



TRANSCONDUCTANCE TUBE TESTER MODEL 539C

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10514 DUPONT AVENUE • CLEVELAND, OHIO 44108

PHONE — 541-8060
TWX — CV 662

CABLE — HICKOK, CLEVELAND
WESTERN UNION — KJ

WARRANTY

The Hickok Electrical Instrument Company warrants instruments of its manufacture to be free from defects in material and workmanship for ninety (90) days from the date of original purchase. Any instrument found to be defective during this period may be returned, transportation prepaid, to the factory for repair, or at our option, replaced without charge.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons, or which have been subject to misuse, negligence, or accident, or which have had the serial number altered, effaced or removed. Neither shall the warranty apply where a warranty registration card has not been properly completed and returned to us promptly after purchase. This warranty is in lieu of all other warranties whether expressed or implied.

RETURNING EQUIPMENT FOR REPAIR

Before returning any equipment for service, the factory must first be contacted, giving the nature of the trouble. Instructions will then be given for either correcting the trouble or returning the equipment. Upon authorization, this equipment should be forwarded directly either to the Hickok factory address at 10514 Dupont Avenue, Cleveland, Ohio, 44108, or to a designated service station in your locality.

OPERATING INSTRUCTIONS
FOR
MODEL 539C
TRANSCONDUCTANCE TUBE TESTER

FOREWORD

The Model 539C Mutual Conductance (Transconductance) Tube Tester is designed for use by technicians, engineers and others who demand an instrument of the very highest quality for rapid and accurate testing of vacuum tubes. Like all Hickok Tube Testers, it is based upon the well known formula for mutual conductance,

$$\frac{\Delta i_p}{\Delta e_g} = G_m,$$

where i_p is the plate current change, e_g is the grid voltage change, and G_m is the Mutual Conductance (Transconductance). Mutual Conductance and Transconductance are used interchangeably.

This instrument is equipped with three meters, all made in our own plant, and calibrated with great accuracy.

- (a) A sensitive Transconductance meter measuring micromhos in six ranges up to 60,000 micromhos. This meter also has a scale reading to 200 volts for V. R. tube testing, and a scale reading to 50 megohms for leakage testing.
- (b) An A. C. voltmeter which insures standardized voltages to the tube's base, and
- (c) A two range (0-10, 0-50) D. C. voltmeter to accurately adjust the negative bias on the tube's control grid. Also a scale to 100 M. A. d. c. for V. R. milliamperes.

Voltage adjustments are made while the tube being tested is delivering its rated load.

NOTE: Always check a tube for shorts before proceeding with Mutual Conductance test.

OPERATING INSTRUCTIONS

Read these instructions through before attempting to operate the tester.

1. There are two rectifier tubes, an 83 and a 5Y3GT necessary to operate this tester. They are included.

The Short Lamp is a 1/25 watt, 110 volt, miniature bayonet base neon signal lamp. This lamp will last indefinitely unless broken.

The Fuse Lamp is a standard No. 81, single contact auto bulb. This can be procured from any auto dealer or gasoline station attendant. This fuse lamp is in the primary circuit of the transformer.

FUNCTIONS OF THE VARIOUS CONTROLS

3. The line adjustment control rheostat in the 539C Tester is connected with a small A.C. voltmeter as a constant calibration indicator which is normally always in circuit. The small A.C. voltmeter may also be used to register 60 cycles A.C. line voltage fed to the set by operating the test button P7 designated "LINE TEST" in the lower right part of the control panel. Readjust after pressing the P4 Test Button.
4. **Selectors:** The row of seven selector switches across the center of the control panel is for the purpose of conducting proper voltages to the tube's base pins. On the roll data chart, below the word "Selectors" appear the switch settings.
Example: JR-6237-5. Starting at the left the first switch is set at "J", the second switch at "R", the third at "6", the fourth "2", the fifth "3", the sixth "7" and the seventh "5".

The first two switches control the filament or heater connections. The other switches control the GRID, PLATE, SCREEN, CATHODE and SUPPRESSOR in that order. In the example given above, the heater terminals are connected to pins 8 and 1. The GRID is connected to pin 6; PLATE, to pin 2; SCREEN, to pin 3; CATHODE, to pin 7 and SUPPRESSOR, to pin 5.

These switches are electrically interlocked in such a way that it is impossible to connect two different voltage elements to the same pin. Thus accidental shorts are avoided.

5. **Short Test.** In the Model 539C, Hickok has introduced an entirely new concept in short and leakage testing. In addition to the conventional neon lamp short indication, there is a d.c. leakage test which registers up to 50 megohms on the scale of the large Gm meter.

Neon Lamp Short Test. Turning the SHORTS switch successively through the positions 1-2-3-4-5 connects the various pairs of elements in turn across the test voltage. Tubes having shorted elements will complete the circuit and cause the neon SHORT lamp to glow. Tubes may be tested for shorts, either hot or cold. Normal sensitivity of the neon lamp is about 1/3 Megohm.

A short is indicated by a steady glow of the neon lamp in certain positions of the SHORTS switch. A shorted tube should be discarded without further test.

An improved neon Short Test is incorporated in the design of this tube tester. Wide experience has demonstrated that most satisfactory results are obtained when tubes are classified for short test purposes.

The toggle switch is thrown to miniature and subminiature position for all subminiature, button seven pin and button nine pin tubes. The other position is used for tubes having regular base pins, including loktal base tubes.

6. **Locating Shorted Elements by Neon Lamp.** In the following table (X) under any position indicates that the neon lamp glows in that position.

KIND OF SHORT	1	2	3	4	5
HEATER - CATHODE	X				
HEATER - GRID	X	X			
HEATER - SCREEN	X	X	X		
HEATER - PLATE	X	X	X	X	
HEATER - SUPPRESSOR	X	X	X	X	X
CATHODE - GRID		X			
CATHODE - SCREEN		X	X		
CATHODE - PLATE		X	X	X	
CATHODE - SUPPRESSOR		X	X	X	X
GRID - SCREEN			X		
GRID - PLATE			X	X	
GRID - SUPPRESSOR			X	X	X
SCREEN - PLATE				X	
SCREEN - SUPPRESSOR				X	X
PLATE - SUPPRESSOR					X

- 6a. **Heater Cathode Leakage:** A particularly troublesome defect in tubes, especially those used in television, is a leakage between heater and cathode. This leakage may be quite high, sometimes running to several megohms. It may be too high to cause the neon lamp to glow in the ordinary way. However, these leaks may be detected on your new 539C.

You will note that a heater-cathode short will cause the neon lamp to glow on position 1 (one). While the short switch is resting on position 1 (one), during short test operation a condenser will be charging through the leak. If the switch is turned from position 1 (one) to position 2 (two), a sharp flash of the neon lamp will be seen. This will not repeat until the switch is again turned to position 1 (one) allowing the condenser to recharge through the leakage. Many baffling cases of trouble can be located in this way.

It has been established that heater cathode leakage as high as 30 megohms will cause "noise" in repeater circuits in television service on coaxial lines.

- 6b. **Noise Test:** The short test circuit is also used in making noise tests on vacuum tubes. Connections are made from the noise test jacks to the antenna and ground posts of any radio receiver. The tube under test is tapped with the finger as the SHORTS switch is turned through positions 1-2-3-4-5.

Intermittent disturbances which are too brief to register on the neon lamp will be reproduced by the loud speaker as static.

7. **Leakage Test on Meter:** An added feature in the Model 539C is its ability to measure element leakage up to 50 megohms on the dial of the large Gm meter. The research

engineer and technician will find this feature a great aid in routine investigations.

Every engineer knows that in certain tube applications, leakage is more significant than in others. The metered leakage feature of the Model 539C will enable him to form sound judgment as to the leakage to be tolerated in different applications.

- 7a. **Operating Leakage Test:** Turning the SHORTS switch through positions A, B, C, D, E isolates tube elements successively from all other elements and registers the leakage in megohms between the chosen element and all others connected in parallel. Forty volts d. c. is applied in this test. The significance of the lettered positions of the short switch is as follows:

* A - HEATER isolated from other elements.

B - GRID isolated from other elements.

C - SCREEN isolated from other elements.

D - PLATE isolated from other elements.

E - SUPPRESSOR isolated from other elements.

* NOTE: Position A includes heater-cathode leakage. In tubes having filamentary cathodes, the heater and cathode are identical; therefore the meter will normally indicate near the zero mark on position A of the shorts switch.

8. **Gas Test:** The push switches P5 (Gas 1) and P6 (Gas 2) are used to test amplifier tubes for gas content.
- Make Micromho test in the ordinary way.
 - Set the Bias Voltmeter switch to the 50 volt range and the Function switch to position D. Hold down P5 and adjust the Bias control to bring the meter reading down to 500 on the 3000 scale.
 - Hold down P5 and press P6. Because of a charging capacitor the meter will deflect either up scale or down scale about one division, after P6 is pressed, and will settle to a new reading. An upscale reading after settling is the result of grid current due to gas or grid emission (sometimes referred to as poisoned grid). If the upward movement is not more than one large division (two small divisions), the gas content is satisfactory.

Some tubes develop gas after being heater for a period of time. If a tube is suspected, allow it to heat for a few minutes. This constitutes a very sensitive gas test. Gas content on the order of 0.1 microampere can be detected.

Gas content is a very important factor in modern receivers of all types, containing AVC and AFC circuits as the presence of gas causes the grid to become conductive and as changes in grid bias operate through resistors of comparatively high value, correct functioning cannot be obtained with a gassy tube. The presence of gas results in actually changing the grid bias. Gas is especially harmful in television tubes.

9. **Dynamic Transconductance:** The Push Switch P4 is mechanically divided into two sections, non-locking and locking. Both sections perform identical electrical functions. If momentary contact is needed, press the non-locking button. If extensive tests are to be made, use the locking button. The locking button is released by pressing the non-locking button.

The indicating meter will register the tube's value in eight ranges:

- A. 60,000 μ mho at .25 Volt signal.
- B. 30,000 μ mho at .25 Volt signal.
- C. 15,000 μ mho at .25 Volt signal.
- D. 6,000 μ mho at .5 Volt signal.
- E. 3,000 μ mho at 2.5 Volt signal.
- F. 600 μ mho at 1. Volt signal.
- G. Rectifiers and Diodes, no signal.
- H. Voltage Regulator tubes.

The 600 micromho range was designed especially to test subminiature tubes. Low plate and screen volts are automatically applied when FUNCTION switch is set on position F.

The FUNCTION switch automatically changes the signal volts when the appropriate setting is made.

The chart setting for the tube to be tested will indicate where the FUNCTION switch should be set, such as A, B, C, D, E, F, G or H, in the column preceding Micromhos.

The Micromho values printed on the data roll are minimum values. Good tubes will read above these values.

In the column headed BIAS VOLTS is listed the exact voltage to which the BIAS VOLTS meter is to be set when testing a tube. Make final bias adjustment after the P4 button is pressed.

Certain pentode tubes, such as the 3A4, are tested with reduced screen voltage. This is accomplished by holding down P1 and pressing P4. Specific instructions are printed in the NOTATIONS column for each tube requiring reduced screen voltage.

10. Rectifier Test. The push switches P1, P2 and P3 are used to test various types of rectifier elements.

- a. The push switch P1 is used when testing detector diodes. It applies a low voltage which will not injure the delicate cathode. Good diodes will cause the meter pointer to read above mark, RECTIFIERS and DIODES O. K.
- b. Push switch P2 is used when testing cold cathode rectifiers such as the OZ4. This applies a voltage sufficiently high to ionize the tube and start conduction. Good tubes will read above the mark, RECTIFIERS and DIODES O. K.
- c. Push switch P3 is used when testing ordinary rectifier tubes such as the 5Y3. This switch applies a medium voltage which is best adapted to reveal defects in this type of tube. Good tubes will read above the mark, RECTIFIERS and DIODES O. K.

In the chart column headed SHUNT are listed the numbers to which the SHUNT dial is to be set when testing Rectifiers and Diodes.

11. **Socket Numbering.** Sockets are wired according to EIA numbering, and the numerical values of the lettered dials are as follows:

<u>Selector Positions</u>			<u>Socket Connections</u>
A	P	0	No Connection
B	R	1	1
C	S	2	2
D	T	3	3
E	U	4	4
F	V	5	5
G	W	6	6
H	X	7	7
J	Y	8	8
K	Z	9	9
1	1	W	10
2	2	X	11
3	3	Y	12
4	4	Z	No Connection

12. **Meter Reverse.** Directly below the indicating meter is a switch marked REVERSE-NORMAL. With certain tubes such as the 117N7, the meter, when set on NORMAL, will deflect backwards (to the left) when push switch P3 is pressed for rectifier test. In such case turn the meter switch to REVERSE which will cause the pointer to move up the scale. After this test has been made, return the switch to NORMAL.

13. **Top Caps.** There are two jacks in the upper center of the control panel marked GRID and PLATE. These are used when making connection to the top cap of the tube being tested. On the data chart in the NOTATIONS column opposite tube types having top caps, is the notation CAP = G, or CAP = P. G means that the top cap is connected to the GRID and P, to the PLATE jack.

14. **Special Notes.** Power line voltage varies with different localities. It may also vary with the different hours of the day.

While a national survey indicates that the average voltage for the USA is 117 volts, it does not mean that every locality maintains a constant voltage at that level.

Occasionally we have had the complaint that a used tube will test GOOD, but will not work in the radio receiver; but when a NEW tube is substituted, the receiver will operate correctly. The answer is this: Tubes are built to specifications. Our tube testers are designed to test tubes in conformity with these specifications.

The used tube that would not perform in a certain receiver was not receiving its specified filament voltage. The new tube performed because of its initial reserve capacity. The used tube would have performed if it had received its specified filament voltage.

Tube failure frequently occurs in A.C. - D.C. sets where several tubes are connected with their heaters or filaments in series. Sometimes, even though the power line voltage is normal, a series tube with abnormally high filament resistance will rob its companion tube of its normal filament voltage. The robbed tube apparently fails; but when tested under specified conditions, the tube will test GOOD.

The Model 539C is valuable in matching tubes for push-pull stages and other applications where matched tubes are essential.

15. Life Test. The Model 539C DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER is equipped with a special feature to enable Life Test to be made on the tube. In the center of the control panel is a switch designated CATH. ACT., NORM. and TEST. While holding everything else at normal this switch reduces the filament voltage by 10%.

- a. Measure the mutual conductance in the ordinary way with switch set on NORMAL.
- b. Throw the CATH. ACT. switch to TEST position. The mutual conductance should not drop more than 20%.
- c. After making life test return the switch to NORMAL for all other tests.

In testing the 35Z5 and 45Z5 rectifier tubes it is advisable to turn the power off for about 15 seconds after throwing the CATH. ACT. switch to TEST to allow the cathode to cool. Then turn the power on and note new reading of the meter.

16. Self Bias. Provision is made to test tubes under self bias condition. In the upper edge of the control panel are two binding posts designated SELF BIAS. These posts are normally shorted by an attached bar. To use SELF BIAS, connect a suitable bias resistor together with an electrolytic capacitor of 2000 μ fd in parallel across these binding posts. The positive terminal of the capacitor should be connected to the positive binding post.

The toggle switch in the upper left of the control panel is thrown from NORMAL position to the SELF BIAS position. The bias volts under self bias condition depends upon the value of the resistor inserted between the self bias posts mentioned above, and also upon the plate current flowing.

Tube handbooks can be used as a guide to the value of the self bias resistance to use. When completing the self bias test, reconnect the two binding posts by the normal shorting bar and throw the toggle switch back to the NORMAL position.

17. Plate Current. In the upper center of the control panel are two posts designated PLATE CURRENT. These posts are normally shorted by an attached bar. A suitable low resistance D.C. milliammeter connected across these posts will measure the plate current flowing through the tube being tested. Connect the positive terminal of the meter to the positive binding post.

NOTE

A D.C. milliammeter connected into the SELF BIAS circuit will measure the total cathode current. In measuring rectifier tube current the meter reading must be multiplied by two, because rectifier tubes conduct only during a positive half-cycle, whereas the meter integrates over a complete cycle.

In checking thyratrons such as the 884 and 885, the bias voltmeter should be set initially at its highest negative value (about 40 volts). The designated button is held down while the bias voltage is gradually reduced until the tube "strikes", that is, begins to conduct, which is indicated by a sudden deflection of the meter. The chart indicates the approximate voltage at which the tube strikes. There may be a small variation above or be-

low the given striking voltage. The meter indication for a good tube is above the point designated "RECTIFIERS OK".

18. Filament and Heater Continuity.

1. Turn the tester on.
2. Set the selectors as per chart for the tube to be tested.
3. Set the FILAMENT switch on BLST instead of voltage indicated on the chart.
4. Set the SHORT TEST switch on position 5.
5. Place the tube in the proper socket.

If the neon lamp glows, the filament is good and a complete test should then be made on the tube, by setting FILAMENT switch on the proper tap, and while the tube heats, rotate the SHORT TEST SWITCH several times thru 1 to 5 positions. If no shorts are indicated, set the switch in TUBE TEST position and proceed to test the tube as per chart.

If the neon lamp does not glow, the filament is open and further test is unnecessary. Certain tubes such as the 35Z5-50Z7, etc., with tapped filaments have special continuity test settings; see roll chart.

NOTE

It sometimes happens that a filament will show continuity when cold, but will open when it warms up.

19. Voltage Regulator Tubes.

- a. Set the selectors for V. R. tube to be tested. The test data for V. R. tubes will be found at the top end of the roll chart. For example, the OA3.
- b. Set FIL VOLTAGE switch to OFF.
- c. Set selector switches to AP-0502-0.
- d. Set function switch on range H, V. R. TEST.
- e. Turn the bias volts toggle switch to V. R. volts and mils.
- f. Turn V. R. volts knob fully counter clockwise.
- g. Turn power adjust knob fully clockwise. Press P4-LOCK.
- h. Place V. R. tube in proper socket and turn power ON.
- i. Turn V. R. voltage control knob slowly clockwise. The large Gm meter should start to read d. c. volts on the 0-200 volt scale.
- j. Example: In the notations column for the OA3 tube appears, "Starts at about 100 Volts - Regulation = 5 volts from 5 to 40 m.a.". In the column marked MIN. MUT. COND. is the nominal operating voltage for this tube - 75V.
- k. When the V. R. tube strikes as explained in (j) above, the voltmeter reading will drop back to operating voltage. The V. R. current is read on the 0-100

m. a. range of the bias meter.

1. For the OA3 example adjust the m. a. current from 5 to 40 milliamperes by turning the V. R. volts and mils knob. The OA3 tube should not exhibit a voltage change of more than 5 volts.

m. When completing a V. R. tube test unlock P4 push button.

20. Ohmmeter Feature. The Model 539C tube tester can be used as a utility ohmmeter as follows:

- a. Set the SHORTS switch on position B.
- b. Connect two prod leads into the grid and plate jacks in the center of the control panel. The red plate jack will be the positive lead.
- c. Touch together the two prods and adjust the ohmmeter pointer to zero. Resistance up to 50 megohms can be read directly on the megohm range.
- d. Electrolytic capacitors can be checked for leakage. Observe that the red (plate) jack is connected to the positive pole of the capacitor.

21. NORMAL-LOW Plate Volts. In the NOTATIONS column of the data chart for some tubes will be found PLATE VOLTS = LOW. This notation indicates that the PLATE VOLTS switch located just above the FUNCTION switch is to be set on the LOW position. Return the switch to NORMAL for all other tubes.

22. Heater - Current. In the lower right hand corner of the panel will be found two binding posts which are normally connected together by a jumper. By removing this jumper and connecting a suitable Milliammeter or Ammeter between these two binding posts, the indicating instrument will read the current being drawn by the heaters of the tube under test.

The actual voltage at the tube under test will be the voltage as indicated by the filament selector switch minus the voltage drop across the indicating Milliammeter or Ammeter. This voltage will generally be of a very low magnitude, but can be calculated by multiplying the current normally drawn by the tube under test by the impedance of the meter connected in series with this tube, or it can be actually measured with a sensitive AC Voltmeter.

If the impedance of the meter is much more than 0.2 ohms, the voltage drop might be appreciable percentage-wise to the voltage delivered to the tube. For example, if the current at the tube is normally 0.6 amperes, and the impedance of the current measuring instrument were 0.5 ohms, the resultant loss would be the product of these two, or 0.3 of one volt.

23. Pilot Lamp Testing. The center of the large 7-pin socket is used to check pilot lamps. Set the filament selector switches on HR. Set the filament voltage switch to the proper voltage for the lamp being tested.

TO TEST BALLAST TUBES

1. Turn Tester on.
2. Set filament switch to BLST.
3. Set SHORT TEST switch on 5.
4. Set first selector switch to letter shown in column marked (first selector switch). Set all numbered selectors on zero.
5. ROTATE second selector switch. NEON LAMP SHOULD LIGHT IN POSITIONS NOTED.

TUBE TYPE	First Selector	Neon Lamp Should Light in these positions							
1A1-1B1-1C1-1E1-1F1-1G1-1J1-1K1-1V1 1Y1-1Z1	E	R							
1L1-1N1-1P1-1Q1-1R1G-1S1G-1T1G-1U1G	H		S						
2	E	R							
2UR224	H			T					Y
2LR212	J	R	S		U				
3	E	R							
O3G	H			T					
4-5	E	R							
6-133	H			T					
6-6AA-7-8-9	E	R							
10A-10AG	H			T					
10AB	E	R							
K17B-M17C-BM17C	H			T					Y
M17HG-M17H	H D	R	S						Y
K23B-K23C	H			T					Y
KX23B	E	R		T					
KX30C	E	R		T					
M30H	H D	R	S						Y
30A-K30A	H			T					
K30D	H		S	T					Y
33A-33AG	H			T					
K34B	H			T					Y
36A	H			T					
K36B-BK36B-L36B-L36C	H			T					Y
KX36Z	E	R							
KX36C	E	R		T					
36D-L36D	H		S	T					Y
L36DJ	H	R	S	T	U				Y
K36H-M36H-M36HG	H D	R	S						Y
40A1	H		S						
L40S1-L40S2	H		S	T		V			
42A	H			T					

TUBE TYPE	First Selector	Neon Lamp Should Light in these positions									
42A1	J				U						
42A2-42B2	J	R			U						
K42B-L42B-M42B	H			T						Y	
KX42B-LX42B-L42BX	E	R		T							
K42C-L42C-M42C	H			T						Y	
BK42D-K42D-L42D	H		S	T						Y	
LX42D-L42DX	E	R	S	T							
K42E-L42E	H			T						Y	
L42F	H D		S							Y	
42HA-42HJ	H E	R	S	T							
M42H-M42HG	H D	R	S							Y	
KX42C	E	R		T							
L42SI	H		S	T		V					
49A-49AJ-K49AJ	H			T							
KX49A	E	R		T							
49A1	J				U						
49A2-49B2	J	R			U						
K49B-L49B-M49B-BM49B-K49C	H			T						Y	
M49C-BM49C-BK49C-K49E-L49E											
K49D-BK49D-L49D	H		S	T						Y	
L49F	H D		S							Y	
M49H-M49HG	H D	R	S							Y	
KZ49B-KZ49C	H		S			V					
K49BJ-L49BJ	H			T	U					Y	
L49S2	H		S	T		V					
49AJ-K49AJ	H			T							
KX49B-LX49B-LX49C	E	R		T							
L49DJ	H		S	T	U					Y	
L49S3	H		S	T		V					
50A2	E	R		T							
50A2MG-50B2	H		S			V					
50X3	E	R									
K52H-M52H	H D	R	S							Y	
K54B	H			T						Y	
55A-K55A	H			T							
55A1	J				U						
KX55A	E	R									
55B-K55B-M55B-BM55B-L55BG	H			T						Y	
LX55B	E	R		T							
55A2-55B2	J	R			U						
K55C-L55C	H			T						Y	

TUBE TYPE	First Selector	Neon Lamp Should Light in these positions							
KX55C	E	R		T					
K55CP	H			T		V			Y
K55D-L55D	H		S	T					Y
L55E-M55E	H			T					Y
L55F-M55F-BL55F	H D		S						Y
K55H-M55H-M55HG	H D	R	S						Y
L55S1-L55S2	H		S	T		V			
60R30G	E	R		T					
64. 23	H			T					
67A	H			T					
K67B-L67B	H			T					Y
L73B-K74B-L74B	H			T					Y
KX74C	E	R		T					
80A	H			T					
K79B-K80B-K80C-L80B	H			T					Y
KX80B	E	R		T					
K80F	H D		S						Y
KX87B-LX87B	E	R		T					
L90B	H			T					Y
K90F-M90F-K92F-M92F	H D		S						Y
92A	H			T					
L92B-95K2	H			T					Y
L99D	H		S	T					Y
100R8	E	R		T					
120R	E	R							
120R8	E	R		T					
135K1	H			T					Y
135K1A	H			T	U				Y
140L4-140L8-140R4-140R8	E	R		T					
140R	E	R							
140L44	E	R		T					
140R44	E	R	S	T					
165L4-165R4-165R8	E	R		T					
165R	E	R							
165L44-165R44	E	R	S	T					
185L4-185L8-185R4-185R8	E	R		T					
185R	E	R							
185L44-185R44	E	R	S	T					
200R-250R	E	R							
250R8	E	R		T					
290L4	E	R		T					
300R4-320R4	E	R		T					
340	E	R							
808-1	H			T	U				Y

TUBE TYPE	First Selector	Neon Lamp Should Light in these positions							
E14980-W43357-W45788-3613	H			T					Y
3334-3334A	H		S	T					Y
3613	H			T					Y
8593-8598-8601-8664	H			T					Y
3CR241	H		S	T					Y
3ER248	H		S	T	U				Y
B9M15822	C E G			T		V		X	Y
B9M16067	H		S	T		V	W		Y
B9M16275	C			T	U	V	W	X	Y
B9M16534	H		S	T		V	W		Y
B9M17571	J H		S	T	U	V			Y
B9M18941	C E G	R		T		V		X	Y
17A470303	H J E	R	S			V	W		
17A485459	H E	R	S	T			W		
TBR102D-TBR104D	C G	R		T	U	V		X	Y
TBR103D	C G	R			U	V		X	Y
397021	C	R		T					
397022	E					V	W		
397023	H								Y
397036	B					V			
407100	H	R	S			V			
408100	H D	R	S		U	V			
SW407300	H		S	T		V	W		Y
571606	C E H	R		T		V	W		Y

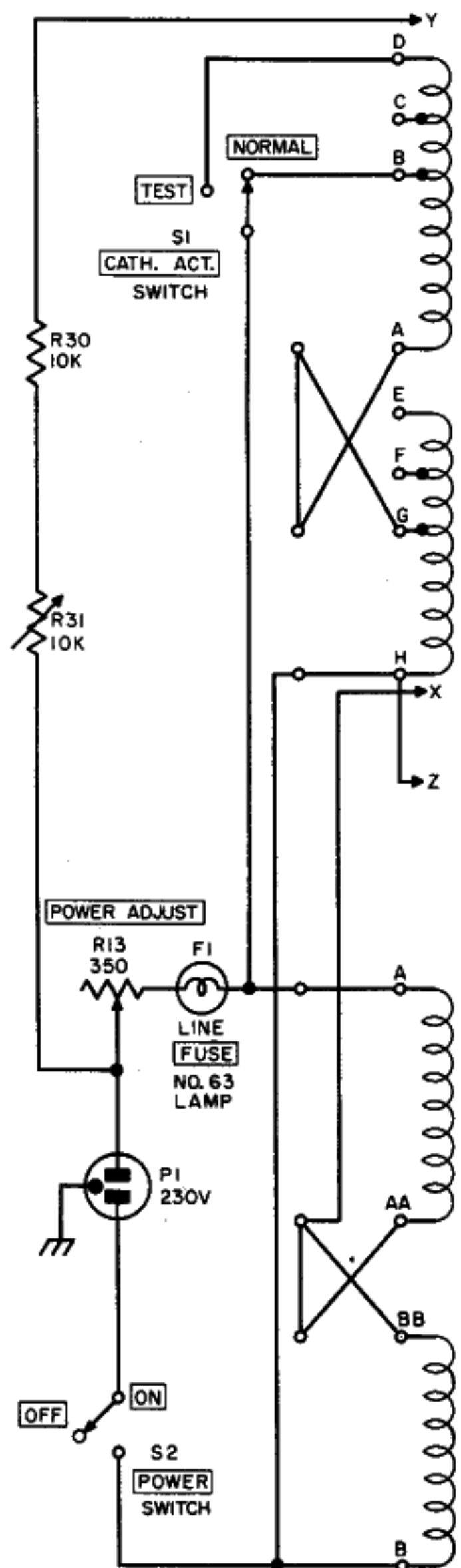
PARTS LIST

Reference designations have been assigned to identify all parts used in this instrument. An asterisk designates a part which should be replaced by authorized Hickok repair stations or factories. It is therefore recommended that the entire instrument be returned for repair if trouble exists with such a part.

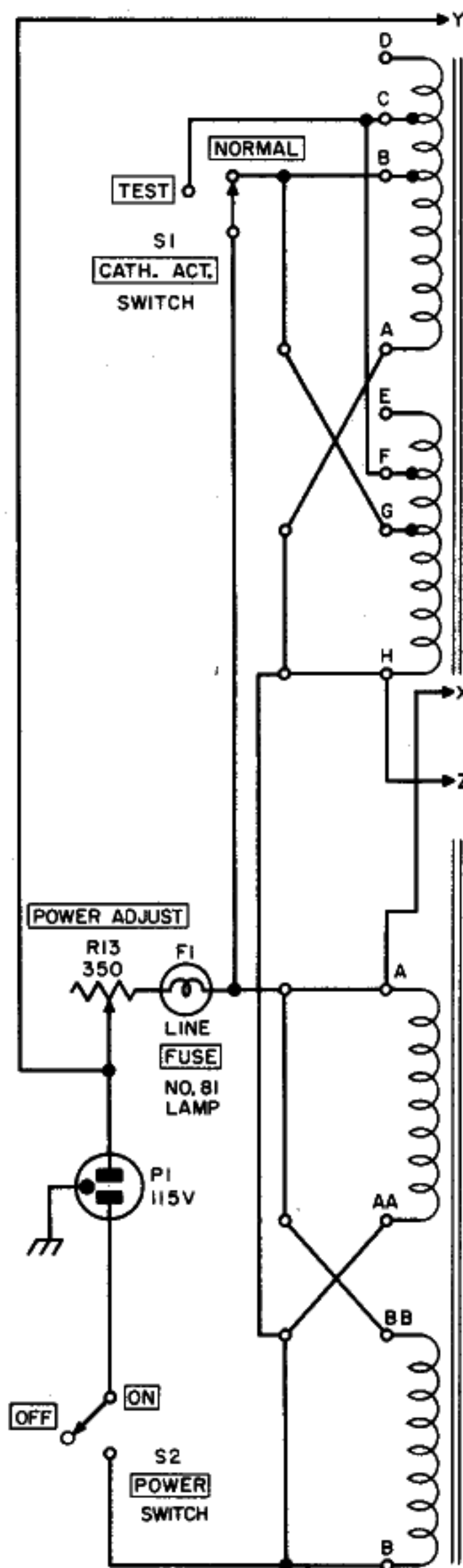
In ordering parts, refer to the current parts price list for this instrument. Prices are subject to change without notice, and the minimum billing charge is

REF. DESIG.	NAME AND DESCRIPTION	HICKOK PART NO.
C1	CAPACITOR, FIXED, ELECTROLYTIC: 8 uf, 350 volts	3085-68
C2, C3	CAPACITOR, FIXED, PLASTIC COATED: .05 uf, 400 volts	3105-175
C4	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf, 6 volts	3085-40
C5	CAPACITOR, FIXED, MICA: 470 pf, 10%, 500 volts	3095-8
C6	CAPACITOR, FIXED, CERAMIC: .005 uf, -0 + 100%, disc type	3110-7
C7	CAPACITOR, FIXED, MICA: 2700 pf, 10%, 1000 volts	3095-268
DS1	LAMP: #47, 6-8 volts, .15 amps, miniature bayonet base, clear	12270-12
DS2	LAMP: NE51, neon	12270-14
E1 thru E3	BAR: shorting	2145-2
F1	LAMP: #81, bayonet type (115 volts)	12270-2
F1	LAMP: #63, G. E. (230 volts)	12270-58
J1	JACK: pin plug type, red	10300-1
J2 thru J4	JACK: pin plug type, black	10300-2
J5 thru J10	BINDING POST: black	2360-51
M1	METER: Line test, Model 57MR	570-450
M2	METER: Model 56R	560-812
M3	METER: Model 68	680-302
P1	CORD AND PLUG ASSEMBLY: 3 wire	3675-34
R1	RESISTOR, FIXED, FILM: 150 ohms, 1%, 2 watts	18540-4
R2	RESISTOR, FIXED, COMPOSITION: 470 K ohms, 10%, 1/2 watt	18414-472
R3	RESISTOR, FIXED, COMPOSITION: 47 ohms, 10%, 1/2 watt	18410-472
R4	RESISTOR, FIXED: 100 ohms, 10%, 10 watts, center tapped	18575-19
R5	RESISTOR, FIXED, COMPOSITION: 15 K ohms, 5%, 1 watt	18423-151
R6	RESISTOR, FIXED, COMPOSITION: 1200 ohms, 10%, 1 watt	18422-122
R7	RESISTOR, FIXED: 1800 ohms, 10%, 10 watts	18575-12
R8	RESISTOR, VARIABLE: 50 ohms	16925-271
R9	RESISTOR, FIXED, FILM: 300 ohms, 1%, 1/2 watt	18537-99
R10	RESISTOR, FIXED, FILM: 100 ohms, 1%, 1/2 watt	18537-96
R11, R12	RESISTOR, FIXED, FILM: 50 ohms, 1%, 1/2 watt	18537-65
R13	RHEOSTAT: 350 ohms, 15%, 25 watts	18750-7
R14	RESISTOR, VARIABLE: wire wound, dual 3000 ohms and 1000 ohms, 5%, 4 watts	16925-270
R15	Same as R8	
R16	Same as R14	
R17	RESISTOR, FIXED, FILM: 2250 ohms, 1%, 1 watt	18539-12
R18	RESISTOR, FIXED, WIRE WOUND: 8500 ohms, 10%, 10 watts	18575-89
R19	RESISTOR, FIXED, FILM: 1200 ohms, 1%, 1 watt	18539-11
R20, R21	RESISTOR, FIXED, COMPOSITION: 1000 ohms, 5%, 1 watt	18422-101
R22	RESISTOR, SPOOL: 560 ohms	18684-124
R23	RESISTOR, FIXED, FILM: 470 K ohms, 1%, 1/2 watt	18537-66
R24	RHEOSTAT: 1000 ohms, 50 watts	18750-26
R25	RESISTOR, VARIABLE: 1000 ohms	16925-88
R26	RESISTOR, FIXED, FILM: 150 ohms, 1%, 1/2 watt	18537-64
R27	RESISTOR, FIXED, FILM: 750 ohms, 1%, 1/2 watt	18537-98
R28	Same as R10	
R29	RESISTOR, FIXED, FILM: 270 ohms, 1%, 1/2 watt	18537-93
R30	RESISTOR, FIXED, COMPOSITION: 10 K ohms, 10%, 2 watts	18433-102
R31	RESISTOR, VARIABLE: 10 K ohms, 20%, 2 watts	16925-495
R32	Same as R3	
R33	RESISTOR, FIXED, FILM: 230 ohms, 1%, 1/2 watt	18537-97
R34	RESISTOR, FIXED, COMPOSITION: 150 K ohms, 5%, 1/2 watt	18414-151
R35, R36	RESISTOR, FIXED, COMPOSITION: 120 K ohms, 5%, 1/2 watt	18414-121
R37	RESISTOR, FIXED, FILM: 500 ohms, 1%, 1/2 watt	18537-58
R38	RESISTOR, SPOOL: 60 ohms	18684-113

REF. DESIG.	NAME AND DESCRIPTION	HICKOK PART NO.
R39, R40	RESISTOR, SPOOL: 40 ohms	18684-111
R41	Same as R38	
R42	Same as R37	
R43	RESISTOR, SPOOL: 198 ohms	18684-119
R44	RESISTOR, SPOOL: 2 ohms	18684-102
R45	RESISTOR, VARIABLE: 250 K ohms	16925-259
R46	RESISTOR, FIXED, COMPOSITION: 1 megohm, 10%, 1/2 watt	18415-102
R47	RESISTOR, FIXED, COMPOSITION: 36 K ohms, 5%, 1/2 watt	18413-361
R48	RESISTOR, FIXED, FILM: 330 K ohms, 1%, 1/2 watt	18537-100
R49	RESISTOR, FIXED, FILM: 40 K ohms, 1%, 1/2 watt	18537-94
R50	RESISTOR, FIXED, FILM: 9900 ohms, 1%, 1/2 watt	18537-95
R51	RESISTOR, FIXED, FILM: 200 ohms, 1%, 1/2 watt	18537-76
R52	Same as R37	
R53	RESISTOR, FIXED, COMPOSITION: 220 K ohms, 10%, 1/2 watt	18414-222
S1	SWITCH: toggle, spdt	19911-19
S2	SWITCH: toggle, spst	19911-9
S3	SWITCH: rotary, filament	19912-202
S4	SWITCH: rotary, 3 pole, double throw	19912-304
S5	SWITCH: gang, push button	19910-92
S6	Same as S4	
S7	SWITCH: slide, dpdt	19911-7
S8	SWITCH: toggle, dpdt	19911-55
S9	SWITCH: rotary, function	19912-308
S10	Same as S8	
S11 thru S15	SWITCH: rotary, selector	19912-479
S16, S17	SWITCH: rotary, suppressor and cathode	19912-480
S18	SWITCH: rotary, short test	19912-312
S19	Same as S8	
V1	TUBE: #83	20875-28
V2	TUBE: #5Y3 GT/G	20875-6
X1	SOCKET: 4 pin	19350-93
X2	SOCKET: 5 pin	19350-94
X3	SOCKET: 6 pin	19350-95
X4	SOCKET: 7 pin	19350-96
X5	SOCKET: octal, 8 pin	19350-98
X6	SOCKET: loctal, 8 pin	19350-97
X7	SOCKET: 7 pin, miniature	19350-76
X8	SOCKET: 10 pin	19350-364
X9, X10	SOCKET ASSEMBLY: combination, 7-8 pin	19351-16
X11	SOCKET: nuvistor, 5 pin	19350-336
X12	SOCKET: novar	19350-367
X13	SOCKET: compactron, 12 pin	19350-365
X14	SOCKET: nuvistor, 7 pin	19350-382
	ADAPTER: socket, 8 pin	1050-39
	ADAPTER: socket, 7 pin	1050-41
	BUTTON: molded, push, black	2920-7
	BUTTON: molded, push, red	2920-8
	DIAL ASSEMBLY: shunt, with knob	4160-66
	KNOB ASSEMBLY: bar type, with pointer	11500-11
	KNOB: molded, 1" dia.	11505-49
	LEAD ASSEMBLY: plate	12450-145
	LEAD ASSEMBLY	12450-180
	SOCKET: bayonet, for #81 lamp	19350-1
	TRANSFORMER: filament	20800-300
	TRANSFORMER: plate	20800-301
	BOOKLET: instructions	2490-581

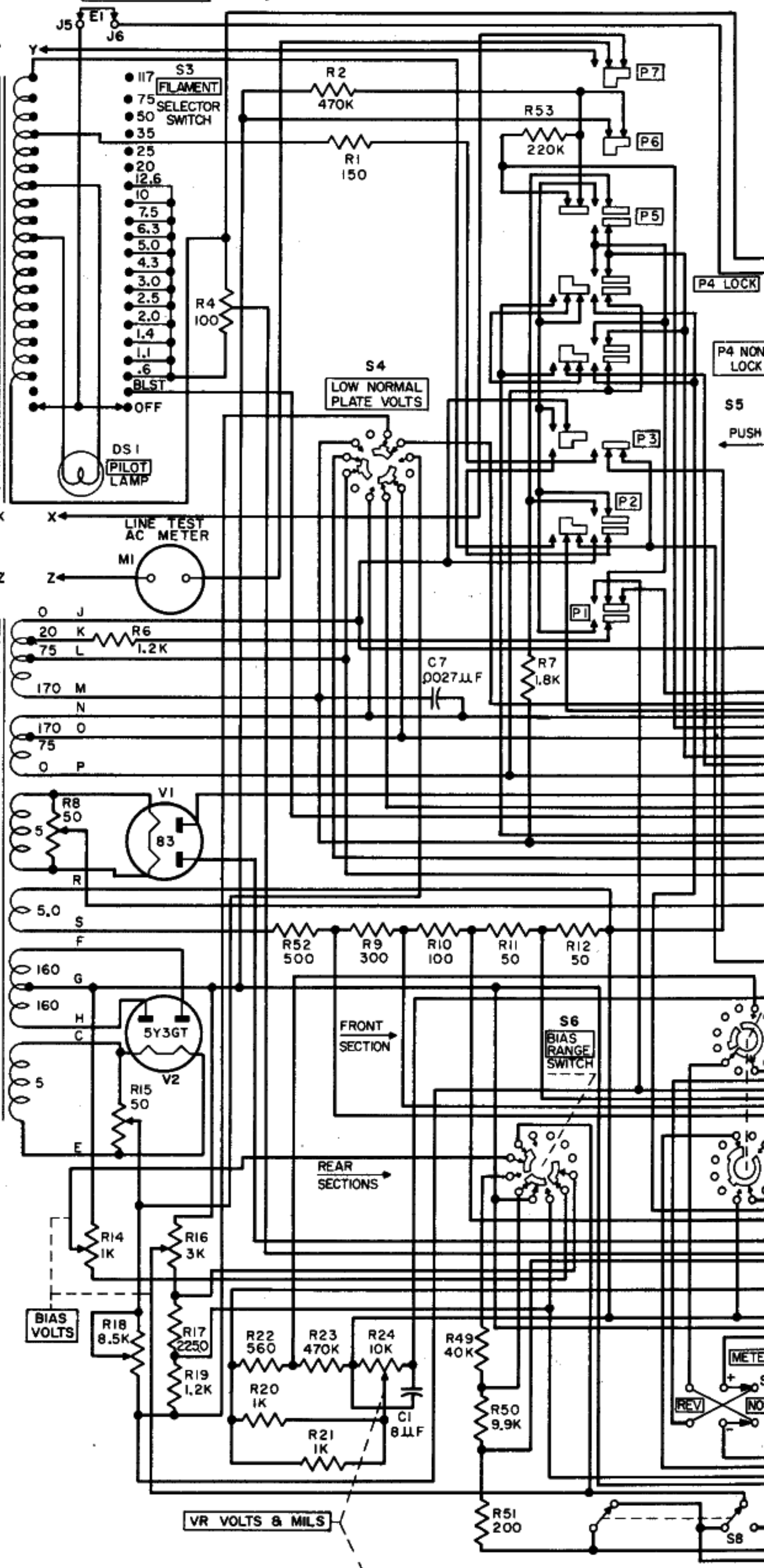


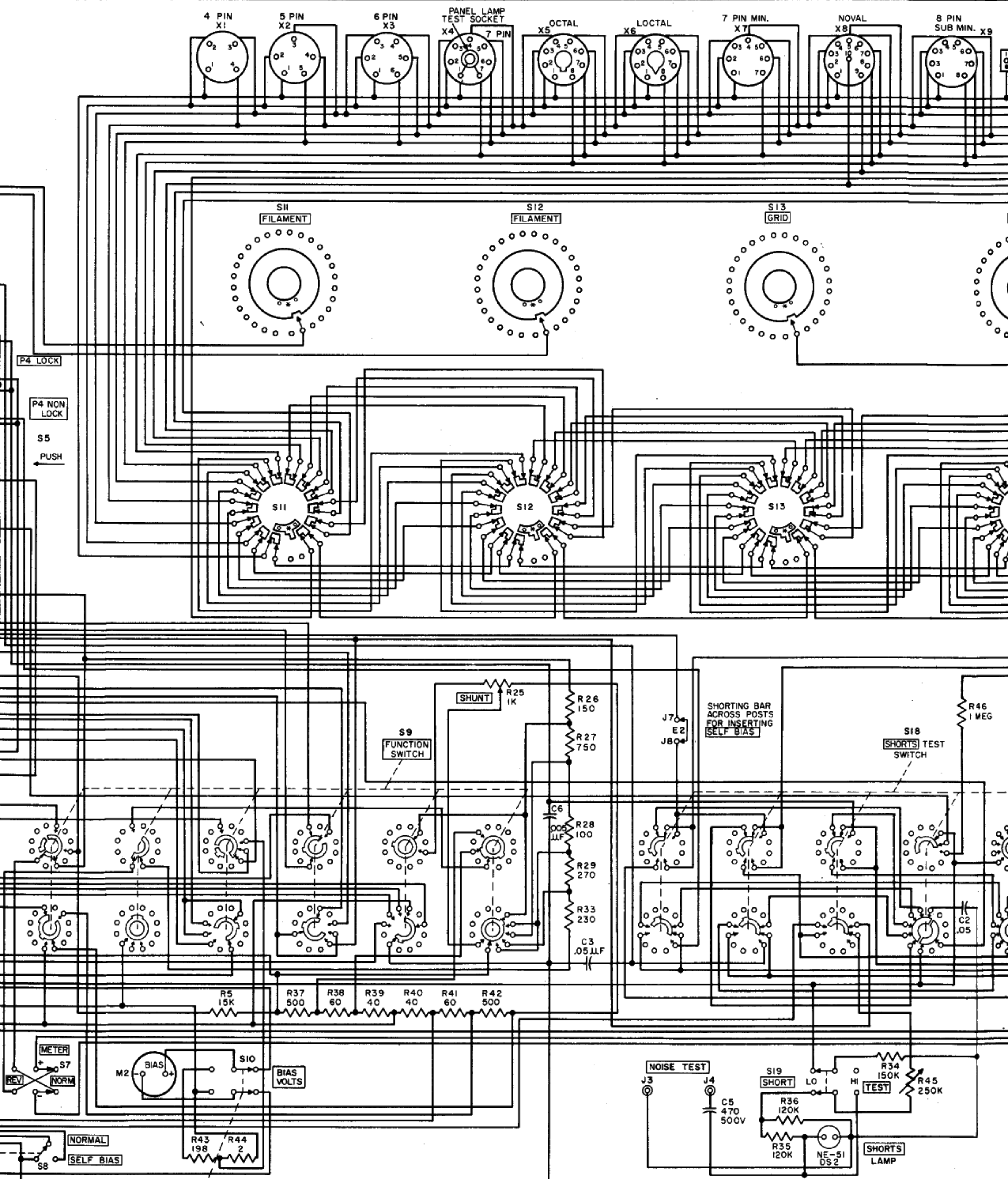
TRANSFORMER WIRING DIAGRAM
FOR 230 VOLT OPERATION.

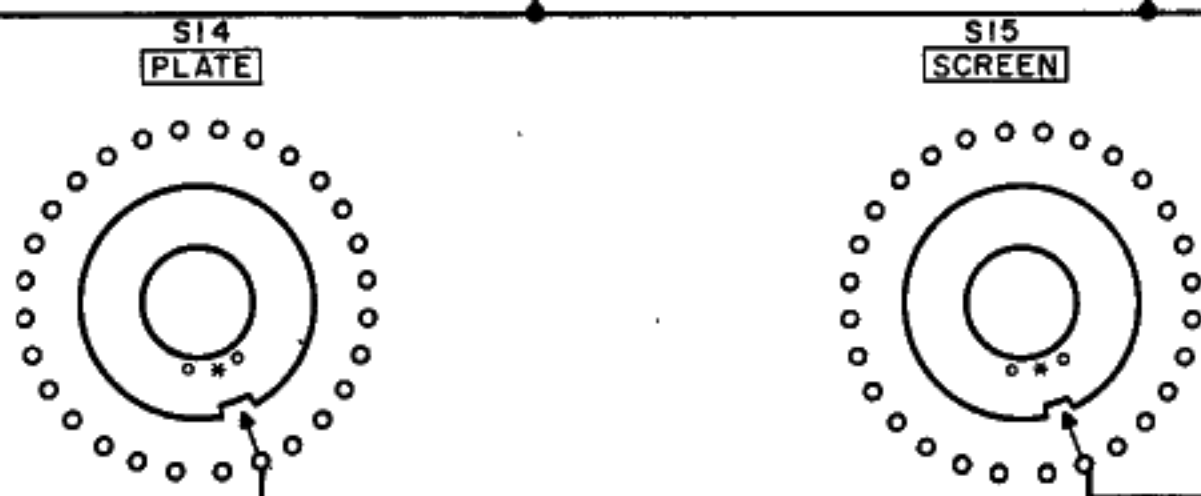
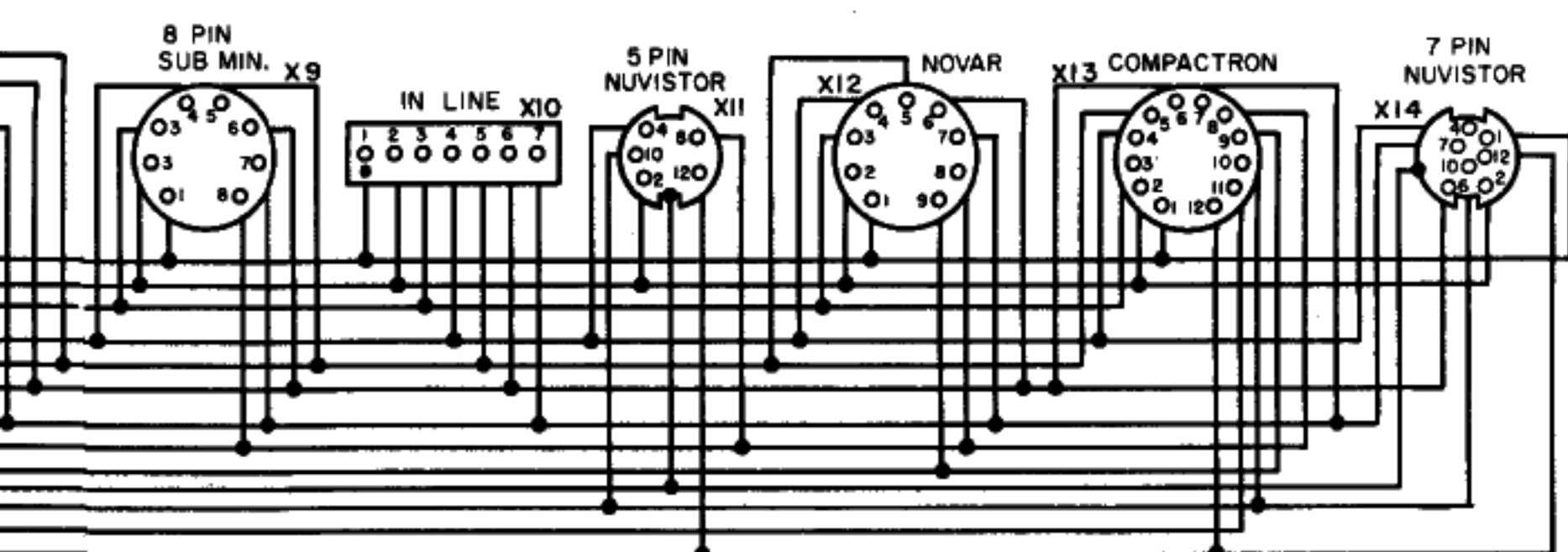


TRANSFORMER WIRING DIAGRAM
FOR 115 VOLT OPERATION.

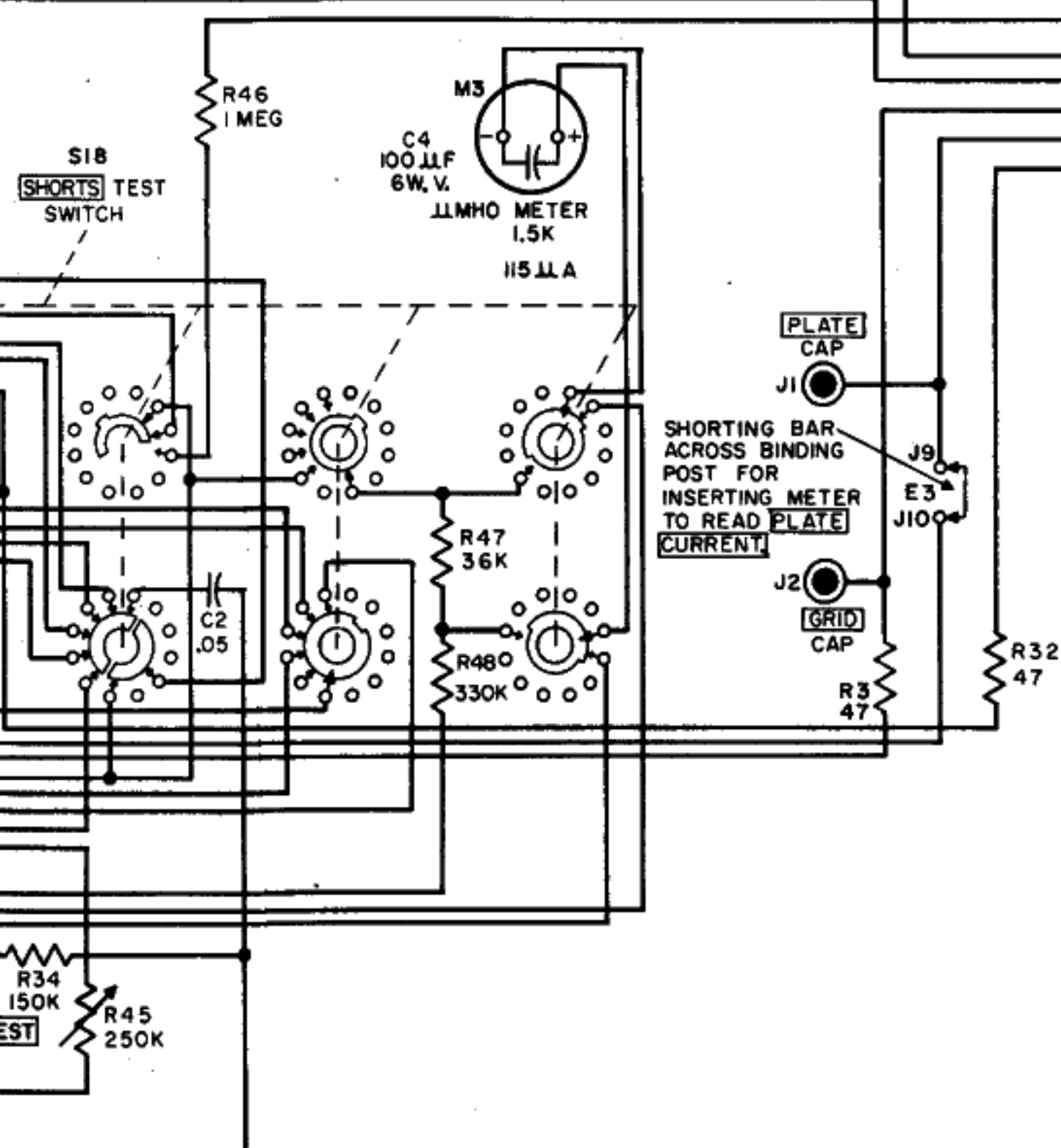
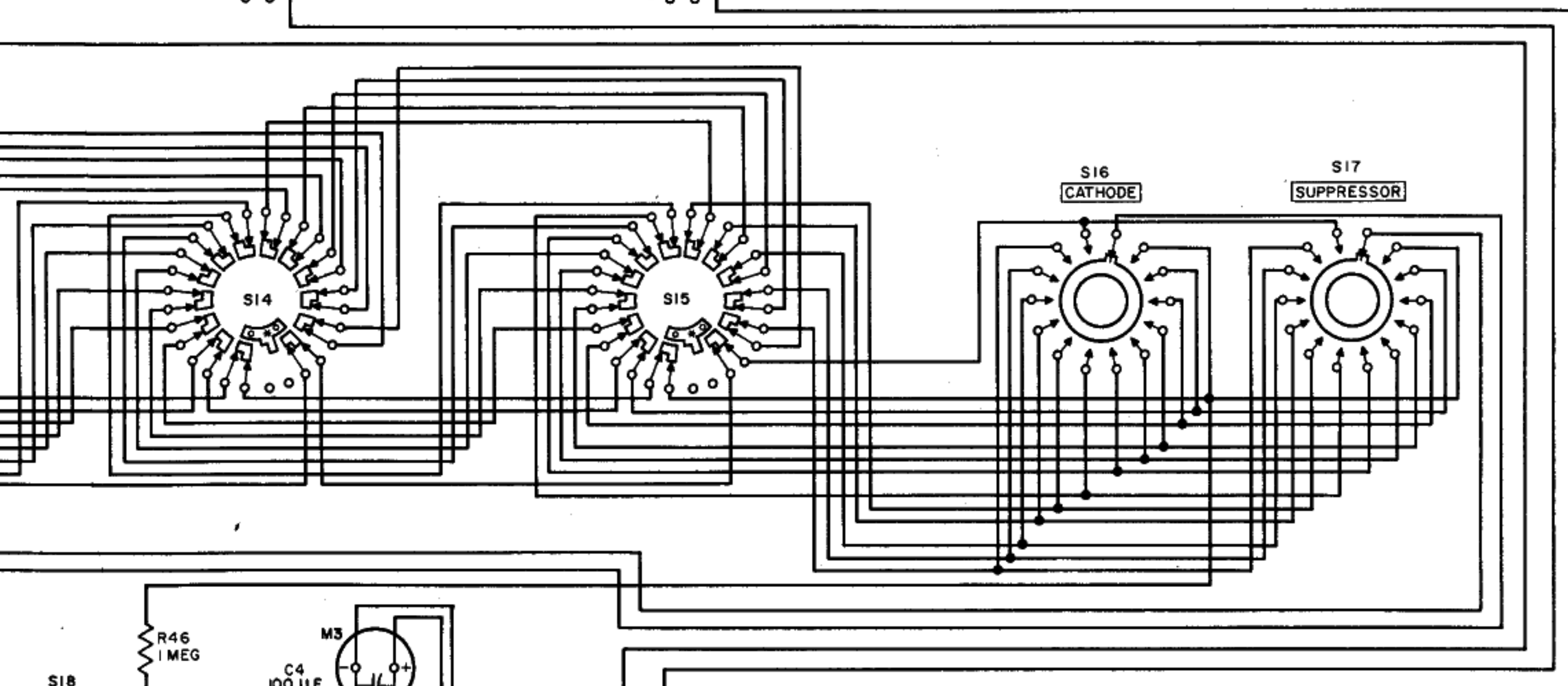
BINDING POSTS FOR
INSERTING METER TO
READ HEATER CURRENT







SELECTORS
FRONT OF SECTIONS
*FRONT AND REAR SECTIONS ELECTRICALLY CONNECTED.
LEFT END OF ALL SWITCHES IS THE KNOB END.



NOTES

1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN PICO FARADS.
2. SWITCHES ARE SHOWN IN EXTREME COUNTERCLOCKWISE POSITION.
3. DENOTES FRONT PANEL DESIGNATION.

SCHEMATIC WIRING DIAGRAM MODEL 539C