

**MONITOR AMPLIFIERS OF THE AUTOMATIC MONITOR,  
REGISTER AND SENDER TEST CIRCUIT  
OPERATING METHODS  
NO. 5 CROSSBAR OFFICES**

1. GENERAL

1.01 This section describes initial adjusting procedures and operating methods for the maintenance of the dial pulse amplifier, repeater and bias controller, and the multifrequency and PCI amplifiers of the automatic monitor, register and sender test circuit in No. 5 crossbar offices.

1.02 This section is reissued:

(a) To add a method for adjusting the PCI pulse amplifier which functions with PCI senders arranged for balanced pulsing.

(b) To add Fig. 6 to show the circuit of the PCI pulse amplifier modified for use with PCI senders arranged for balanced pulsing.

(c) To add 1.12 to explain the meaning of dual designations applied to terminals and terminal strips.

(d) To add the WV-98A voltohmyst test set, as the WV-97A voltohmyst is no longer manufactured.

1.03 Information in this section is arranged as follows:

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1.04 The automatic monitor connects to registers and senders as they are selected for service calls. When the monitor is connected to a register, it records the called number pulsed into the register and checks it against the number passed from the register to the marker. When the monitor is connected to a sender, it records the number pulsed out over the trunk and checks it against the number passed from the marker to the sender. If the numbers do not check, the trouble recorder is called in and a trouble record is made.

1.05 The dial pulse amplifier, repeater, and bias controller, which are a part of the automatic monitor, provide a high impedance link between the register or sender and the checking relays. It consists of three parts as follows:

(a) DC and AC Power Supply (Fig. 1):

The dc and ac power supply provides three separate voltages for the dial pulse amplifier, repeater, and bias controller. A low ac voltage is furnished to the heater elements of the tubes by connections to the 6.3 volt taps on the ac transformer. An ungrounded regulated dc voltage (+256 volts) is furnished to the plates of the amplifier and repeater tubes by the rectifier and voltage regulator tubes in combination with the filters and resistors. A second ungrounded dc voltage (+130 volts) is obtained from the output of a varistor that is connected directly to the ac transformer. This second dc voltage is in series with and supplements the office battery for the plate supply for plate 4 of the B1 tubes.

(b) Bias Controller (Fig. 2): The bias controller provides the ungrounded bias voltage between the grid and cathode of the amplifier tube. The amount of fluctuation in the office battery voltage is reflected in the bias voltage by the use of rectifiers, voltage dividers, and voltage regulators in the bias controller

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- to keep the bias voltage at the same value as the office battery voltage.

### (c) Amplifier and Repeater (Fig. 3):

Voltage changes that occur across the tip and ring conductors during pulsing also change the voltage between the grid and cathode of the amplifier. This voltage change is converted into current changes by the amplifier, to control the pulsing relay. The P tube and B fuse are provided to prevent hazardous voltages from being connected to external leads if the high-voltage portion of the power supply becomes grounded.

1.06 The multifrequency amplifier (Fig. 4) completes a transmission circuit for the multifrequency pulses from either an incoming register or a sender to the monitor receiving circuit. This circuit is arranged to provide the same level of input to the monitor receiver as that obtained at the input of the registers.

1.07 The PCI amplifier (Fig. 5) converts the potential changes, which occur in the PCI sender not arranged for balanced pulsing, into closures of ground on the leads to the register circuit of the monitor. The amplifier presents a high impedance to the receiving circuits in order that normal operation of the receiving circuits is not affected.

1.08 The modified PCI pulse amplifier (Fig. 6) converts the potential changes, which occur in the PCI sender arranged for balanced pulsing, into closures of ground on the leads to the register circuit of the monitor. The modified PCI pulse amplifier presents a high impedance to the receiving circuits in order that normal operation of the receiving circuits is not affected.

1.09 It is recommended that the bias adjustments (B1, B2, GN1, GN2, PM1, and PM2 potentiometers) be checked at least once a week during the first month of operation, and at monthly intervals thereafter. The B1 and B2 potentiometer adjustments should also be checked and rechecked at the above intervals whenever a PA, B1, or B2 tube is changed. The GN1, GN2, PM1, and PM2 potentiometer adjustments should be checked whenever a GN or PM tube is changed.

1.10 The cold cathode voltage regulator tubes should be checked in accordance with Section 024-707-701. Heater-type tubes should be checked in accordance with Section 100-630-101.

1.11 The timing requirements of the P relay and associated PA and DP tubes, and the G, N, POS, and MG relays associated with the GN and PM tubes should be checked as outlined in the circuit requirements table. For the description of the timing test set, see Section 100-130-101.

1.12 For terminals with dual designations, as C6/A15, the number to the left of the diagonal indicates the terminal designation for units equipped with 224- and 227-type terminal strips. The designation to the right of the diagonal indicates the terminal designation for units equipped with solderless D-type terminal strips.

## 2. APPARATUS

2.01 3-inch cabinet screwdriver.

2.02 6-1/2-inch long-nose pliers.

2.03 5-inch diagonal pliers.

2.04 Electric soldering copper.

2.05 Testing cords - Three No. 893 cords, 6 feet long, each equipped with two No. 360A tools (1W13B cord), a No. 419A tool (for connecting to 224- or 227-type terminal strips) or a No. 624B tool (for connecting to D-type terminal strips), and a KS6278 connecting clip.

2.06 Testing cord - No. 893 cord, 3 feet long, equipped with two No. 360A tools (1W13A cord), and two No. 419A, or two No. 624B tools.

2.07 Voltohmyst (RCA type No. 195A WV-97A, or WV-98A) test set.

## 3. PREPARATION

3.01 Calibrate the voltohmyst test set for ac and dc voltages as outlined in the manufacturer's manual. Mount the test set on a support that is insulated from battery and ground, and then make the following connections:

### Voltohmyst Type No. 195A

(a) Connect the ground (black) cord to the GND terminal.

(b) Connect the dc (blue) cord to the dc terminal.

(c) Connect the ac (red) cord to the ac OHMS terminal.

### Voltohmyst Type WV-97A

(d) Connect the ground (black) cord to the GND terminal.

(e) Connect the direct probe and cable (blue) to the VOLTS AC-DC terminal. When making dc measurements, attach the dc probe to the direct probe and cable.

(f) When resistance measurements are to be made, connect the OHMS (red) lead to the OHMS terminal.

Voltohmyst Type WV-98A

(g) Connect the probe and cable to the test set. When making dc measurements, push switch on probe to front position. When making AC-OHMS measurements, push switch on probe to rear position.

Caution: In making these tests avoid contact with live terminals since the normal operating voltages at various points in the amplifier may be as high as 665 volts.

4. METHODA. Bias Controller Calibration

- 4.01 This procedure describes the method of strapping the V2, V3, and V4 resistors in order that a minimum voltage difference between the voltage outputs of the V1 through V4 varistors and the V5 through V8 varistors may be obtained.
- 4.02 Set the RANGE switch to the 5V position and the SELECTOR switch to the +VOLTS position.
- 4.03 At the amplifier unit, terminal strip C/A, connect the C6/A15 terminal to the C16/A26 terminal.
- 4.04 Connect the GND cord of the test set to the C8/A17 terminal of the amplifier unit and then connect the dc probe to the C4/A16 terminal.
- 4.05 On the automatic monitor, register and sender test panel, operate the MAC key.
- 4.06 Remove any straps at the C/A terminal strip that are shown in Table A. Turn the B1 potentiometer to its minimum and then to its maximum settings. Make a record of these voltage readings.
- 4.07 Temporarily place a strap on the C/A terminal strip as shown in Step 1, and turn the B1 potentiometer to its minimum and then its maximum settings. Make a record of these voltage readings.

TABLE A

Step	Strap C/A Term. Strip Punchings
1	C8 to C18/A17 to A27
2	C9 to C18/A18 to A27
3	C9 to C8/A18 to A17
4	C9 to C19/A18 to A28
5	C9 to C19 and C8 to C18/ A18 to A28 and A17 to A27
6	C19 to C18/A28 to A27
7	C19 to C8/A28 to A17

4.08 Change the strapping and repeat the operations for Steps 2 through 7. If the voltage change exceeds 0.5 volt for any of the above measurements, a trouble condition is indicated, in which case proceed as outlined in Part 5 of this section covering trouble locating.

4.09 Strap permanently the C/A terminals which, when strapped, produce the minimum voltage change under the test conditions indicated in 4.07 and 4.08.

4.10 Disconnect the testing cords from the C/A terminal strip.

4.11 Restore the MAC key if automatic monitoring is not required.

B. Dial Pulse Amplifier Bias Adjustment (B1 Potentiometer)

- 4.12 This procedure provides for checking or adjusting the position of the B1 potentiometer that is used in adjusting the amplifier bias voltage.
- 4.13 On the automatic monitor, register and sender test panel, operate the MAC key.
- 4.14 After approximately one minute, operate the AAB (adjust amplifier bias) key. Observe that the AAB lamp flashes slowly.
- 4.15 If the AAB lamp does not flash or is not lighted, the bias is probably too high. If it is lighted steadily, the bias is probably too low. Adjust the B1 potentiometer until a point is reached where a slight change in either direction will light or extinguish the lamp. If a proper adjustment cannot be obtained, the PA or B1 tube may be defective and should be replaced.
- 4.16 Restore the AAB key.
- 4.17 Restore the MAC key if automatic monitoring is not required.

C. Dial Pulse Amplifier Bias Adjustment (B2 Potentiometer)

- 4.18 This procedure provides for checking or adjusting the position of the B2 potentiometer that controls the bias for one section of the B2 tube.
- 4.19 Connect the GND cord of the test set to the C10/A24 terminal, and then connect the DC probe to the C0/A14 terminal.
- 4.20 On the automatic monitor, register and sender test panel, operate the MAC key.

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- 4.21 After approximately one minute, operate the AAB key.
- 4.22 Adjust the B2 potentiometer, if necessary, so that a reading of 2.3 volts is obtained.
- 4.23 Restore the AAB key. Disconnect the test set cords.
- 4.24 Restore the MAC key if automatic monitoring is not required.

### D. PCI Amplifier Bias Adjustment (GN1 and GN2 Potentiometers)

- 4.25 This procedure provides for checking or adjusting the GN1 and GN2 potentiometers that control the bias on the GN vacuum tube of the PCI amplifier, which is used with PCI senders not arranged for balanced pulsing.
- 4.26 Block operated the CON1 relay.
- 4.27 Connect the 1B and 4B springs of the CSP relay to the middle terminal of the PM10 resistor.
- 4.28 On the automatic monitor, register and sender test panel, operate the MAC key.
- 4.29 Adjust the GN1 potentiometer to the position where the N relay just operates.
- 4.30 Adjust the GN2 potentiometer to the position where the G relay just operates.
- 4.31 When the G and N relays do not meet the timing requirements as specified in the circuit requirements table, readjust the GN1 and GN2 potentiometers as outlined in 4.26 through 4.30.
- 4.32 Remove the testing cords. Remove the blocking tool from the CON1 relay.
- 4.33 Restore the MAC key if automatic monitoring is not required.

### E. Modified PCI Pulse Amplifier Bias Adjustment (GN1, GN2, PM1, and PM2 Potentiometers)

- 4.34 This procedure provides a method of adjusting the GN1, GN2, PM1, and PM2 potentiometers that control the bias on the GN and PM vacuum tubes of the modified PCI pulse amplifier, which is used with senders arranged for balanced pulsing.
- 4.35 Block operated the CON1 relay.
- 4.36 Referring to Fig. 6, connect the 3B and 6B springs of relay CSP to point A, connect 1T of relay CSP to point B, and 4T of CSP to point C.

- 4.37 On the automatic monitor, register and sender test panel, operate the MAC key.
- 4.38 Adjust the GN1 potentiometer to the position where the N relay just operates.
- 4.39 Adjust the GN2 potentiometer to the position where the G relay just operates.
- 4.40 Adjust the PM1 potentiometer to the position where the MG relay just operates.
- 4.41 Adjust the PM2 potentiometer to the position where the POS relay just operates.
- 4.42 When the G, N, MG, and POS relays do not meet the timing requirements as specified in the circuit requirements table, readjust the GN1, GN2, PM1, and PM2 potentiometers as outlined in 4.35 through 4.41.
- 4.43 Restore the MAC key if automatic monitoring is not required.
- 4.44 Remove all testing cords. Remove the blocking tool from the CON1 relay.

## 5. TROUBLE LOCATING

- 5.01 Trouble conditions in the amplifier circuits may be disclosed in the course of performing routine tests, or as a result of trouble recorder cards that indicate the probability of trouble being located in these circuits.
- 5.02 To facilitate locating trouble within the dial pulse amplifier, follow the procedures given below.
  - (a) Check the B1 potentiometer adjustment as described in 4.13 through 4.17.
  - (b) Test the tubes in accordance with information specified in 1.09.
  - (c) Recheck the B1 potentiometer.
  - (d) Check the P relay and associated PA and DP tubes in accordance with the timing requirements specified in the circuit requirements table.
  - (e) Check the B2 potentiometer adjustment as described in 4.19 through 4.24.
  - (f) Check the bias controller calibration as outlined in 4.02 through 4.11 and restrap if necessary.
  - (g) Check the point-to-point voltages as covered in Part 6.

5.03 To facilitate locating trouble within the PCI amplifier, follow the procedures given below.

- (a) Check the GN1, GN2, PM1, and PM2 potentiometers as described in 4.26 through 4.44.
- (b) Test the tubes in accordance with information specified in 1.09.
- (c) Recheck the GN1, GN2, PM1, and PM2 potentiometer adjustments.
- (d) Check the G, N, POS, and MG relays and associated GN and PM tubes in accordance with the timing requirements specified in the circuit requirements table.
- (e) Check the point-to-point voltages as covered in Part 6.

#### 6. VOLTAGE MEASUREMENTS FOR TROUBLE LOCATING

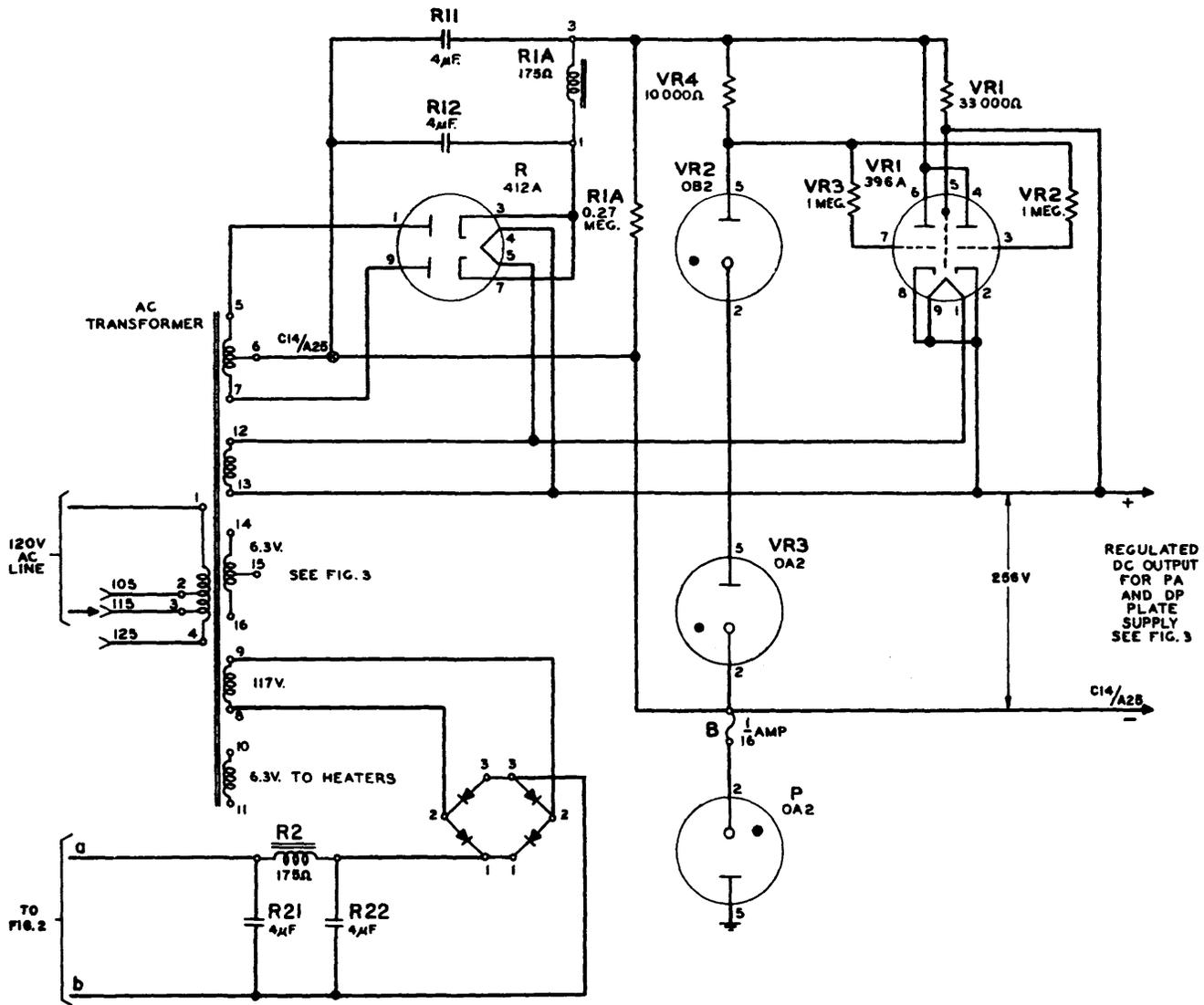
6.01 All high-voltage measurements should be made with the plastic cover in place by inserting the probe of the test set through the holes provided for this purpose.

6.02 Fig. 1 through 6 provide information relative to the setting of the SELECTOR and RANGE switches of the test set, connecting information, and the voltage readings that should be obtained at the various points in the circuits under test. Abbreviated schematics of the circuits to be tested are included for information purposes.

6.03 The voltages given in the tables are subject to variations due to manufacturing tolerances in the equipment and test set and are to be used as a guide in locating short circuits, false grounds, checking for continuity, and resistance values. The ac voltages are RMS values. If desired, the resistance of individual pieces of equipment may be measured by means of the test set, first making certain that the monitor ac supply is disconnected and the MAC key is normal.

#### 7. REPORTS

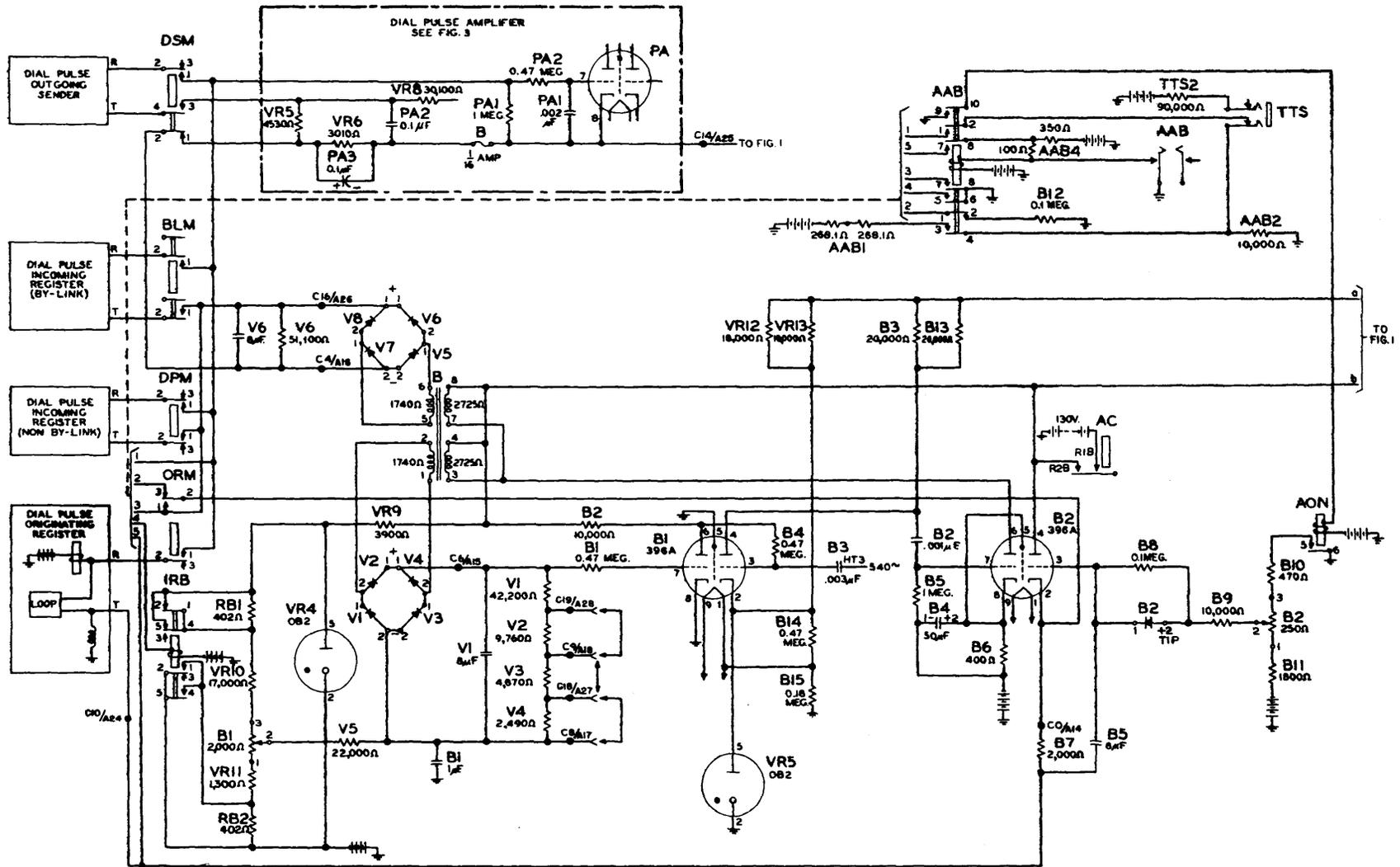
7.01 The required record of these tests should be entered on the proper forms.



SELECTOR Switch Setting	RANGE Switch Setting		Connect GND Lead of Test Set to		Connect Probe of Test Set to			Voltage Reading		Remarks
	195-A	WV-97A WV-98A	Apparatus	Term.	Probe	Apparatus	Term.	Min	Max	
+Volts	500	500	Frame Ground	-	DC	VR1 E.T.	4	380	460	(a)
"	500	500	"	-	"	VR1 E.T.	2	245	265	(a)
"	500	500	"	-	"	VR1 E.T.	2	195	215	With AAB key operated
"	500	500	"	-	"	VR2 E.T.	5	245	265	(a)
"	500	500	"	-	"	VR2 E.T.	2	140	155	(a)
"	5	5	"	-	"	VR3 E.T.	2	0	0	(a)
"	5	5	"	-	"	P E.T.	5	0	0	(a)
"	5	5	"	-	"	P E.T.	2	0	0	(a)
AC Volts	500	500	"	-	AC	R E.T.	1	290	350	(a)
"	500	500	"	-	"	R E.T.	9	290	350	(a)
"	500	150	"	-	"	AC Trans.	2	100	110	
"	500	150	"	-	"	AC Trans.	3	110	120	
"	500	150	"	-	"	AC Trans.	4	120	130	
"	10	15	R E.T.	5	"	R E.T.	4	6.0	6.6	(a)
"	10	15	VR1 E.T.	1	"	VR1 E.T.	9	6.0	6.6	(a)

(a) With C14/A25 terminal connected to frame ground

Fig. 1 - Power Supply



SELECTOR Switch Setting	RANGE Switch Setting		Connect GND Lead of Test Set to		Connect Probe of Test Set to			Voltage Reading		Remarks
	195-A	WV-97A WV-98A	Apparatus	Term.	Probe	Apparatus	Term.	Min	Max	
+Volts	500	150	Frame Ground	-	DC	B1 E.T.	2	105	110	(a)
"	500	500	"	-	"	" "	4	230	280	(a)
"	5	5	"	-	"	" "	5	0	0	(a)
"	150	150	"	-	"	" "	6	65	100	(a)
"	5	5	"	-	"	" "	8	0	0	(a)
"	500	150	"	-	"	B2 E.T.	4	125	135	(a)
"	500	150	"	-	"	" "	6	115	135	(a)
-Volts	50	50	"	-	"	" "	8			(a) 2.5V to 3.0V less than C.O. Bat. Voltage
+Volts	100	150	"	-	"	VR4 E.T.	5	50	62	(a)
-Volts	100	150	"	-	"	VR4 E.T.	2	48	50	C.O. Bat. Voltage
+Volts	500	150	"	-	"	VR5 E.T.	5	105	110	(a)
"	5	5	"	-	"	VR5 E.T.	2	0	0	(a)
-Volts	50	50	"	-	"	DSM Relay	1T			(e) With AAB Key operated
+Volts	50	50	"	-	"	DSM Relay	3B	14.2	15.8	(a)
"	10	15	"	-	"	DSM Relay	1B	5.7	6.3	(a)
-Volts	50	50	"	-	"	V5 Varistor	2	33	40	(d) With AAB Key operated
"	50	50	"	-	"	V1 "	2	31	37	(c)
"	50	50	"	-	"	V1 "	2	34	40	(f) With AAB Key operated
"	5	5	"	-	"	V2 "	1	1.0	2.0	(b)
+Volts	500	500	"	-	"	R2 Inductor	3	235	285	(a)
AC Volts	10	15	"	-	AC	B3 Cond.	HT3 Lead	6.0	9.0	
"	10	15	B1 E.T.	1	"	B1 E.T.	9	6.0	6.6	
"	10	15	B2 E.T.	1	"	B2 E.T.	9	6.0	6.6	

(a) With C14/A25 terminal connected to frame ground.

(b) Reading not to vary more than 0.1 volt over full range of B1 Potentiometer.

(c) Voltage should be 10 to 22 volts less than the central office voltage with the value dependent upon the setting of the B1 potentiometer. Range of adjustment using B1 potentiometer approximately 10 volts.

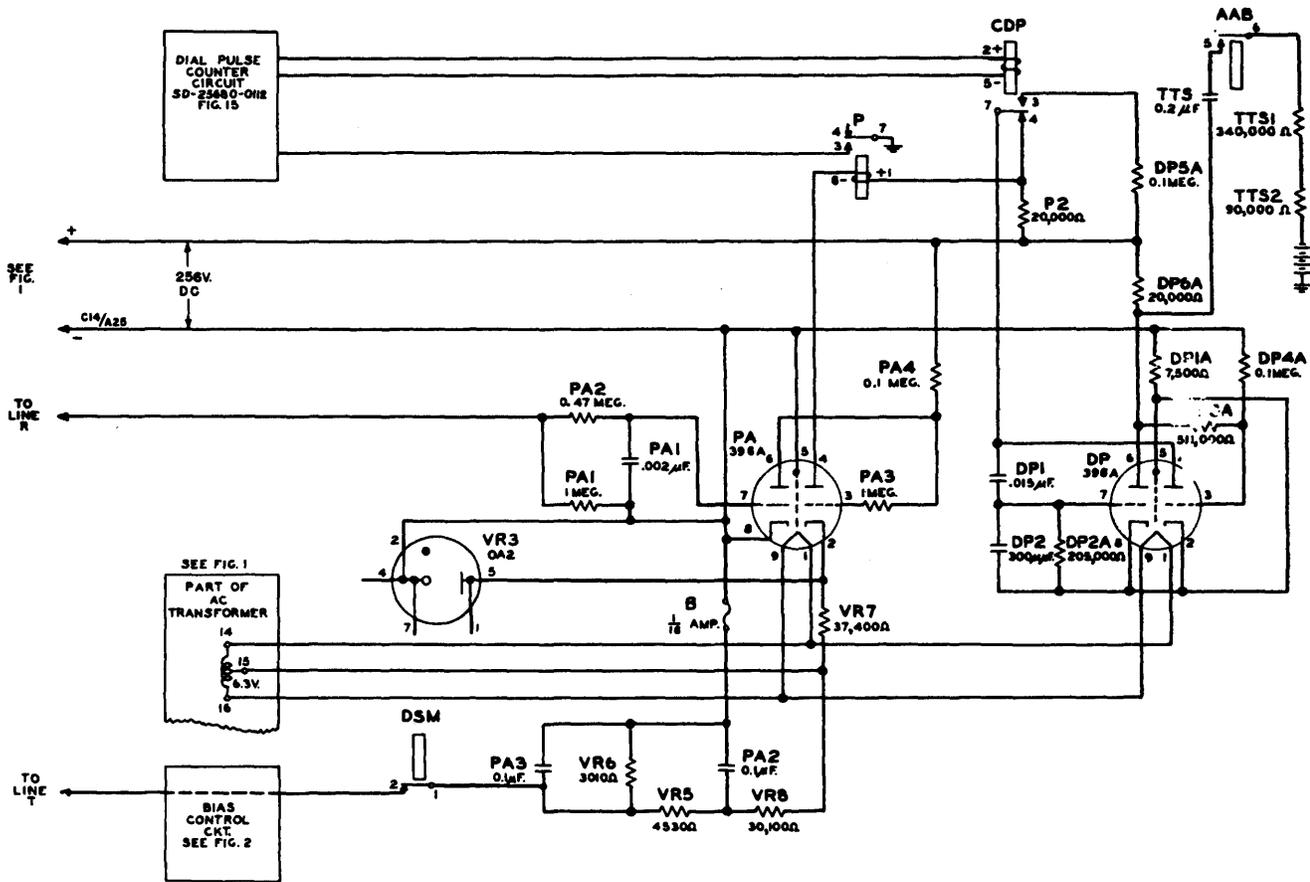
(d) Voltage dependent upon position of B1 potentiometer. With an average tube in the PA position, voltage measures 38 volts when circuit is in adjustment. Normal variation  $\pm$  2 volts.

(e) 2.5 volts less than central office battery voltage.

(f) Operation of AAB key should make voltage 2 volts higher.

Fig. 2 - Dial Pulse Bias Controller

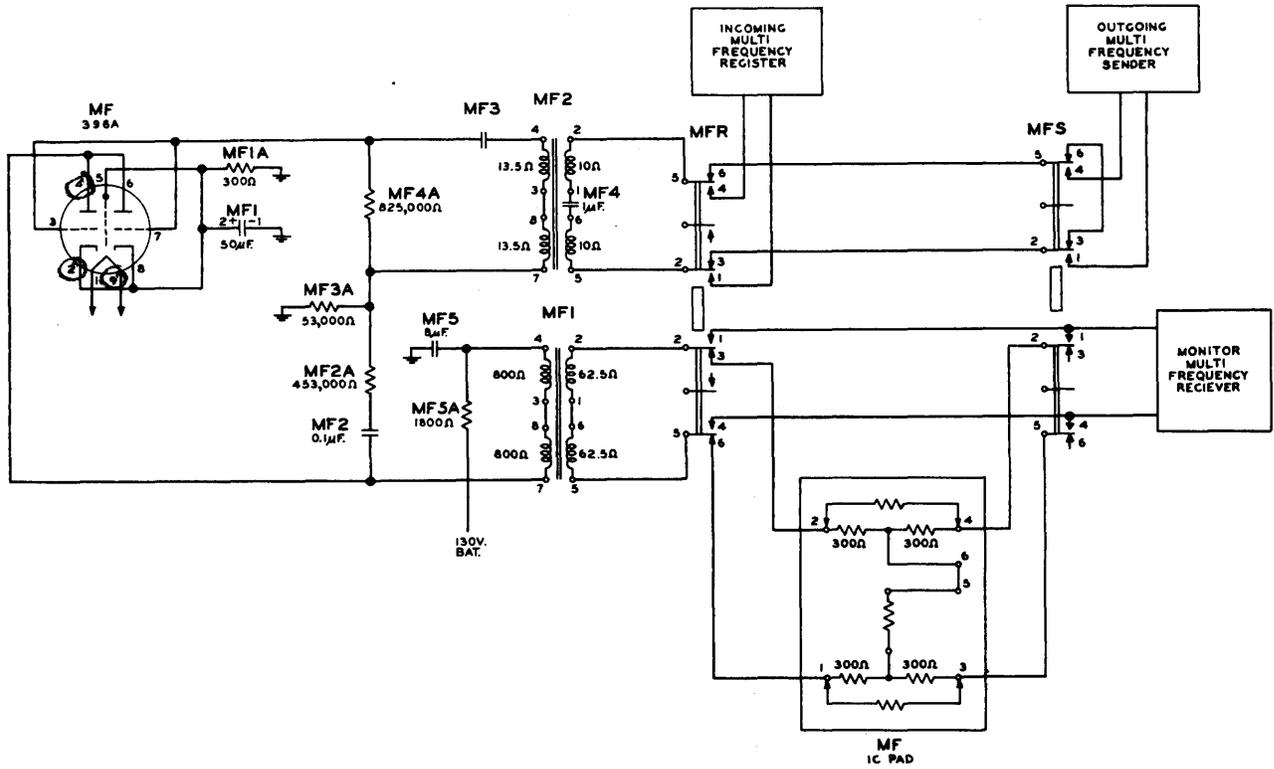
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SELECTOR Switch Setting	RANGE Switch Setting		Connect GND Lead of Test Set to		Connect Probe of Test Set to			Voltage Reading		Remarks
	195-A	WV-97A WV-98A	Apparatus	Term	Probe	Apparatus	Term.	Min	Max	
+Volts	500	500	Frame Ground	-	DC	DP E.T.	4	245	265	(a)
"	100	150	"	-	"	DP E.T.	5	42	56	(a)
"	500	150	"	-	"	DP E.T.	6	100	145	(a)
"	100	150	"	-	"	DP E.T.	2	42	56	(a)
"	100	150	"	-	"	DP E.T.	8	42	56	(a)
"	50	50	"	-	"	DP E.T.	3	16	24	(a)
"	500	500	"	-	"	PA E.T.	2	140	155	(a)
"	500	500	"	-	"	PA E.T.	4	245	265	(a)
"	500	500	"	-	"	PA E.T.	4	150	170	With AAB key operated
"	5	5	"	-	"	PA E.T.	5	0	0	(a)
"	100	150	"	-	"	PA E.T.	6	30	66	(a)
"	5	5	"	-	"	PA E.T.	8	0	0	(a)
AC Volts	10	15	DP E.T.	1	AC	DP E.T.	9	6.0	6.6	(a)
"	10	15	PA E.T.	1	"	PA E.T.	9	6.0	6.6	(a)

(a) With C14/A25 terminal connected to frame ground.

Fig. 3 - Dial Pulse Amplifier and Repeater

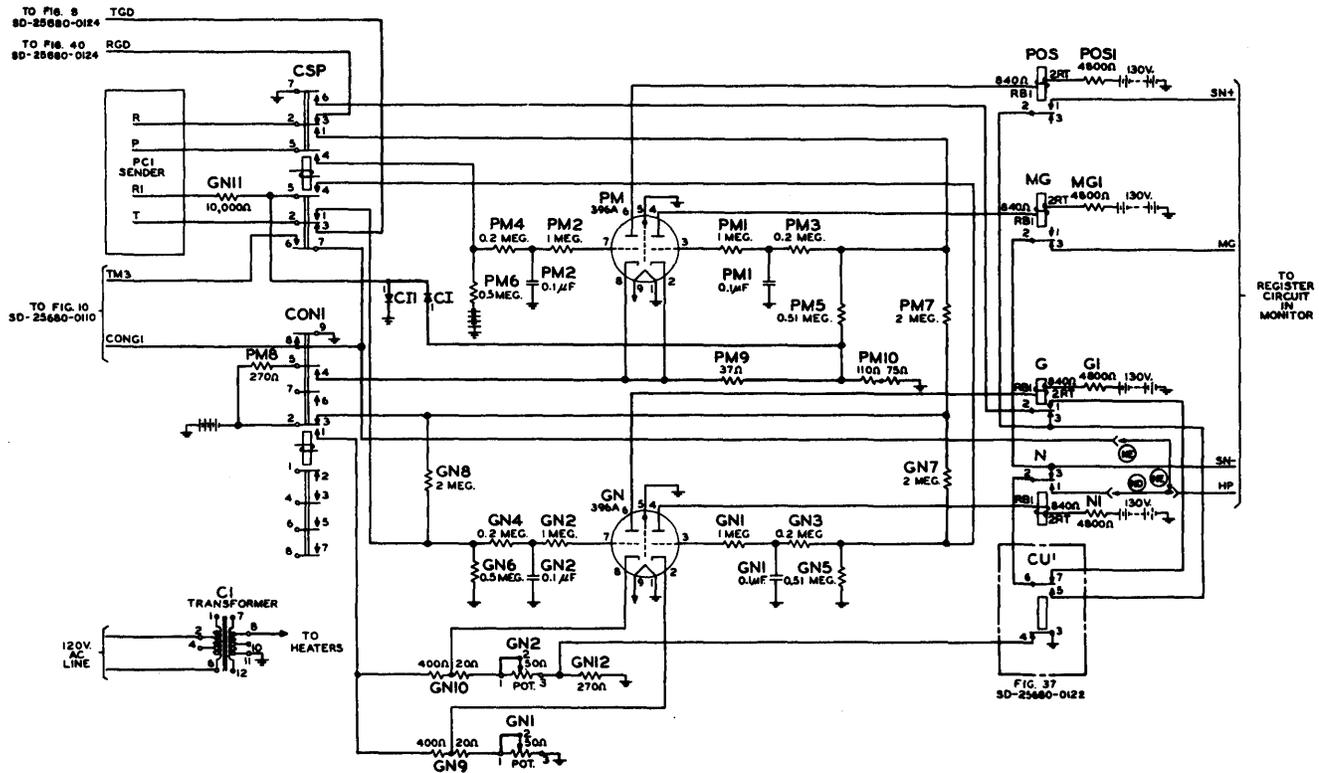


SELECTOR Switch Setting	RANGE Switch Setting		Connect GND Lead of Test Set to		Connect Probe of Test Set to			Voltage Reading		Remarks
	195-A	WV-97A WV-98A	Apparatus	Term.	Probe	Apparatus	Term.	Min	Max	
+Volts	5	5	Frame Ground	-	DC	MF E.T.	2	1.5	2.5	
+Volts	500	150	"	-	DC	" "	4	100	120	
AC Volts	10	15	MF E.T.	1	AC	" "	9	6.0	6.6	

Fig. 4 - Multifrequency Amplifier

MF 396A Tube

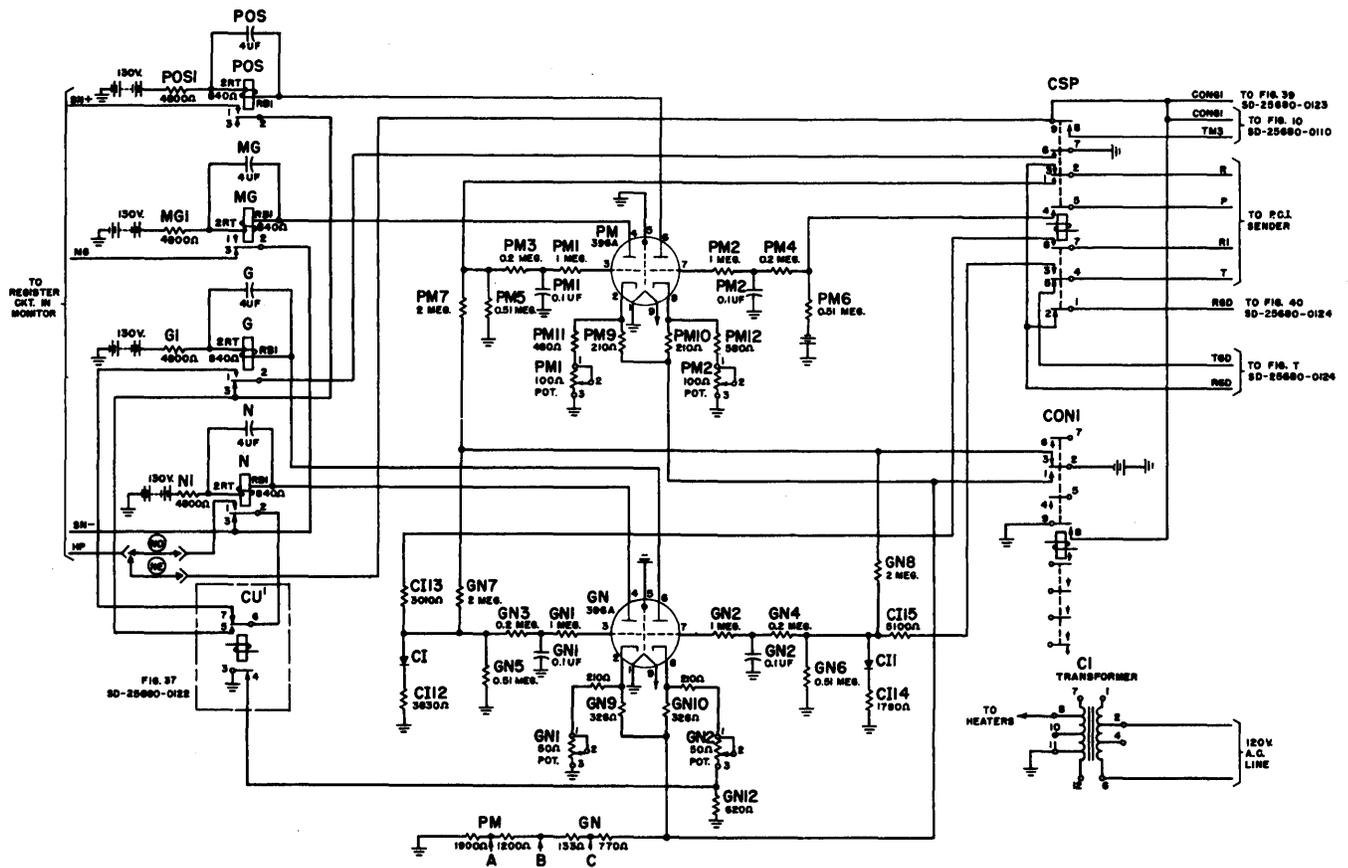
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SELECTOR Switch Setting	RANGE Switch Setting		Connect GND Lead of Test Set to		Connect Probe of Test Set to			Voltage Reading		Remarks
	195-A	WV-97A WV-98A	Apparatus	Term.	Probe	Apparatus	Term.	Min	Max	
+Volts	500	150	Frame Ground	-	DC	PM E.T.	6	125	135	(g)
"	100	150	"	-	"	PM E.T.	4	70	96	(g)
"	100	150	"	-	"	GN E.T.	6	70	100	(g)
"	100	150	"	-	"	GN E.T.	4	70	100	(g)
AC Volts	10	15	GN E.T.	1	AC	GN E.T.	9	6.0	6.6	
AC Volts	10	15	PM E.T.	1	AC	PM E.T.	9	6.0	6.6	

(g) Block CON1 relay operated.

Fig. 5 - PCI Amplifier



SELECTOR Switch Setting	RANGE Switch Setting		Connect GND Lead of Test Set to		Connect Probe of Test Set to			Voltage Reading		Remarks
	195-A	WV-97A WV-98A	Apparatus	Term.	Probe	Apparatus	Term.	Min	Max	
+Volts	500	150	Frame Ground	-	DC	PM E.T.	6	125	135	(g)
"	100	150	"	-	"	PM E.T.	4	70	96	(g)
"	100	150	"	-	"	GN E.T.	6	70	100	(g)
"	100	150	"	-	"	GN E.T.	4	70	100	(g)
AC Volts	10	15	GN E.T.	1	AC	GN E.T.	9	6.0	6.6	
AC Volts	10	15	PM E.T.	1	AC	PM E.T.	9	6.0	6.6	

(g) Block CON1 relay operated.

Fig. 6 - Modified PCI Pulse Amplifier

