Full Scale Gm = 500 (1 + 84) = 500 x 85 = 42, 500.

Desired: 80, 000 micromhos full scale.

Choice No. = 80, 000 ÷ 500 less 1 = 160 - 1 = 159.

Choice No. 159 represents shunt resistors A, B, C, D, E and H or switches C, D, E, F, G, K-12 closed with L-7 closed and L-12 open.

5. 57 Negative Grid Bias Voltages. The grid bias voltages are obtained according to the formula: Ec = 150R ÷ (R + 15, 000).

The following switches must be closed to apply a negative voltage from cathode (row 4) to grid (row 3):

H-14	K-13 (without 0. 222 V signal)
L-14	L-13 (with 0. 222 V signal)
A-16	Never close both K-13 and L-13.
C-16	

Select resistance "R" according to the above formula by leaving one or more of the following switches open:

10Ω:	D-13	100Ω:	E-13	1000Ω:	F-13	10, 000Ω:	G-13
20Ω:	D-14	200Ω:	E-14	2000Ω:	F-14	20, 000Ω:	G-14
30Ω:	D-15	300Ω:	E-15	3000Ω:	F-15	30, 000Ω:	G-15
40Ω:	D-16	400Ω:	E-16	4000Ω:	F-16		

5. 58 Self-bias Tests. If a triode or pentode is desired to be tested under self-bias the grid-cathode circuit must be arranged according to the following:

Close H-14, K-14, A-16, C-15, K-13 (L-13 if the signal is desired instead of K-13) and all except the resistance desired of the following:

10Ω:	D-13	100Ω:	E-13	1000Ω:	F-13	10, 000Ω:	G-13
20Ω:	D-14	200Ω:	E-14	2000Ω:	F-14	20, 000Ω:	G-14
30Ω:	D-15	300Ω:	E-15	3000Ω:	F-15	30, 000Ω:	G-15
40Ω:	D-16	400Ω:	E-16	4000Ω:	F-16		

Note that a resistance may be made up of several combinations of these series resistors. A resistance of 50 ohms may consist of 10 and 40 or 20 and 30. A resistance of 1000 ohms may consist of 1000 ohms; 100, 200, 300, 400; or 10, 20, 30, 40, 200, 300 and 400. These decade resistors are within 1% of their indicated value. Also, 200 milliamperes may be passed through any resistor from 10 ohms up to and including the 1000 ohm resistor which is across F-13. The remaining individual resistors should never have in excess of 200 volts across them.

5. 59 Plate Circuit Arrangement for Plate Current Measurements. In the event that a plate current test is desired using the regulated B+ source close J-15, K-15, A-13, C-13, J-17 and the suitable meter shunts C, D, E, F, G, H, J, K, L-12 and/or L-7. For pentodes the screen and plate voltage are the same for this circuit.

5. 60 Meter Current Ranges. Since 50 on the 0-100 scale is the rejection point for most tubes, a convenient mathematical relationship was made to exist at half-scale for the current ranges. This tester has three sets of overlapping DC current ranges. With reference to the lettered resistors used for meter shunting in the "Choice Number" system for mutual conductance ranges the following formulas are useful in setting desired meter ranges.

With L-12 closed:

I (half scale) = 50 + (Choice No. x 10) microamperes.

Example: For Choice No. 200 (resistors D, G, H: switches F-12, J-12 and K-12 closed)

I (at 50) = 50 + 200 x 10 = 50 + 2000 = 2050 microamperes or 2. 05 milliamperes

This value of 2. 05 ma at 50 means 4. 1 milliampere full scale.

With L-12 open and L-7 closed:

I (half-scale) = 50 + (Choice No. x 50) microamperes.

Example: For Choice No. 192 (resistors G, H: switches J-12 and K-12 closed)

I (at 50) = 50 + (192 x 50) = 50 + 9600 = 9650 microamperes or 9. 65 milliamperes

This value of 9. 65 ma at 50 means 19. 30 milliamperes full scale.

With L-7 and L-12 open:

I (half scale) = 0. 05 + (Choice No.) milliamperes

Example: For Choice No. 96 (resistors F, G: switches H-12 and J-12 closed)

I (at 50) = 0. 05 + 96 = 96. 05 milliamperes

This value of 96. 05 milliamperes means 192. 1 ma full scale.

With L-12 closed the maximum available full scale value is 5200 microamperes or 5. 2 milliamperes, with L-7 closed the maximum available full scale value is 25.6 milliamperes and with L-7 and L-12 open the maximum available full scale value is 510. 1 milliamperes.

Examples of useful ranges are as follows:

Full Scale Microamperes	Close L-12 and:	Full Scale Microamperes	Close
100	L-12 alone	1000	C, E, F, H-12
200	C, E-12	2000	C, D, E, F, G, J-12
500	E, G-12	5000	C, E, G, H, J, K-12

Full Scale Milliamperes	Close L-7 and:	Full Scale Milliamperes	Close L-7 and:
6	C, D, F, G, H-12	12	C, D, E, G, H, J-12
8	C, D, E, F, J-12	15	C, E, G, K-12
10	C, D, H, J-12	20	C, D, E, J, K-12

Full Scale Milliamperes	(L-7 and L-12 Open) Close	Full Scale Milliamperes	(L-7 and L-12 Open) Close
30	C, D, E, F-12	200	E, H, J-12
50	C, F, G-12	300	D, E, G, K-12
100	D, G, H-12	500	D, F, G, H, J, K-12

5.61 Miscellaneous Switches. For filamentary tubes switch L-11 places a 100 ohm center-tapped resistor across the filament to reach the electrical center. One end of this resistor is permanently connected to row 2 or the filament minus (-) supply and the center-tap becomes connected to the cathode supply after the quality button (No. 2 button) is depressed. Do not close L-11 when the filament or heater voltage is greater than 12.6 volts.

Switch G-17 is closed for filamentary amplifier tubes to prevent a meter deflection for normal tubes on the heater-cathode leakage test.

For all filamentary tube types close switches A-12, B-14 and C-14. If these switches are open and a plate or screen to filament short is present the meter will deflect to the left with appreciable force although no damage will be done. Since this deflection is not intended to identify the short, the meter sensitivity may be reduced by using the three heater-cathode leakage parallel resistors across the meter.

close T14 not know why! GLK connects 4pF cap between grid and cathode MP.

D. Diode and Rectifier Tube Test Circuit Programming

5.62 The filaments and heaters of diodes and rectifiers should be treated the same as those for amplifier tubes. For filamentary types it will be sufficient to close L-11 only and it will not be necessary to close the switch in row 4 that corresponds to the switch closed in row 2. Also, it will not be necessary to close G-17 for diodes and rectifiers.

5.63 Heater - Cathode Leakage Consideration for Diodes and Rectifiers. For detector-type diodes wherein signals to be amplified are involved, a lower value of rejection may be set. A value of 20 microamperes is generally satisfactory. For power rectifiers a higher level of leakage is acceptable and 150 microamperes is suitable for most tubes such as the 6X4. Damper diodes used in horizontal deflection circuits for cathode ray tubes are made to withstand higher heater-cathode voltages than other types of rectifiers. Therefore a lower level of leakage is an inherent feature of this tube. Rejection at 10 microamperes is desired for damper diodes. For filamentary diodes or rectifiers use switches A-14, B-14, and C-14 for the reason stated in paragraph 5.61, Miscellaneous Switches.

5.64 Plate-Cathode Circuit Configurations.

a. The simplest of diode test circuits is one wherein the diode is treated as a triode without the grid-cathode circuit consideration. With L-14 closed and the rest of the plate circuit arranged per paragraph 5.58 a plate current test is readily provided. For DC currents up to 30 milliamperes the manually controlled Auxiliary B+ supply may be used by opening J-15 (and K-5) and by closing L-5. The 0-100 scale indication X3 will be the applied DC voltage when monitored by depressing the Aux. B+ button in the Auxiliary Control Compartment. If current limiting resistance is desired in the plate-cathode circuit open L-14, close H-14, A-16, C-15 and open the switches across the desired decade resistors described in paragraph 5.57. Because of the current delivering capability of the regulated DC supplies, the meter ranges available and the resistances attainable the described circuit is suitable for plate current tests on high voltage diodes and high and low perveance diodes.

b. Half-wave power rectifiers intended for use with a 117 VAC line may be tested in a circuit that subjects the tube to its rated inverse voltage at the same time that it is delivering rated DC current. The plate of such a tube should be connected to the proper switch on row 7 (see paragraph 5.49) and switch L-17 should be closed. Switch L-17 provides 250 VAC (350 V peak) to be applied between the floating ground and the plate of the tube. The cathode to ground circuit is completed by the following switches: H-14, the desired decade resistors for a load, B-16, C-13, A-13, the desired meter range, and J-13. For a half-wave rectifier with a maximum 330 volt inverse rating do not close J-14. It is recommended that the meter sensitivity be set so that 63 on the 0-100 scale represents the value of rated current for the tube. Then, starting with the highest value for the load resistance, the decade resistance should be decreased until the meter reads 63. A reading of 63 for rectifiers will provide the acceptable 80% of average rejection factor for output current when rejection is to be regarded at 50.

c. Full-wave power rectifiers may be treated the same as half-wave power rectifiers except the second plate must be connected to the "screen" row 5 and switch L-15 must be closed. Switches L-15 and L-17 provide 500 VAC plate to plate with the center of this transformer winding connected to the floating ground. Close switch J-14 to place a 4 microfarad capacitor across the load resistance. The maximum current that may be passed through a rectifier tube is limited by the rating of the resistors that are used as a load in the tester. See paragraph 5.57 for these ratings.

d. Damper diodes such as the 6AX4 may be tested in a half-wave circuit that subjects the tube to an inverse voltage of about 1200 volts. Connect the cathode pin to row 4 and close switches H-14, J-14, open the switches across the desired load resistances (decades), close B-16, C-13, A-13, the switches for the desired meter sensitivity, J-17 and L-17. The plate of the damper diode must be connected to the screen row 5 and L-15 must be closed. If the rated current is attempted to be drawn through this type of tube the load reflected to the primary of the transformer will cause a fuse to open. Therefore, it is recommended that 92 milliamperes maximum be drawn through any damper diode. The decade resistances will be near 5500 ohms for this condition.

6. MAINTENANCE

A. General

6.01 Most maintenance on this equipment can be accomplished with the aid of the Routine Calibration procedure, the Complete Calibration Procedure, the Trouble Shooting Procedure and the Voltage and Resistance Chart. All these procedures make use of test cards stored in the tester case cover.

B. Complete Calibration

6.02 Perform the Routine Calibration procedure as listed in section 3. Then proceed as follows:

6.03 Signal Adjustments:

a. Connect the tube tester to the power line thru a Variac set to 115 volts. See figure 13. Turn the instrument on.

   Insert Card 11, SIG. REG. AND AMPL, into the Card Switch. Connect a high-impedance, sensitive AC voltmeter from pin 3 to pin 6 on any convenient socket. NOTE: THIS MUST BE A HIGH IMPEDANCE AC VACUUM TUBE VOLTMETER, CAPABLE OF ACCURATE MEASUREMENT OF 0.222 VOLTS RMS. BALLANTINE MODEL 300 OR EQUIVALENT IS RECOMMENDED.

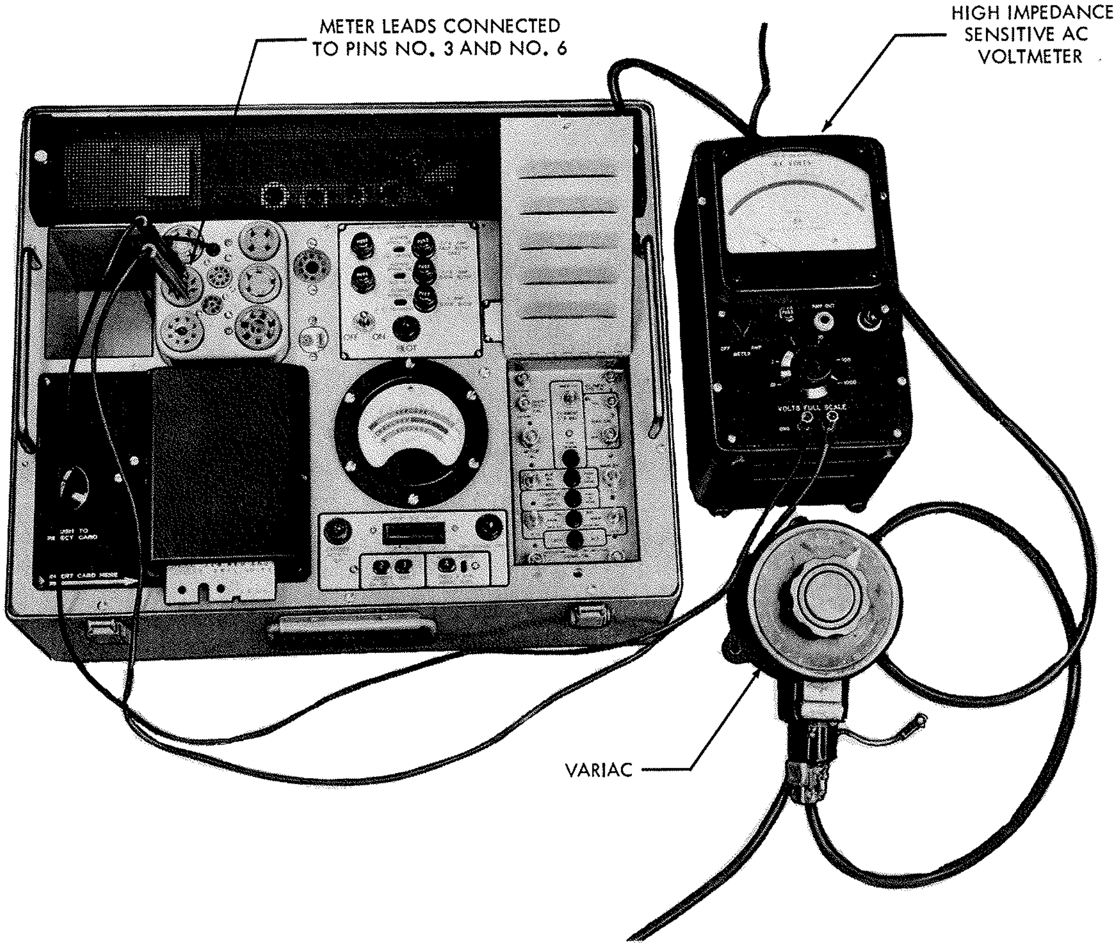

Figure 13 - Signal Regulation and Amplitude Check

b. While holding down button #2, vary the line voltage from 105 to 125 volts. Note reading indicated on the vacuum tube voltmeter. The indicated voltage at 105 and 125 should be identical and should not vary more than 1% from the indicated voltage at 115 volts line. If the circuit is not regulating as specified, adjust the SIGNAL CAL REGULATION control and vary the line voltage to attain the desired regulation.

c. After the signal regulation is properly adjusted, set the exact signal level of 0. 222 volts rms by adjusting the SIGNAL CAL AMPLITUDE control.

6. 04 Filament Standardization Adjust.

a. Method One.

Connect the instrument to the power line thru a Variac. Turn instrument on. Monitor the voltage delivered to the instrument with an AC voltmeter and adjust the Variac to deliver 115 V RMS.

Insert Card 12, FIL STD ADJUST.

Set the FILAMENT STD ADJ located in the auxiliary control compartment, to the NOM 115V position (white dot on knob lines up with dot on panel).

Press the FILAMENT STD ADJ push button. The meter should read half scale ± 1 division.

If correction is necessary adjust the FILAMENT STD CAL control located in the upper right corner of the control compartment, for proper indication

b. Method Two.

Connect the instrument to the power line and turn it on. Connect an AC voltmeter capable of accurately measuring 5 volts RMS to pins 3 and 6 on any convenient tube socket. (The Ballantine Model 300 or equivalent used for signal adjustments can also be used for this measurement.) See Figure 13.

Insert Card 12, FIL. STD. ADJ. into switch.

Set the FILAMENT STD ADJ knob so that the external AC voltmeter indicates 5 volts.

Press the FILAMENT STD ADJ push button. The tester meter should read half-scale ± 1 division.

If correction is necessary adjust the FILAMENT STD CAL control, located in the upper right corner of the control compartment, for proper indication.

6. 05 Main B+ Power Supply

a. Feedback current adjust:

Remove the black perforated cover over the power supply tubes. Remove the 6CD6, V103, and the 6AW8A, V105, from their sockets. See Figure 14. Insert Card 13, FEEDBACK B PLUS.

WARNING: BE SURE TUBES ARE REMOVED BEFORE INSERTING CARD 13.

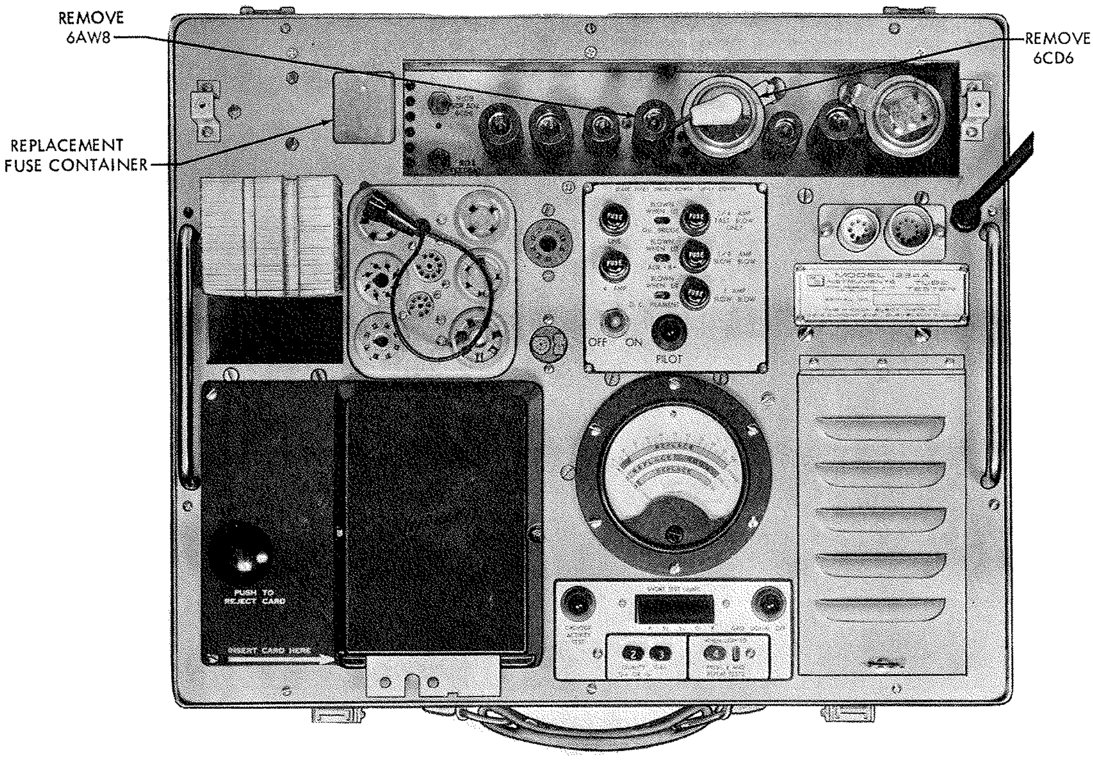

Figure 14 - B+ Power Supply Feed Back Current Test

Press button #2. The meter should read mid-scale (1MA feedback current.) If reading is not correct, adjust the FEEDBACK CURRENT ADJ. control, R123, located on the power supply chassis, for proper indication.

After proper adjustment - REMOVE CARD 13 FROM THE CARD SWITCH BEFORE RETURNING THE 6CD6 AND 6AW8A TO THEIR PROPER SOCKETS.

Insert Card #8, MAIN B PLUS CAL. Press button #2 and check for a mid-scale reading. Readjust the MAIN B+ CAL control if necessary.

b. Series Regulator Screen Voltage Adjustment.

Insert Card 14A, 6CD6, SCRN ADJUST. Press button #2. The meter reading should be approximately mid-scale. While holding down button #2, slowly rotate the SCR. ADJ. control, R109 (located on the power supply chassis) counter-clockwise until the meter indication just starts to drop from its normal mid-scale position. Then turn the control clockwise just enough to restore the mid-scale reading and leave it at this setting.

C. Trouble Shooting Procedure

6.06 General

As stated earlier the Model 1234A is equipped with self-calibrating features. The calibration program cards also greatly simplify the troubleshooting of the tester. The following procedures will aid in isolating defective parts in various circuits in this equipment.

6.07 Line Power

The Model 1234A Tester is designed to operate from a 105-125 volt, 50-400 cps power source.

If the PILOT light does not light when the tester is connected to a proper power source and the ON-OFF switch is held in the ON position, check the following components:

(a) Line fuses - F102 and F103
(b) PILOT lamp - DS107
(c) ON-OFF switch - S105
(d) Power transformer - T101

If the tester turns on when the ON-OFF switch is thrown, but turns off when the switch is released to the center position, check the following components.

(a) Bridge rectifier - CR103
(b) Resistor - R158
(c) Relay - K101
(d) ON-OFF switch - S105

6.08 Short Test Circuit and Negative & Positive Bias Supplies

The 300 volt supply necessary for the short test circuit (see section 5.16, Fig. 11) is obtained from the combination of a +150 volt source and a -150 volt source. These same sources are also used individually for positive and negative bias supplies and other uses (see Sections 5.27 and 5.28). If any of the cards from card 2 thru card 7 give an improper indication, the trouble is likely to be in one of these two supplies. The trouble can be isolated in the following manner:

Measure the voltage from pin 7 of the OA2WA, V108, to pin 3 of the 6AU8, V107. This should be approximately 300 volts. If this reading is correct, and if any of cards 2, 3, 4 or 5 cannot be adjusted to operate properly as instructed in Section 3.07, the difficulty is in the short test circuit. This includes neons DS301 thru DS305, resistors R303 thru R316 and R135, and capacitors C301 thru C306 (schematic Sheet 3)

If the 300 volt reading is correct, and card 6, FIXED BIAS CAL NEG, gives an improper indication, check resistors R150 and R151 and potentiometer R149.

If the 300 volt reading is correct, and card 7, FIXED BIAS CAL POS, gives an improper indication, check resistor R131, potentiometer R136, and capacitor C110.

If the voltage reading as directed above is not approximately 300 volts, the difficulty is in the individual power supplies and can be located by checking for proper voltage and resistance values as listed in the power supply voltage and resistance chart (Figure 20).

6.09 GM Bridge Balance

The adjustments on the GM bridge are set using cards 9 and 10 as instructed in Section 3.10. If proper adjustment cannot be made, or if other test results indicate that the GM measuring circuit is at fault, the GM bridge should be checked. This includes the diamond-shaped network in the center of schematic sheet 2, along with the associated fuse circuit.

The operation of the GM bridge is presented in Section 5.39. Check the components of this network for proper characteristics, and check the power transformer T101 between taps 18 and 19 for 10 volts RMS.

6.10 Signal Regulation

The signal bridge adjustments are set using card 11 as instructed in Section 6.03. If proper adjustment cannot be made, check the components of the signal bridge circuit, including resistors R153, R154 and R156, potentiometers R152 and R155 and the #47 lamps DS109 and DS110. Also check the power transformer T101 for the proper voltage (10 volts RMS) between taps 20 and 21.

6.11 Main B+ Power Supply Tracking.

Insert Cards 15 thru 22 successively into the card switch. Push button #2. The meter should indicate mid-scale ± 2 divisions in each case.

During these tests an accurate DC voltmeter (20,000 ohms per volt, Hickok Model 456, or equivalent) may be connected to pins 3 and 6 on any convenient socket as shown in Figure 15. The voltage readings on the external meter should be as follows:

Card #	Indicated Voltage	Component	
15	10	R238	10K ± 1%
16	20	R239	20K ± 1%
17	20	R240	20K ± 1%
18	60	R237	62K ± 1%
19	110	R236	52K ± 1%
20	160	R235	52K ± 1%
21	210	R234	52K ± 1%
22	260		

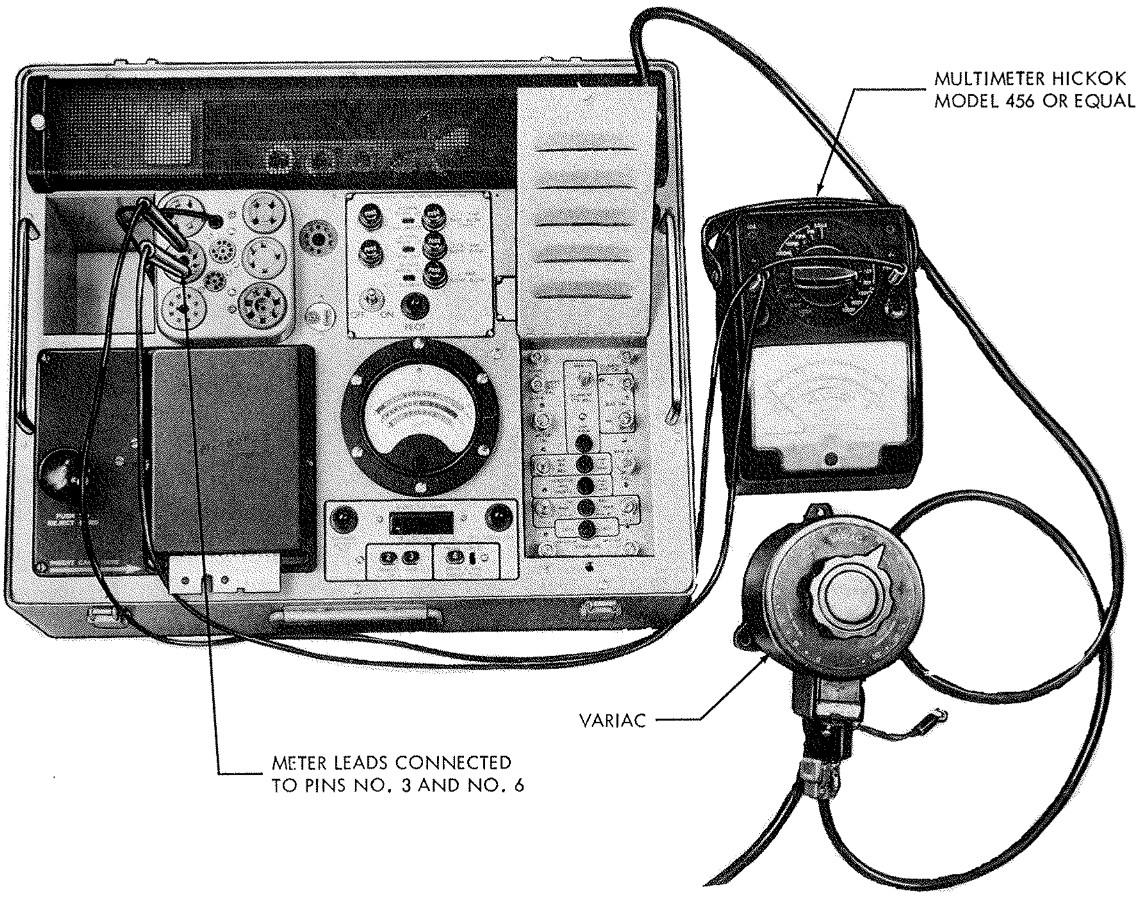

Figure 15 - Checking Main B+ Power Supply With the Aid of an External Meter

If the readings are not mid-scale ± 2 divisions on the tester meter and not within 3% plus meter tolerance on the external meter, the associated resistor listed in the component column should be checked for proper value.

If the readings are improper on the tester meter while the external meter indicates proper tracking, check the meter shunts and multipliers (See Meter Circuits Checks, paragraph 6. 11).

If the readings are incorrect on both the tester meter and the external meter, check tubes V103, 6CD6; V105, 6AW8A (both sections); and V108, OA2WA. Also check for proper voltage and resistance values as listed in the power supply voltage and resistance chart (Figure 20).

6. 12 Main B+ Power Supply Regulation

Connect the tube tester to the power line through a Variac set to 115 volts. Insert Card 23, MAIN B PLUS REG. Press button #2. The tester meter should read mid-scale ± 2 divisions. Note the exact readings, then check the readings at 105 and 125 line voltages. These readings should not vary more than ± 1 division from the 115 volt indication.

Reset Variac for 105 volt line. Again note reading indicated on meter (150 volts at 1. 5 MA load). While holding down button #2, press button #4 (150 volts at 140 MA load). The meter indication should not vary more than 1 division from the 1.5 MA load (button 2 only) to the 140 MA load (button #2 and #4.)

If circuits are not regulating properly check tubes V103, 6CD6; V105, 6AW8A, (both sections), and V108, OA2WA. Also check for proper voltage and resistance values as listed in the Power Supply Voltage and Resistance chart, (Figure 20.)

6. 13 D. C. Filament - Cathode Activity Checks

To check the operation of the D.C. Filament and the Cathode Activity circuits use the following procedure:

Insert Card 24, DC FIL-CATH ACT. , into card switch. The left short lamp should light.

Standardize the filament supply with the FILAMENT STD. ADJ.

Press button #2. This permits the tester meter (set at 10 volts F. S.) to monitor the D. C. filament supply voltage under load (5 volts at 500 MA load). The meter should read mid-scale ± 3 div.

If reading is out of tolerance check the D. C. filament rectifiers CR-201, CR-202, CR-203 and CR-204.

Hold down button #2 and press the CATH ACT switch located in the auxiliary control compartment. This increases by 10% the number of windings used for the primary side of the filament transformer. The meter reading should drop 5 divisions. If the meter reading does not drop approximately 5 divisions, check the filament transformer T102 for a short between taps No. 34 and No. 35.

6. 14 Auxiliary B+ Power Supply

Connect the tester to the power line through a Variac. Insert Card 25, AUX B PLUS REG, in card switch. Short lamps 1, 2, 3 and 5 should light.

Supply Range: Press the AUX B+ ADJ button in auxiliary control compartment. This permits the tester meter (set at 300 volts F. S.) to monitor the voltage output of the AUX B+ Supply. Rotate the associated control knob in the auxiliary control panel thru its complete range. The tester meter indication should vary from approximately 10 on the scale to at least full scale. (Some overswing is permissible at both ends of the control adjustment).

Voltmeter Circuit: While still pressing the AUX B+ ADJ. button set the control to give a mid-scale reading on the meter. Release the AUX B+ ADJ. button and press button #2. The meter should read mid-scale ± 2 division. This is a check of the auxiliary B+ supply metering circuit which is separate from the main metering circuits. If the reading is out of tolerance, check R-320, 3 megohm ± 1%.

Line Regulation: While holding down button #2 vary the line voltage from 115 to 125 then to 105. The meter readings at 105 and 125 volts should not vary more than ± 3 divisions from the reading at 115 volts line.

Load Regulation: Set line voltage at 105 volts. Push button #2. Note the reading on the meter (it should still be at mid-scale, from the previous steps). This is a 150 volt indication at a low output current. While holding button #2, press button #4. The meter will indicate the output voltage with rated output current being drawn from the supply. The deviation between the two readings should not exceed ± 3 divisions.

If indications during the above tests are not proper, check V106, 6203, V104, 6CL6; and V107B, 6AU8 pentode section. Also check voltage and resistances at tube sockets against values listed in the voltage and resistance chart.

If desired a 20,000 ohms per volt meter (Hickok Model 456 or equivalent) may be connected from pin 3 (+) to pin 6 (-) on any convenient socket to externally monitor the same output voltage being measured on the tester meter.

6.15 Meter Circuit Checks

The first test in Routine Calibration, together with the Trouble Shooting procedure listed below, form complete tests of the basic meter sensitivity, the meter shunts and the meter multipliers.

Each of these tests is designed to check a particular "primary component". However, additional components are also used in the test circuit and are "secondary components" in each test.

The following table lists the test card number, function, the primary component number and values, and the secondary components involved. When a number of tests give improper readings a comparison of the primary and secondary components involved will help isolate the defective part. Questionable parts can then be checked with a resistance bridge or an accurate ohmmeter. In each of the following tests insert the proper card in the switch press button #2. The meter should read mid-scale ± 2 divisions.

Card No.	Primary Component	Secondary Components
	Meter Shunts	
26	R207, 1280Ω± 1%	R206, R215, R216, R218, R226, R270, R241
27	R208, 640Ω± 1%	R206, R216, R-219, R223, R224, R225
28	R209, 320Ω± 1%	R206, R217, R220, R222, R-223
29	R210, 160Ω± 1%	R206, R216, R221, R225
30	R211, 80Ω± 1%	R206, R215, R216, R219, R226
31	R212, 40Ω± 1%	R206, R215, R216, R218, R220, R221
32	R213, 20Ω± 1%	R206, R216, R219, R223, R225, R241
33	R214, 10Ω± 1%	R206, R219, R224, R241
	Meter Multipliers	
34	R206, 25,344Ω± 1%	
35	R241, 1067Ω± 1%	R206
36	R230, 100K ± 1%	

6.16 Decade Resistor Checks

The following tests are similar to the Meter Circuit checks listed above except that the decade resistors are the "Primary Components". The "Secondary Components" involved are also listed.

a. Procedure for test cards 37 through 40:

Insert proper card into card switch, the left three short lamps should light. Press the FILAMENT STD ADJ. push button and set FILAMENT STD. ADJ switch for mid-scale indication on the tester meter. Press button #2, meter should read mid-scale ± 2 divisions.

Card No.	Primary Component	Secondary Component
37	R218, 10 Ω ± 1%	R206, R210, R213, R214
38	R217, 20 Ω ± 1%	Same as card 35
39	R216, 30 Ω ± 1%	Same as card 35
40	R215, 40 Ω ± 1%	Same as card 35

b. Procedure for test cards 41 and 42:

Insert proper test card into card switch. The left three short lamps should light. Press the FILAMENT STD ADJ push button and set FILAMENT STD ADJ switch for mid-scale indication on the tester meter. Press button #2. The tester meter should indicate mid-scale ± 2 divisions.

Card No.	Primary Component	Secondary Component
41	R219, 100 Ω ± 1%	R206, R210, R213, R214
42	R220, 200 Ω ± 1%	R206, R210, R213, R214

c. Procedure for test cards 43 through 48:

Insert proper test card. The extreme left short lamp should light. Press button #2. Read mid-scale ± 2 divisions.

Card No.	Primary Component	Secondary Component
43	R221, 300 Ω ± 1%	R206, R208, R209, R210 R211, R212
44	R222, 400 Ω ± 1%	R206, R207, R208, R209, R210, R212
45	R226, 1000 Ω ± 1%	R206, R207, R208, R211
46	R225, 2000 Ω ± 1%	R206, R207, R208, R209, R213, R214
47	R224, 3000 Ω ± 1%	R206, R209, R214, R241
48	R223, 4000 Ω ± 1%	R206, R207, R208, R212, R213, R241

d. Procedure for test Cards 49 thru 51 is the same as above except tolerance is mid-scale ± 4 divisions.

Card No.	Primary Component	Secondary Components
49	R227 & R231 in parallel 10K ± 5%	R207, R208, R213, R214
50	R228, 20K ± 5%	R207, R208, R209, R210, R211, R213
51	R229, 30K ± 5%	R208, R209, R210, R211, R212

6. 17 Main B+ Protection

The tester meter and the main B+ supply are protected against overloads by means of a slave relay protective circuit whose primary components are a line slave relay K101 and two reedrelays K102 and K104. (See Section 5. 21 and Figure 16). Cards 52A and 53A are used to check out part of this circuit as follows:

Insert Card 52A B+ PROTECTION, NO GO. Short lamps 1 and 2 should light. Press button #2. This applies a heavy load to the main B+ supply. The load is not excessive and should not shut off the tester.

Insert Card 53A B+ PROTECTION, GO. Short lamps 1 and 2 should glow. Press button #2. This applies an excessive load to the main B+ supply. The tester should shut off.

If either of these cards does not operate correctly, check reedrelay K102, capacitor C111 and resistor R160.

6. 18 Slave Relay Protective Circuit

If the tester shuts off after the tubes heat up and will not remain on after again pressing the ON-OFF switch, the trouble may be in the slave relay protective circuit and can be located by the following procedure:

While pressing the ON-OFF switch S105 in the ON position, check the voltage across the slave relay operating coil K101. This should be about 3 volts D. C. If this voltage is not present, the coil of the relay is probably being shorted out by a reedrelay K102 or K104 (See Figure 16).

The operating coil of reedrelay K102 is in the plate circuit of the 6CD6, V103, and therefore all main B+ current must pass through this coil. Any faulty conditions in the power supply which cause the current to be excessive will close the reedrelay contacts and short out the slave relay K101. The power supply voltage and resistance chart (Figure 20) can be helpful in locating this type of trouble.

Reedrelay K104 contains 2 coils. One of these is a hold coil which is energized at all times by means of the -150 volt supply. The current in this coil is maintained slightly less than that necessary to close the reedrelay contacts. If the -150 volt supply is operating incorrectly and allowing a voltage more negative than -150 volts, this may cause the reedrelay K104 contacts to close. This trouble also can be found by using the voltage and resistance chart (Figure 20).

D. Miscellaneous Adjustment Procedures

6. 19 Adjustment of upper micro switch

The microswitch is adjusted at the factory prior to shipment, consequently adjustment should not be attempted unless absolutely necessary. There are two ways in which to properly adjust the micro switch. The first procedure requires two 1/8" diameter pins, but is more accurate than the second procedure.

W A R N I N G

High Voltage is present across upper micro switch terminals. Disconnect line cord from power source before adjustment.

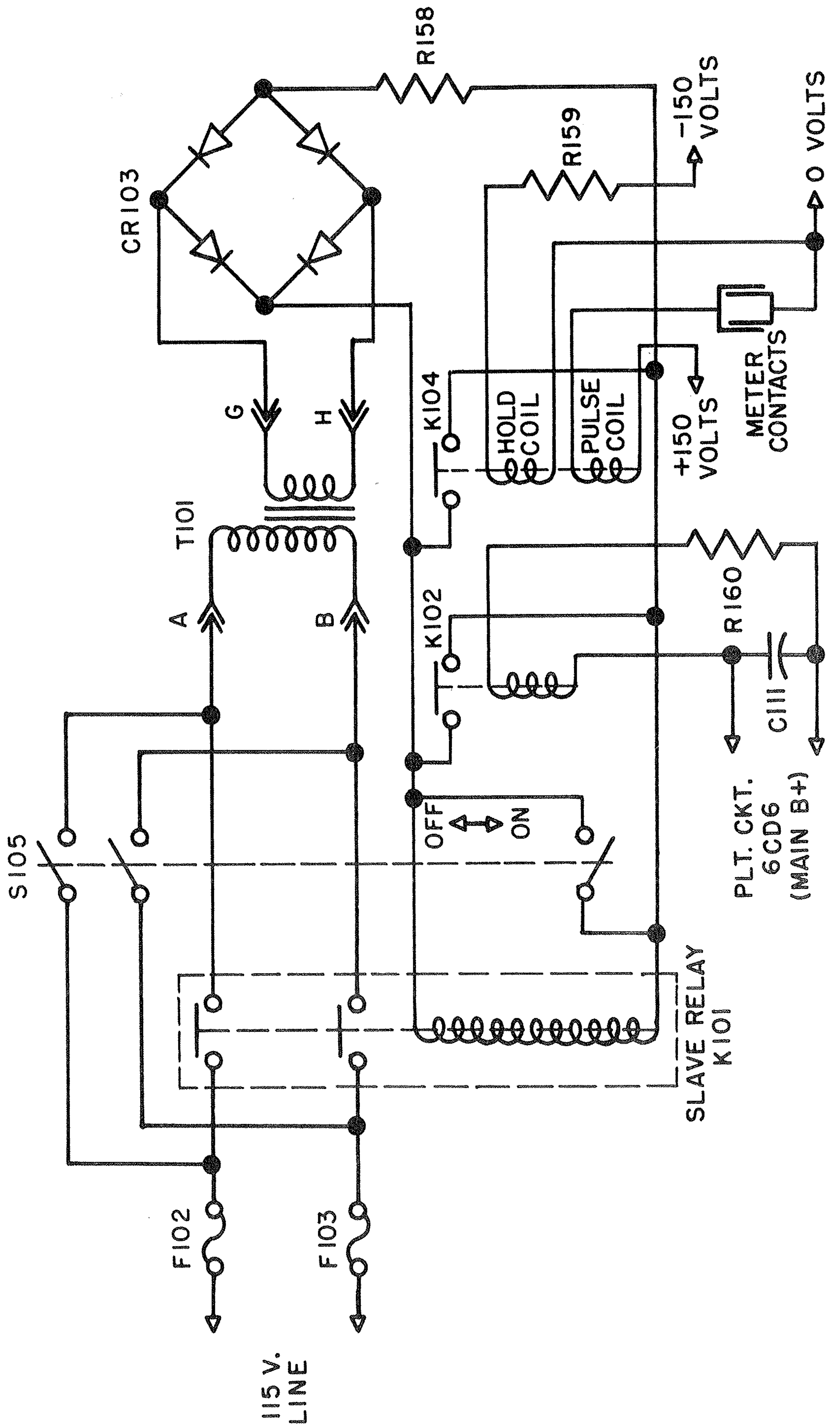

Figure 16 - Slave Relay Protective Circuit

a. First Procedure:

1. Remove card switch cover and insert non-test code card into card switch.

2. Insert two .125 inch diameter (1/8 inch diameter) pins or drill shanks into the switch plate holes A-1 and L-1 to retain the code card. (See figure 19).

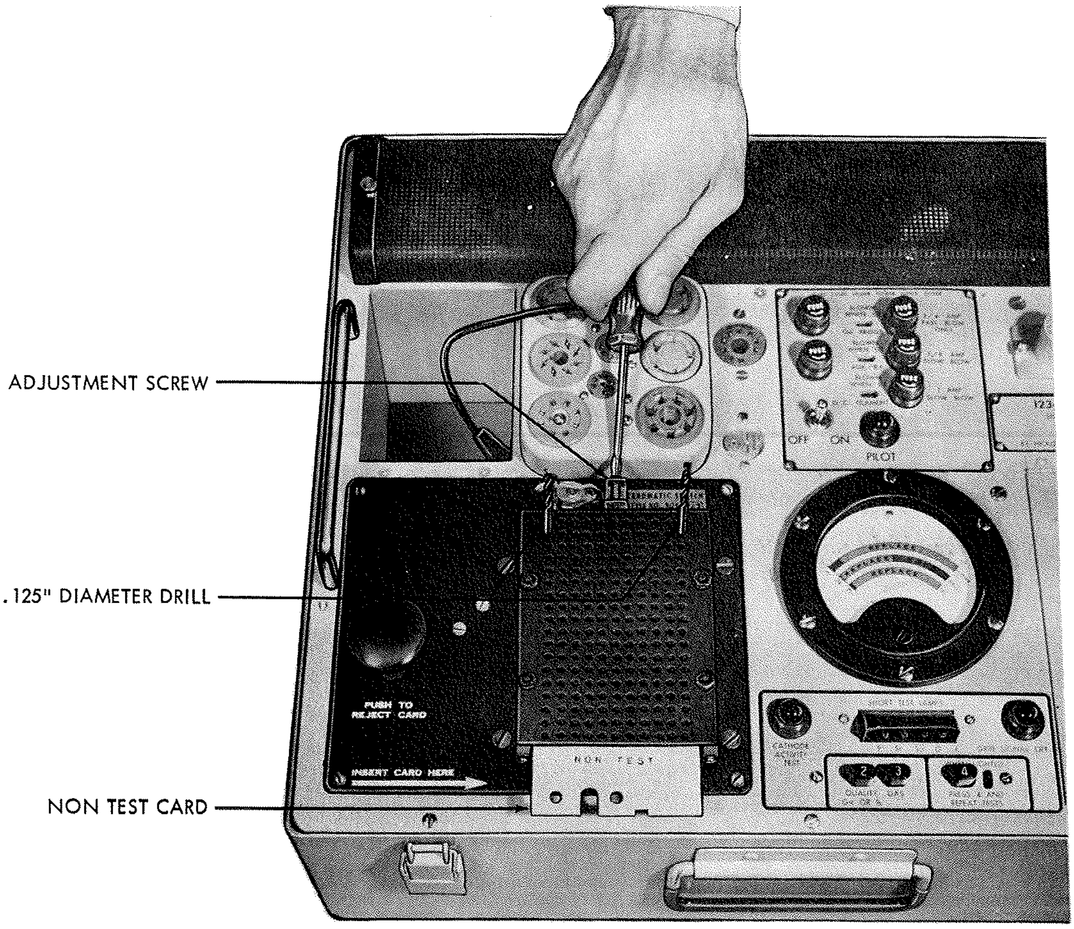

Figure 17 - Adjustment of Upper Micro Switch

3. Gently pull on the code card to remove all clearance between the two pins and holes A-1 and L-1 in the code card.

4. Adjust the micro switch inward (toward the card switch) with the adjustment screw (see Figure 17), until the micro switch actuates (an audible CLICK can be heard).

5. Reverse direction of the adjustment screw and move the micro switch out until it de-actuates (an audible CLICK will be heard). Approximately 1/2 turn of the adjustment screw will be necessary to de-activate a properly operating microswitch.

6. Connect tester to power source and press ON switch. Retest the action of the switch with the code card. Replace the card switch cover.

b. Second Procedure:

1. Remove card switch cover and insert code card into card switch.

2. Observe the code card holes through the row 1 holes in the top switch plate. The code card material should just disappear (.005 inch) at the top of the row 1 switch

plate holes when the micro switch actuates (an audible CLICK will be heard). If adjustment is necessary, turn the adjustment screw. (See figure 19) until alignment is correct.

3. Connect the tester to power source and press ON switch. Retest the action of the switch with the code card. Replace the card switch cover.

6.20 Adjustment of Contact Pins

If code card will not come out of card switch when reject knob is pressed, a contact pin has moved above its normal position and is projecting through a hole in code card. Correct as follows:

a. Disconnect power source line cord. Remove switch cover.

b. Inspect tops of contact pins to see if one or more has moved above normal position. Use probe and carefully push pin or pins down until they clear code card.

c. Connect power source line cord and press ON switch. Reactivate card switch several times with same code card. Card must slide out each time reject knob is pressed.

E. Miscellaneous Parts Replacement

6.21 Replacement of Parts. The replacement instructions contained herein are limited to high mortality parts which are in some way unusual in installation. When trouble shooting procedures reveal defective parts and replacement is necessary, every effort must be made to duplicate original condition of equipment. Recalibrate tube tester after replacement of parts to assure accuracy of tube test readings.

6.22 Replacement of Tubes. Exercise care when removing or installing electron tubes to assure high quality performance from associated circuits. Observe handling precautions which are common to all vacuum tubes.

6.23 Replacement of Diodes. The diodes (CR401, CR402, CR403 and CR404 (Schematic Sheet 2), mounted on the terminal board are either matched pairs or all four are matched together and must be replaced as matched units. They shall be physically mounted in the same manner as those which are removed. Note direction of arrow printed on diodes and position replacement part in identical relationship to terminals.

C A U T I O N

Do not overheat diodes during soldering operation. Hold lead wire with pliers positioned between diode body and point being soldered.

6.24 Replacement of Upper Micro-Switch. (See figure 18). Unsolder leads from terminals on micro-switch. Remove nuts, washers and screws securing micro-switch to bracket. Remove microswitch. Exercise care not to lose small actuating pin in card switch. Install new micro-switch in reverse order of removal procedure.

6.25 Replacement of Lower Micro Switch. Remove screws and spacers securing terminal board to card switch. Lift terminal board away from card switch to gain access to lower micro switch. Unsolder leads to micro switch terminals. Remove nuts, washers, screws and defective micro switch. Position new micro switch in place and install it in reverse order of removal procedure. Check to see that switch actuating screw engages micro switch as required when card-reject knob is pressed. If adjustment is required, loosen lock nut, make adjustment, and retighten lock nut.

6.26 Replacement of Card Switch Solenoid. (See Figure 21) Unsolder leads to terminals on solenoid. Disengage spring from clip on plunger and remove cotter pin and clip. Remove screws from face of panel and disengage solenoid from solenoid actuating arm. Install new solenoid and reconnect associated parts in the reverse order of removal.

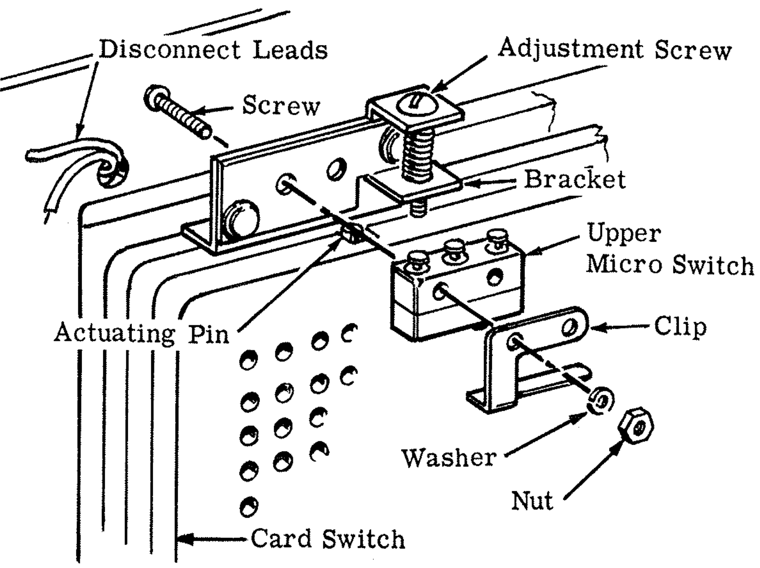

Figure 18 - Replacement of Upper Micro Switch

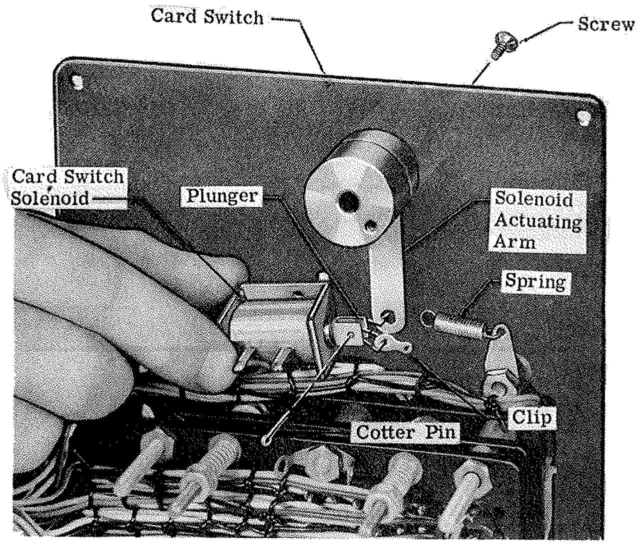

Figure 19 - Replacing Card Switch Solenoid

6.27 Figures 24 through 30 have been provided to aid in the location of components.

POWER SUPPLY MODEL 1234A

Note 1. Insert test card #23 in card switch. Press the AUX B+ ADJ Button and adjust the AUX B+ Supply for mid-scale meter reading.

Note 2. All voltages measured with VTVM. Zero voltage reference point is Pin 1 of OA2 socket.

TUBE	SOCKET PIN NO. 1	2	3	4	5	6	7	8	9
6AU8	0 (0Ω)	-2 (3MΩ)	150.0 (70KΩ)	3.1 AC (0Ω)	3.1 AC (0Ω)	-86.0 (40KΩ)	-87.0 (160KΩ)	-28.0 (115KΩ)	97.0 (10MΩ)
6CL6	150.0 (650KΩ)	100.0 (10MΩ)	405.0 (95KΩ)	150.0 (650KΩ)	150.0 (650KΩ)	405.0 (95KΩ)	150.0 (650KΩ)	NC	NC
OA2WA	0 (0Ω)	NC	NC	-150.0 (34KΩ)	NC	NC	-150.0 (34KΩ)	--	--
6AW8 A	-99 (50KΩ)	-100 (63KΩ)	0 (0Ω)	3.1 AC (0Ω)	3.1 AC (0Ω)	-100.0 (60KΩ)	-100.0 (70KΩ)	-55.0 (60KΩ)	121.0 (600KΩ)
6CD6	NC	156.0 (80KΩ)	150.0 (80KΩ)	NC	121.0 (580KΩ)	NC	150.0 (80KΩ)	275.0 (Infinity Ω)	--
6C4WA	400.0 (95KΩ)	NC	150.0 (80KΩ)	150.0 (80KΩ)	400.0 (95KΩ)	260.0 (350KΩ)	275.0 (Infinity Ω)	--	--
6203	305.0 AC (73Ω)	NC	150.0 (660KΩ)	150.0 (660KΩ)	NC	--	406.0 (100KΩ)	--	305.0 AC (73Ω)
5U4 GB	NC	370.0 (510KΩ)	NC	260.0 AC (67Ω)	NC	260.0 AC (67Ω)	NC	370.0 (510KΩ)	--

Figure 20 Voltage and Resistance Data