OPERATING INSTRUCTIONS

FOR

HICKOK

RADIO TEST EQUIPMENT

MODEL 510X

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
CLEVELAND, OHIO U. S. A.

THE INSTRUMENT PACKED HEREWITH IS:

	PACKER'S CHECK
1 MODEL 530 DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER.	
1 MODEL 510X DYNAMIC MUTUAL CONDUCTANCE COMBINATION TUBE TESTER AND ANALYZER	

ACCESSORIES INCLUDED WITH THE 530 TESTER ARE:	
1 - TAG "IMPORTANT" INFORMATION	
1 - BOOKLET INSTRUCTIONS FOR 530	
1 - GRID CAP	

SERIAL NO. _____

SIGNED: _____

ACCESSORIES INCLUDED WITH THE 510X TESTER ARE:	
1 - TAG "IMPORTANT" INFORMATION	
1 - BOOKLET INSTRUCTIONS FOR 510X	
1 - GRID CAP	
1 - TUBE CHART MOUNTED IN COVER	
1 - PAIR FLEXIBLE LEADS WITH PINS AND PRODS	
1 - CONDENSER CABLE WITH PLUG, PIN TIP & ALLIGATOR CLIP	

SERIAL NO. 556166

SIGNED: T R Lyk

IMPORTANT

READ INSTRUCTIONS THOROUGHLY BEFORE ATTEMPTING TO OPERATE TESTER.

There are two rectifier tubes, an 83 and a 5W4, necessary to operate this tester. They are not included and we want you to know what they are. The price of the tester is based upon not furnishing them. Also, to avoid breakage in shipment. See following pages for details. NOTE: Pages 1 to 13 inclusive, together with Dwg. 289W1, 325W apply to 530 tester. Pages 1 to 20 inclusive together with Dwg. 289W1, 325W, 310W2 apply to 510X testers.

CIRCUITS USED IN THIS TESTER ARE COVERED BY PATENTS.
ALL INFRINGEMENTS WILL BE PROSECUTED.

INSTRUCTIONS FOR OPERATION OF MODELS 530 - 510X

STANDARD LABORATORY TYPE DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER.

WITH VOLTS,OHMS,CAPACITY,MILLIAMPERES,DECIBELS & INDUCTANCE MEASUREMENTS

Read these instructions through before attempting to operate tester.

1. There are two rectifier tubes, an 83 and a 5W4, necessary to operate this tester. They are not included and we want you to know what they are. The price of the tester is based upon not furnishing them. Also, to avoid breakage in shipment. See paragraph 3 below.

2. Use on 60 cycles 110-125 volt circuit. 25 or 50 cycles supplied on special order at extra cost.

3. To install the No. 83 and No. 5W4 tubes proceed as follows:

   (a) Remove Control Panel from Cabinet.

   (b) Insert a new 5W4 tube in the 8 pin socket on sub-panel inside the tester.

   (c) Insert a new 83 tube in the 4 pin sockot on sub-panel.

   (d) Turn on power. If meter vibrates and fuse lamp lights up brilliantly a defective No. 83 tube is indicated. This is caused by an excess of mercury within the glass bulb. Select an 83 tube that will not flash.

   (e) Replace screws in panel and instrument is ready for use.

4. FUNCTIONS OF THE VARIOUS CONTROLS:

   (a) The Selectors "A" and "B" control the socket contacts. Plate, Grid, Cathode, etc., are led to any combination of socket contacts as required. These switches are fully wired but only slightly more than one-third of the available combinations are used with tubes announced. The master switch (see page 14) must be set on TUBE TEST when instrument is used as a tube tester.

   (b) The Center switch in the top row controls the filament voltage. The 530 and 510X testers are now equipped to test tubes with filament voltages up to 117 volts.

(c) The Potentiometer "L" controls the sensitivity of this meter. When set at 60 (Gm) the scale is read in micromhos from 0-3000. When set at 71 the micromho scale reads from 0-6000. When set at 77 the micromho scale reads 0-15,000. The other settings for the left potentiometer as given in the chart after each type of tube are used when it is required that a good tube read in the green sector of the meter. This Red-Green scale is the so-called English Reading Scale. This scale is used when testing tubes for customers who know nothing about micromhos. As an example, a No. 24 tube when the left potentiometer is set at 60, should read 1000 micromhos, but when the left potentiometer is moved to 42, as gi en in the chart under "L" settings, the meter should read in the green sector. In either case, the reading is dynamic mutual conductance. These "L" settings for the various types of tubes are chosen so that a power tube will be rejected when it is down 25%, and an amplifier tube when it is down 20% below standard. (Manufacturers Specifications). This dual scale feature is found only in Hickok instruments.

(d) The Potentiometer "R" controls the "C" bias on the tube. Different tubes are operated at different values of "C" bias. A change in "C" bias causes a change in mutual conductance. The "R" settings as given in the chart are correct for each type of tube and are the same whether using the micromho or English Reading scales.

(e) The Short Test-Tube Test Switch enables checks for shorts to be made before making the regular tube test. Turn the switch through the positions 1-2-3-4-5 while watching the neon short lamp. If the lamp burns continuously in anyone of these positions the tube contains a "SHORT". An instantaneous flash as the switch is moved from one position to another is to be disregarded. That is caused by the charging of a condenser in the circuit. Intermittent shorts can be detected by tapping the tube with the finger. If tube is found to be free from shorts turn switch to Tube Test position for regular tube test. See Noise Test.

(f) The Short Lamp is a 1/4 watt, 110 volt, candelabra base neon signal lamp made by The General Electric Company. This lamp will last indefinitely unless broken.

(g) 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.

(h) Line Adjustment. This control is a rheostat in primary circuit of the transformer. Set master switch at bottom of panel on TUBE TEST. Press Line Test button and adjust knob until pointer of meter is exactly over the mark "LINE TEST" on the dial. Make this adjustment while the tube being tested is in the socket.

(i) The ON-OFF switch is for turning power on or off.

(j) There are two push buttons marked "Rectifier Test." The one marked "ST'D" (standard) is for all standard filament or heater type rectifier tubes. The button marked 0Z4 is used when testing the gaseous rectifiers 0Z3 and 0Z4 made by Raytheon. Rectifier tubes should read in the green sector if satisfactory. Separate tests are made for each plate.

(k) In the center of the panel are two push buttons marked "GAS TEST" and "AMPL.TEST". The button "AMPL.TEST" is used when testing all tubes having mutual conductance, that is, all amplifier tubes. This includes all kinds of amplifying tubes and power tubes, but is not to be used when testing Rectifier or Diode tubes. On the chart under "Notations" will be noted the injunction "Press Rect. Button" or "Press Diode Button" after certain tubes. Where no specific instruction is given, the AMPL Button is to be used. Some tubes contain both an amplifying and a rectifying element or amplifying and diode elements. These tubes, such as the 6B6 and 12A7 are listed for each element that is being tested.

(l) GAS TEST. A tube can be checked for gas content as follows:

Set the "L" Potentiometer on 60 (Gm) and hold down button marked "GAS NO. 1". Adjust "R" potentiometer until meter reads 100 micromhos. Hold down "GAS NO. 1" and press "GAS NO.2" If the meter hand moves more than ONE of the small divisions the tube contains too much gas.

Some tubes such as the #5 and 71A cannot be brought down to 100 micromhos by turning the "R" knob. In that case, turn "R" to 82 and test for gas.

Some tubes develop gas after being heated for a period of time. If a tube is suspected, allow it to heat for a few minutes.

(m) The Line Test Button has been described under par. 4 (h).

(n) Diode Test. The Diode Test Button is to be pressed when testing a diode element of a tube. This places a low voltage on the element as recommended by tube manufacturers. Do NOT Press AMPL. OR RECT. buttons when testing a diode element as the high voltage applied will paralyze the diode element.

5. As an example, suppose we are testing the 6B6 tube which contains an amplifying element and two diode elements.

(a) First, of course, we check for shorts.

(b) Assuming tube contains no shorts, we check next the amplifying element. Consulting the chart we find the following settings for the amplifying section: A, 7----B, 5----Fil., 6.3----L, 32----R, 10. As this is the amplifier section we press AMPL. button. The pointer rises in the green sector say slightly above the G in Good. We now wish to know the actual micromhos of this tube. We turn the "L" knob to 60 (Gm) and note that the meter reads 800 micromhos. As this agrees with the value given in the chart we know that the tube is normal as to the amplifier section. We next check No. 1 diode. From the chart we note that the settings are A, 10----B, 5----Fil., 6.3----L, 0----R, 0. We note that chart states Press Diode Button. If the pointer of the meter rises above the mark designated "Diodes OK" the No. 1 diode element is OK. No. 2 element is tested in the same manner, merely change "B" from 5 to 2.

YNAMIC MUTUAL CONDUCTANCE-WHAT IT IS-WHY IT IS THE ONLY EXACT TEST.

. Conductance is the opposite of resistance. The greater the conductance of a tube, the easier it is for electrons to flow thru it. Mutual means pertaining to both of two things. The two things considered when measuring mutual conductance are the grid and the plate of the tube. The plate will pass current but its value will depend on the grid voltage as well as plate voltage. Therefore, the conductance of the tube depends on both the plate and the grid voltages. It is Mutual Conductance. Dynamic pertains to motion. In measuring Dynamic Mutual Conductance the tube must be working. To simply take an emission reading is meaningless, because the tube is not working. Likewise, to take a reading, then shift the grid and take another reading is simply finding the difference between two static readings. That is not Dynamic Mutual Conductance. In the 510X and 530 tube testers there is applied to the grid, in addition to its regular direct current "C" bias, an alternating signal voltage which modulates the plate current. The meter measures the amount of modulation or dynamic mutual conductance.

Due to the success of the Hickok line of Dynamic Mutual Conductance Tube Testers, some of our competitors are attempting to mislead the public by calling their product "Dynamic Mutual Conductance" testers. Do not be fooled - unless the tester reads in <u>actual micromhos</u> it is <u>not</u> a dynamic mutual conductance tester.

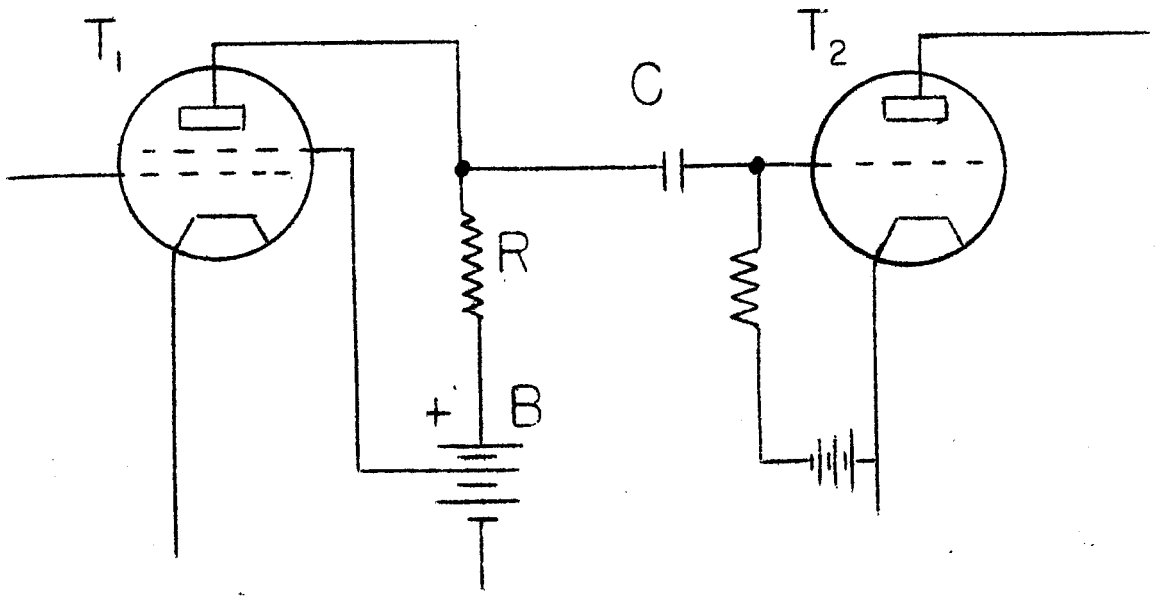
The three principal characteristics of a vacuum tube are amplification factor, plate resistance and mutual conductance. To measure the amplification factor or plate resistance alone will not give a measure of the value of the tubes as an amplifier, but mutual conductance is tied in such a way with amplification factor and plate resistance that mutual conductance is the quotient of amplification factor divided by plate resistance. In the form of an equation it will look like this:

$$Gm = \frac{Mu}{r_p}$$

WHERE: Gm is mutual conductance.
Mu is amplification factor.
r_p is plate resistance.

It is thus seen that when we measure mutual conductance we automatically measure both the other two characteristics. So mutual conductance is a 3 in 1 measurement. That is why it is considered of first importance by tube engineers and manufacturers.

The following simple illustrations will make clear the value of the mutual conductance test, and the fallacy of the emission test.



The above figure represents a conventional stage of resistance coupling. The gain for this stage is the product of the resistance, R, multiplied by the Mutual Conductance in mhos of the tube T_1. Suppose R is 100,000 ohms and the mutual conductance of T_1 is 750 micromhos, then:

100,000 x .00075 = 75. which is the gain. If the mutual conductance were 700 micromhos, the gain would be 70. etc. There is no correlation between emission and gain.

Likewise, in an r.f. transformer coupled stage the voltage amplification or voltage gain is express:

$$\text{Gain} = \frac{r_p \times R_p}{r_p + R_p}$$ Multiplied by the mutual conductance of T_1

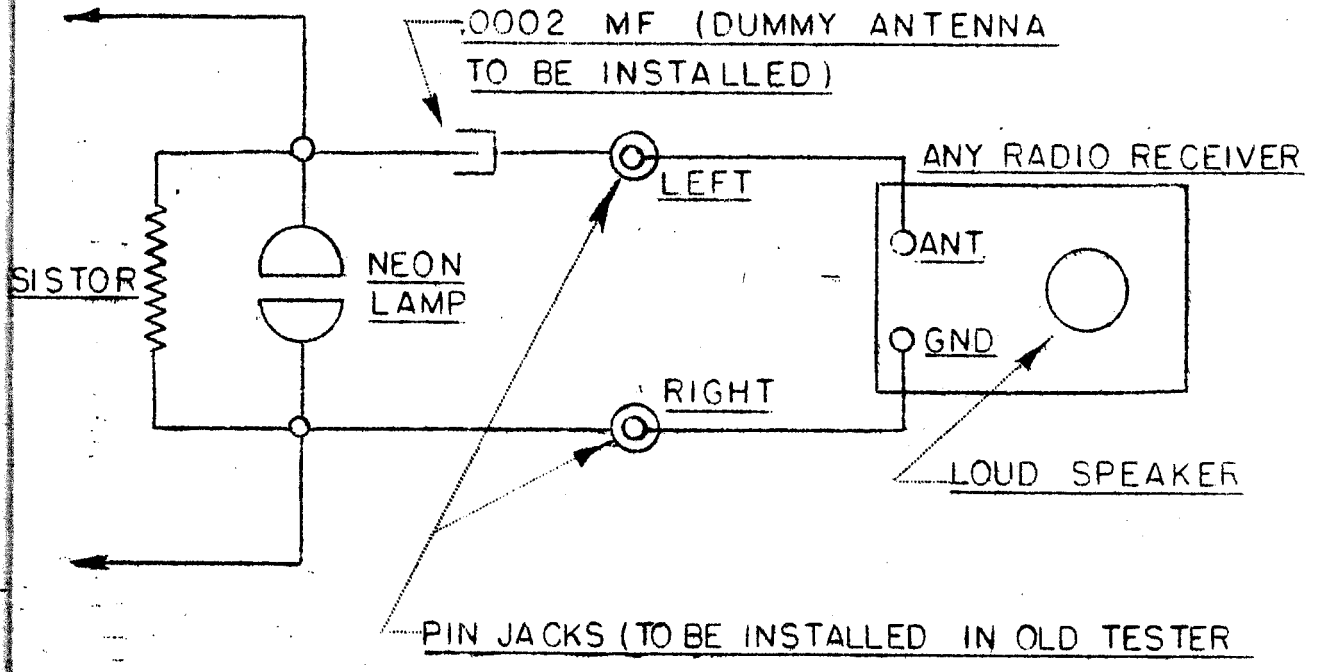
WHERE: r_p is the plate resistance of T_1 and R_p is the load resistance.

NOISE TEST

That you may demonstrate in a very convincing way the effects of a noisy tube in a radio receiver, we have incorporated in the circuit of the 510X and 530 a simple but effective noise test.

The following diagram which explains its operation also shows you how this test may, in a few minutes time, be installed in any of our previous models of tube testers which have the neon short test.

In the 510X and 530 testers, the pin jack to the LEFT is to be connected to ANT. post of radio receiver.



HOW THE NOISE TEST OPERATES.

As the Short Test switch on the tube tester is rotated through the points 1-2-3-4-5, tap the tube under test with the fingers. Any loose or jangling elements will cause loud crashes of static in the loud speaker. Sixty cycle hum cannot get through the R.F. stages of the radio receiver.

X

LOCATING SHORTED ELEMENTS: In the following table, X under any selector switch position indicates that Neon Lamp burns in that position.

	SELECTOR SWITCH POSITION				
KIND OF SHORT	1	2	3	4	5
FIL. - CATHODE				X	X
FIL. - GRID			X	X	X
FIL. - PLATE	X	X	X		
FIL. - SCREEN		X	X	X	X
CATHODE - GRID			X		
GRID - PLATE	X	X		X	X
GRID - SCREEN		X			
PLATE - SCREEN	X			X	X
CAP - FIL.	X	X	X	X	
CAP - GRID	X	X			X
CAP - CATHODE	X	X	X		X
CAP - SCREEN	X				X
CAP - PLATE				X	
SHELL - FIL.	X				
SHELL - PLATE		X	X		
SHELL - GRID	X		X	X	X
SHELL - SCREEN	X	X	X	X	X
SHELL - CATHODE	X			X	X
SHELL - CAP.		X	X	X	

BALLAST TUBES

STRUCTIONS FOR TESTING "BALLAST TUBES" ON THE 530 and 510X TESTERS.

In the following chart of settings, an "X" under any "Short Switch" position indicates that neon lamp will light in that position with Selectors A and B set as shown following the tube bype number.

Certain ballast tubes having complicated internal connections, such as the K36H, have three selector settings for complete test.

Noisy ballast tubes are detected by using the Noise Test, same as for other tubes. Tap tube with fingers while making test.

NOTE; ALWAYS SET FILAMENT SWITCH ON"BLST" POSITION. SHORT TEST SWITCH IS NOT TURNED TO TUBE TEST POSITION.

BALLAST TUBES

TUBE TYPE	SELECTOR A	SELECTOR B	SHORT SWITCH POSITION 1	2	3	4	5
1A1-1B1-1C1-1E1-1F1-1G1-1J1-1K1-1L1-1N1-1P1-1Q1-1R1G-1S1G-1T1G-1U1G-1V1-1Y1-1Z1-2	1	1	X	X	X	X	
2UR224	3	1	X	X	X	X	X
2UR212	2	12	X	X	X	X	X
	3	2	X	X	X	X	X
3	1	1	X	X	X	X	
03G	1	1				X	X
4-5	1	1	X	X	X	X	
6-133	1	1				X	X
6-6AA	1	1	X	X	X	X	
7-8-9	1	1	X	X	X	X	
10A - 10AG	1	1				X	X
10AB	1	1	X	X	X	X	
K17B - M17C - BM17C	3	1	X	X	X	X	X
M17HG - M17H	4	4	X	X	X		X
	5	1	X	X	X		
	7	12	X	X	X	X	X
K23B-K23C-KX23B-KX30C	3	1	X	X	X	X	X
M30H	4	4	X	X	X		X
	5	1	X	X	X		
	7	12	X	X	X	X	X
30A - K30A	1	1				X	X
K30D	3	1	X	X	X	X	X
	3	12	X	X	X	X	X
33A-33AG	1	1				X	X
K34B	3	1	X	X	X	X	X
36A	1	1				X	X
K36B-BK36B-L36B-M36C-BM-36C-L36C-KX36C	3	1	X	X	X	X	X
KX36A	1	1	X	X	X	X	
36D-L36D	3	1	X	X	X	X	X
	3	12	X	X	X	X	X

BALLAST TUBES (cont.)

TUBE TYPE	SELECTOR A	SELECTOR B	SHORT SWITCH POSITION 1	2	3	4	5
L36DJ	4	2	X	X	X	X	X
	7	5	X	X	X	X	X
	8	12	X	X	X	X	X
K36H-M36H-M36HG	4	4	X	X	X		X
	5	1	X	X	X		
	7	12	X	X	X	X	X
L40S1 - L4CS2	2	1	X	X	X	X	X
	3	12	X	X	X	X	X
	4	4	X	X	X	X	X
42A	1	1				X	X
42A1	1	1				X	
42A2 - 42B2	7	1	X	X	X	X	X
K42B-L42B-M42B-KX42B-LX42B - L42BX-K42C-L42C-M42C	3	1	X	X	X	X	X
BK42D-K42D-L42D	3	1	X	X	X	X	X
	3	12	X	X	X	X	X
LX42D - L42DX	1	2	X	X	X	X	X
	1	7	X	X	X	X	X
K42E - L42E	3	1	X	X	X	X	X
L42F	1	2	X	X	X		X
42HA-K42HJ-M42H-M42HG	4	4	X	X	X		X
	5	1	X	X	X		
	7	12	X	X	X	X	X
KX42C	3	1	X	X	X	X	X
L42S1	2	1	X	X	X	X	X
	3	12	X	X	X	X	X
	4	4	X	X	X	X	X
49A - 49AJ - K49AJ	1	1				X	X
KX49A	3	1	X	X	X	X	X
49A1	1	1				X	
49A2 - 49B2	7	1	X	X	X	X	X
K49B - L49B - M49B - BM49B - K49C - L49C - M49C - BM49C - BK49C - K49E - L49E	3	1	X	X	X	X	X
K49D - BK49D - L49D	3	1	X	X	X	X	X
	3	12	X	X	X	X	X
L49F	1	2	X	X	X		X
M49H - M49HG	4	4	X	X	X		X
	5	1	X	X	X		
	7	12	X	X	X	X	X
KZ49B - KZ49C	1	1	X	X	X	X	X

BALLAST TUBES (cont.)

TUBE TYPE	SELECTOR A	SELECTOR B	SHORT SWITCH POSITION 1	2	3	4	5
K49BJ - L49BJ	7	1	X	X	X	X	X
	8	12	X	X	X	X	X
L49S2	2	1	X	X	X	X	X
	3	12	X	X	X	X	X
	4	4	X	X	X	X	X
49AJ - K49AJ	1	1	X	X	X	X	X
KX49B - LX49B - LX49C	3	1	X	X	X	X	X
L49DJ	4	2	X	X	X	X	X
	7	5	X	X	X	X	X
	8	12	X	X	X	X	X
L49S3	2	1	X	X	X	X	X
	3	12	X	X	X	X	X
	4	4	X	X	X	X	X
50A2	3	1	X	X	X	X	X
50A2MG - 50B2	1	1	X	X	X	X	X
50X3	1	1	X	X	X	X	
K52H - M52H	4	4	X	X	X		X
	5	1	X	X	X		
	7	12	X	X	X	X	X
K54B	3	1	X	X	X	X	X
55A - K55A	1	1				X	X
55A1	1	1				X	
KX55A	1	1	X	X	X	X	
55B-K55B-M55B-BM-55B-L55BG-LX55B	3	1	X	X	X	X	X
55A2 - 55B2	7	1	X	X	X	X	X
K55C - L55C - KX55C	3	1	X	X	X	X	X
K55CP	4	12		X	X	X	X
	1	11	X	X	X	X	X
	1	9	X	X	X	X	X
K55D - L55D	3	1	X	X	X	X	X
	3	12	x	x	x	x	x
L55E - M55E	3	1	X	X	X	X	X
L55F - M55F - BL55F	1	2	X	X	X		X
K55H - M55H - M55HG	4	4	X	X	X		X
	5	1	X	X	X		
	7	12	X	X	X	X	X
L55S1 - L55S2	2	1	X	X	X	X	X
	3	12	X	X	X	X	X
	4	4	X	X	X	X	X
60R30G	3	1	X	X	X	X	X
64.23	1	1				X	
67A	1	1				X	

BALLAST TUBES (cont.)

TUBE TYPE	SELECTOR A	SELECTOR B	SHORT SWITCH POSITION 1	2	3	4	5
K67B - L67B	3	1	X	X	X	X	X
L73B - K74B - L74B - CX74C	3	1	X	X	X	X	X
80A	1	1				X	X
K79B - K80B - M80B - K80C - CX80B - L80B	3	1	X	X	X	X	X
K80F	1	2	X	X	X		X
CX87B - LX87B - L90B	3	1	X	X	X	X	X
K90F - M90F - K92F - M92F	1	2	X	X	X		X
92A	1	1				X	X
L92B - 95K2	3	1	X	X	X	X	X
L99D	3	1	X	X	X	X	X
	3	12	X	X	X	X	X
100R8	3	1	X	X	X	X	X
120R	1	1	X	X	X	X	
120R8 - 135K1	3	1	X	X	X	X	X
135K1A	7	1	X	X	X	X	X
	8	12	X	X	X	X	X
140L4-140L8-140R4-140R8	3	1	X	X	X	X	X
140R	1	1	X	X	X	X	
140L44 - 140R44	1	2	X	X	X	X	X
	1	7	X	X	X	X	X
165L4-165L8-165R4-165R8	3	1	X	X	X	X	X
165R	1	1	X	X	X	X	
165L44 - 165R44	1	2	X	X	X	X	X
	1	7	X	X	X	X	X
185L4 - 185L8 - 185R4 - 185R8	3	1	X	X	X	X	X
185R	1	1	X	X	X	X	
185L44 - 185R44	1	2	X	X	X	X	X
	1	7	X	X	X	X	X
200R - 250R	1	1	X	X	X	X	
250R8 - 290L4	3	1	X	X	X	X	X
300R4 - 320R4	3	1	X	X	X	X	X
340	1	1	X	X	X	X	
808-1	7	1	X	X	X	X	X
	8	12	X	X	X	X	X
E14980-W43357-W45788-3613	3	1	X	X	X	X	X
3334-3334A	3	1					
	3	12	X	X	X	X	X
8593-8598-8601-8664	3	1	X	X	X	X	X
3ER248	4	2	X	X	X	X	X
	7	5	X	X	X	X	X
	8	12	X	X	X	X	
3CR241	3	1	X	X	X	X	X
	3	12	X	X	X	X	

SUPPLEMENTARY CHART FOR

MODELS AC-51, AC51X, T-53, 530, 610 and 510X TUBE TESTERS.

TUBE TYPE	SELECTOR A	SELECTOR B	FIL. VOLTS	POTENTIOMETER L	POTENTIOMETER R	MUT. COND.	NOTATIONS
XXL	6	2	6.3	67	0	3000	AMPL. Left at 70½ for 6000 micromhos
XXD	12	5	12.6	64	0	2500	AMPL. Plt.No. 1 Short on 1-4-5
XXD	2	9	12.6	64	0	2500	AMPL. Plt. No. 2
6SR7	12	9	6.3	41	82	1000	Press DIODE BUTTON Triode Section.
6SR7	9	4	6.3	0	0	- - -	DIODE NO. 1
6SR7	9	9	6.3	0	0	- - -	DIODE NO. 2
6AD7G	8	5	6.3	60	24	2000	AMPL. Pent. Section.
6AD7G	5	5	6.3	60	64	325	DIODE Triode Section OK over 260
117N7GT	8	10	117.	75	25	7000	AMPL. Pent. Section.
117N7GT	4	3	117.	40	0	- - -	RECT. STD. Also press 117N7 Button
2050	8	5	6.3	40	*	- - -	RECT. STD.
2051	8	5	6.3	40	*	- - -	RECT. STD.
35Z5	1	3	BLST	40	0	- - -	MAKE SHORT TEST Short on 1-2-3-4-5

* Tube strikes at 32 on R pot.

VOLTS, OHMS, CAPACITY, MILLIAMPERES, DECIBELS AND INDUCTANCE.

1. When operating as a tube tester, the master switch in the lower right hand corner of the panel is set on TUBE TEST. The capacity switch is set on NORMAL at all times except when measuring capacity.

The analyzer section of the 510X is entirely independent of the tube test section but employs the same indicating meter. The rectifying elements used in this tester when measuring A.C. voltages are type 6H6 diodes instead of the usual copper oxide rectifiers. In the tube test position of the master switch, the heaters of the diodes are not connected. On ohms and volts, the heaters of the diodes are connected in circuit. It requires approximately 10 seconds for the diodes to reach normal operating temperature. An entirely new patented circuit is employed in the analyzer section of the 510X which avoids the disadvantages of the copper oxide rectifiers, at the same time securing a linear scale for A.C. volts.

2. The lower center of the tube tester panel there are three rows of pin jacks. The top row is used in measuring D.C. volts. The middle row is used in measuring A.C. volts and the bottom row in measuring ohms and milliamperes.

VOLTS D.C.

3. Set the master switch on volts D.C. The pin jack in the top row at the left is negative. The ranges secured are 9-20, 0-200, 0-500 and 0-1000 volts. The pin jacks numbered 200, 500 and 1000 are common to both D.C. and A.C. volts. The meter resistance is 1000 ohms per volt on both D.C. and A.C. ranges.

VOLTS A.C.

4. Power must be turned on for A.C. volts in order to heat the 6H6 diode tubes. Set capacity switch on NORMAL. The pinjack to the left of the middle row marked plus-minus is the common terminal. When using the 20 volt range, the master switch is set on volts A.C. 20. Ten seconds must be allowed for the diode tubes to heat. When using the A.C. voltage range 200 or higher, the master switch is set on volts A.C.200 - 500 - 1000.

OHMS.

5. Ohms are measured in three overlapping ranges, the center scale readings of which are respectively 30, 300 and 30,000 ohms. The scale on the meter is read directly when the master switch is set on ohms X1 and the connecting leads are placed in the corresponding pin jacks. To measure lower resistance, move connector lead from pin jack marked X1 to the pin jack ÷ 10. Then the center scale reading is 30 ohms. In this position, resistance as low as 1/10 ohm can be estimated. The third range on the ohmmeter multiplies the scale by 100. In this range, the center reading of the scale is 30,000 ohms. The connecting leads are placed in the corresponding pinjacks. In this position, resistances as high as 5 megohms can be measured. 5 megohms is the mark on the meter scale midway between 20,000 and INF. To operate, throw the master switch to the range desired. The pointer of the meter will move to the end of the "Ohms" scale marked infinity (INF.) By means of the "Line Adjustment" knob bring the pointer exactly over the "INF" mark. Resistance is then determined by connecting the flexible lead wires to the resistor being measured and noting the readigg of the meter on the ohms scale.

TO CHECK LEAKAGE OF ELECTROLYTIC CONDENSERS.

6. Set the master switch on ohms X100. Adjust meter to "INF." Place the connecting leads in the pinjacks marked Ohms 0 and X100. The pinjack marked 0 is to be connected to the negative terminal of the electrolytic condenser, the X100 jack to the positive terminal. When connection is made to the electrolytic condenser, the pointer of the meter will drop back about half scale then gradually rise to about 2 megohms if the condenser leakage is normal. If condenser is OK for leakage, check for capacity as explained in the following paragraph. NOTE: Many servicemen consider that a leakage of 1 megohm is satisfactory.

CAPACITY

7. (1) Set the master switch on the "Ohms X100" and adjust meter to "INF."
   (2) Throw master switch to volts A.C. 20-CAP.
   (3) Place the connecting leads in pin jacks marked "capacity"
   (4) The capacity scale on the meter is numbered from 0 to 24 microfarads. For electrolytic condensers, set the capacity switch on Capacity X1. Capacity can then be read directly in microfarads on the scale of the meter. In checking smaller condensers, set the capacity switch on capacity ÷ 10. The scale reading is then, of course, divided by 10.

NOTE: Set Fil. Switch on "OFF" when checking capacity.

INDUCTANCE

8. In measuring the inductance of choke coils, place the connecting lead in the pinjacks marked "CAPACITY". Adjust to INF. as for capacity. Set the capacity switch on Capacity ÷ 10. Connect the ends of the leads to the terminals of the choke and read the capacity scale on the meter.

EXAMPLE: If the meter reads .4 microfarads, divide this into 7.04 which gives 17.6 henries. In like manner, when measuring chokes of any size divide the reading in microfarads into 7.04, which will give the result in henries.

If it is desired to measure the inductance of a choke coil with a D.C. component of current, connect a small dry battery in series with one of the connecting leads.

EXAMPLE: If the choke coil has a D.C. resistance of 300 ohms, connecting a 4-1/2 volt dry battery in series will allow 15 milliamperes of direct current to flow thru the coil.

Conversion table for Inductance Values.

CAPACITY READING M.F.	INDUCTANCE HENRIES.
.1	70.4
.2	35.2
.3	23.4
.4	17.6
.5	14.1
.6	11.7
.7	10.1
.8	8.8
.9	7.8
1.0	7.0

MILLIAMPERES D. C.

N MEASURING MILLIAMPERES,BE SURE TO TURN THE OFF-ON SWITCH TO "OFF" POSITION.

. To measure D.C. milliamperes, set the master switch on ohms ÷ 10 There are two scales available for D.C. milliamperes, namely, 0-20 and 0-200. To use the 0-20 scale, the pinjack marked "Ohms 0" is the negative terminal. The pin jack marked ohms ÷ 10 is the positive terminal. The capacity switch must, of course be set on Normal. Milliamperes are read on the voltmeter scale numbered 0-20. To use the 0-200 milliampere scale, the pin jack marked "Ohms 0" is negative and the pinjack marked "MA-200" is positive. Milliamperes in this case are read on the voltmeter scale numbered 0-200.

DECIBELS

0. The term decibel replaces the former transmission unit (T.U.) which was introduced by the American Tele & Tele. Company. as a measure of the smallest increment of power that the normal human ear could detect. Thus, if the power on a radio set is increased by the smallest amount that the ear can detect as being louder, the power has been increased by 1 decibel. This is represented by plus 1 decibel. Conversely, if the power is increased by the smallest amount, it is represented by -1 decibel. The term is thus seen to be purely relative and the point selected for comparison, zero decibels, can be any level of power. However, it has been agreed that zero decibels shall be represented by the power expanded by 1.73 volts across a resistance of 500 ohms, or 6 milliwatts. This voltage is the A.C. component, and must be measured by a meter that does not respond to direct current, if direct current is pressed. This is true of the 0-20 volts A.C. range of the 510X tester.

A good way, when aligning receivers is to:

(a) Disconnect the voice coil of the speaker.
(b) Connect the primary of a special radio transformer in parallel with the primary of the regular audio transformer.
(c) The secondary of the special transformer is connected across the 500 ohm resistor.
(d) The 0-20 volt A.C. range of the 510X is connected across the 500 ohm resistor.
(e) The special transformer should conform to the following formula.

$$T = \sqrt{\frac{R}{500}}$$

WHERE: T = turn ratio of transformer.
R = plate resistance of power tube.

(f) EXAMPLE 1: Power tube is single #45. then R is 2000.

$$T = \sqrt{\frac{2000}{500}} = 2.$$ Therefore

If primary contained 3000 turns, the secondary would contain 1500 turns.

(g) EXAMPLE 2: power tubes are two #45's in push pull, then R is 4000. $T = \frac{4000}{500} = 2.83$

CONVERSION TABLE FOR DECIBELS

DECIBELS	VOLTS ACROSS 500 OHMS	RELATIVE LOUDNESS AT 400 CYCLES WITH SAME SIGNAL.
10	.55	48.
9	.61	51.
8	.69	54.
7	.77	58.
6	.87	63.
5	.97	67.
4	1.09	73.
3	1.23	79.
2	1.38	85.
-1	1.54	92.
0	1.73	100.
+1	1.94	108.
2	2.18	117.
3	2.45	128.
4	2.75	139.
5	3.08	150.
6	3.46	168.
7	3.88	186.
8	4.35	207.
9	4.88	230.
10	5.47	256.
11	6.12	285.
12	6.89	314.
13	7.74	351.
14	8.68	388.
15	9.74	432.
16	10.93	482.
17	12.26	535.
18	13.76	593.
19	15.44	658.
20	17.32	730.
21	19.43	805.

The sensitivity of the human ear varies with frequency, also with different sound levels. As an average, an increase of 24 decibels in power will produce a sound that appears to be 10 times as loud as the original sound.

11. TO CHECK HIGH RESISTANCE.

RESISTORS FROM 2 to 25 MEGOHMS MAY BE CHECKED AS FOLLOWS:

(a) Be sure that the resistor is not connected in parallel with another resistor, condenser, etc.

(b) Make Line Test same as for tube testing.

(c) Set master switch on A.C. volts 200.

(d) Set Selector A on 1, Selector B on 6.

(e) Furnished with the 510X is a special cable for testing small condensers. One end of the cable is equipped with a plug. The black wire terminates in a pin tip. The red wire terminates in an alligator clip.

(f) Insert the plug in the 5 pin socket. Insert the pin tip in the plus-minus pin jack.

(g) Connect the alligator clip to one terminal of the resistor to be measured. Insert one of the voltmeter leads in the 200 V pin jack and hold the prod on the other terminal of the resistor to be measured.

(h) Press OZ4 button and note reading of the voltmeter on the 0-200 volt scale. The value of the resistor is found in the chart below:

RESISTANCE IN MEGOHMS	VOLTMETER READING ON 200 VOLT SCALE	RESISTANCE IN MEGOHMS	VOLTMETER READING ON 200 VOLT SCALE.
2.	28.	8.	7.5
2.5	22.	9.	6.5
3.	18.	10.	6.
4.	14.5	12.	5.
5.	12.	15.	3.5
6.	10.	20.	2.5
7.	8.5	25.	2.

HUM IN FILTER SYSTEM

12. Hum voltage in filter system can be measured as follows:

(a) Disconnect antenna and ground wires.
(b) Turn down volume control.
(c) Turn on power.
(d) Connect 0-20 volt A.C. range of 510X across plate and cathode of any socket in which it is desired to check hum.
(e) The meter reads ripple volts directly. Disregard swing of pointer as connection is first made. The 0-20 A.C. range does not respond to direct current.

13. TO CHECK SMALL CONDENSERS:

Condensers from .0001 to .05 M.F. may be checked as follows:

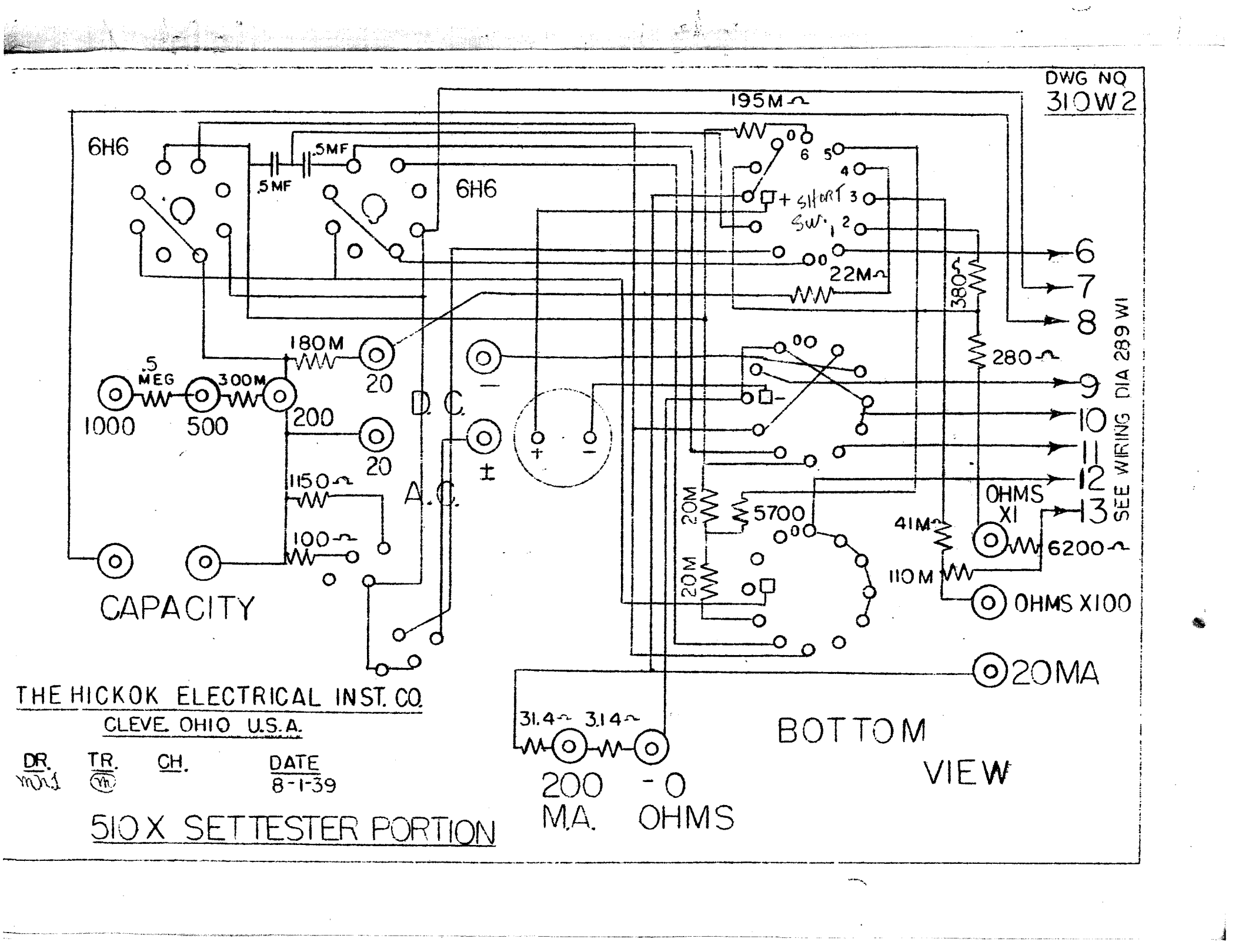
(a) Make Line Test same as for tube testing.
(b) Set master switch on A.C. volts 200.
(c) Set Selector A on 1, Selector B on 6.
(d) Furnished with the 510X is a special cable for testing small condensers. One end of this cable is equipped with a plug. The black wire terminates in a pin tip. The red wire terminates in an alligator clip.
(e) Insert the plug in the 5 pin socket. Insert the pin tip in the plus-minus pin jack.
(f) Connect the alligator clip to one terminal of the condenser to be measured. Insert one of the voltmeter leads in the 200 V. pin jack and hold the prod on the other terminal of the condenser.
(g) Press Rect. Std. Button and note reading of the voltmeter. The value of the condenser is found in the chart below. See note below.

CAPACITY IN M.F.	VOLTMETER READING ON 200 VOLT SCALE	CAPACITY IN M. F.	VOLTMETER READING ON 200 VOLT SCALE.
.0001	1.5 volts	.008	85. volts
.0002	3. "	.009	92. "
.00025	3.5 "	.01	99. "
.0005	7. "	.015	125. "
.001	13. "	.02	139. "
.002	25. "	.025	147. "
.003	37. "	.03	153. "
.004	49. "	.035	156. "
.005	59. "	.04	160. "
.006	70. "	.05	162. "
.007	79. "		

CONVERSION TABLE FOR CHECKING CAPACITY OF SMALL CONDENSERS ON 50 CYCLE AND 25 CYCLE MODELS ONLY.

(14).

CAPACITY IN M.F.	VOLTMETER READING ON 200 VOLT SCALE, 50 CY.	VOLTMETER READING ON 200 VOLT SCALE, 25 CY.
.0001	1.25	.6
.0002	3.4	1.7
.00025	5.	2.5
.0005	7.5	3.7
.001	10.	5.
.002	20.	10.
.003	28.	15.
.004	39.	20.
.005	48.	25.
.006	57.	30.
.007	66.	35.
.008	74.	40.
.009	81.	45.
.01	87.	49.
.02	130.	89.
.03	146.	114.
.04	157.	132.
.05	160.	142.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THE HICKOK ELECTRICAL INST. CO.
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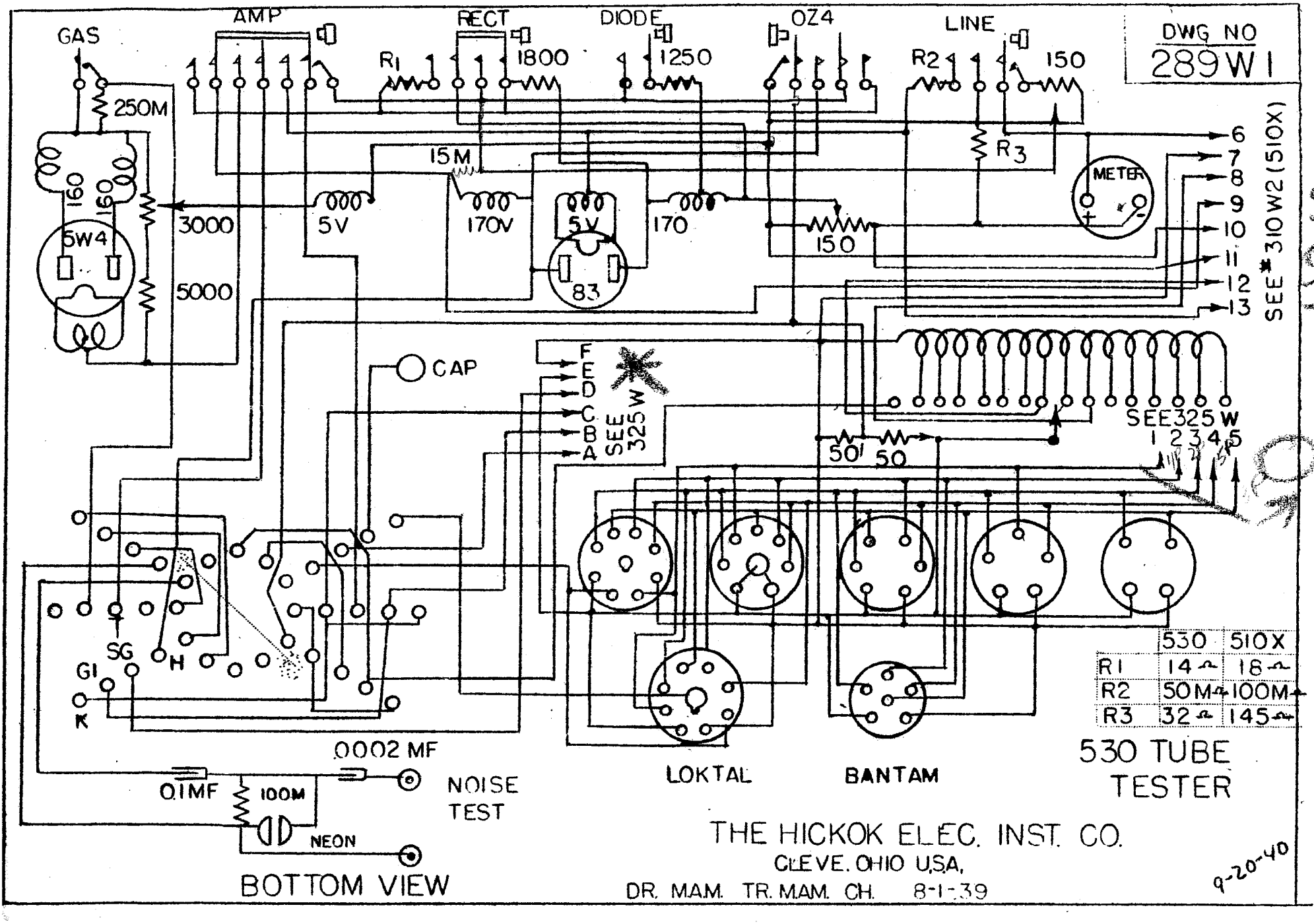
510X SETTESTER PORTION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BOTTOM VIEW
THE HICKOK ELEC. INST. CO.
CLEVE. OHIO U.S.A.
DR. M.A.M. TR. M.A.M. CH. 8-1-39
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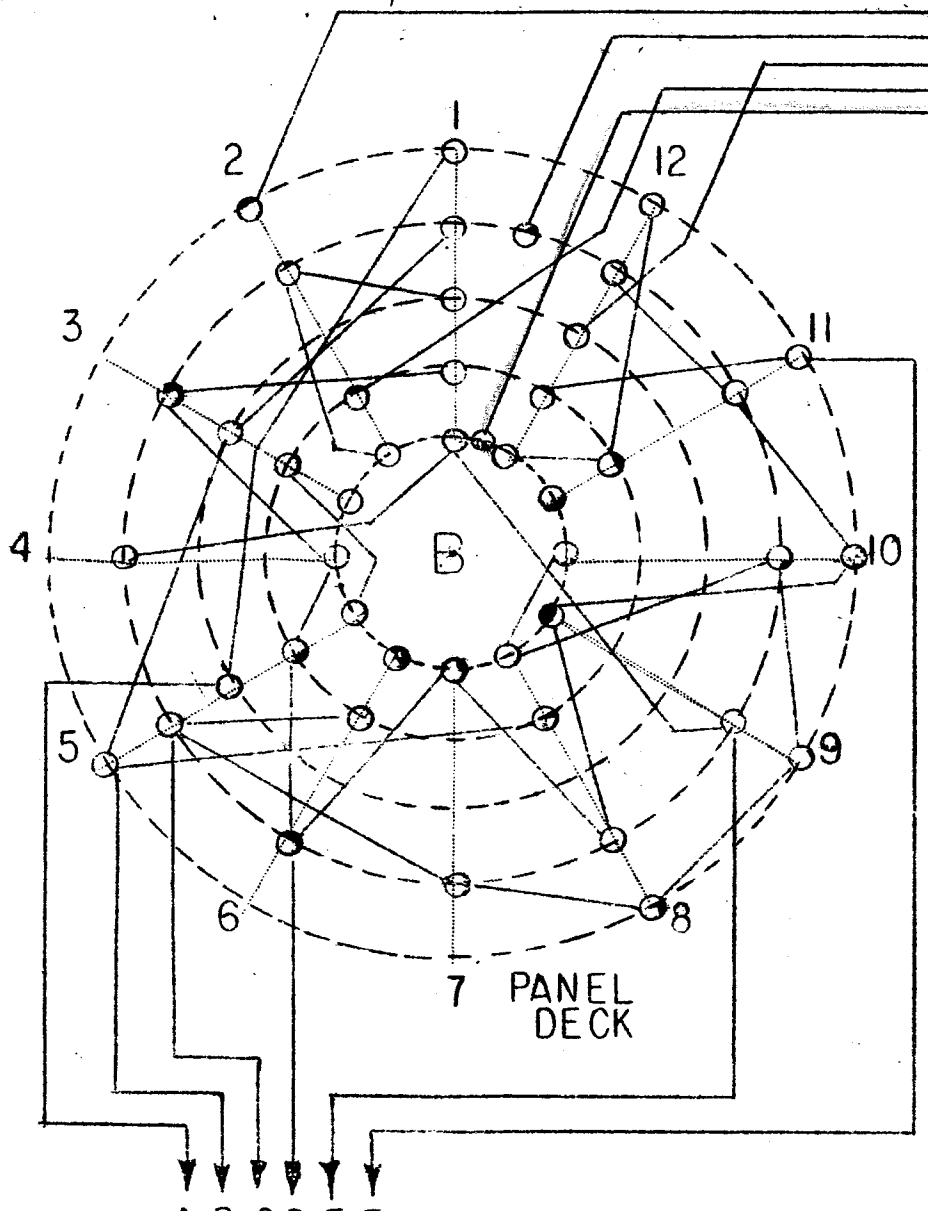

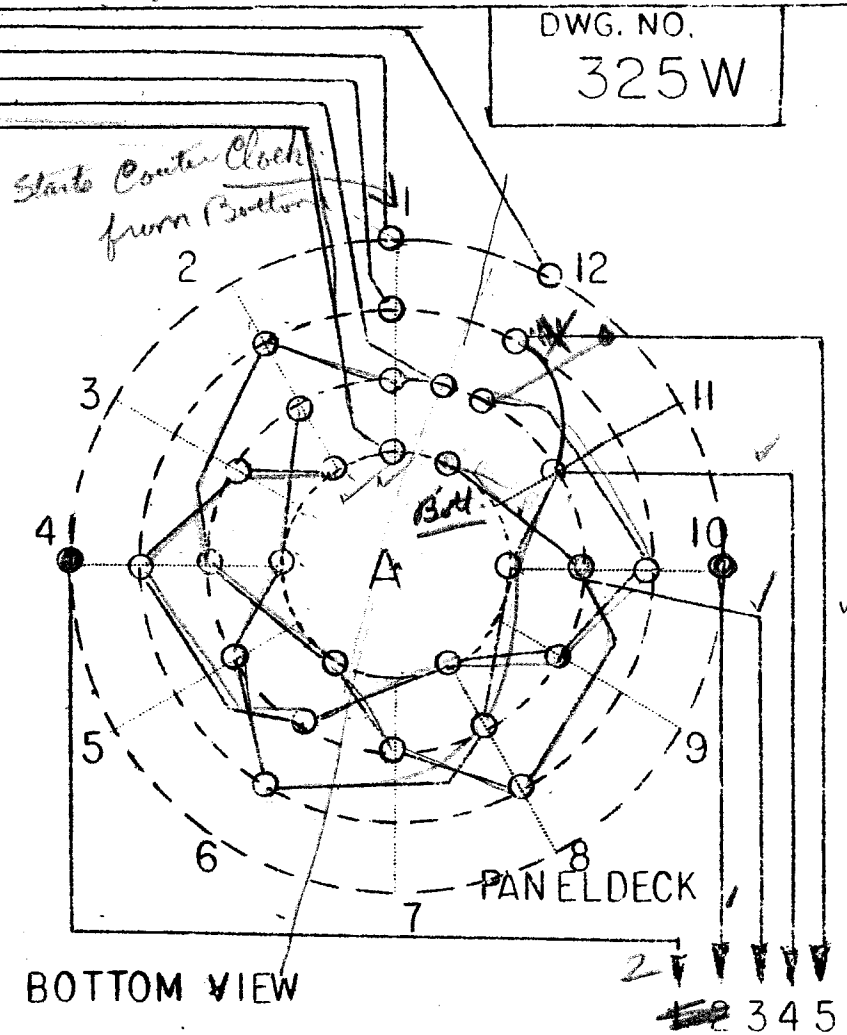

PERMUTATOR SWITCH

MODEL 530-510X

THE HICKOK ELECT INST CO
CLEVE. OHIO USA

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