

ELECTRON TUBES AND DIODES USED FOR RINGING IDENTIFICATION, INSTALLATION, AND CONNECTIONS (425A, 426A TUBES AND 426N, 813BH DIODE)

1. GENERAL

1.01 This section contains information on 425A and 426A cold-cathode gas filled electron tubes used in telephones, subscriber sets, and connecting blocks. It also provides information on the 426N (MD) and 813BH diodes as used with certain telephone sets.

1.02 This section is reissued to:

- Add information on 813BH diode
- Show 426N diode MD
- Add Tables H and I
- Add Fig. 8
- Revise Tables B through G
- Revise Fig. 7.

1.03 These tubes and diodes are intended for use with grounded ringing on 4-party selective or 8-party semiselective lines. This type service requires superimposed ringing (ac ringing voltage plus a dc bias voltage), in order to assure satisfactory ringer operation.

1.04 In addition to the ringing selectivity provided, 425A or 426A tubes also have been used with high-impedance grounded ringers to minimize the effects of inductive noise when encountered, however, there are other coupling devices which provide noise isolation and greater ringing range (refer to Section 500-114-100).

1.05 ♦The 426N diode is rated MD and replaced by 813BH diode (identified by a black body, and red and gray stripes on one end).♦

1.06 ♦The 426N (MD) or 813BH diode does not provide as much noise isolation and reduces ringing range compared to the electron tube. However, in cases of low noise and relatively short loops they can be used as a lower cost replacement for the tubes. It is recommended that the diode be used first in these cases and if satisfactory performance is not obtained, then one of the tubes be used in those sets where mounting space is available (500-, 554-, 2500-, 750-, 2750-, and 702-types). For sets that do not contain mounting space for the tube and for those cases where the tube does not provide satisfactory performance, a 28A ringer isolator (Section 501-375-101) or D-180036 Kit of Parts (Section 501-375-100) should be used. In all cases, the limitations and recommendations given in Section 500-114-100 should be adhered to.♦

1.07 The number of tube equipped ringing bridges and the permissible loop resistance are more restricted than for regular capacitor-equipped ringing bridges. For specific information on ringer limitations, refer to Section 500-114-100.

1.08 The maximum number of tube or diode-coupled ringers is not limited by dialing, but by the resistance zone and central office pretripping considerations. Pretripping limits the maximum number of ringers of the same polarity on the same side of the line to three. In addition, with tube or diode connected ringers the minimum loop resistance is 300 ohms to prevent pretripping.

Note: When three P-type ringers, with the same polarity, are connected to the same side of the line, pretrip may occur on loops less than 500 ohms. To solve this problem, the connections specified for the slate (S) and slate-red (S-R) ringer leads should be reversed.

NOTICE

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1.09 When using tubes or diodes, ringers should be operated in low notch bias for adequate ringing.

2. IDENTIFICATION

2.01 The 426A (Fig. 1) and 425A (Fig. 2) tubes are permanently mounted on plastic angle brackets with a No. 6 self-tapping screw provided for mounting the bracket. Spade-tipped conductors, approximately 6 inches long are provided for connection to other apparatus.

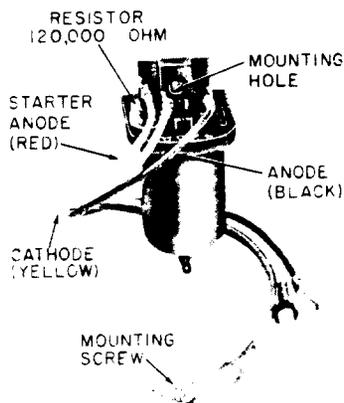


Fig. 1—426A Electron Tube

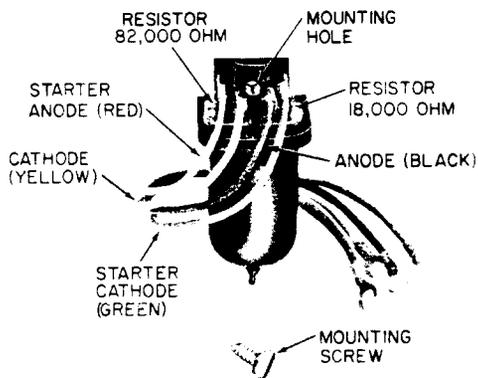


Fig. 2—425A Electron Tube

2.02 The glass envelope of these tubes is coated with a lacquer compounded of red dye and black pigment. This coating is sufficiently translucent to allow the cathode glow to be visible.

2.03 The 425A and 426A electron tubes are compatible and can be mixed with no adverse effects on the circuit.

A. 426A Tubes (3-Element)

2.04 The 426A electron tube (Fig. 1) is a 3-element, inert gas-filled, cold-cathode tube with three spade tip conductors; red, yellow, and black. A 120,000-ohm resistor mounted on the base is included in the control anode (red) lead (Fig. 3).

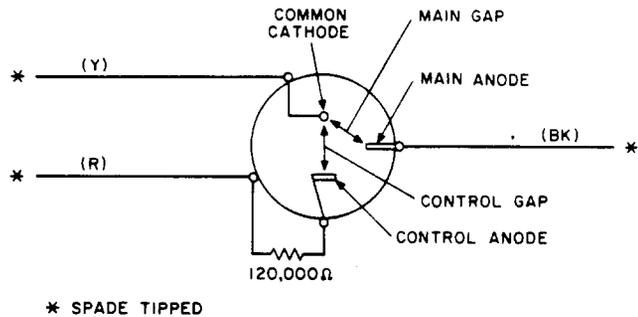


Fig. 3—Three Element Tube, Schematic

2.05 Both the control and main gaps are an open circuit at low voltage. The minimum instantaneous potential required to activate the tube is about 75 volts, in the forward direction. The tube will sustain at about 70 volts over a wide range of current values.

2.06 When connected with main gap and control gap in parallel, the tube will withstand approximately 175 volts of reverse potential i.e., if tube is wired for one polarity, it would take 175 volts of the opposite polarity to fire the tube.

2.07 For positive stations on lines experiencing inductive interference, induced noise voltages of 25 volts may be sufficient to cause the control gap to conduct. This conduction ("flashover") will result in noise (sputtering) on the line during conversation.

2.08 At negative station, the (R) tube lead is normally connected to tip to put the control gap across the line. The main gap will normally withstand 150 volts of induced noise before "flashover" (conduction). At stations without ANI

the (R) lead may be connected to ground if ringer operation is marginal, however tolerance to inductive interference will be limited to 25 volts as explained in 2.07. Where negative stations are connected to 96-volt long line circuits, the (R) lead must be connected to ground.

2.09 When 3-element tubes are used to provide isolation from inductive interference, station ringers should be typically connected as shown in Fig. 9.

B. 425A Tubes (4-Element)

2.10 The 425A electron tube (Fig. 2) is a 4-element inert gas-filled, cold-cathode tube with four spade tip conductors: red, green, yellow, and black. An 18,000-ohm resistor is in series with the control cathode and the green lead. An 82,000 ohm resistor, to limit current flow, is in series with the control anode and the red lead (Fig. 4).

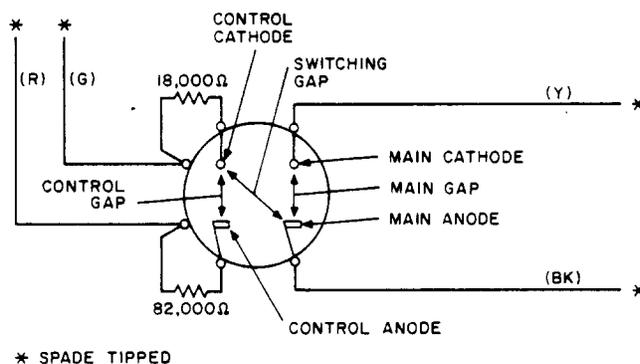


Fig. 4—Four Element Tube, Schematic

2.11 The 4-element tube corresponds in action to the 3-element tube. This 4-element tube may be required for superimposed ringing in cases where the induced voltage on the telephone line exceeds the values for satisfactory operation of the 3-element tube.

2.12 Both the control and main gaps are an open circuit at low voltage. The minimum instantaneous potential required to activate the tube is 100 volts, in the forward direction. The tube will sustain at about 70 volts over a wide range of current values.

2.13 As normally connected, the tube will withstand approximately 175 volts of reverse potential

i.e. if tube is wired for one polarity, it would take 175 volts of the opposite polarity to fire the tube.

2.14 The control gap of the 4-element tube is bridged across the line (and the main gap connected between the line and ground) for both positive and negative stations (Fig. 10). The line is protected from induced noise voltages of 160 volts by the high breakdown point of the main gap.

2.15 When a station set is equipped with a 4-element 425A electron tube and used with 96-volt dial long line circuit, install a 542K $.5\mu\text{f}$ capacitor (furnished locally) in series with the (G) tube lead to block dc voltage and prevent breakdown of the control gap. Use any spare terminal or D-161488 connector to connect capacitor in series with (G) tube lead.

C. 426N (MD) or 813BH Diode

2.16 The 426N (MD) or 813BH diode (Fig. 7) is a two lead device which may be used to provide ringing isolation for grounded ringers on 4-party full selective or 8-party semiselective service. Refer to paragraph 1.06.

2.17 The diodes may be ordered as a D-180697 Kit of Parts which consists of:

- 1—813BH diode or 840363113 diode assembly (MD) [426N (MD) diode]
- 2—840363121 sleeving
- 2—840363139 sleeving
- 2—840363147 screw assembly
- 1—840363154 lead assembly
- 2—801219320 (P-121932) connector assembly

Note: Some sets will not require all of these components.

2.18 The noise isolation provided by the diodes, connected for positive superimposed ringing, is equivalent to that of a 426A gas tube (Fig. 9 or paragraph 2.07). For installations equipped with a diode where inductive noise is a serious problem, it may be necessary to replace the diode in the set with a ringer isolator (Section 500-114-100).

3. INSTALLATION

A. Tubes

3.01 Installation of tubes shall consist of mounting the tube within the telephone set and connecting as indicated by the appropriate table.

3.02 Tubes may be used with all sets that have space available for mounting. In all 500- and 2500-type sets the tube is mounted to the base, (Fig. 5) using the mounting screw provided. In a 702-type set it will be necessary to remove the dial in order to place the tube beside the network (Fig. 6).

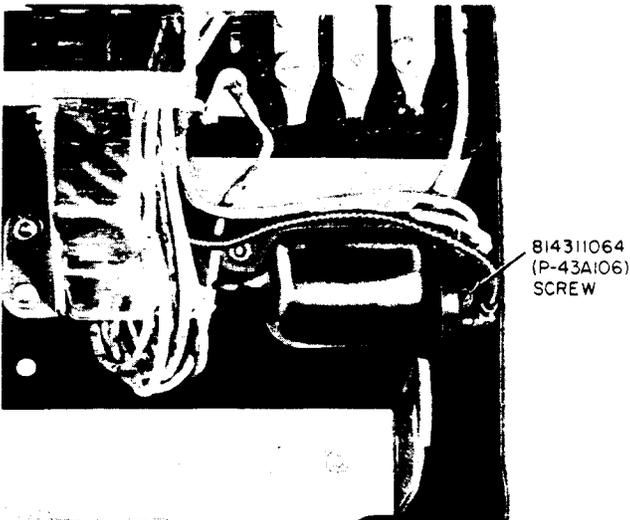


Fig. 5—500-Type Telephone Set, Tube Assembly

B. 426N (MD) or 813BH Diodes

3.03 If a D-180697 Kit of Parts is used, connect the diode into the set using sleeving and connectors supplied. Dress the diode to avoid any interference with set components. Figure 7 shows the 813BH diode mounted on a TRIMLINE® base. Figure 8 shows the D-180697 Kit of Parts installed in a PRINCESS® telephone set.

3.04 Previous issues have described the use of gas tubes with sets that can not contain a tube. This was done by using a 74-type connecting block with the tube located in the connecting block. Since the change to modular telephone sets, if the diode will not provide satisfactory isolation or if there are multiple sets on the line the use of a protector mounted device is advised (Section 500-114-100).

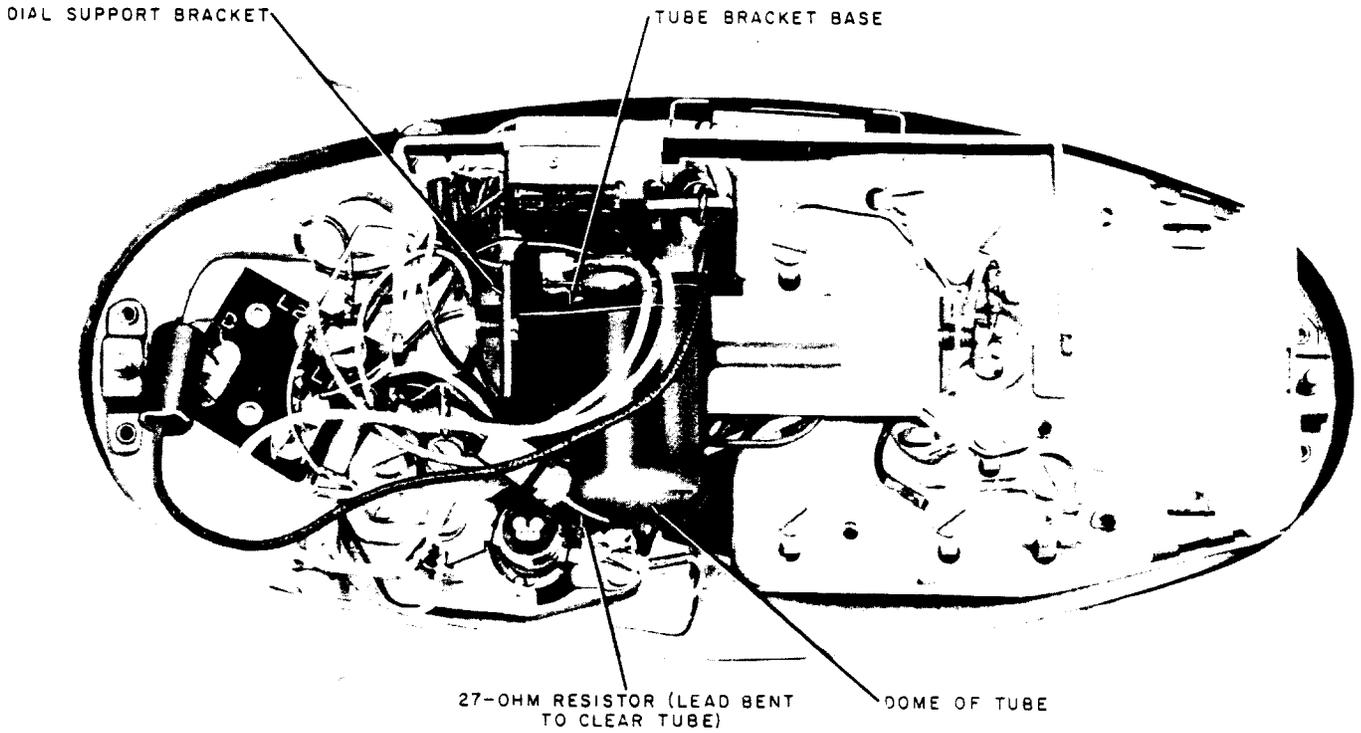


Fig. 6—Cold-Cathode Tube Installation in 702-Type Telephone Set

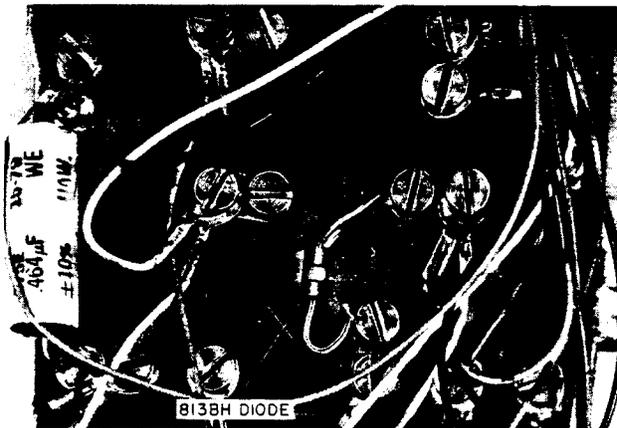


Fig. 7—Typical Installation of 813BH Diode in AC- or AD-Type Telephone Base

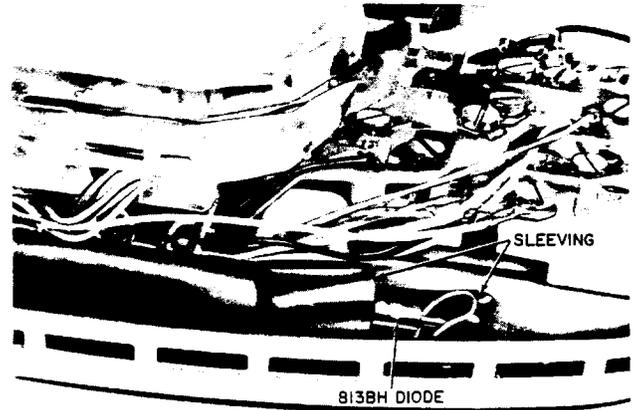
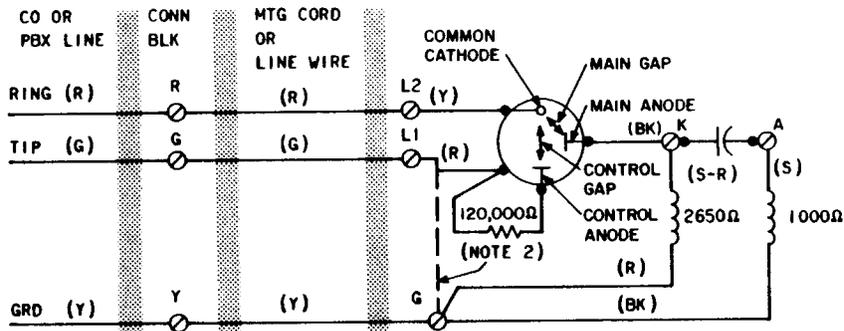
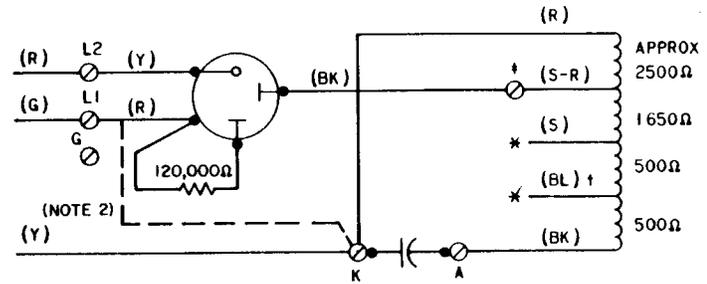


Fig. 8—Typical Installation of D-180697 Kit of Parts (813BH Diode) in 702- or 2702-Type Telephone Set

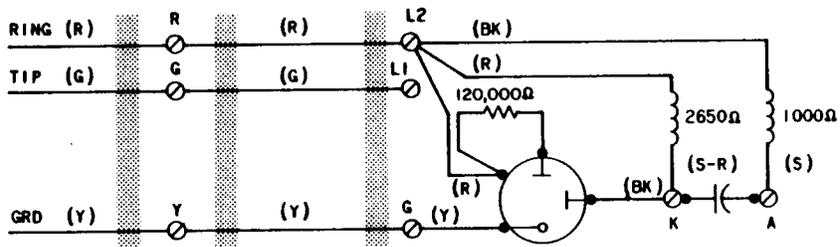


A. C4A RINGER

NEGATIVE RING STATION
426A ELECTRON TUBE (NOTE 1)

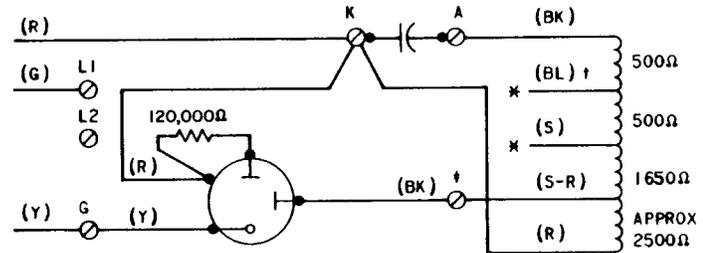


B. M1A, M2B, N1A OR P1A RINGER



A. C4A RINGER

POSITIVE RING STATION
426A ELECTRON TUBE (NOTE 1)



B. M1A, M2B, N1A OR P1A RINGER

NOTES:

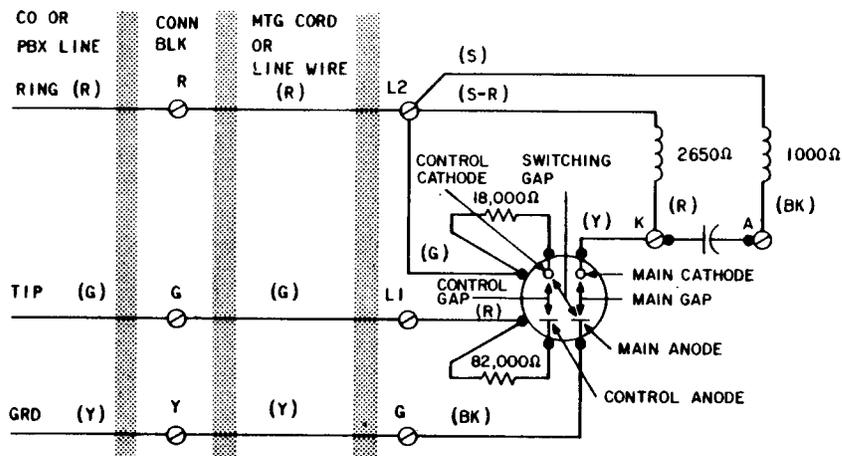
1. FOR TIP STATION, REVERSE TIP AND RING LEADS WITHIN SET.
2. WHERE RINGER OPERATION IS MARGINAL AT STATIONS WITHOUT ANI, (R) TUBE LEAD MAY BE CONNECTED TO GROUND. AT STATIONS USING 96V LONG LINE CIRCUITS, (R) LEAD MUST BE CONNECTED TO GROUND.

* INSULATE AND STORE

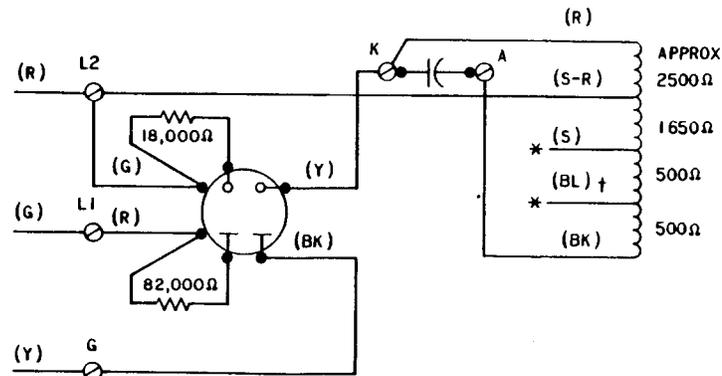
† (BL) LEAD REMOVED FROM LATER MODEL P1A RINGERS

‡ D-161488 CONNECTOR OR SPARE TERMINAL

Fig. 9—Three-Element Tube, Typical Ringing Bridge Connections

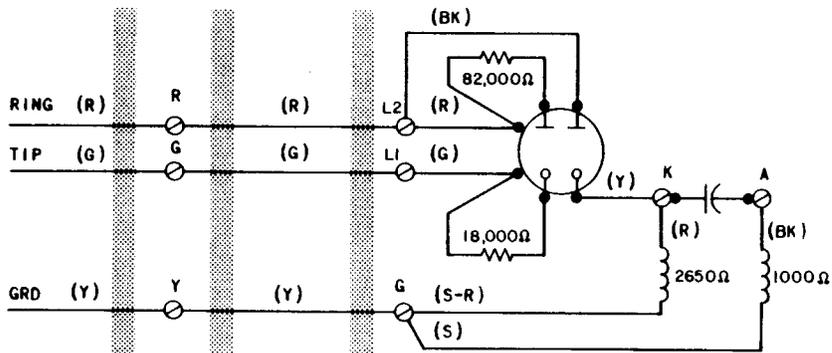


A. C4A RINGER

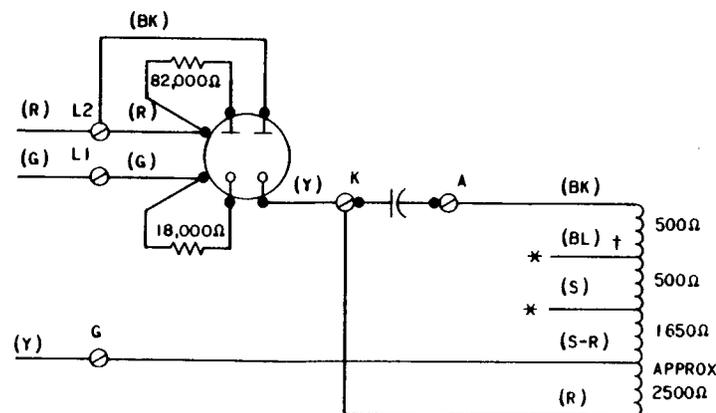


B. MIA, M2B, NIA OR PIA RINGER

NEGATIVE RING STATION
425A ELECTRON TUBE (NOTES 1 AND 2)



A. C4A RINGER



B. MIA, M2B, NIA OR PIA RINGER

POSITIVE RING STATION
425A ELECTRON TUBE (NOTES 1 AND 2)

NOTES:

1. WHEN A STATION SET IS EQUIPPED WITH A 4-ELEMENT 425A ELECTRON TUBE AND USED WITH 96 VOLT DIAL LONG LINE CIRCUIT, INSTALL A 542K CAPACITOR .5UF (FURNISHED LOCALLY) IN SERIES WITH THE (G) TUBE LEAD USING ANY SPARE TERMINAL OR D-161488 CONNECTOR.

2. FOR TIP STATION, REVERSE TIP AND RING LEADS WITHIN SET.

* INSULATE AND STORE

† (BL) LEAD REMOVED FROM LATER MODEL PIA RINGERS.

Fig. 10—Four-Element Tube, Typical Ringing Bridge Connections

TABLE A

500-, 2500-, OR 554-TYPE TELEPHONE SETS
RINGER AND TUBE CONNECTIONS

WIRE OR LEAD		COLOR	425A TUBE				426A TUBE			
			NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES		NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES	
			RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)	RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)
IW, MTG Cord, Plug or Jack Leads in Set	Ring	R	L2	L1	L2	L1	L2	L1	L2	L1
	Tip	G	L1	L2	L1	L2	L1	L2	L1	L2
	Grd	Y	G	G	G	G	G	G	G	G
	Spare	BK	*	*	*	*	*	*	*	*
Ringer Leads		R	K	K	K	K	G	G	L2	L2
		BK	A	A	A	A	G	G	L2	L2
		S	L2	L2	G	G	A	A	A	A
		S-R	L2	L2	G	G	K	K	K	K
Line Switch Leads		W	F	F [Ⓢ]						
		BR	C	C [Ⓢ]						
Tube Leads		R	L1	L1	L2	L2	L1†	L1†	L2	L2
		BK	G	G	L2	L2	K	K	K	K
		Y	K	K	K	K	L2	L2	G	G
		G	L2	L2	L1	L1	—	—	—	—

*Insulate and Store.

†If ringer operation is marginal, (R) lead from 426A tube may be connected to G.

Ⓢ Indicates connections for TOUCH-TONE equipped sets or when G36 handset is provided.

◆ TABLE B ◆

702-TYPE TELEPHONE SET
RINGER AND TUBE CONNECTIONS

WIRE OR LEAD		COLOR	425A TUBE				426A TUBE			
			NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES		NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES	
			RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)	RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)
623P4 Jack Leads in Set†	Ring	R	L2	L1	L2	L1	L2	L1	L2	L1
	Tip	G	L1	L2	L1	L2	L2	L2	L1	L2
	Trnsf	Y**	3	3	3	3	3	3	3	3
	Trnsf	BK	4	4	4	4	4	4	4	4
Line Switch Leads		W	F	F (C)						
		S	*	*	*	*	*	*	*	*
		BR	C	C (F)						
Straps		BK	*	*	*	*	*	*	L2-K	L2-K
		‡	—	—	—	—	3-K	3-K	—	—
Ringer Leads		R	K	K	K	K	K	K	K	K
		BK	A	A	A	A	A	A	A	A
		S	*	*	*	*	*	*	*	*
		S-R	L2	L2	3	3	§	§	§	§
Tube Leads		R	L1	L1	L2	L2	L1 ¶	L1 ¶	L2	L2
		BK	3	3	L2	L2	§	§	§	§
		Y	K	K	K	K	L2	L2	3	3
		G	L2	L2	L1	L1	—	—	—	—

* Insulate and store.

† Terminals 3 and 4 in set are on lamp terminal block.

‡ Wire a strap (M1W cord or equivalent) between 3 and K as shown.

§ Connect (S-R) ringer lead and (BK) tube lead together using D-161488 connector or connect to lamp terminal 5, if available.

¶ If ringer operation is marginal, (R) lead from tube may be connected to 3.

** The (Y) lead from the transformer should be wired to ground (terminal Y) at the connecting block.

○ Indicates connections when G36 handset is provided.

◆ TABLE C ◆

750AM/BM OR 2750AM/BM TELEPHONE SETS
RINGER AND TUBE CONNECTIONS

WIRE OR LEAD		COLOR	425A TUBE				426A TUBE			
			NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES		NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES	
			RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)	RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)
652A4 Jack at 71B Conn Block	Ring	R	2	1	2	1	2	1	2	1
	Tip	G	1	2	1	2	1	2	1	2
	Grd	Y	3	3	3	3	3	3	3	3
	Spare	BK	4	4	4	4	4	4	4	4
623P4 Jack Leads at TB1		R	R	R	R	R	R	R	R	R
		G	G	G	G	G	G	G	G	G
		Y	Y	Y	Y	Y	Y	Y	Y	Y
		BK	BK	BK	BK	BK	BK	BK	BK	BK
Line Switch Leads		W	F	F (C)						
		S	L1	L1	L1	L1	L1	L1	L1	L1
		BR	C	C (F)						
Straps		Y	*	*	*	*	*	*	*	*
		BK	K	K	K	K	K	K	K	K
Ringer Leads		R	K	K	K	K	Y	Y	L1	L1
		BK	A	A	A	A	Y	Y	L1	L1
		S	L1	L1	Y	Y	A	A	A	A
		S-R	L1	L1	Y	Y	K	K	K	K
Tube Leads		R	1	1	2	2	1†	1†	2	2
		BK	3	3	2	2	4	4	4	4
		Y	4	4	4	4	2	2	3	3
		G	2	2	1	1	—	—	—	—

* Insulate and store.

† If ringer operation is marginal, (R) lead from 426A tube may be connected to 3.

○ Indicates connections for TOUCH-TONE sets or when G36 handset is provided.

◆ TABLE D ◆

**2554-TYPE TELEPHONE SETS
RINGER AND DIODE CONNECTIONS**

WIRE OR LEAD		LEADS OR COLOR	NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES	
			RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)
Inside Wire or 523A-Type Plug Leads in Set	Ring	R	2 (L2)	2 (L2)	2 (L2)	2 (L2)
	Tip	G	1 (L1)	1 (L1)	1 (L1)	1 (L1)
	Grd	Y	3 (G)	3 (G)	3 (G)	3 (G)
	Spare	BK	*	*	*	*
P1A Ringer Leads		R	A	A	A	A
		BK	K	K	K	K
		S	*	*	*	*
		S-R	‡	‡	‡	‡
Strap From A		BK	3 (G)	3 (G)	2 (L2)	1 (L1)
Line Switch		S	*	*	*	*
D-180697 Kit of Parts	426N (MD) Diode	Flanged End †	2 (L2)	1 (L1)	3 (G)	3 (G)
		Knob End ‡	‡	‡	‡	‡
	813BH Diode	Unstriped End †	2 (L2)	1 (L1)	3 (G)	3 (G)
		Striped End ‡	‡	‡	‡	‡

* Insulate and store.

† Connect flanged or unstriped end of diode to one end of (W) strap lead provided, using sleeving and an 801219320 connector assembly. Connect other end of (W) strap lead to terminal indicated.

‡ Connect knob or striped end of diode to (S-R) ringer lead using other connector assembly provided.

○ Indicates terminals in sets equipped with 4228-type networks.

◆ TABLE E ◆

702B (MD), BM OR 2702B (MD), BM TELEPHONE SETS
 RINGER AND DIODE CONNECTIONS

WIRE OR LEAD		COLOR	NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES	
			RING	TIP	RING	TIP
Mtg Cord or 623P4 Jack Leads in Set	Ring	R	L2	L2	L2	L2
	Tip	G	L1	L1	L1	L1
	Trnsf ‡	Y	3†	3†	3†	3†
	Trnsf	BK	4†	4†	4†	4†
Line Switch		S	*	*	*	*
Strap From H		BK	*	*	*	*
Strap From A		§	3	3	L2	L1
Ringer Leads		R	A	A	A	A
		BK	K	K	K	K
		S	*	*	*	*
		S-R	G	G	G	G
D-180697 Kit of Parts ¶	426N (MD) Diode	Flanged End **	L2	L1	3	3
		Knob End ††	G	G	G	G
	813BH Diode	Unstriped End **	L2	L1	3	3
		Striped End ††	G	G	G	G

* Insulate and store.

† Terminals 3 and 4 are on lamp terminal block.

‡ Connect the (Y) lead from the transformer to terminal Y (ground) at the connecting block.

§ Wire a strap (M1W cord or equivalent) from A to designated terminal.

¶ Connect diode into set as indicated using sleeving supplied, and dress diode to avoid interference with set components.

** Connect flanged or unstriped end of diode to one end of (W) strap lead provided using sleeving and 801219320 (P-121932) connector assembly. Connect other end of (W) strap to terminal indicated.

†† Connect knob or striped end of diode to terminal G using other connector assembly provided.

◆ TABLE F ◆

**AC- AND AD-TYPE TRIMLINE TELEPHONE BASES
RINGER AND DIODE CONNECTIONS**

WIRE OR LEAD		LEADS OR COLOR	NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES	
			RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)
Inside Wire (AC-Type) or Jack Lead in Set	Ring	R	L2	L2	L2	L2
	Tip	G	L1	L1	L1	L1
	Trnsf†	Y [W]	3	3	3	3
	Trnsf	BK	1	1	1	1
Strap From A		BK	3	3	L2	L1
Line Switch Lead		S	*	*	*	*
Ringer Leads		R	A	A	A	A
		BK	K	K	K	K
		S	B	B	B	B
		S-R	G	G	G	G
D-180697 Kit of Parts	426N (MD) Diode	Flanged End	L2	L1	3	3
		Knob End	G	G	G	G
	813BH Diode	Unstriped End	L2	L1	3	3
		Striped End	G	G	G	G

[] Early model bases.

* Insulate and store.

† One side of transformer should be bridged with ground lead at connecting block or in set.

Caution: Do not store spade-tipped leads under terminal board mounting screws.

◆ TABLE G ◆

960A01M AND 2960A01M TELEPHONE SETS
 RINGER AND DIODE CONNECTIONS (SEE NOTE)

WIRE OR LEAD		LEADS OR COLOR	NEGATIVE (-) PARTIES		POSTIVE (+) PARTIES	
			RING (1-5)	TIP (2-6)	RING (3-7)	TIP (4-8)
Ringer		R	1	1	6	7
		BK	4	4	4	4
		S	*	*	*	*
		S-R	5	5	5	5
PSB-Lead†		BL	1	1	6	7
D-180697 Kit of Parts	426N (MD) Diode	Flanged End	6	7	1	1
		Knob End	5	5	5	5
	813BH Diode	Unstriped End	6	7	1	1
		Striped End	5	5	5	5

Note: All terminals found on power supply board (PSB).

* Insulate and store.

† (BL) lead is on PSB-6 in factory-wired sets.

◆ TABLE H ◆

500-, 2500-, OR 554-TYPE TELEPHONE SETS
RINGER AND DIODE CONNECTIONS

WIRE OR LEAD		COLOR	NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES	
			RING	TIP	RING	TIP
IW, Mtg Cord, Plug or Jack Leads in Set	Ring	R	L2	L2	L2	L2
	Tip	G	L1	L1	L1	L1
	Grd	Y	G	G	G	G
	Spare	BK	*	*	*	*
Ringer Leads		R	G	G	L2	L1
		BK	G	G	L2	L1
		S	A	A	A	A
		S-R	K	K	K	K
D-180697 Kit of Parts	426N (MD) Diode	Flanged End †	L2	L1	G	G
		Knob End ‡	K	K	K	K
	813BH Diode	Unstriped End †	L2	L1	G	G
		Striped End ‡	K	K	K	K

* Insulate and store.

† Connect flanged or unstriped end of diode to one end of (W) strap lead provided, using sleeving and 801219320 (P-121932) connector assembly. Connect other end of (W) strap lead to terminal indicated.

‡ Connect striped or knob end of diode to terminal K using other connector assembly provided.

♦ TABLE I ♦

750AM/BM OR 2750AM/BM TELEPHONE SETS
RINGER AND DIODE CONNECTIONS

WIRE OR LEAD		COLOR	NEGATIVE (-) PARTIES		POSITIVE (+) PARTIES	
			RING	TIP	RING	TIP
652A4 Jack at 71B Conn Block	Ring	R	2	2	2	2
	Tip	G	1	1	1	1
	Grd	Y	3	3	3	3
	Spare	BK	4	4	4	4
623P4 Jack Leads at TB1		R	R	R	R	R
		G	G	G	G	G
		Y	Y	Y	Y	Y
		BK	BK	BK	BK	BK
Straps		Y	*	*	*	*
		BK	*	*	*	*
Ringer Leads		R	Y	Y	R	G
		BK	Y	Y	R	G
		S	K	K	K	K
		S-R	A	A	A	A
D-180697 Kit of Parts	426N (MD) Diode	Flanged End †	R	G	Y	Y
		Knob End ‡	A	A	A	A
	813BH Diode	Unstriped End †	R	G	Y	Y
		Striped End ‡	A	A	A	A

* Insulate and store.

† Connect flanged or unstriped end of diode to one end of (W) strap lead provided using sleeving and 801219320 (P-121932) connector assembly. Connect other end of (W) strap lead to terminal indicated.

‡ Connect knob or striped end of diode to terminal A using other connector assembly, provided.