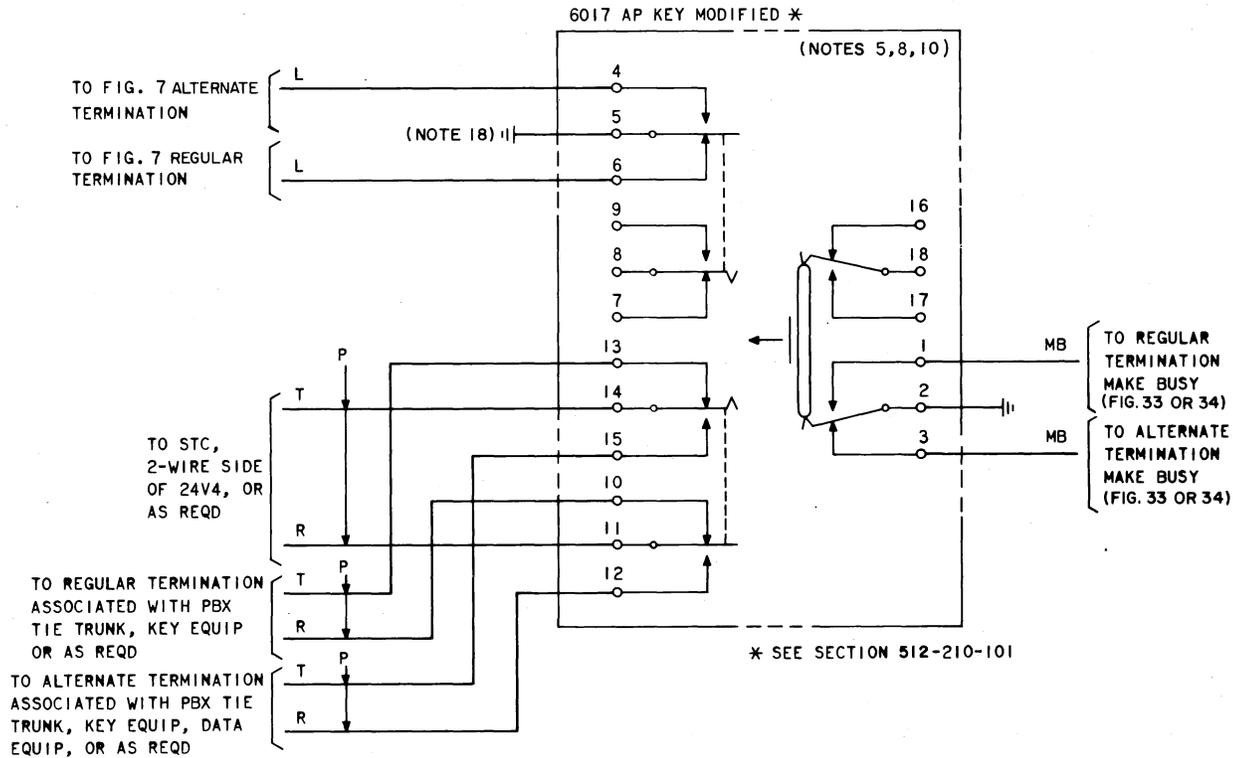


Fig. 1—2-Wire Transfer Circuit (Locally Controlled)

4.22 Apparatus requirements:

- Key telephone unit, 241B
- Control key (as required)
- Indicator (as required).

Key and Lamp (Fig. 7 and 8)

4.23 Fig. 7 and 8 show a typical key and lamp which may be externally mounted or a part of a multibutton telephone set or other equipment.

4.24 Apparatus requirements:

- Key and indicator (as required).

5. RANGE EXTENSION CIRCUIT (FIG. 9)

5.01 Fig. 9 shows a 17B KTU. This is used to extend the range of the S leads of Fig. 5 and 6, when required. The maximum range of the S lead without Fig. 9 is 35 ohms. The maximum range of the S lead with Fig. 9 is 1100 ohms.

5.02 Apparatus requirement:

- Key telephone unit, 17B.

6. AUTOMATIC RINGING ARRANGEMENT (USOC 27M FOR KEY SYSTEMS OR SINGLE LINE TELEPHONE SETS) (FIG. 10-13)

6.01 Uniform Service Order Code (USOC) 27M specifies an automatic ringing arrangement to transmit one nonrecurring two second outgoing signal to the distant end of a private line circuit (the use of USOC 27M eliminates the requirement for manually operating a ringing key).

6.02 Due to the single spurt of outgoing signal, consideration must be given to equipping the distant end with one of the following:

USOC BCA—On incoming calls operates the audible and/or visual signal continuously upon receipt of a single spurt of incoming signal and continues operating until

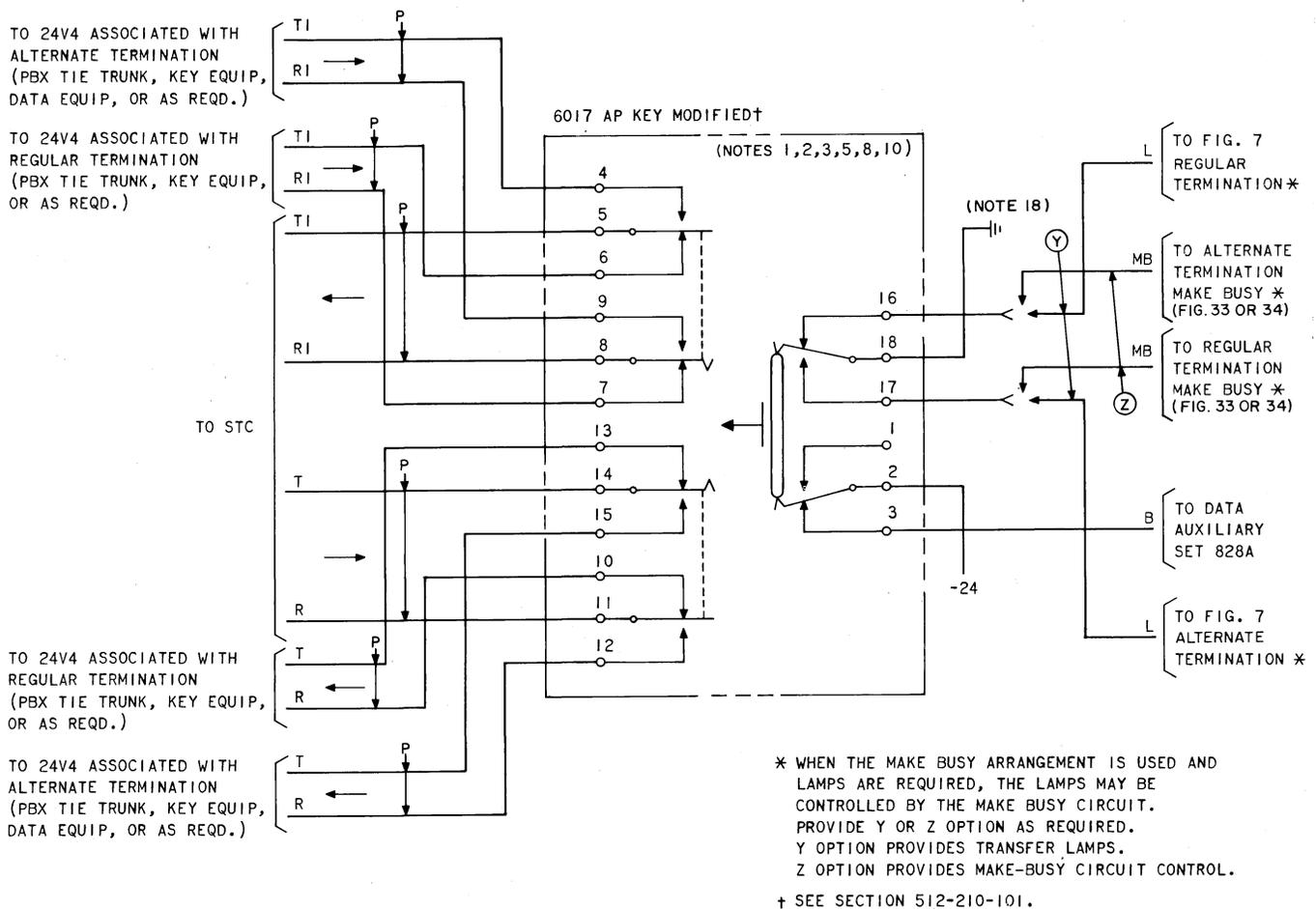


Fig. 2—4-Wire Transfer Circuit (Locally Controlled)

manually released by a key or switchhook operation.

USOC UU5—Steady incoming signal with time-out.

**Note:** The 419A KTU of Fig. 10 has a built-in time-out circuit (USOCs UU5 or 7FW) which will be provided even though not specified by USOC BCA or BCB.

USOC BCB—Identical to BCA except the audible and/or visual signal is interrupted.

USOC 7FW—Intermittent incoming signal with time-out.

6.03 Should the private line circuit require 2-way signaling (both the local station and distant

end equipped with USOC 27M), consideration must be given to equipping both ends of the circuit with either USOC BCA or BCB.

6.04 Fig. 10, 11, 12, and 13 show arrangements which fulfill the requirement for USOC 27M.

6.05 Fig. 10 requires a 419A KTU which is designed to connect a telephone set over a private line to a distant location. Another 419A KTU or tie line KTU which will respond to and transmit ringing voltage is required at the distant location. The distant telephone set is automatically signaled when the line key is operated and the local telephone handset is lifted. The 419A KTU provides a talking and signaling circuit with the following operating features:

- Pickup and hold.

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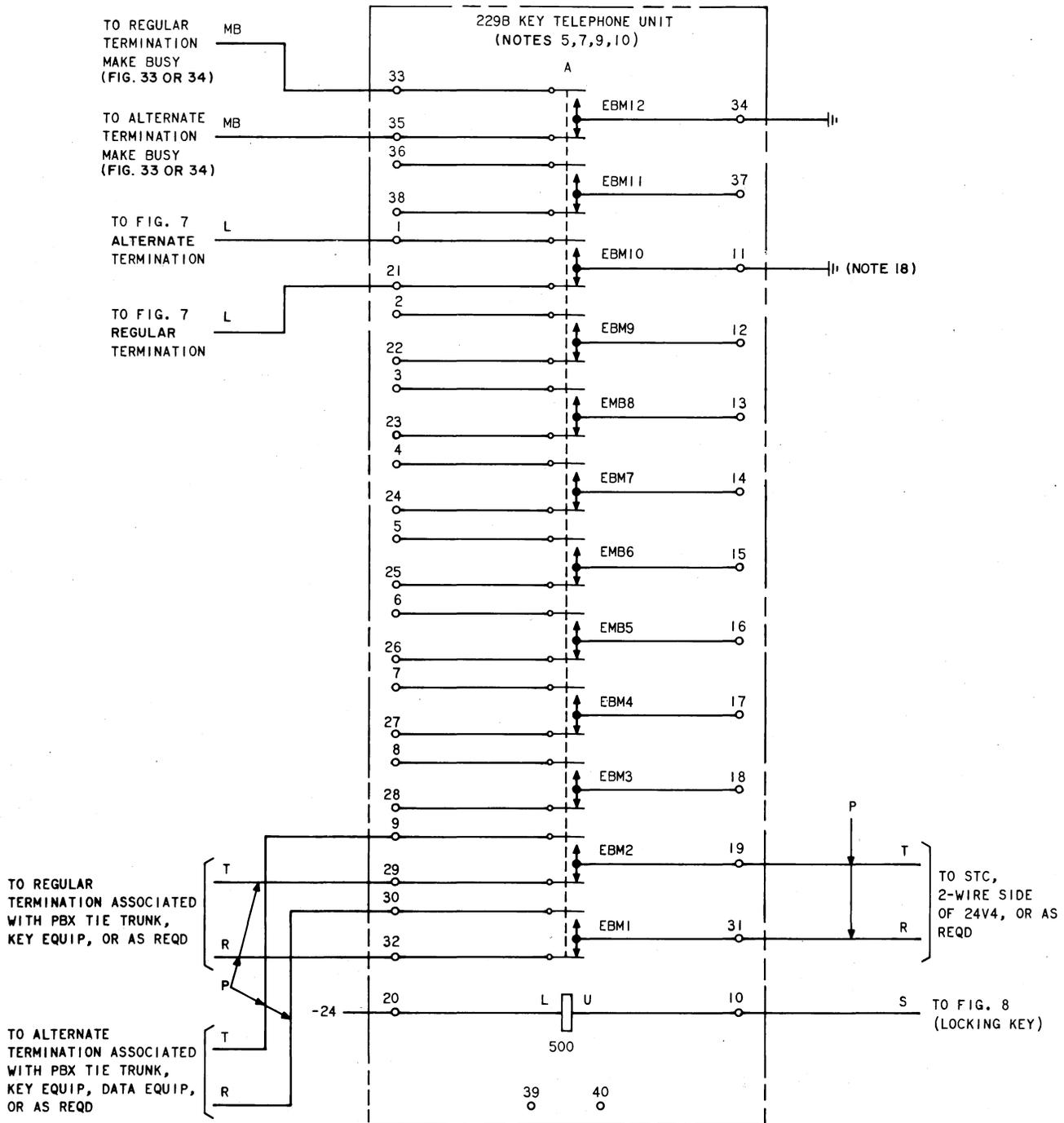


Fig. 3—2-Wire Transfer Circuit (Remotely Controlled by Locking Key)

- Flashing line lamp on incoming call.
- Steady lamp indicating line busy.
- Winking lamp indicating line hold.
- Choice of audible signals: common audible, steady, or interrupted.
- Audible ringback signal optional.
- Connections for idle circuit termination.

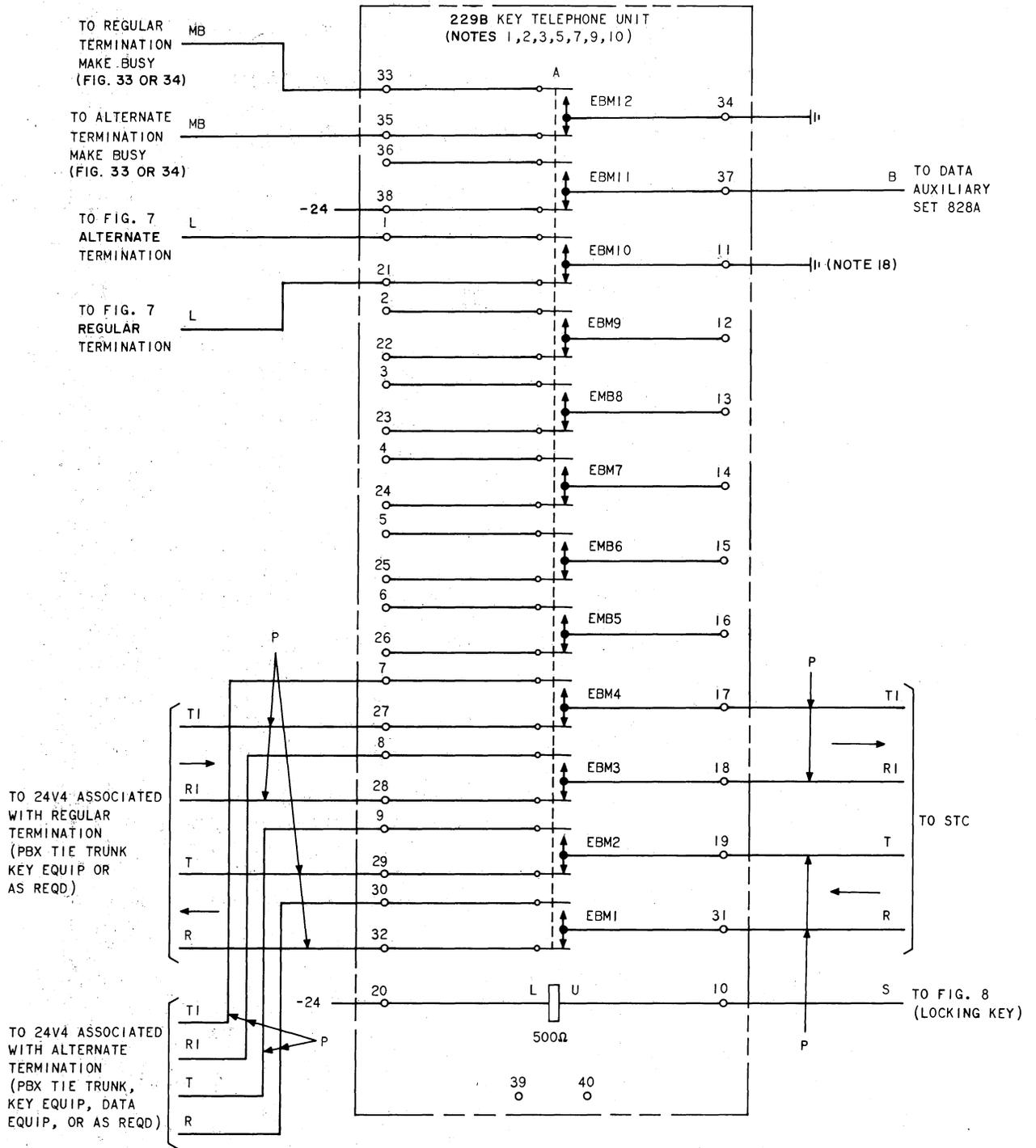


Fig. 4—Wire Transfer Circuit (Remotely Controlled by Locking Key)

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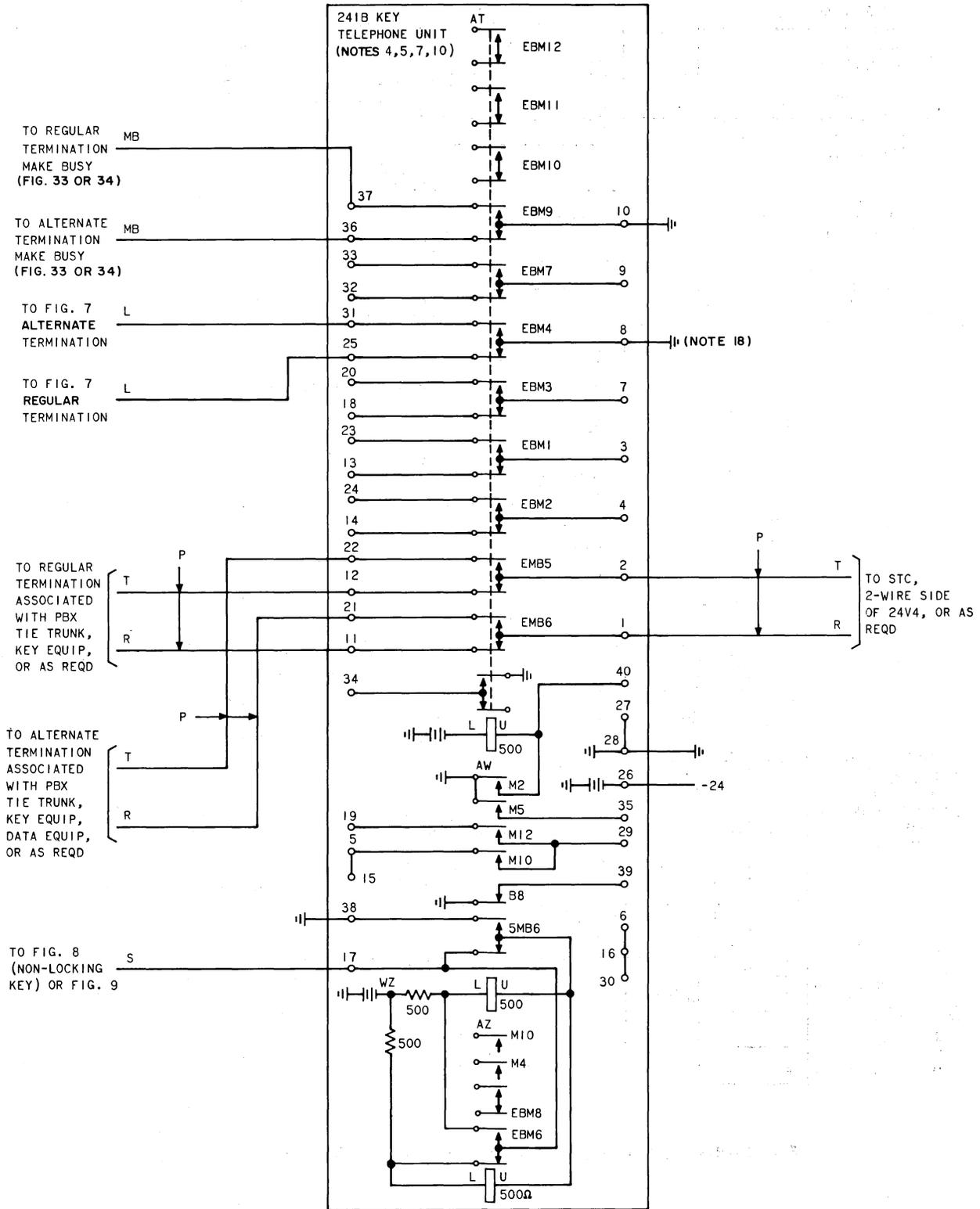


Fig. 5—2-Wire Transfer Circuit (Remotely Controlled by Non-Locking Key)

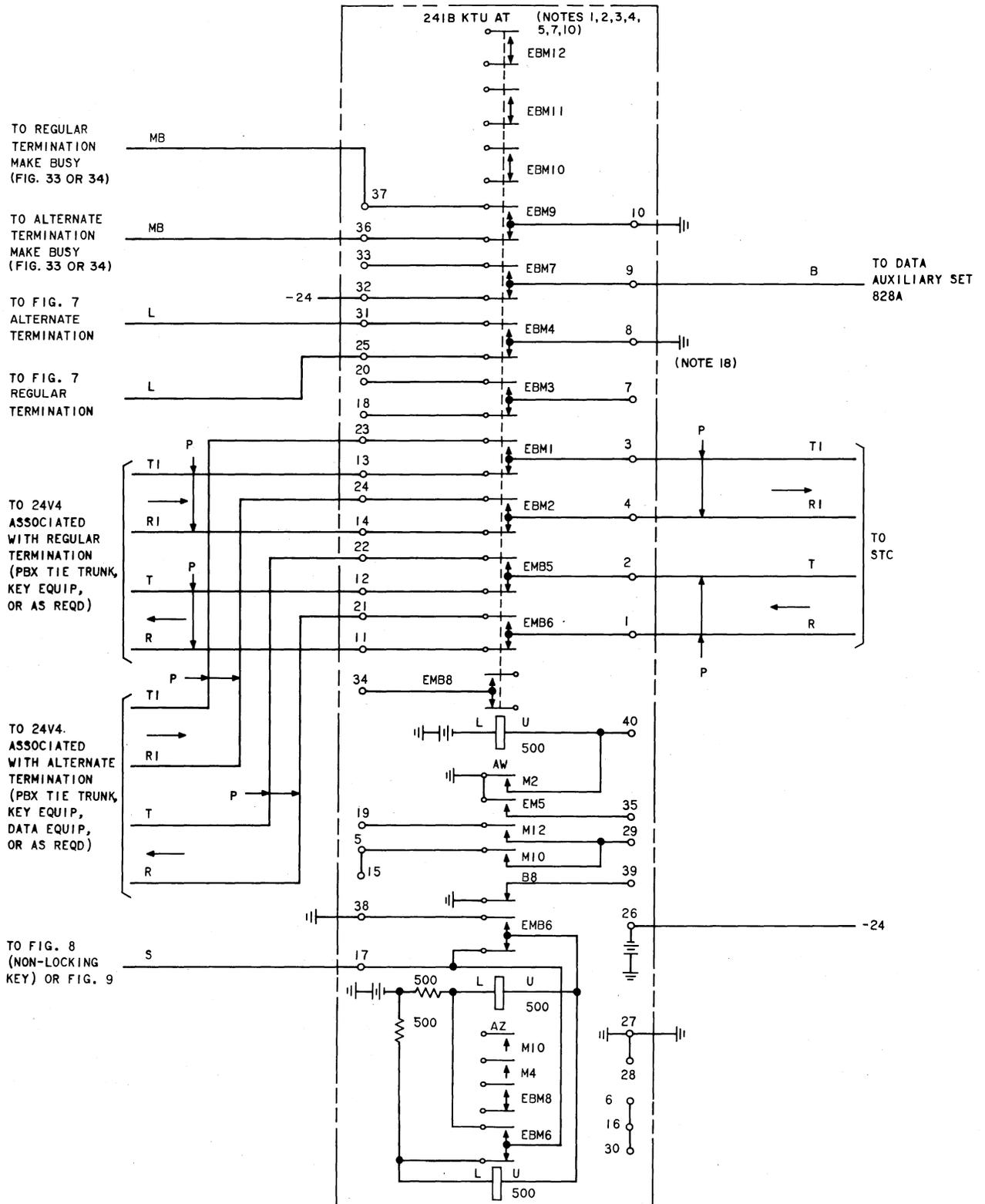


Fig. 6—4-Wire Transfer Circuit (Remotely Controlled by Non-Locking Key)

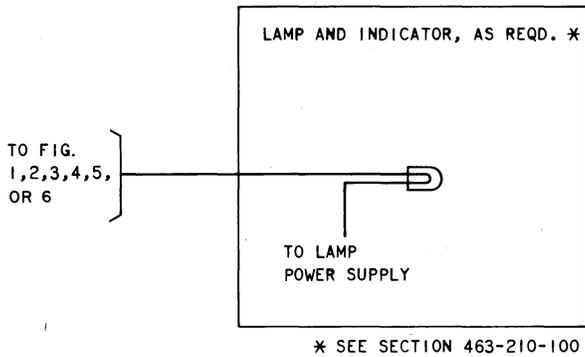


Fig. 7—Lamp and Indicator

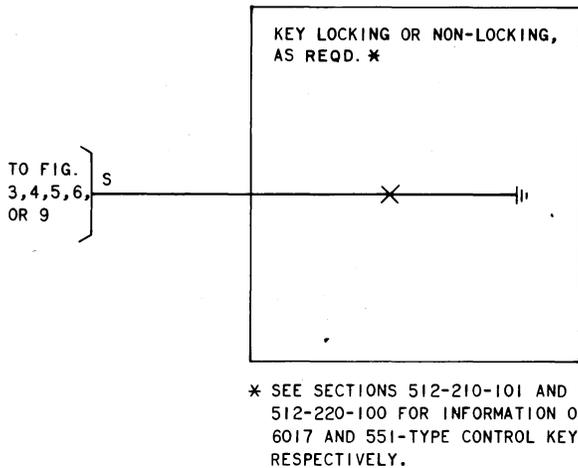


Fig. 8—Control Key

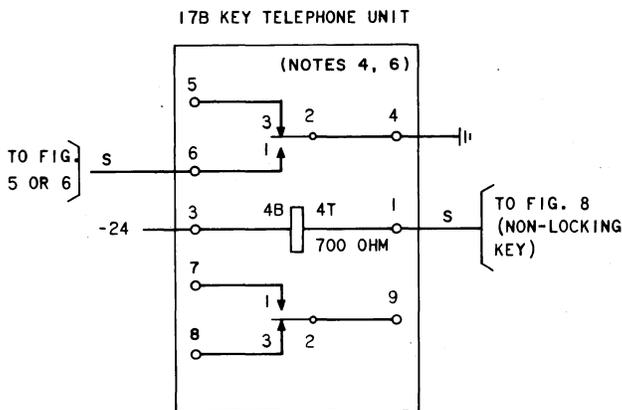


Fig. 9—Range Extension Circuit

- Time-out on unanswered incoming calls with optional time intervals.
- Hold-interrupt control to change status of 419A KTU at the distant location from HOLD to Incoming Calls (by replacing and again lifting handset of local telephone set).
- Ringing ranges (ohms) vs RMS ringing voltage. (See Table C.)

TABLE C

RINGING RANGES VS. RMS RINGING VOLTAGE

MINIMUM RMS RINGING VOLTAGE	STANDARD LOOPS 15K-OHM LEAKAGE	UNIGAUGE LOOPS 20K-OHM LEAKAGE
		OHMS
75 } volts (20 Hz)	2600 ohms	4000
84 } volts (20 Hz)		4600
92 } volts (20 Hz)		5000
110 } volts (30 Hz)	2600 ohms	5000
120 } volts (30 Hz)		5400

6.06 Fig. 11 and 12 provide schematics of the 69B and 69D apparatus mountings as applied to this arrangement. Each of these mountings are designed to accommodate one 419A KTU. Either mounting may be used for this application.

6.07 The 69B and 69D apparatus mountings are designed for frame mounting with a 99A (MD) or 99B bracket. Mounting screws are furnished with each apparatus mounting.

**Note:** The 99A (MD) or 99B bracket consists of two 23-inch mounting bars on which a maximum of 12 apparatus mountings may be installed. The upper bar includes cable supports which retain the connector cables. The bracket requires a 9-inch vertical mounting space.

6.08 An A25B connector cable is required to extend the 69B or 69D apparatus mountings to distributing terminals.

6.09 Fig. 13 provides an application schematic depicting typical interconnecting circuits

associated with the 419A KTU. The interconnecting circuits shall be provided as required.

**6.10 Apparatus requirements and reference information:**

Description	Section
Key Telephone Unit, 419A	518-215-400
Mounting, Apparatus, 69B or 69D	518-215-420
Bracket, Mounting, 99B	518-215-420
Cable, Connector, A25B	461-200-101

**Description of Operation of 419A KTU (Fig. 10-13)**

*Note:* Only a brief description is included in this section. For detailed information, refer to SD- and CD-69559-01.

**Incoming Signal**

**6.11** In the idle circuit condition, all relays are unoperated. Ringing voltage is applied to the line from the tie line circuit at the distant end which causes relay R to operate and remain operated as long as ringing voltage is present on the line. Relay R operated results in the operation of relay B. Relay B (a) operates relay C, (b) connects the LG lead to the ST lead, (c) connects the LF to the L lead, (d) connects interrupted (option W) or steady (option T) ringing current or ground (option V) to the RC lead for audible signal; with option Q or R, the audible signal is controlled by the signaling station through the R contact.

**6.12** Relay B will remain operated until the call is answered or times out. Relay C will remain operated until the call has timed out and will remain operated if the call is answered.

**Time-out of Ringup Circuit**

**6.13** Cessation of ringing current results in the release of relay R which, after a predetermined interval, results in the release of relays B and C. Relay B released disconnects the audible and visual signals to the station.

**Answering an Incoming Call**

**6.14** Removal of the handset on the associated telephone set grounds the A lead operating relay A. Relay A operated (a) releases relay B to retire the audible signals, (b) provides a holding path for the C relay, (c) removes the ringing detector bridge and idle line termination from the line and, (d) connects the local station loop to the distant circuit loop through capacitors C1 and C2.

**Outgoing Call**

**6.15** Removal of the handset on the associated telephone set grounds the A lead operating relay A. Relay A operated results in the operation of relay RO. Relay RO operated, (a) connects  $\pm 105$  ringing voltage and ringing ground to the line to signal the distant end, (b) removes the local station from the ringing voltage source, (c) feeds part of the ringing signal through capacitor C5 to the local station as audible ringback during the outgoing signaling interval, if option M is provided, (d) operates the C relay, and (e) provides a control path to maintain a ringing interval of approximately two seconds.

**Holding**

**6.16** A hold signal is generated by depressing a hold key, if provided, when the local station is off-hook and relays A and C are operated. When the hold key is depressed, ground is removed from the A lead releasing relay A. At this time the telephone set is still across the line. This condition results in the operation of relay H. Relay H operated (a) connects the LG lead to the ST lead, (b) connects the LW lead to the L lead, and (c) provides a holding path for relay C. When the hold key is released, the pickup key associated with the line releases and disconnects the telephone set from the line. Relay H is held operated through its own contacts.

**6.17** Relays H and C will remain operated until either the local station goes off-hook (and/or depresses the pickup key) or the distant tie line applies ringing voltage to the line. If the pickup key is depressed and the local station goes off-hook, the A relay will operate, releasing relay H to restore the circuit to the busy condition of relays A and C operated. If ringing voltage is applied to the line, relay R operates, operating relay B. Relay B operated, releases the H relay removing the

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hold condition and generates an incoming signal as described in 6.11 and 6.12.

### Disconnection

**6.18** When the local station goes on-hook, the telephone set is disconnected from the line, and ground is removed from the A lead; relay A releases, releasing relay C and the circuit is restored to normal.

### Idle Line Termination

**6.19** Resistor R3 and capacitor C3 in parallel with the ringing detector bridge, terminate the line at its characteristic impedance during the idle circuit condition.

## 7. SIGNAL CONTROL ARRANGEMENT (USOC UU5, 7FW) (FIG. 14 AND 15)

**7.01** Uniform Service Order Codes (USOC) UU5 and 7FW specify a signal control arrangement for providing a timed locked-in audible and/or visual signal variable from .5 seconds to 200 seconds (UU5 continuous, 7FW intermittent signals).

**7.02** When locked-in signaling is provided, the signal at the customer station remains activated until the call is answered or the time-out feature takes effect.

**7.03** Fig. 14 and 15 provide an arrangement which fulfills the requirements for USOC UU5 and 7FW by providing a variable timing interval of .25 seconds to 300 seconds. *Provide this arrangement only when other than 30 second timeout is required.*

**7.04** Fig. 14 requires a 227B KTU which provides for two circuits, relays CA1 and CA2.

**7.05** Fig. 15 requires a 271A KTU, 23A KTU, and a 7B timer. The 271A is arranged to mount two 7B timers. Therefore, a second circuit may be equipped by providing a second 23A key telephone unit and a 7B timer.

**7.06** Apparatus requirements:

- 7B Timer
- 23A KTU

- 271A KTU
- 227B KTU.

### Description of Operation

#### Seizure

**7.07** Ground on lead HA from an external circuit operates relay CA1 or CA2 of Fig. 14. Relay CA1 or CA2 operated grounds lead HA1 to start an external interrupter circuit, if required, and connects battery to the ST lead of Fig. 15.

**7.08** Battery on the ST lead starts the timing function of the 7B timer of Fig. 15 (for detailed description of the 7B timer, refer to CD-69512-01). In the idle condition, battery is connected to lead LK via contacts of the T relay of Fig. 15 for the purpose of providing a locking lead for the control of an external circuit. After a predetermined timing interval, relay T operates removing battery from lead LK releasing the external circuit.

#### Release

**7.09** Upon release of the external circuit, as described in 7.02, ground is removed from lead HA of Fig. 14, releasing relay CA1 or CA2 of Fig. 14. Relay CA1 or CA2 released removes battery from the ST lead to Fig. 15, restoring the 7B timer to normal.

## 8. 2400 HZ AND 2600 HZ FILTER (USOC F4F) (Fig. 16)

**8.01** Uniform Service Order Code (USOC) F4F specifies a loudspeaker filtering arrangement to eliminate dial signals (2400 Hz and 2600 Hz SF tones) from associated loudspeakers connected to the circuit.

**8.02** Failure to provide this feature results in objectional tones emitting from the loudspeaker which are not only annoying but, under some conditions, may result in a disconnect on a long distance call in progress at an adjacent telephone (similar to talk-off of SF units).

**8.03** Fig. 16 provides an arrangement which fulfills the requirements for USOC F4F and is required one per loudspeaker.

TO  
FIG 11  
OR 12

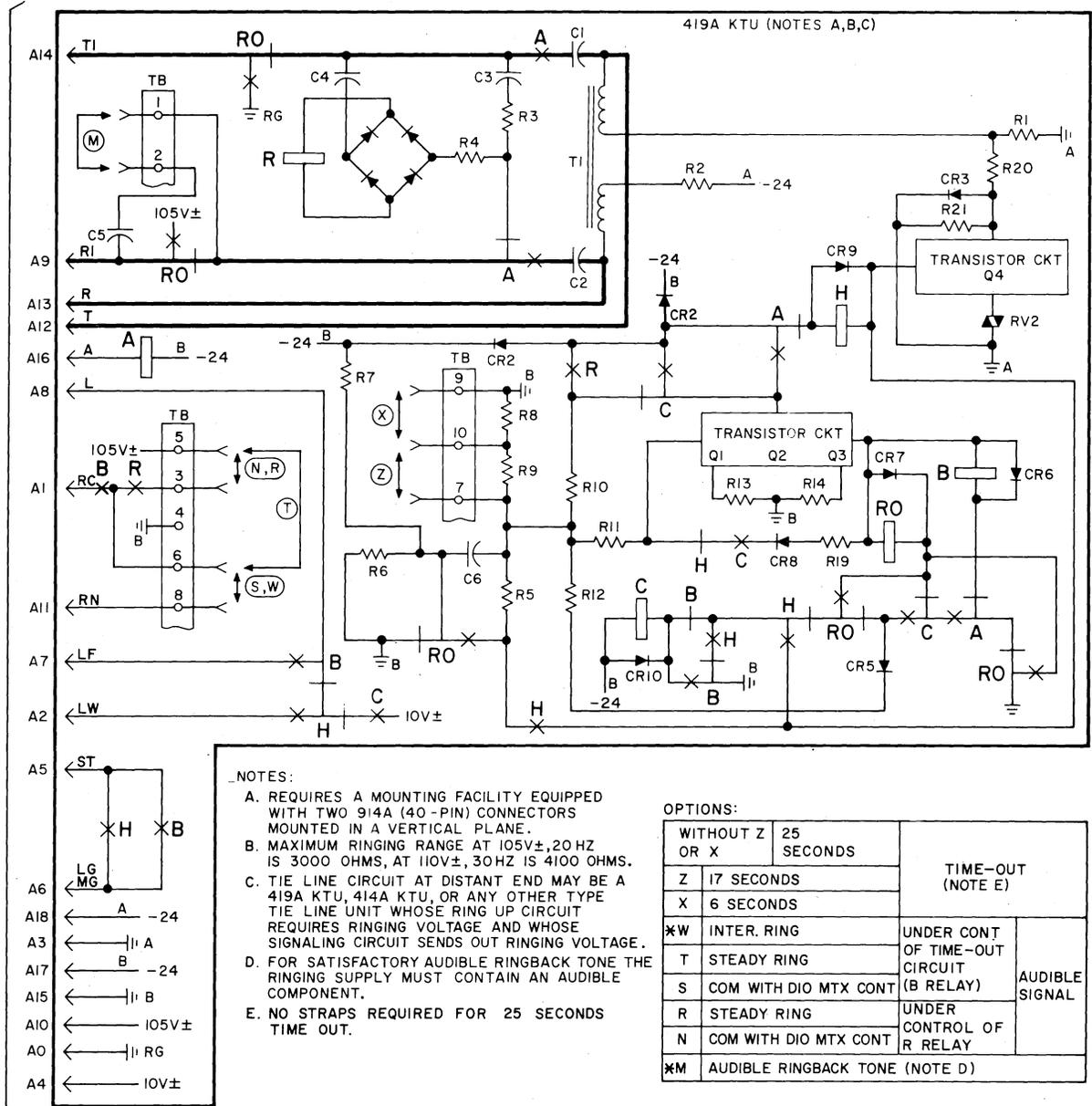


Fig. 10—419A KTU Schematic and Connections

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66B4-25  
CONN BLOCK

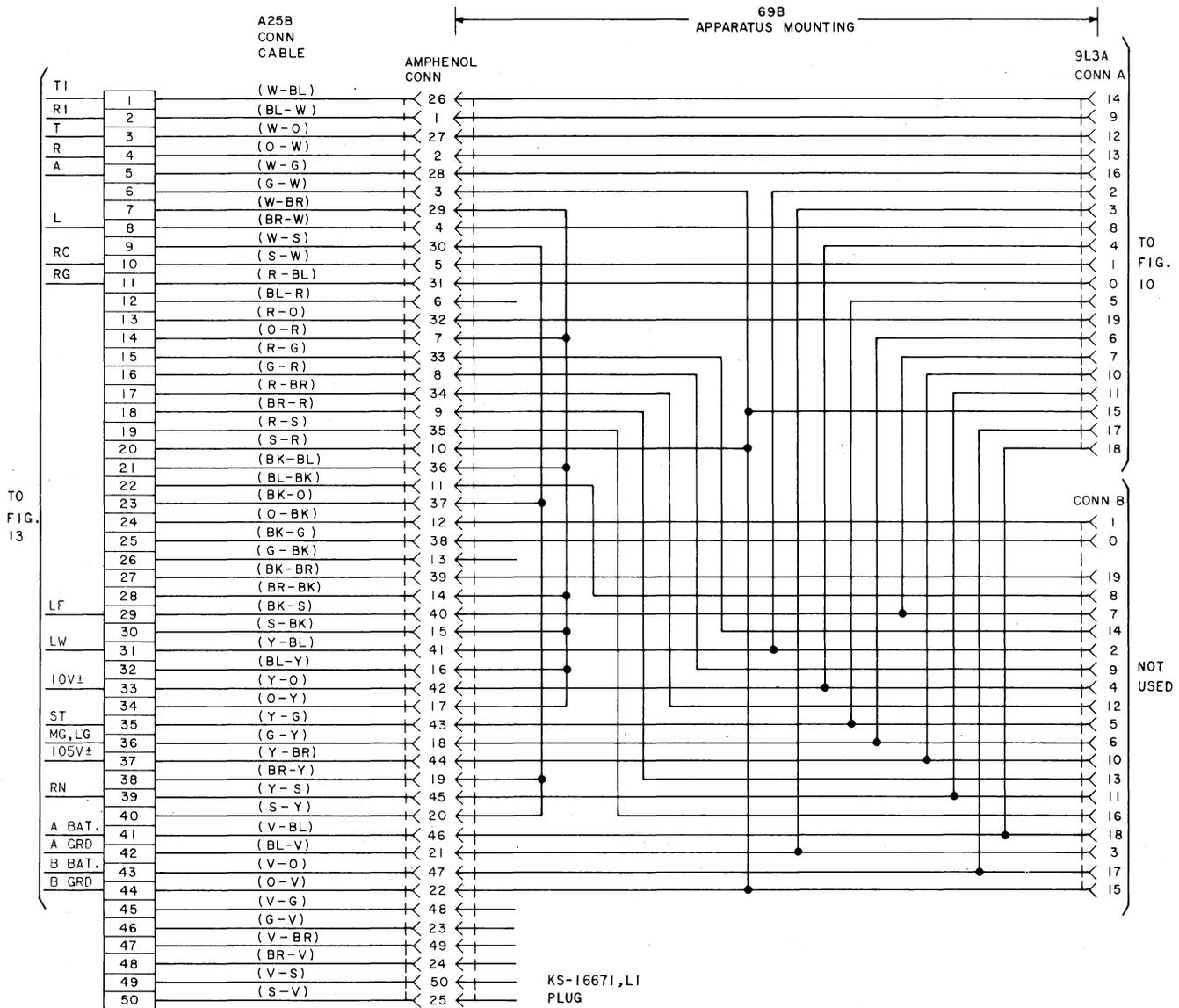


Fig. 11—Schematic of 69B Apparatus Mounting and the External Connections of the A25B Connector Cable to a 66B4-25 Connecting Block

8.04 Apparatus requirements:

- 200 M Network
- 200 N Network
- ED-90185-50 GRP3 mounting bars for 23-inch mounting or GRP8 for 19-inch mounting.

9. SWITCHING ARRANGEMENTS (USOC 28S, 29A, 29B, 29C) (FIG. 17, 18, AND 19)

9.01 Uniform Service Order Codes (USOC) 28S, 29A, 29B, and 29C specify various key-controlled interexchange channel switching arrangements.

9.02 Uniform Service Order Code (USOC) 9BX specifies a lamp indicator which may be used to provide visual status of the switching arrangements.

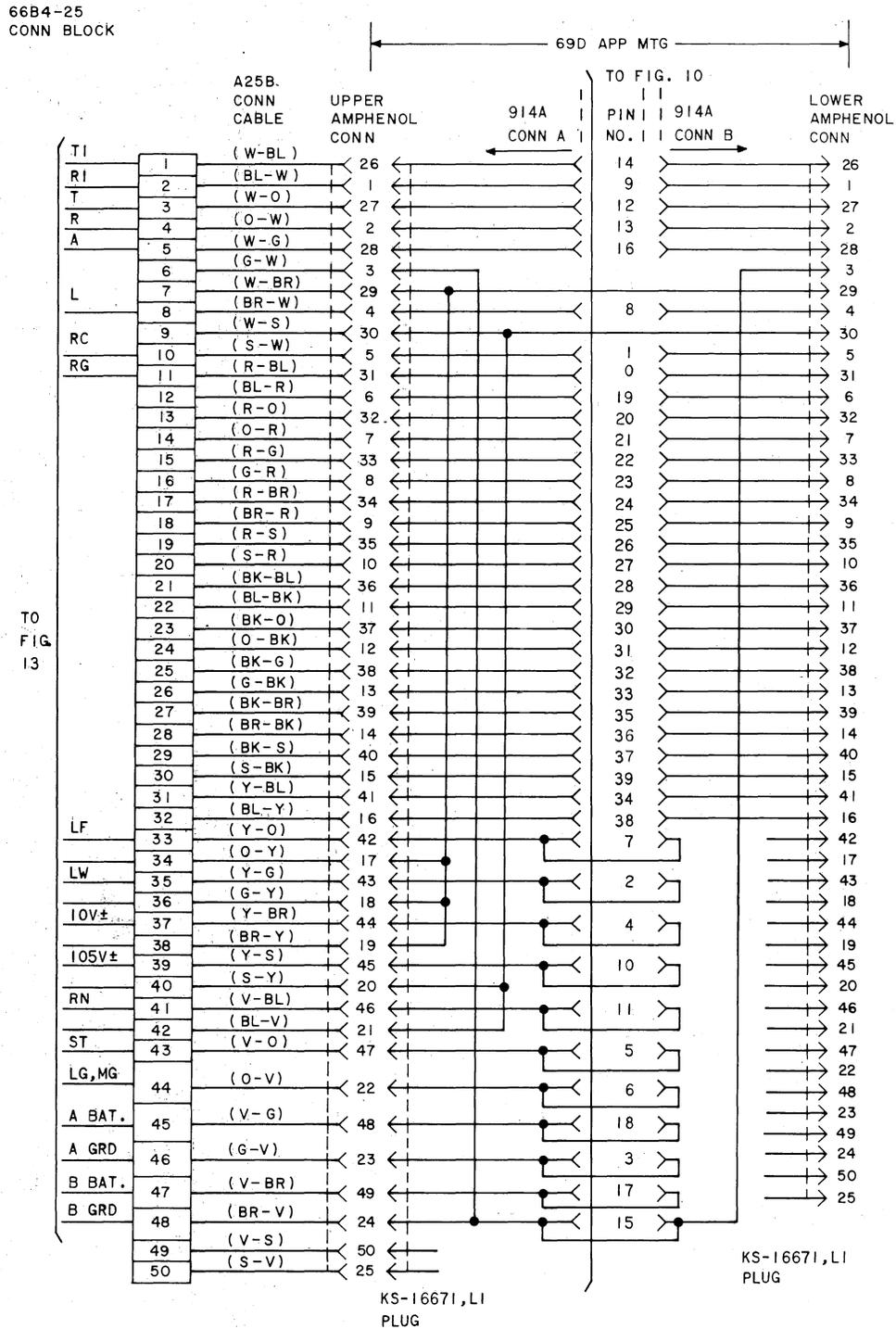
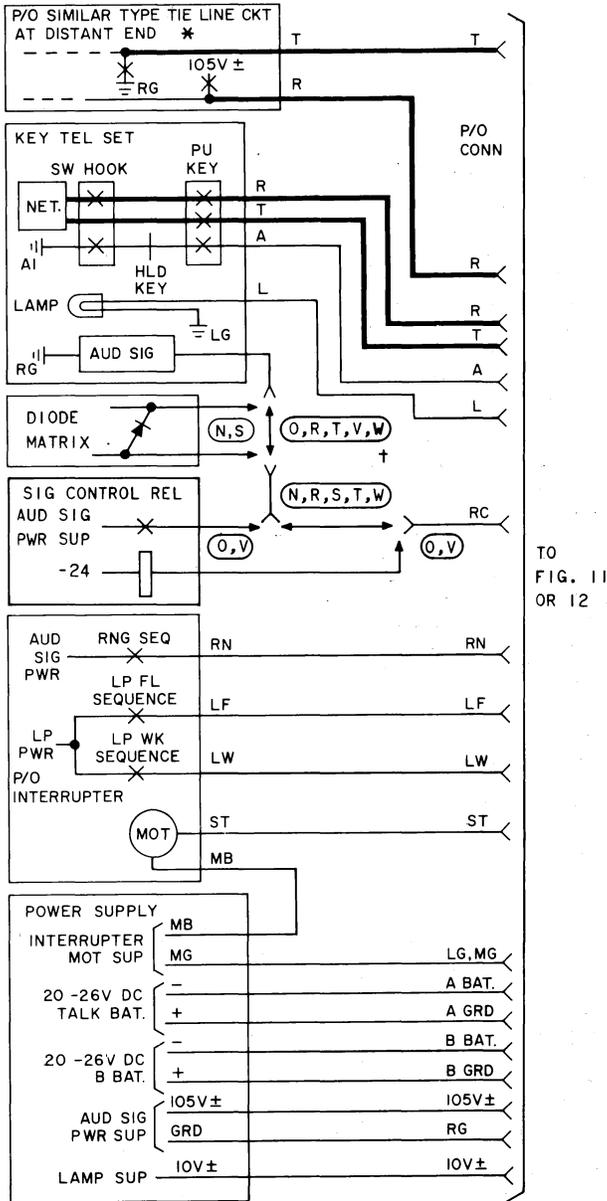


Fig. 12—Schematic of 69D Apparatus Mounting and the External Connections of the A25B Connector Cable to a 66B4-25 Connecting Block



**Fig. 13—Application Schematic for External Circuits Associated With 419A KTU**

**9.03** Fig. 17 and 18 provide a typical key and lamp, respectively, which fulfill the requirements for the control and visual status features required for these USOCs.

**9.04** Associated equipment per SD-55647-01 (2- and 4-wire bridging, switching and signaling arrangements) or equivalent is required in the central office to perform the switching functions specified by the particular USOC.

**9.05** Occasions may arise where it will be necessary to provide a switching function on the customer premises. In these cases, the 229B may be arranged to perform the functions of the equivalent figure as shown on SD-55647-01.

**9.06** Fig. 19 provides the 229B KTU with each lead numerically designated which may be connected for universal applications as required. (The numerical designation will provide a means of communicating connecting information.)

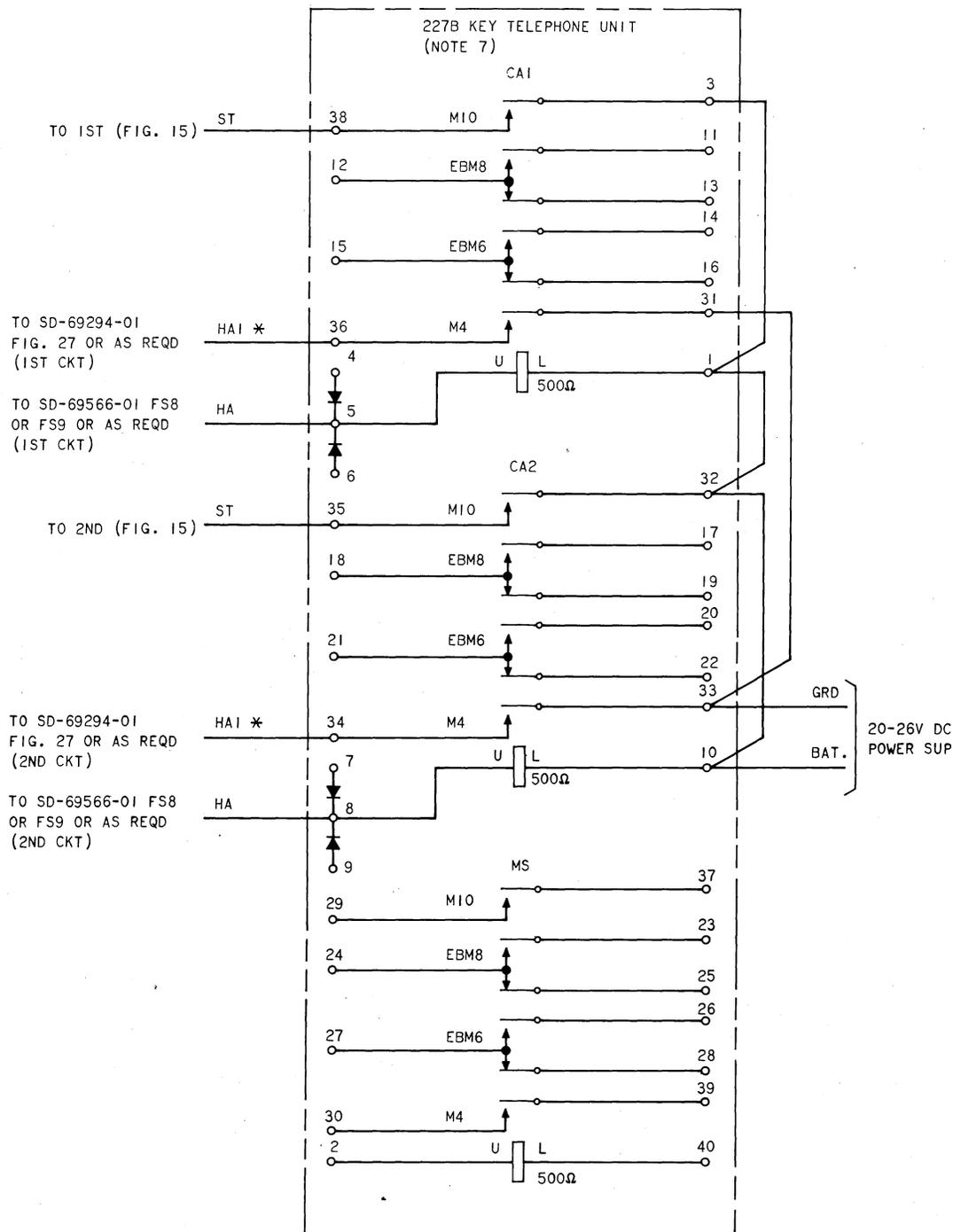
**9.07** Apparatus requirements:

- Key and indicator as required
- 229B KTU Fig. 19 (if required).

**10. IDLE CIRCUIT TERMINATION (FIG. 20, 21, AND 22)**

**10.01** Each point on a private line service is terminated on the drop side in station equipment (PBX trunk, key equipment, telephone set, etc) which generally has a characteristic impedance of 600 or 900 ohms. (Generally PBXs will call for a 600-ohm impedance. Most other locations will require 900-ohms.) Since the associated transmission facility is designed with this fact in mind, should the station equipment at any terminating point not present this impedance to the facility, the stability of the circuit is upset which may result in the circuit howling, sounding hollow, echoing, etc. When the associated station equipment is off-hook at a terminating point, the proper impedance is always presented to the facility. In the on-hook condition, some types of station equipment provide a built-in idle circuit termination which presents this same impedance to the facility. Other types of station equipment do not provide this termination.

**10.02** Fig. 20, 21, and 22 provide arrangements for idle circuit terminations for those situations where this feature is not provided as a part of the station equipment.



\* PROVIDE LEAD HAI TO START THE INTERRUPTER WHEN INTERRUPTED RINGING IS REQUIRED. (USOC 7FW)

Fig. 14—227B KTU Schematic and Connections (Signal Control Arrangement)

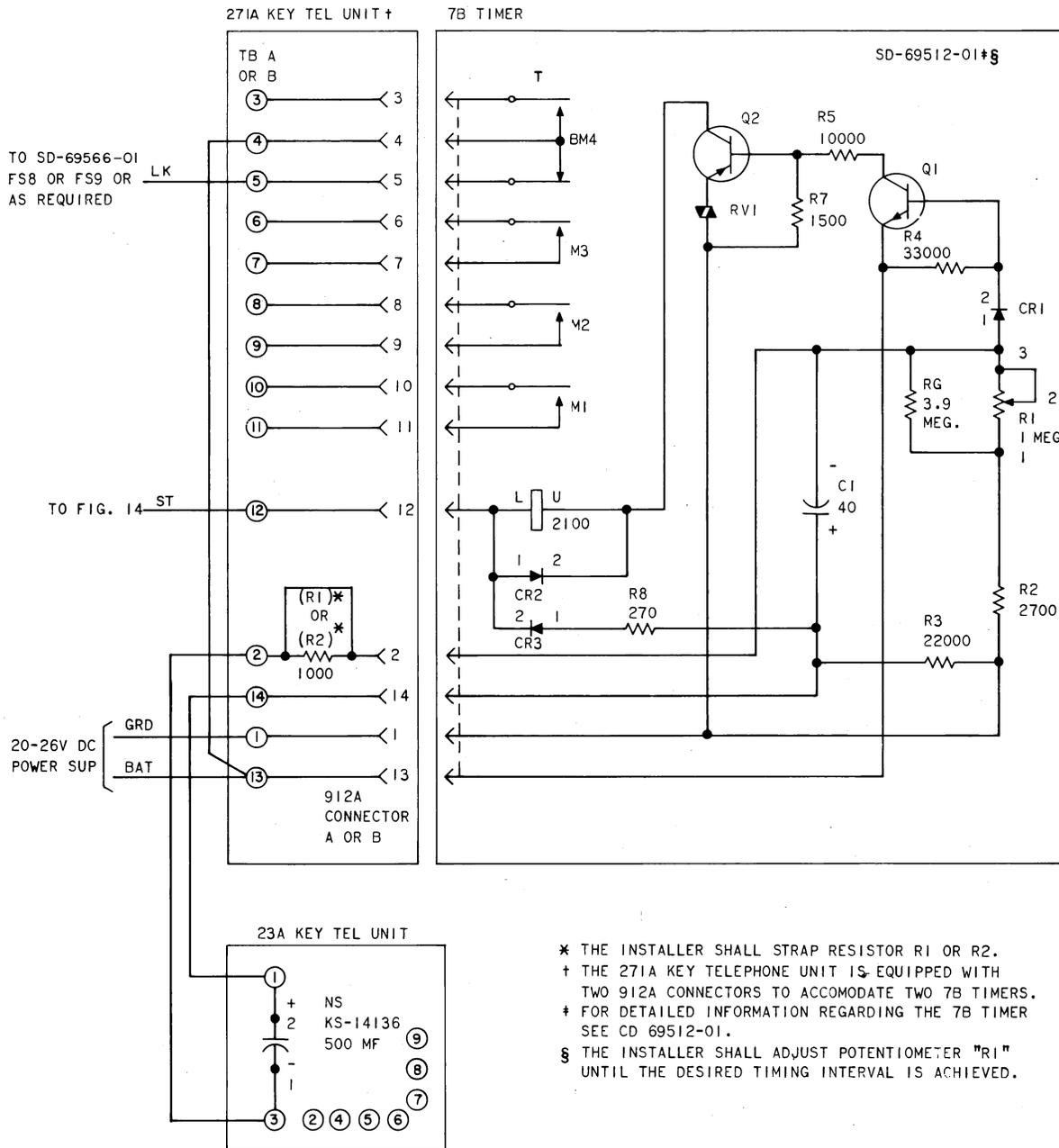


Fig. 15—23A KTU—271A KTU—7B Timer—Schematic and Connections (Signal Control Arrangement—5-200 Sec)

10.03 Fig. 20, 21, and 22 are not required at a terminating point equipped with the 24V4A repeater per drawing H831-078 or the 24V4B repeater per drawing H831-044. Both of these units are equipped with a loop disabler. See Section 812-002-290.

**Note:** The loop disabler opens the transmit portion of the 4-wire transmission path but does not provide a termination.

10.04 If a terminating point on a multipoint circuit is equipped with the idle circuit per Fig.

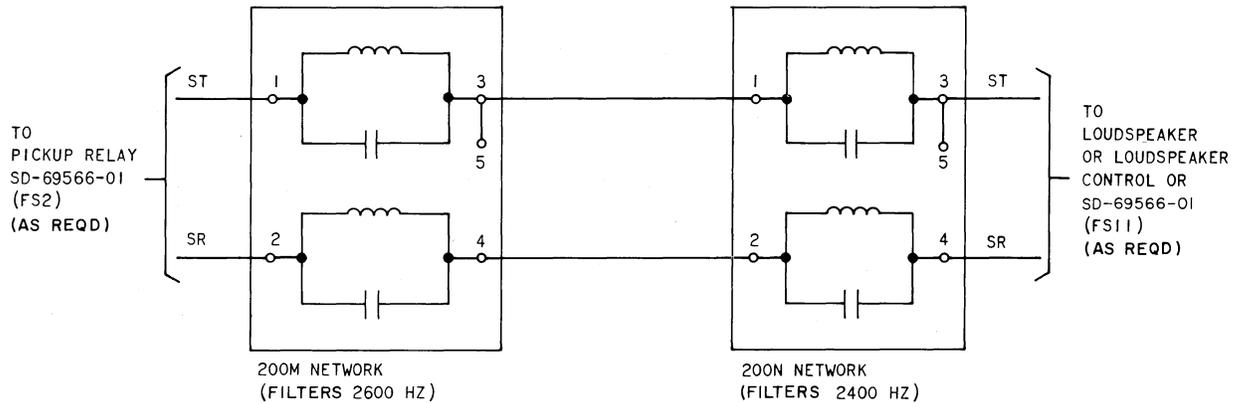


Fig. 16—Filter Arrangement for 2400 and 2600 Hz

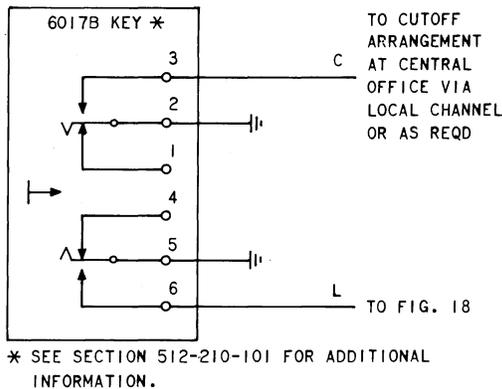


Fig. 17—Typical Control Key

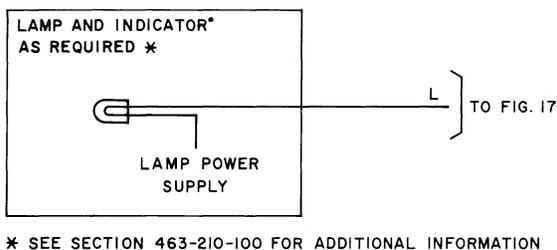


Fig. 18—Typical Control Lamp

20, it is not necessary to provide Fig. 21 or 22 at the same terminating point.

**Idle Circuit Termination For Transmit Portion of the 4-wire Section of 24V4 Repeaters—Application (Fig. 20)**

**10.05** When a 2-wire termination is connected to a 4-wire facility, a transmission path is established between the 4-wire transmit and receive facility via the terminating set of the 24V4-type repeater. Should this termination be associated with multipoint circuits, this path may cause echo problems. In the case of SS-1A selective signaling applications, pulse mutilation may occur.

**10.06** Fig. 20 and Table D provide information for connecting this termination to 24V4A, B, C, and D repeaters. The associated 2-wire station equipment (PBX trunk key system, etc) must be arranged to provide a ground to operate the 17B KTU of Fig. 20 in the off-hook condition. If dc voltage is present in the 2-wire portion of the circuit, Fig. 30 may be used to control Fig. 20.

**10.07 Apparatus requirements:**

- 17B KTU
- 600-ohm resistor, 227C or equivalent

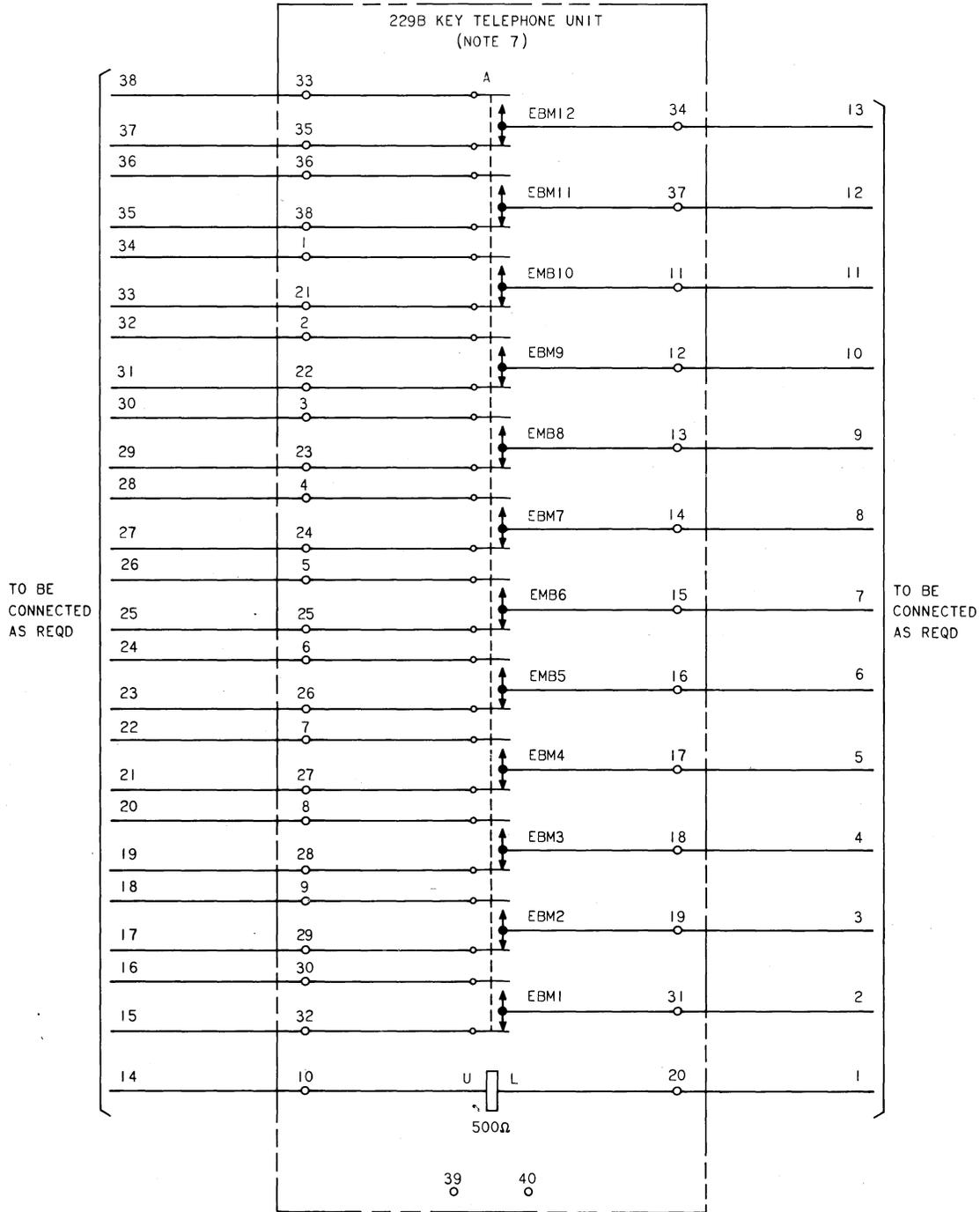
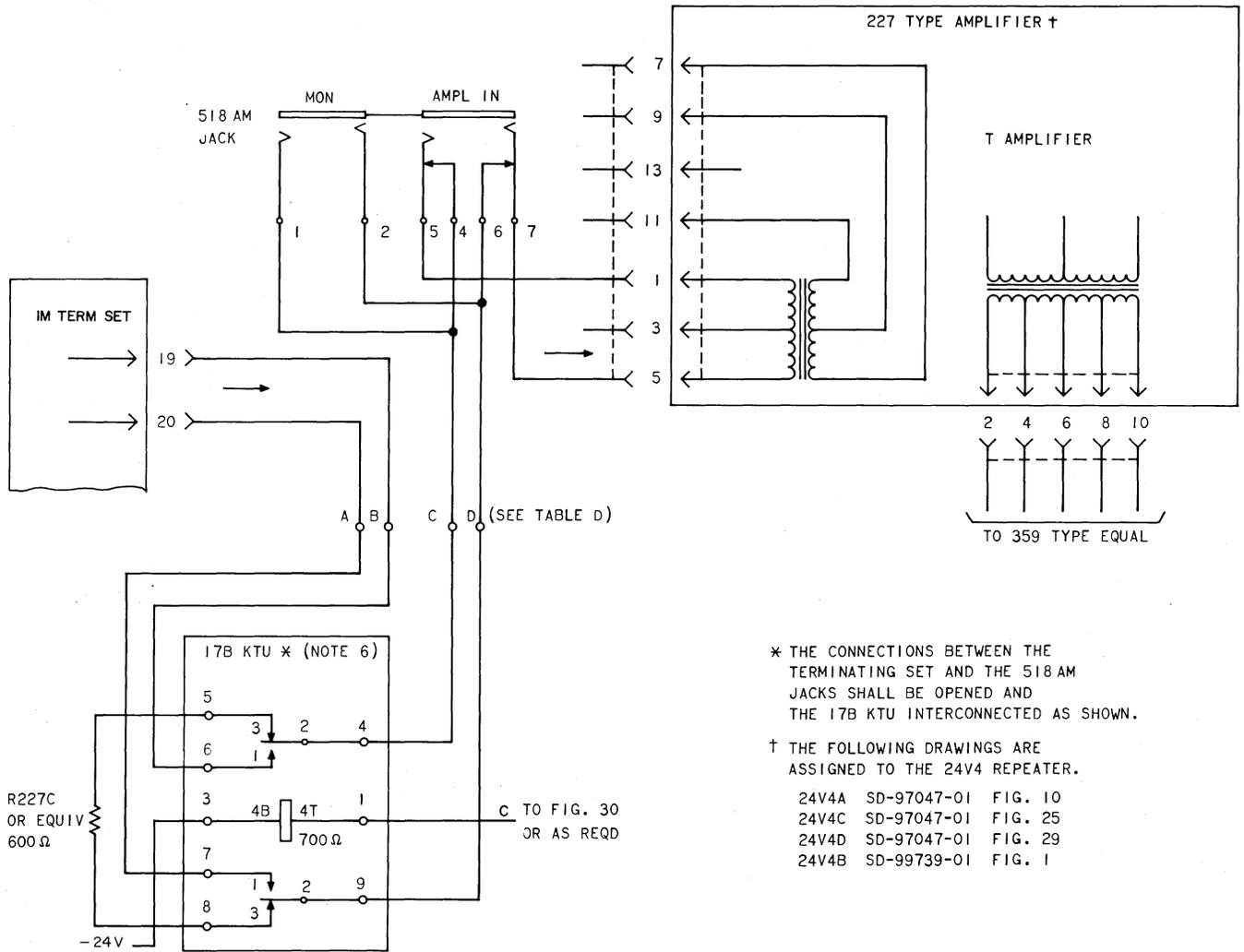


Fig. 19—229B KTU (Arranged for Universal Application)



**Fig. 20—Idle Circuit Termination for Transmit Portion of the 4-Wire Section of the 24V4 Repeater (Required on Multipoint Circuits)**

**Idle Circuit Termination for Wet Loops—Application (Fig. 21)**

**10.08** When a 2-wire loop has dc voltage present, an 18D or 18E KTU per Fig. 21 may be used to provide an idle circuit termination.

**10.09** The B relay is connected in series with the ring side of the loop and will operate when the loop is closed. (The B relay is noninductive and, therefore, does not affect the transmission path.)

**10.10** The idle circuit termination consists of a 900-ohm resistor and a 2-microfarad capacitor.

The capacitor is provided to block the dc voltage to prevent shunting the loop.

**10.11** The termination is under control of the SR relay which operates when relay B operates. The SR relay is made slow release to prevent connecting and disconnecting the idle circuit termination as the B relay is pulsed by the station dialing.

**10.12** Apparatus requirements:

- 18D or E KTU
- 900-ohm resistor, 227C or equivalent



- 900-ohm resistor, 227C or equivalent
- 2MF capacitor, 542F or equivalent.

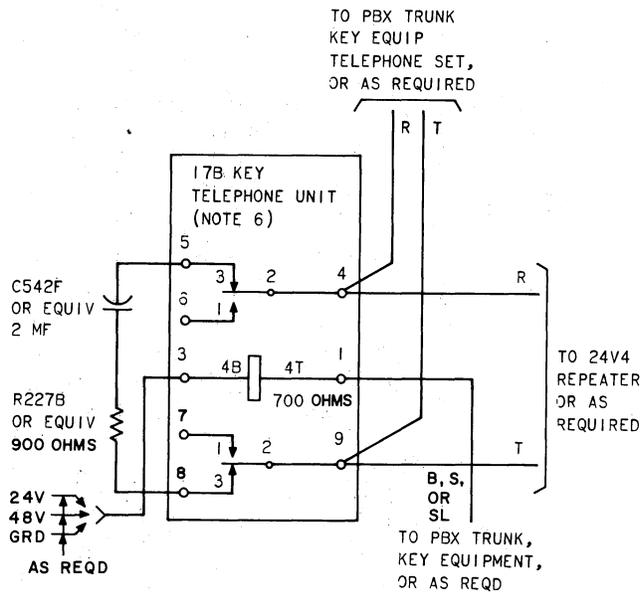


Fig. 22—Dry Loop (no DC Voltage in Loop) Idle Circuit Termination

11. LOOP-TO-LOOP DIAL LONG LINE (FIG. 23)

11.01 Fig. 23 provides a modification requirement for loop-to-loop-type dial long lines SD-96555-01 or equivalent.

11.02 This modification is to be applied when the dial long line is used for signaling purposes only.

11.03 This modification provides better signaling characteristics and, using the proper terminating set (inductors in series with the A and B lead), improves the signal-to-noise ratio.

11.04 Apparatus requirement:

- None.

12. TYPICAL REPEAT COIL DUPLEX SIGNALING APPLICATION (FIG. 24)

12.01 Fig. 24 provides a repeating coil arranged for duplex (DX) signaling where required.

12.02 The Transmission department will specify the proper components for this application based on the following transmission considerations:

- Type of repeat coil and strapping
- Type and value of capacitance required for the line side of the repeat coil.

12.03 Fig. 24 is used where available terminating equipment does not, in itself, provide the necessary A and B leads for DX operation. This arrangement is generally used for Dial Repeating Tie Trunks or for Foreign Exchange Trunks where additional leads are required.

12.04 Apparatus requirements:

- Repeat coil (as required)
- Capacitor (as required).

13. REPEAT COIL ARRANGEMENTS USING 219A KTU (FIG. 25, 26, 27, 28, AND 29)

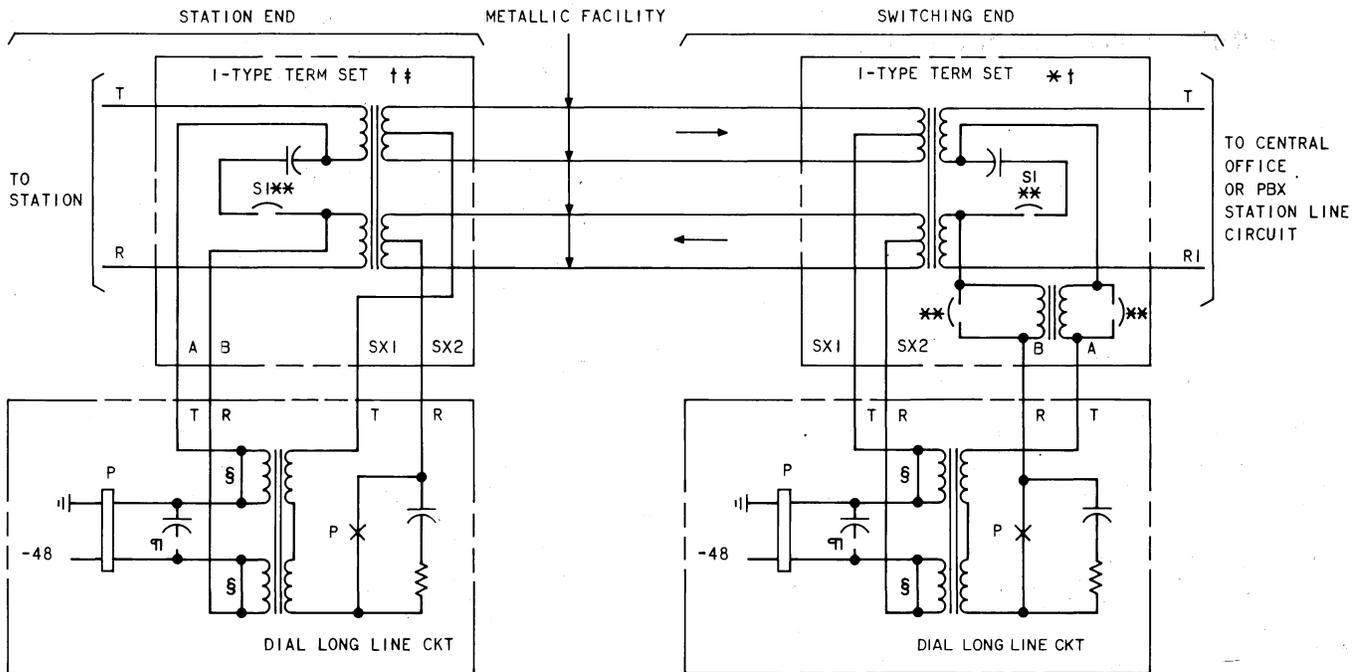
13.01 Fig. 25 through 29 provide connections using the 219A KTU for impedance ratios of:

- 600 to 1350—Fig. 25
- 600 to 600—Fig. 26
- 600 to 340—Fig. 27
- 600 to 150—Fig. 28
- 1350 to 150—Fig. 29.

13.02 For use where a key telephone unit mounted 177D repeat coil is required for a 4-wire line termination as in SD-69410-01.

13.03 Apparatus requirement:

- 219A KTU.



- \* TERMINATING SETS WITH THE INDUCTOR IN SERIES WITH THE A AND B LEADS \*\* SCREW TYPE SWITCH MUST BE USED AT THE SWITCHING END, SUCH AS THE IK, IL, IM, OR IN.
- † WHEN TWO DIAL LONG LINES ARE USED IN TANDEM, INDUCTORS ARE NOT TO BE PROVIDED IN THE TERMINATING SET ASSOCIATED WITH THE STATION END.
- ‡ THE DIAL LONG LINE WILL NOT BE REQUIRED AT THE STATION END IN EVERY APPLICATION. IN EITHER CASE, THE SWITCHING END SHALL BE ARRANGED AS SHOWN.
- § STRAP OUT REPEAT COIL WINDINGS.
- ¶ DISCONNECT CAPACITOR.

**Fig. 23—Loop-to-Loop Type Dial Long Line Modification (Applies When Dial Long Line is Used for Signaling Purposes Only or to Reduce Longitudinal Noise)**

#### 14. WET LOOP CONTROL CIRCUIT (FIG. 30)

**14.01** Fig. 30 provides an 18D or 18E KTU which may be used in conjunction with 2-wire loops, which have dc voltage present to control external circuitry, as required.

**14.02** This arrangement may be used to control the idle circuit termination of Fig. 20, (when required).

**14.03** Apparatus requirement:

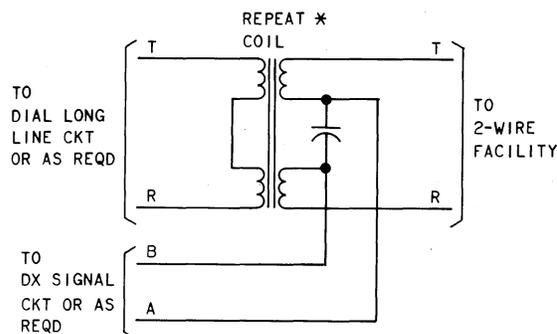
- 18D or 18E KTU.

#### 15. DIAL PULSE SUPPRESSION CIRCUIT (FIG. 31)

**15.01** Many private line services using 24V4-type repeaters are arranged to provide direct current (dc) dial pulses to the serving test center via the tip and ring of the 2-wire side and the simplex path of the 4-wire side.

**15.02** This arrangement introduces dial pulses to the transmit side of the 4-wire facility via the transmit portion of the 24V4 repeater.

**15.03** In some applications, this dual transmission of signals (dc path via simplex and ac path via transmit side) causes interaction of signals resulting in pulse mutilation.



\* THE TRANSMISSION DEPARTMENT SHALL SPECIFY THE PROPER COMPONENTS BASED ON TRANSMISSION CONSIDERATIONS, AS FOLLOWS;  
 (A) TYPE OF REPEAT COIL AND STRAPPING.  
 (B) TYPE AND VALUE OF CAPACITANCE REQUIRED FOR LINE SIDE OF REPEAT COIL.

**Fig. 24—Typical Repeat Coil-Duplex Signaling Application for 2-Wire Circuit**

**15.04** Fig. 31 and Table E provide information for connecting a 100A varistor in the transmit portion of the 4-wire section of the 24V4 repeater to eliminate this condition by limiting the voltage.

**15.05** Apparatus requirement:

- Varistor, 100A.

**16. VOICE-OPERATED BUSY SIGNAL CIRCUIT (FIG. 32)**

**16.01** A voice-controlled switch circuit is provided on a private line service as shown in Section 812-002-221 when USOC 27S is called for on the Universal System Service Order (USSO). This optional feature is normally used with other USOCs.

**16.02** The voice-controlled switch circuit is arranged for plug-in mounting and operation with 110 to 120 volts ac, -48, or -24 volts dc power.

**16.03** When the circuit is bridged across Private Line Terminating Unit SD-69566-01 (J53045A),

a 234-type switch is operated when voice or tone signals are present on the line. This operates a relay with transfer contacts for connection to an external busy lamp indicating circuit.

**16.04** Fig. 32 shows the arrangement for connecting the voice-controlled switch circuit to the receive loop of SD-69566-01 (J53045A).

**16.05** For description, installation, connections, and lineup procedures for the voice-controlled switch circuit, refer to Section 463-240-100.

**17. MAKE BUSY ARRANGEMENTS (FIG. 33 AND 34)**

**17.01** A make busy feature may be required when PBX tie trunks, PBX CO trunks, key systems, or data sets are associated with an alternate arrangement.

**17.02** An alternate arrangement is a private line service with the transmission facility terminating in a transfer arrangement. This will permit switching of the facility from a regular termination to an alternate termination.

**17.03** Typical alternate arrangements may be associated with terminations or combinations of the following:

- PBX tie trunks (Ringdown, Dial Repeating, etc)
- Data equipment
- Key Systems (1A1, 1A2, etc)
- Private lines
- Station line circuits.

**17.04** Section 812-002-250 provides block diagrams showing overall circuit application for alternate arrangements.

219A KEY TELEPHONE UNIT

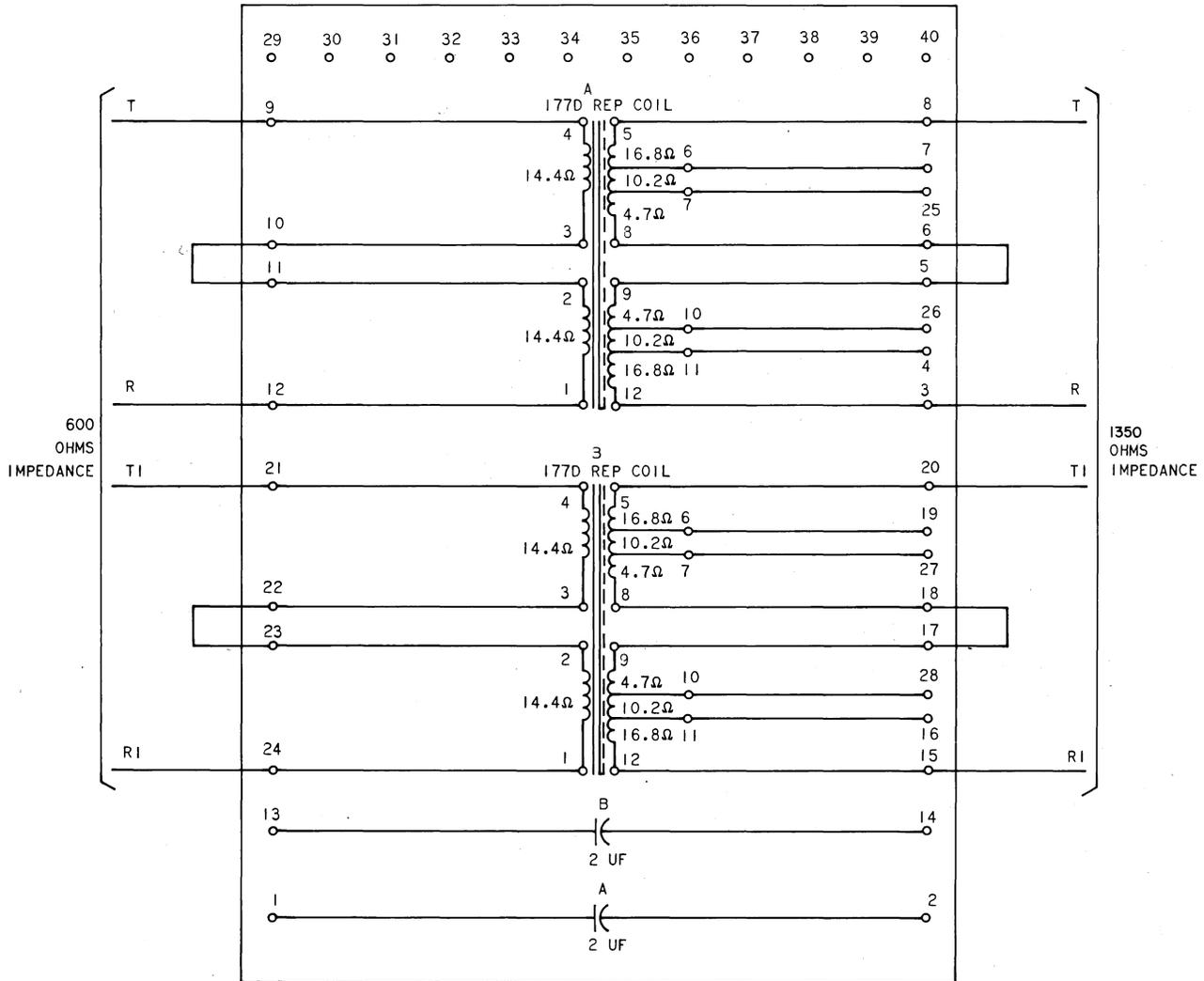


Fig. 25—219A KTU (Connections for Impedance Ratio of 600 to 1350)

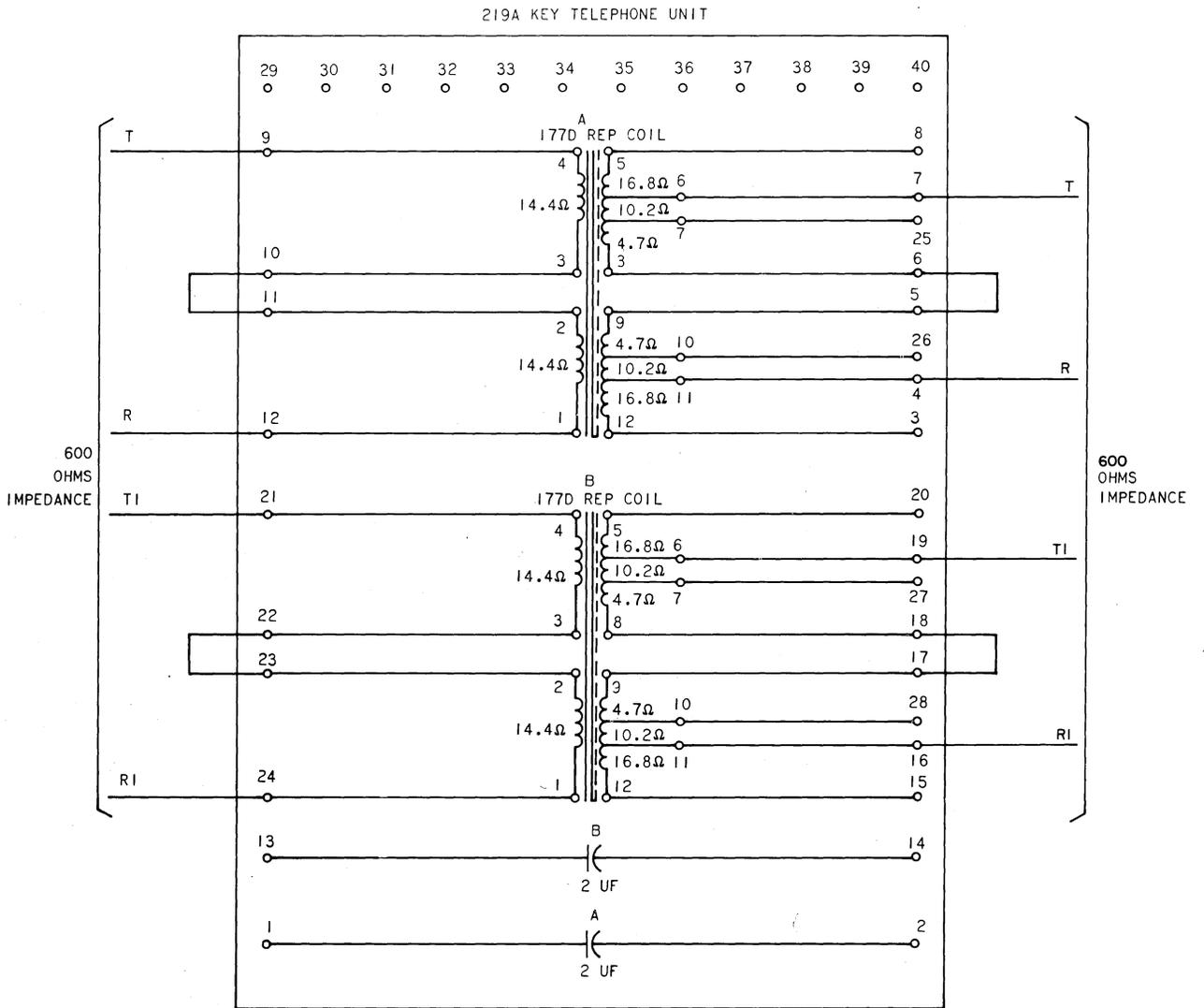


Fig. 26—219A KTU (Connections for Impedance Ratio of 600 to 600)

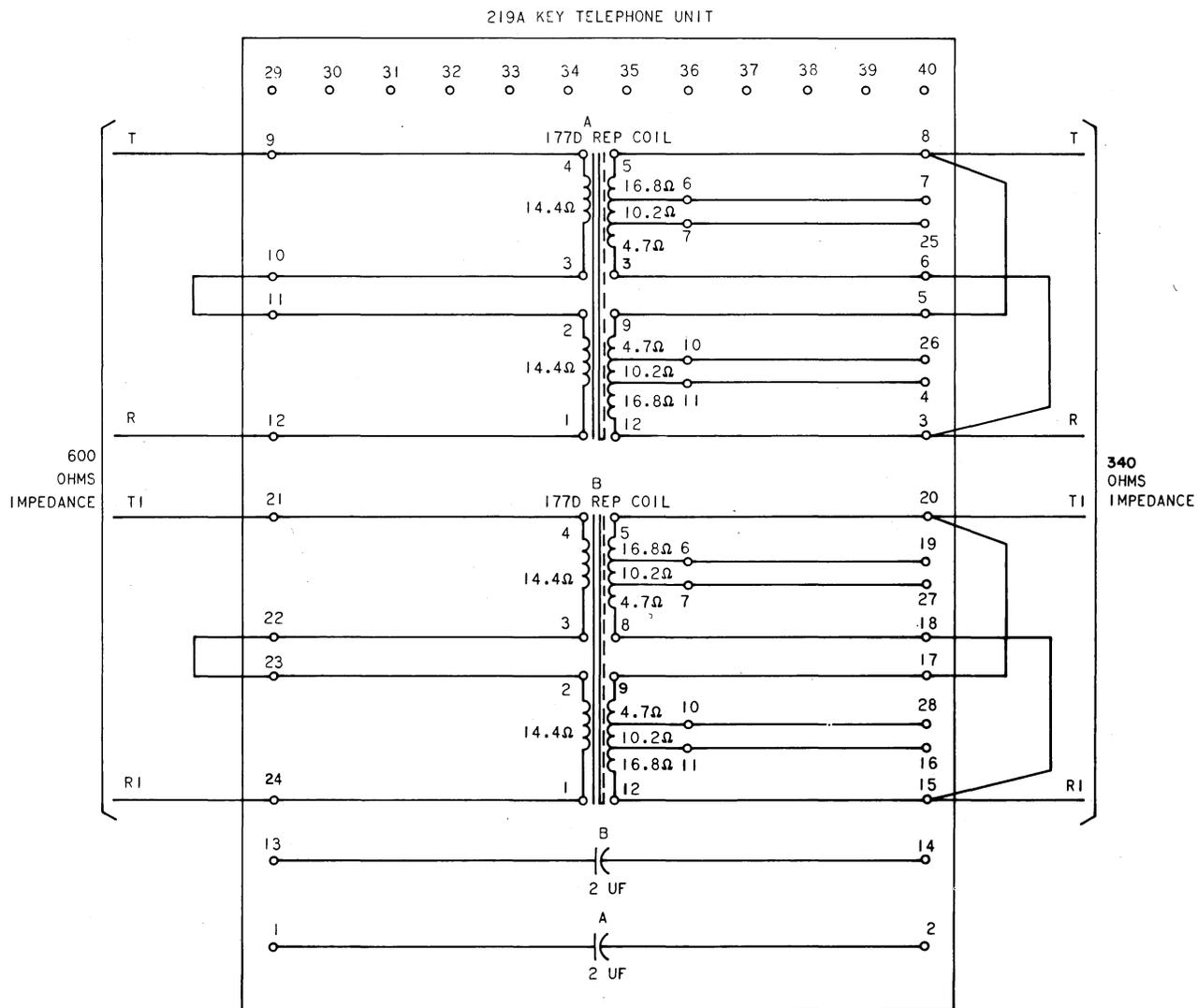


Fig. 27—219A KTU (Connections for Impedance Ratio of 600 to 340)

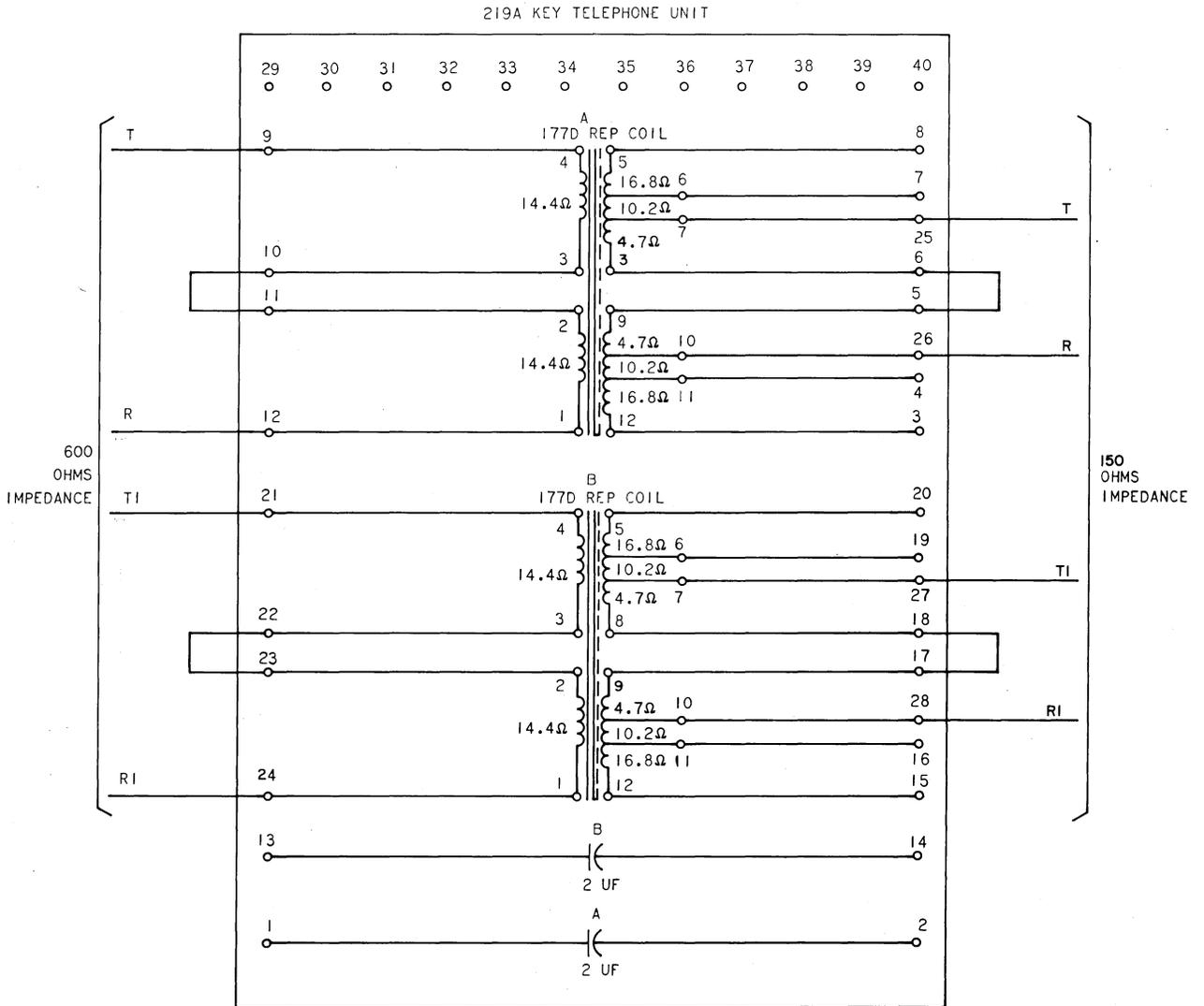


Fig. 28—219A KTU (Connections for Impedance Ratio of 600 to 150)

219A KEY TELEPHONE UNIT

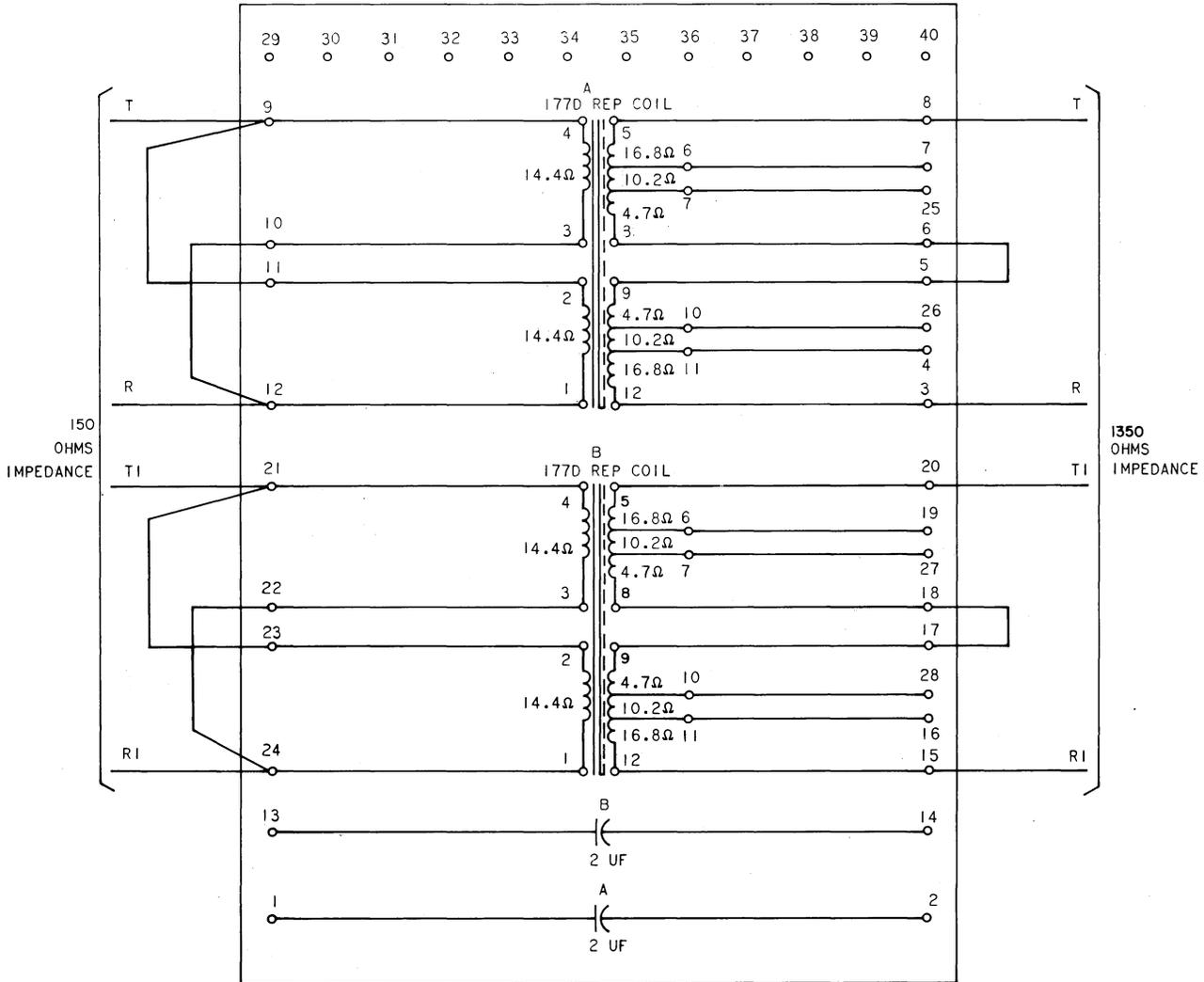


Fig. 29—219A KTU (Connections for Impedance Ratio of 1350 to 150)

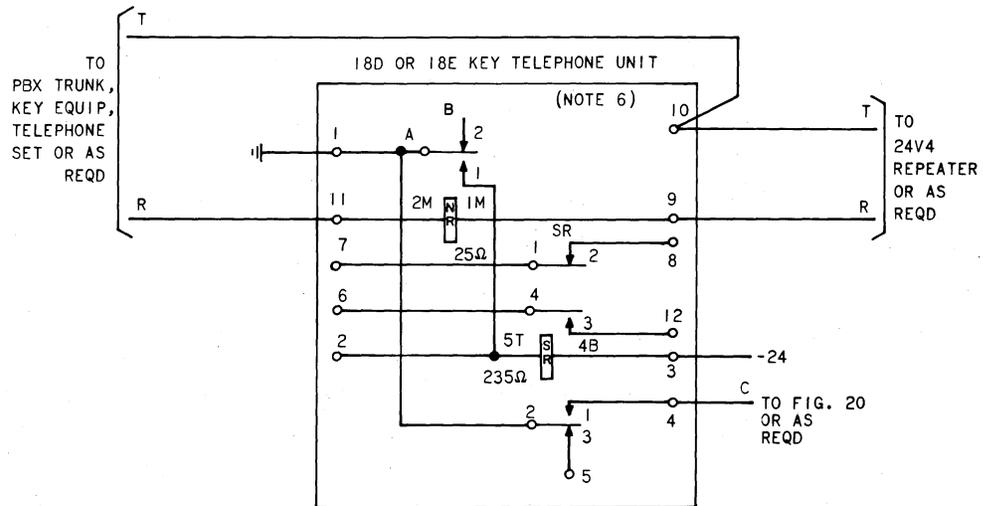
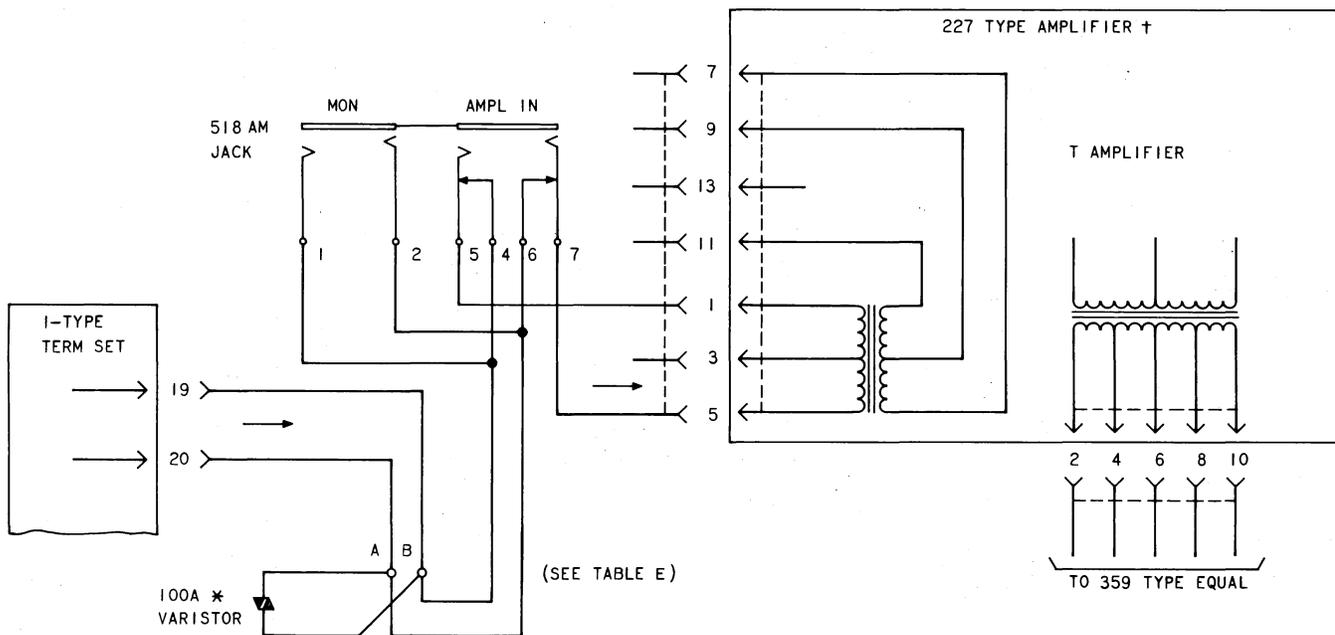


Fig. 30—Wet Loop (DC Voltage in Loop) Control for External Circuits

TABLE E  
CONNECTIONS FOR THE 100A VARISTOR IN 4-WIRE  
PORTION OF 24V4 REPEATERS (FIG. 31)

ARBITRARY DESIGNATION	CONNECTION TO BE MADE AT			
	24V4A*	24V4B	24V4C	24V4D
A		TB1 Term 43	TS1 Term 17	TS1 Term 17
B		TB1 Term 47	TS1 Term 5	TS1 Term 5

\* See Asterisk Fig. 31.

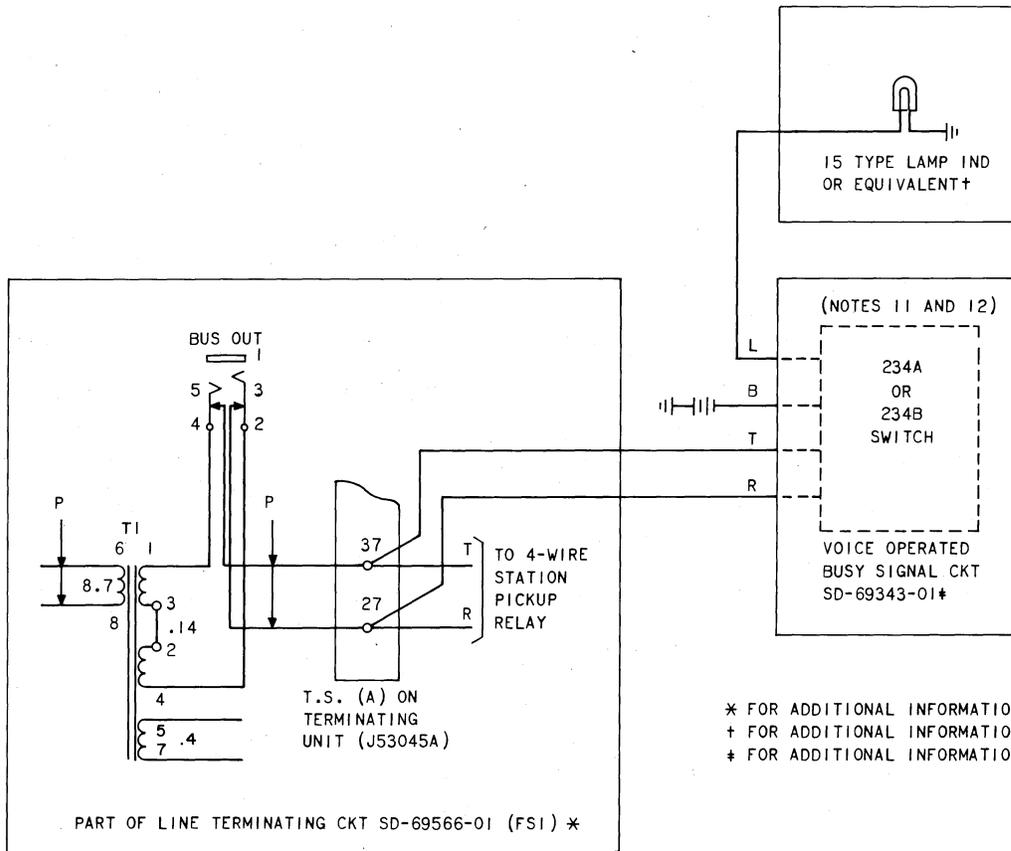


\* THE 100A VARISTOR MAY BE CONNECTED ACROSS 19 AND 20 OF THE I-TYPE TERM SET OR 1 AND 2 OF THE 518AM MONITOR JACK, AS REQUIRED.

† THE FOLLOWING DRAWINGS ARE ASSIGNED TO THE 24V4 REPEATERS.

- 24V4A SD-97047-01 FIG. 10
- 24V4C SD-97047-01 FIG. 25
- 24V4D SD-97047-01 FIG. 29
- 24V4B SD-99739-01 FIG. 1

Fig. 31—Dial Pulse Suppression Circuit



\* FOR ADDITIONAL INFORMATION SEE SECTION 480-615-100  
 † FOR ADDITIONAL INFORMATION SEE SECTION 463-210-100  
 ‡ FOR ADDITIONAL INFORMATION SEE SECTION 463-240-100

Fig. 32—Voice-Operated Busy Signal Circuit (Connections to SD-69566-01)

17.05 The following is a typical example of a full alternate service arrangement.

**Regular Termination**  
*(Full Period Portion of Circuit)*  
 PBX Dial Repeating Tie Trunk  
 Arranged for PBX Station Dial  
 Access

**Alternate Termination**  
*(Foreign Exchange Portion of Circuit)*  
 PBX Central Office Trunk  
 Arranged for PBX Station Dial Access

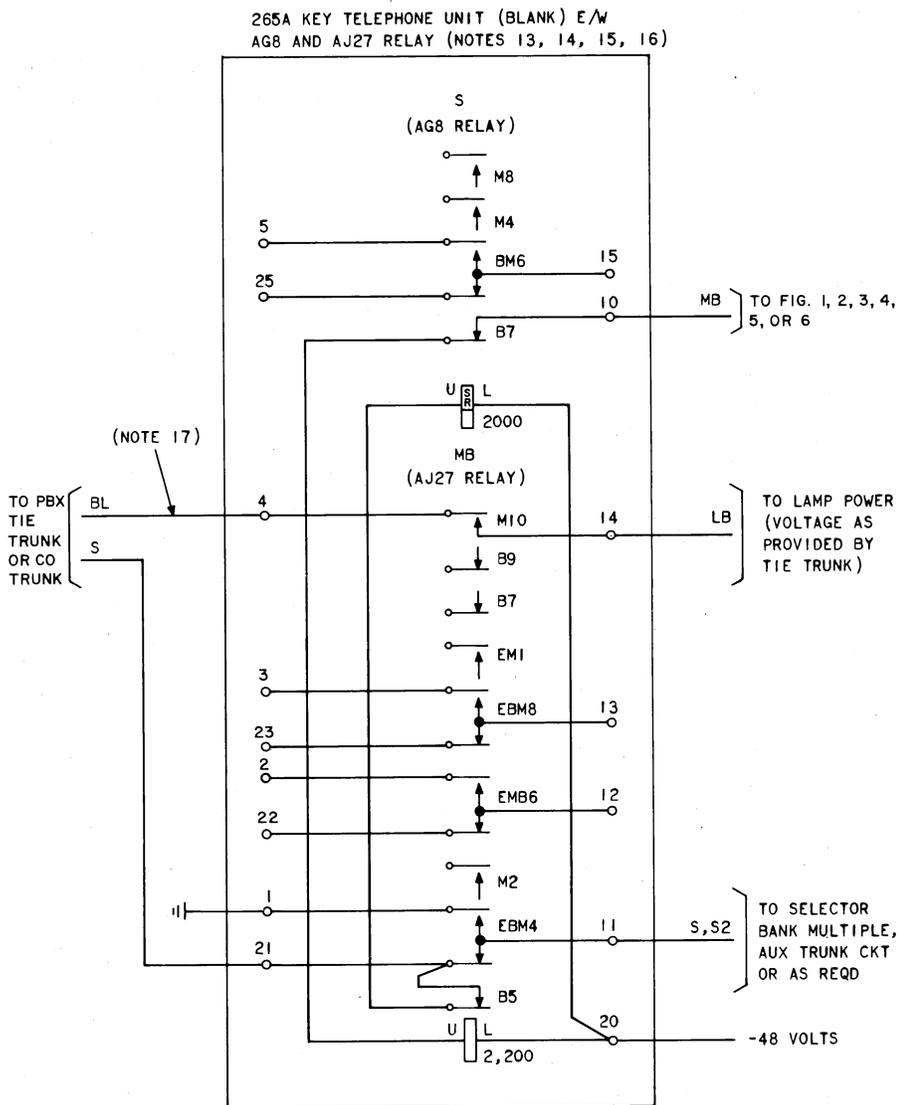
17.06 With the arrangement in 17.05, one of the terminations will always be open (not connected to the facility). This will result in a trouble indication to the attendant or to a PBX station attempting to access the termination not

connected to the facility. With this situation, a make busy arrangement becomes necessary to provide a busy indication to the attendant or PBX stations.

**PBX Tie Trunk or Central Office Trunk Make Busy Arrangement**

17.07 Fig. 33 shows a make busy circuit arrangement that will permit busying out an associated PBX tie trunk when alternate service is required on trunks arranged for dial access by PBX stations.

17.08 This arrangement may be used with any PBX system or PBX trunk which may be busyed out by grounding the sleeve to prevent dial selection by the associated PBX stations. Consideration need not be given to making the distant end busy because this arrangement is for use with alternate services only.



**Fig. 33—PBX Tie Trunk or CO Trunk Make Busy Arrangement**

**17.09** The arrangement shown in Fig. 33 may be controlled by the transfer arrangements of Fig. 2, 3, 4, 5, and 6 of this section.

**Circuit Description (Fig. 33)**

**17.10** Ground connected to lead MB by the transfer circuit operates relay MB. Relay MB operated opens the sleeve lead toward the tie trunk, grounds the sleeve lead toward the selector bank multiple or auxiliary trunk circuit, and lights the attendants busy lamp (if required).

**17.11** Should the tie trunk be in use when lead MB is grounded, relay S will be operated from ground on the sleeve furnished by the tie trunk. This prevents the operation of relay MB until the tie trunk is idle. This function prevents grounding the sleeve lead until all relays of the tie trunk have released, thus permitting the connected PBX station to disconnect.

**17.12** Table F provides circuit requirements when relay adjustments are required.

**TABLE F**  
**CIRCUIT REQUIREMENTS FOR RELAY ADJUSTMENTS (FIG. 33)**

APPARATUS		SECTION 040-930-701 FIGURE	TEST CLIP DATA	TEST SET PREPARATION	DIRECT CURRENT FLOW REQUIREMENT			
			CONNECT GROUND		TEST FOR	AFTER SOAK	TEST	READJ
DESIGNATION	CODE				MA.	MA.	MA.	
S	AG-8	44B	Term 21	GRD	0	20	7.7	7.3
					H	20	1.7	1.0
					R	20	0.7	0.5
MB	AJ-27	213	Term 10	GRD	0		14.9	14.2
					NO		9.0	8.6

**17.13** Apparatus requirements:

- 265A KTU
- Relay AG8
- Relay AJ27
- Wire (As Required—General Note 15)

Mount the relays per General Note 14 and wire per Fig. 33.

**17.14** On PBX tie trunks and CO trunks which terminate at the attendants position only (no dial access), the transfer circuits of Fig. 1 through 6 may be used to light the PBX tie trunk or CO trunk busy lamp. A separately mounted lamp indicator may be used to provide the busy indication, if desired. The proper lamp voltage should be connected to the lamp lead of Fig. 1 through 6 instead of ground as shown. (See General Note 18.)

**17.15** In many applications the attendant will control the transfer circuit. The attendant will be aware that the associated trunk is out of service. In these situations a busy lamp may not be required.

**Data Equipment Make Busy Arrangement**

**17.16** Transfer arrangements, Fig. 2, 4, and 6 of this Section, will provide a busy indication to an 828 Data Auxiliary Set, if required. (See 4.05 and 4.06.)

**17.17** Other data set make busy applications must be engineered on a local basis as required.

**Station Line Circuit Make Busy Arrangement**

**17.18** Due to the many systems involved, local engineering will be required when a PBX or CO station line circuit must be made busy.

**Key Systems Make Busy Arrangement (Fig. 34)**

**17.19** Fig. 34 shows a make busy arrangement for private line services terminating in key telephone sets. This arrangement will be used when the set is associated with transfer arrangements Fig. 1 through 6 of this section.

**Circuit Description (Fig. 34)**

**17.20** The KTU (17B) operates from ground through made contacts of the transfer relay associated with Fig. 34.

**17.21** Battery through an operated contact of the 17B KTU will light the busy lamp. This is done via the L lead of the key telephone set associated with any one of the transfer arrangements shown in Fig. 1 through 6.

**17.22** The key telephone busy lamp, when lighted, will indicate to the user that the circuit appearing on the key associated with this lamp has been transferred.

17.23 Apparatus requirement:

- 17B KTU.

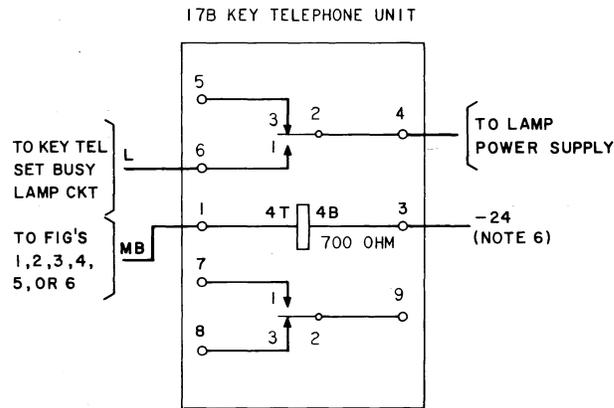


Fig. 34—Make Busy Arrangement For Key Telephone Set Termination

## GENERAL NOTES

1. Remote loopback will not function for alternate services except when the facility is transferred to the data termination.
2. Refer to Section 598-080-100 for additional information on the Data Auxiliary Set 828A.
3. Maximum resistance of the B lead associated with the Data Auxiliary Set 828A is 33 ohms based on 22 volts dc minimum.
4. Maximum resistance of the S lead is 35 ohms. If this range is exceeded, a 17B KTU may be provided, per Fig. 9, to extend the range to 1,100 ohms with a minimum of 20 volts dc.
5. See Section 812-002-250 for typical applications of this arrangement.
6. See SD-69243-01 for circuit requirements when relay adjustment is required.
7. See SD-69288-01 for circuit requirements when relay adjustment is required.
8. The 6017 AP key shall be modified per 4.11.
9. Maximum resistance of the S lead is 350 ohms based on a minimum of 20 volts dc.
10. P denotes pair.
11. See Section 812-002-221 for apparatus associated with this circuit.
12. For description, installation, and connections, refer to appropriate section.
13. The 265A KTU is a blank unit with three relay mounting positions.
14. Mount the AG8 relay in the middle position and the AJ27 relay in the bottom position of the 265A KTU. Wire per figure.
15. All wiring should be 24BW Green (P46B054 GRN, Wire, BW, 24 Gauge Single) unless otherwise specified.
16. See SD-69288-01 Fig. 88 for information on the 265A KTU.
17. In some applications, the busy lamp will not be required.
18. In some applications, it will be necessary to connect a lamp voltage (10 volts ac, 24 volts, 48 volts, etc) instead of ground as shown.