HICKOK

OPERATING INSTRUCTIONS

for

DYNAMIC MUTUAL CONDUCTANCE MULTI-TESTER

MODEL 546

Hickok
Dynamic Mutual
Conductance Tester

Reads Directly In

MICROMHOS

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
10514 DUPONT AVENUE • CLEVELAND 8, OHIO

OPERATING INSTRUCTIONS

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10514 Dupont Avenue
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MODEL 546

The Instrument Packed Herewith is: _____

1. Model 546 Vacuum Tube Tester _____

Accessories included with the Model 546 Tester are:

1 -- Booklet Instructions for Model 546 _____

2 -- Leads with Prods _____

1 -- Capacity Lead Assembly _____

1 -- Grid Lead with Clip _____

1 --"Lighthouse" Grid Connector _____

1 -- Extra Lead with Clip _____

Serial Number _____

Signed: _____

INSTRUCTION FOR OPERATION OF MODEL 546.

Read These Instructions Through Before Attempting to Operate the Tester.

1. This instrument is designed to operate on 60 cycles 110-125 volt power source. It can be used on frequencies from 50 to 400 cycles, 110-120 volts.

2. There are two rectifier tubes, an 83 and a 5Y3GT, necessary to operate this tester. They are included. The fuse lamp is a standard #81 auto lamp. The neon lamp is a General Electric, 1/4 watt, 110 volt, candelabra base signal lamp.

3. LINE VOLTAGE ADJUSTMENT. - The ten point MASTER SWITCH in the upper right of the main panel must be set on the point TUBE TEST when the instrument is used as a tube tester. After the power is turned ON, press the push switch P7 which will cause the pointer of the meter to move up the scale. The button P7 is held down and the knob, LINE ADJUST, is turned until the meter pointer rests exactly over the mark, LINE TEST, at the center of the meter scale. This establishes standard voltages on the tube. Make final line adjustment after the tube being tested is placed in its socket.

4. SELECTORS. - The row of selector dials across the center of the control panel is for the purpose of conducting proper voltages to the tube's base pins. The operation of setting these dials is similar to dialing a telephone number. On the roll data chart, below the word SELECTORS, appear the dialing numbers. These dialing numbers consist of two letters and five figures. EXAMPLE: JR-6237-5. Starting at the left, the first dial (FIL) is turned until the letter J appears through the window. The second dial (FIL) is turned until R appears. The third dial (GRID) indicates 6. The fourth (PLATE), 2. The fifth (SCREEN), 3. The sixth (CATH), 7. and the seventh (SUP), 5. These dial switches are electrically interlocked so that it is impossible to connect two different voltages to the same tube pin. Thus accidental shorts are avoided.

The dialing system is designed to simplify dial setting. For example the filament setting is nearly always JR. These two dials seldom need resetting. Also in testing du-diode-triode tubes the amount of dialing has been reduced to a minimum.

5. SHORT TEST. - The SHORTS switch has six positions. The first five are used in testing the tube for shorts. The sixth position TUBE TEST is used when

indicating mutual conductance. Use the TUBE TEST Position only if the tube has no shorts.

Turning the SHORTS switch successively through the positions 1-2-3-4-5 connects the various elements in turn across the test voltage. Tubes having shorted elements will complete the circuit and cause the neon lamp to glow. Tubes may be tested for shorts either hot or cold. A short is indicated by a steady glow on both plates of the neon lamp. A momentary flash of the neon lamp as the shorts switch is turned from one position to another should be disregarded. This flashing is caused by the charging of a condenser in the short test circuit. A shorted tube should be discarded without further test. With tubes having more than one section such as the 6J6, make short test for each section.

Locating Shorted Elements. In the following table (X) under any SHORT switch position indicates that the neon lamp glows in that position.

KIND OF SHORT	1	2	3	4	5
FIL -- CATHODE			X		
FIL -- GRID	X	X			X
FIL -- PLATE	X	X		X	X
FIL -- SCREEN	X		X	X	X
FIL -- SUP		X			
GRID -- CATHODE	X	X	X		X
GRID -- PLATE				X	
GRID -- SCREEN		X	X	X	
GRID -- SUP	X				X
PLATE -- SCREEN		X	X		
PLATE -- SUP	X			X	X
SCREEN -- SUP	X	X	X	X	X

6. 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. MUTUAL CONDUCTANCE. - Tubes having SHORTS should be discarded without further tests.

If the tube passes the preliminary short test it is then tested for MUTUAL CONDUCTANCE which is the best test for amplifier tubes. Turn the SHORTS switch to TUBE TEST position. On the roller chart, reading from left to right, opposite the tube type appear: FIL.VOLTAGE; SELECTORS, which were explained in paragraph (4) above; BIAS, which gives the setting for the BIAS dial; ENG, which gives the setting for the ENGLISH dial; PRESS, which indicates the push button to be pressed for meter reading; MUT. COND. which gives the AVERAGE MUTUAL CONDUCTANCE in MICROMHOS of the tube being tested. Under the heading NOTATIONS appear special notes pertaining to the testing of the tube.

The ENGLISH setting is used when it is desired to read the value of the tube on the RED-GREEN (ENGLISH) sector of the meter scale. When using the ENGLISH scale the MICROMHO readings are disregarded.

NOTE

Tubes having less than 500 Micromhos cannot be made to read in the GREEN sector of the meter scale. Such tubes list micromho reading only and are good if the reading is above a specified minimum.

Micromhos are indicated in four ranges;

a. 1000 with normal signal.

b. 10,000 with normal signal.

c. 5000 with low signal.

d. 10,000 with low signal.

e. Signal voltages are available in two values; NORMAL 5 volts and LOW 1 volt.

f. Signal voltage is controlled by the toggle switch at the left edge of the control panel marked SIG. NORM-LOW. Normal signal is used unless the notation "LOW SIG" appears on the data chart under the heading ENG as for example the 6AK5 tube. At all other times use normal signal.

g. Low signal is used with certain tubes having low bias and sharp cutoff to prevent the grid from swinging from positive to cutoff. This results in a more accurate test.

NOTE

When using LOW SIGNAL the readings are in micromhos only. The RED-GREEN scale is not used.

MICROMHOS RANGES.

h. With NORMAL signal and with the ENGLISH dial set at 93 against the stop, micromhos are read on the 0-10,000 meter scale.

i. With normal signal and with the ENGLISH dial set at 26, micromhos are read on the 0-1000 meter scale.

j. With low signal and with the ENGLISH dial set at 26, micromhos are read on the 0-5000 scale.

k. With low signal and with the ENGLISH dial set at 64, micromhos are read on the 0-10,000 meter scale.

l. When reading micromhos the RED and GREEN sectors of the meter scale are disregarded.

m. When testing for mutual conductance the push switch P4--Gm is pressed. Gm is the symbol for mutual conductance.

CAUTION: Do not press P4 when testing rectifier tubes.

n. Tubes having more than one section, such as the 6J6, require different dial settings for each section.

8. **RECTIFIER TUBE TEST.** - Rectifier tubes, including diode tubes and diode sections of multiple element tubes, having no mutual conductance are tested for emission only.

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 pointer of the meter to move above the point marked DIODES O.K.

b. The push switch P2 is used when testing cold cathode rectifiers such as the 0Z4. This applies a voltage sufficiently high to ionize the tube and start conduction. Good tubes will read in the green (GOOD) sector of the meter scale.

c. The push switch P3 is used when testing ordinary rectifier tubes, such as the 5Y3. This applies a medium voltage which is best adapted to reveal defects in this type of tube. Good tubes will read in the green (GOOD) sector of the meter scale.

NOTE

On the data chart a star (★) following P1, P2 and P3 indicates that the ENGLISH setting only is used.

9. **GAS TEST.** - The push switches P5 and P6 are used to test an amplifier tube for gas content.

a. Set the English dial at 78.

b. The push switch P5 is pressed and held down while the BIAS dial is turned to cause the pointer of the meter to indicate 100 micromhos on the 0-1000 scale.

c. Hold down P5 and press P6.

d. If the tube contains gas the pointer of the meter will move UP the scale. If the pointer movement is not more than one division of the scale the gas content is satisfactory.

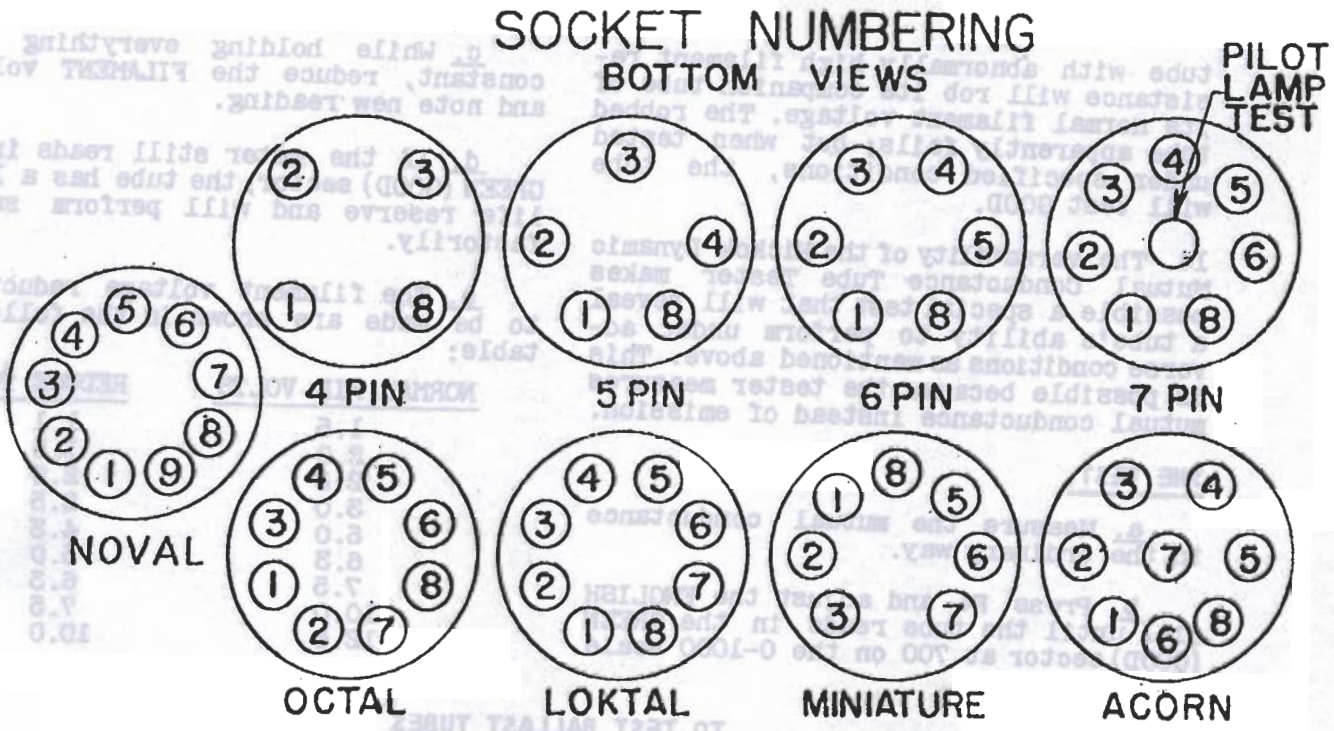
NOTE

With some tubes, such as the type 45, the micromho reading cannot be brought down to 100 by turning the BIAS dial. In such case turn the BIAS dial to 100 and test for gas.

e. 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.

10. **METER REVERSE.** - Directly below the indicating meter is a switch marked REVERSE-NORMAL. With certain tubes, such as the 117N7, the meter when this switch is 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 of the meter to move up the scale. After the test has been made return the switch to NORMAL.

11. **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 GRID jack and P that it is connected to the PLATE jack.

12. SOCKET NUMBERING. - In order to reduce dialing to a minimum the socket contacts are numbered as shown on Plate 1 which shows the bottom views. The numerical values of the lettered dials are as follows:

0	A	P
1	B	R
2	C	S
3	D	T
4	E	U
5	F	V
6	G	W
7	H	X
8	J	Y
9	K	Z

The letter I was omitted because of its resemblance to the figure 1. The letter Q was omitted because of its resemblance to the figure 0.

NOTE

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

13. SPECIAL NOTES. - Power line voltage varies with different localities. It may also vary with different hours of the day.

While a national survey indicates that the average voltage for the USA is about 115 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.

14. The versatility of the Hickok Dynamic Mutual Conductance Tube Tester makes possible a special test that will reveal a tube's ability to perform under adverse conditions as mentioned above. This is possible because the tester measures mutual conductance instead of emission.

THE TEST.

a. Measure the mutual conductance in the ordinary way.

b. Press P4 and adjust the ENGLISH dial until the tube reads in the GREEN (GOOD) sector at 700 on the 0-1000 scale.

c. While holding everything else constant, reduce the FILAMENT voltage and note new reading.

d. If the meter still reads in the GREEN (GOOD) sector, the tube has a large life reserve and will perform satisfactorily.

e. The filament voltage reductions to be made are shown in the following table:

NORMAL FIL. VOLTS	REDUCE TO
1.5	1.1
2.0	1.5
2.5	2.0
3.0	2.5
5.0	4.3
6.3	5.0
7.5	6.3
10.0	7.5
12.6	10.0

TO TEST BALLAST TUBES

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

TUBE TYPE	First Selector	Neon lamp should light in these positions.						
1A1-1B1-1C1-1E1-1F1-1G1-1J1-1K1-1L1-1N1-1P1-1Q1-1R1G-1S1G-1T1G-1U1G-1V1-1Y1-1Z1-2	J	R						
2UR224	J			T				X
2LR212	H	R	S		U			
3	J	R						
03G	J			T				
4-5	J	R						
6-133	J			T				
6-6AA	J	R						
7-8-9	J	R						
10A-10AG	J			T				

TUBE TYPE	First Selector	Neon lamp should light in these positions.						
10AB	J			T				X
K17B-M17C-BM17C	J			T				X
M17HG-M17H	J		S					X
	D	R						
K23B-K23C-KX23B-KX30C	J			T				X
M30H	J		S					X
	D	R						
30A-K30A	J			T				
K30D	J	R		T				X
33A-33AG	J			T				
K34B	J			T				X
36A	J			T				
K36B-BK36B-L36B-BM-L36C-KX36C	J			T				X
KX36A	J	R						
36D-L36D	J	R		T				X
L36DJ	J	R		T	U			X
K36H-M36H-M36HG	J		S					X
	D	R						
L40S1-L40S2	J	R		T		V		
42A	J			T				
42A1	H				U			
42A2-42B2	H		S		U			
K42B-L42B-M42B-KX42B-LX42B-L42BX-K42C-L42C-M42C	J			T				X
KB42D-K42D-L42D	J	R		T				X
LX42D-L42DX	J	R	S	T				
K42E-L42E	J			T				X
L42F	J							X
	D	R						
42HA-K42HJ-M42H-M42HG	J		S					X
	E	R		T				
KX42C	J			T				X

TUBE TYPE	First Selector	Neon lamp should light in these positions.						
L42S1	J	R		T		V		
49A-49AJ-K49AJ	J			T				
KX49A	J			T				X
49A1	H				U			
49A2-49B2	H		S		U			
K49B-L49B-M49B-BM49B-K49C-M49C-BM49C-BK49C-K49E-L49E	J			T				X
K49D-BK49D-L49D	J			T				X
L49F	J							X
	D	R						
M49H-M49HG	J		S					X
	D	R						
KZ49B-KZ49C	J	R				V		
K49BJ-L49BJ	J			T	U			X
L49S2	J	R		T		V		
49AJ-K49AJ	J			T				
KX49B-LX49B-LX49C	J			T				X
L49DJ	J	R		T	U			X
L49S3	J	R		T		V		
50A2	J	R		T				
50A2MG-50B2	J	R				V		
50X3	J	R						
K52H-M52H	J		S					X
	D	R						
K54B	J			T				X
55A-K55A	J			T				
55A1	H				U			
KX55A	J	R						
55B-K55B-M55B-BM55B-L55BG-LX55B	J			T				X
55A2-55B2	H		S		U			
K55C-L55C-KX55C	J			T				X
K55CP	J			T		V		X

TUBE TYPE	First Selector	Neon lamp should light in these positions.						
K55D-L55D	J	R		T				X
L55E-M55E	J			T				X
L55F-M55F-BL55F	J							X
	D	R						
K55H-M55H-M55HG	J		S					X
	D	R						
L55S1-L55S2	J	R		T		V		X
60R30G	J	R		T				
64.23	J			T				
67A	J			T				
K67B-L67B	J			T				X
L73B-K74B-L74B-CX74C	J			T				X
80A	J			T				
K79B-K80B-M80B-K80C-KX80B-L80B	J			T				X
K80F	J							X
	D	R						
KX87B-LX87B-L90B	J			T				X
K90F-M90F-K92F-M92F	J							X
	D	R						
92A	J			T				
L92B-95K2	J			T				X
L99D	J	R		T				X
100R8	J			T				X
120R	J	R						
120RS-135K1	J			T				X
135K1A	J			T	U			X
140L4-140L8-140R4-140R8	J	R		T				
140R	J	R						
140L44-140R44	J	R	S	T				
165L4-165R4-165R8	J	R		T				
165R	J	R						
165L44-165R44	J	R	S	T				
185L4-185L8-185R4-185R8	J	R		T				
185R	J	R						
185L44-185R44	J	R	S	T				
200R-250R	J	R						
250R8-290L4	J			T				X
300R4-320R4	J			T				X
340	J	R						
808-1	J			T	U			X
E14980-W43357-W4588-3613	J			T				X
3334-3334A	J	R		T				X
8593-8598-8601-8664	J			T				X
3ER248	J	R		T	U			X
3CR241	J	R		T				X

VOLTS, OHMS, MILLIAMPERES, MICROFARADS.

15. The ten position MASTER SWITCH in the upper right of the main panel is used to select the range used in making measurements. It switches the indicating meter into different circuits. The meter has a sensitivity of 425 microamperes and an internal resistance of 970 ohms.

When used as a tube tester the MASTER SWITCH must be set on the point TUBE TEST.

16. The two jacks just above the meter are used when measuring VOLTS, OHMS, MILLIAMPERES or CAPACITY. The RED jack is positive when D. C. measurements are made.

17. The different scales on the meter dial are shown in distinctive colors. The points on the MASTER SWITCH are shown in corresponding colors. Thus OHMS are shown in ORANGE, VOLTS and MILS are shown in RED and CAPACITY is shown in GREEN. This makes it easy to select the meter scale to be read when making measurements.

18. VOLTS D. C. - When measuring volts the circuit has a sensitivity of 1000 ohms per volt.

a. Set the MASTER SWITCH to the appropriate range.

b. Set the slide switch at the left of the meter to D.C.

c. Insert the test leads into the jacks at the upper right hand corner of the main panel. The RED jack is POSITIVE.

19. VOLTS A. C. - The sensitivity is 1000 ohms per volt.

a. Set the MASTER SWITCH to the appropriate range the same as for D.C. volts.

b. Set the slide switch to A.C.

c. Insert the test leads into the jacks at the upper right hand corner of the main panel. In measuring A. C. the polarity does not matter.

20. OHMS. - Ohms are measured in two overlapping ranges, the center scale reading of which are respectively 100 and 100,000 ohms. No batteries are used. The power is obtained from a built in power supply. Therefore when measuring ohms the power must be turned on.

When the MASTER SWITCH is set on OHMS X1 the ohms scale reads direct. The center of the scale is 100 ohms and may be read from 1 ohm to 10,000 ohms.

When the MASTER SWITCH is set on OHMS X1000 the scale is multiplied by 1000. The center of the scale is 100,000 and may be read from 1000 ohms to 10 megohms.

TO OPERATE:

a. Set the MASTER SWITCH on the appropriate point. (OHMS X1 or OHMS X1000)

b. Plug the line cord of the tester into a 110 volt A. C. socket and turn the power ON.

c. The pointer of the meter will move to the top of the scale.

d. Turn the LINE ADJUST knob until the meter pointer rests exactly over the end of the scale marked INF. (infinity).

e. Insert the test leads in the two jacks, in the upper right hand corner of the panel, marked VOLTS, OHMS, MILS, CAP.

f. Touch the prods of the test leads to the terminals of the resistance to be measured. The meter pointer will indicate the resistance in ohms. The resistance being measured should not be shunted by other resistance, capacitance or inductance.

21. CAPACITY. - Capacity is measured in two ranges 0-5 and 0-50 microfarads. It is necessary to apply a standard voltage to the capacitor being measured therefore:

a. Turn the MASTER SWITCH to OHMS X1000 and turn LINE ADJUST knob to bring the meter pointer to the INF mark. This establishes standard voltage across the capacitor.

b. Turn the MASTER SWITCH to the appropriate point (5 MFD or 50 MFD).

c. Set the slide switch to CAP-A.C.

d. Insert the test leads in the two jacks marked VOLTS, OHMS, MILS, CAP

e. Touch the prods of the test leads to the terminals of the capacitor being measured. The pointer of the meter will indicate the value of the capacitance in microfarads. The capacitor being

measured should not be shunted by other capacitance, resistance or inductance.

f. The capacity scale is calibrated for use on 60 cycles.

TO CHECK SMALL CAPACITORS. - Capacitors from .0001 to .05 M. F. may be checked as follows:

a. Make Line Adjustment the same as for tube testing. See paragraph 3, page 1.

b. Set the master switch on Volts 200. Set slide switch to A.C.-CAP.

c. Set Selectors: JR-0204-0.

d. Furnished with the Model 546 MULTI-TESTER is a special cable. One end of this cable is equipped with a 5 pin 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 black pin jack.

f. Connect the alligator clip to one terminal of the capacitor to be measured. Insert one of the voltmeter leads in the red pin jack and hold the prod on the other terminal of the capacitor.

g. Press button marked P5 and note the reading of the voltmeter. The value of the capacitor is found in the table below.

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

22. MILLIAMPERES, D. C. - Milliamperes D. C. are measured in two ranges, 0-20 and 0-200.

a. Turn the power switch to OFF position.

b. Turn the MASTER SWITCH to the appropriate position.

c. Set the slide switch to D. C.

d. Connect the current being measured to the jacks marked VOLTS, OHMS, MILS, CAP.

e. The RED jack is positive.

23. INDUCTANCE. - In measuring inductance of choke coils make switch settings exactly as for measuring capacity. -

a. Set the MASTER SWITCH on CAP 5 MFD.

b. Connect the prods to the terminals of the choke being measured and read the microfarad scale of the meter.

c. Divide the reading in microfarads into 7.04 which will give the results in henries.

d. The following is a 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

24. DECIBELS.

a. The term "Decibel" is 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 expended by 1.73 volts across a resistance of 500 ohms, or 6 milliwatts.

A good way, when aligning receivers, is to:

b. Disconnect the voice coil of the speaker.

c. In parallel with the primary of the regular audio transformer connect an audio transformer with a multi-tapped secondary. The multi-tapped transformer should have about 3000 turns in the primary. The turn ratio of each tap should be known.

d. The ratio to be used can be determined from the following formula:

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

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

e. EXAMPLE 1 - Power tube is a single #45. Then R is 2000 ohms, and -

$$T = \sqrt{\frac{2000}{500}} = 2 = \text{turn ratio}$$

f. EXAMPLE 2 - Power tubes are two #45's in push pull. Then R is 4000 ohms, and

$$T = \sqrt{\frac{4000}{500}} = 2.83 = \text{turn ratio}$$

g. When the proper turn ratio has been determined connect a resistance of 500 ohms across the taps of the transformer which are nearest to the computed ratio. These ratios are not critical so if the computed ratios were 2.83, connection could be made to the 3:1 ratio taps, etc.

h. Connect the 0-20 range of the A. C. voltmeter across the 500 ohm resistor.

The decibel output of the receiver is found by consulting the Conversion Table for Decibels, which is printed below.

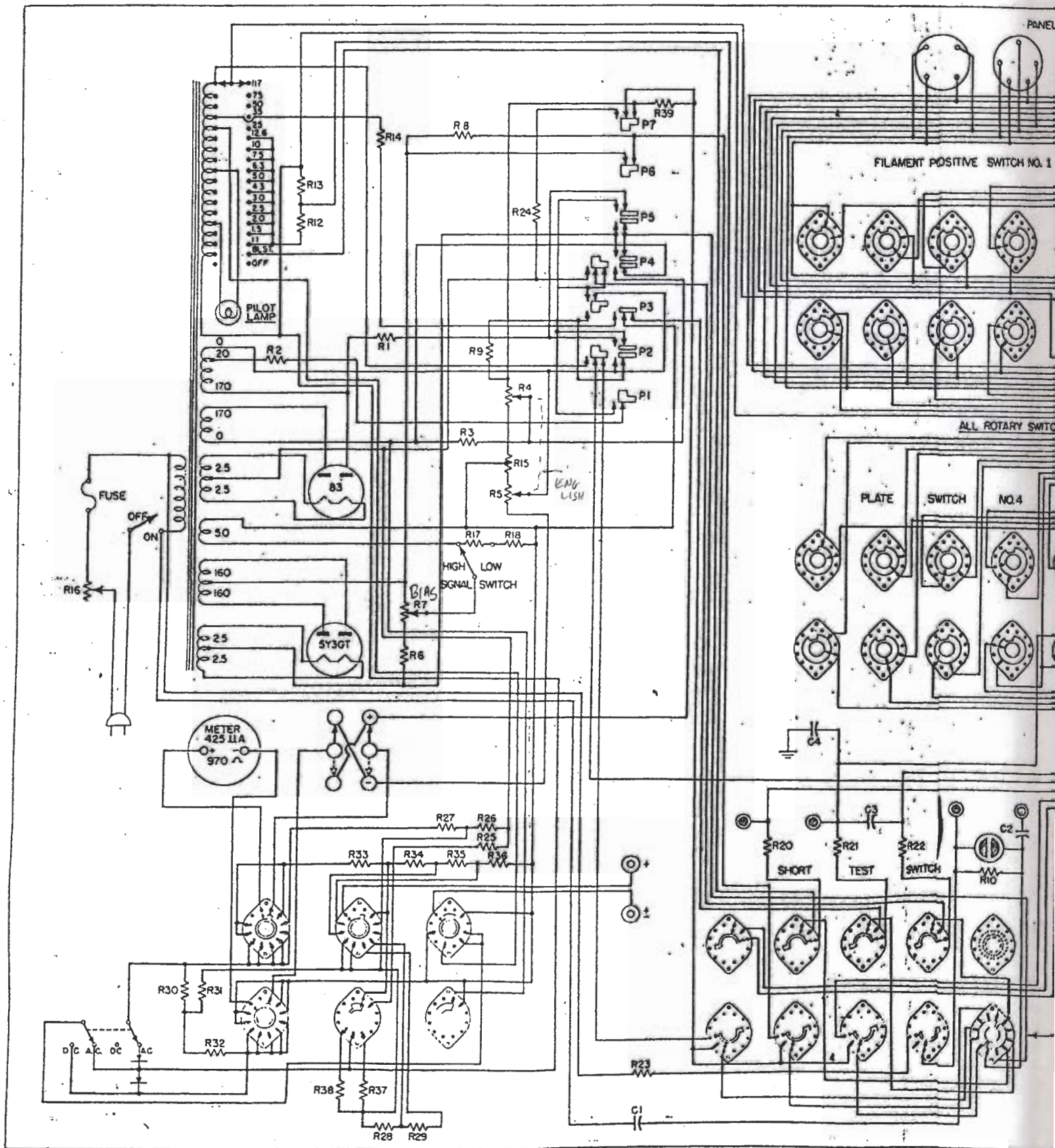
CONVERSION TABLE FOR DECIBELS

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.

A SIMPLE WAY TO EXTEND THE DECIBEL RANGE. - Simply remember that an increase of 20 decibels represents a voltage 10 times as great.

EXAMPLE: Find the voltage corresponding to +25 decibels. Subtract 20 decibels which leaves 5 decibels. The voltage corresponding to 5 decibels is 3.08. This multiplied by 10 gives 30.8 volts which is the voltage corresponding to 25 decibels.



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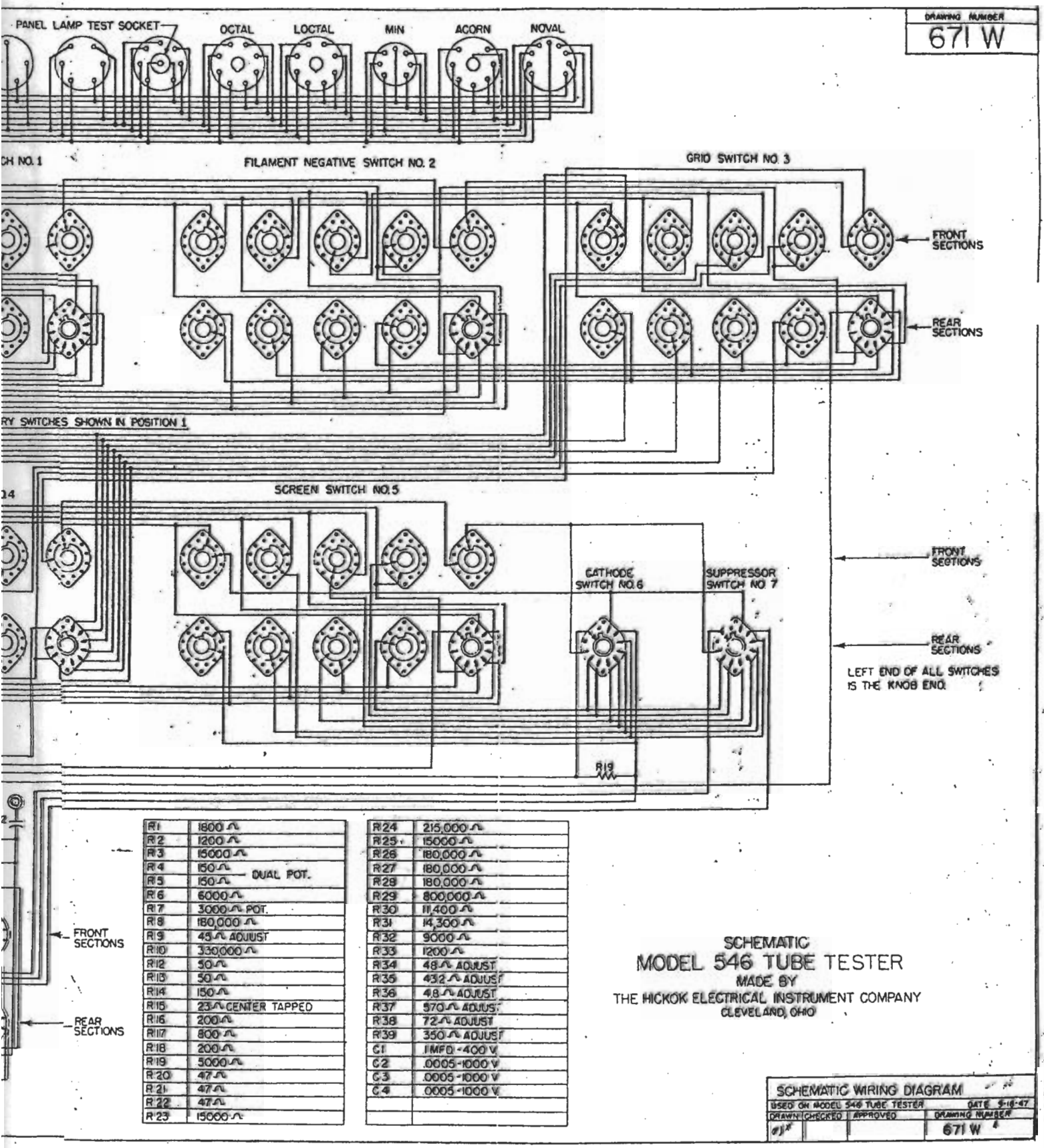

R1	1800 Ω
R2	1200 Ω
R3	15000 Ω
R4	150 Ω — DUAL POT.
R5	150 Ω — DUAL POT.
R6	6000 Ω
R7	3000 Ω POT.
R8	180,000 Ω
R9	45 Ω ADJUST
R10	330,000 Ω
R12	50 Ω
R13	50 Ω
R14	150 Ω
R15	23 Ω CENTER TAPPED
R16	200 Ω
R17	800 Ω
R18	200 Ω
R19	5000 Ω
R20	47 Ω
R21	47 Ω
R22	47 Ω
R23	15000 Ω

R24	215,000 Ω
R25	15000 Ω
R26	180,000 Ω
R27	180,000 Ω
R28	180,000 Ω
R29	800,000 Ω
R30	11,400 Ω
R31	14,300 Ω
R32	9000 Ω
R33	1200 Ω
R34	48 Ω ADJUST
R35	432 Ω ADJUST
R36	48 Ω ADJUST
R37	570 Ω ADJUST
R38	72 Ω ADJUST
R39	350 Ω ADJUST
C1	1 MFD - 400 V
C2	.0005 - 1000 V
C3	.0005 - 1000 V
C4	.0005 - 1000 V

SCHEMATIC
MODEL 546 TUBE TESTER
MADE BY
THE HICKOK ELECTRICAL INSTRUMENT COMPANY
CLEVELAND, OHIO

SCHEMATIC WIRING DIAGRAM			
USED ON MODEL 546 TUBE TESTER			DATE 5-15-47
DRAWN	CHECKED	APPROVED	DRAWING NUMBER
			671 W

Model 546 Tube Tester