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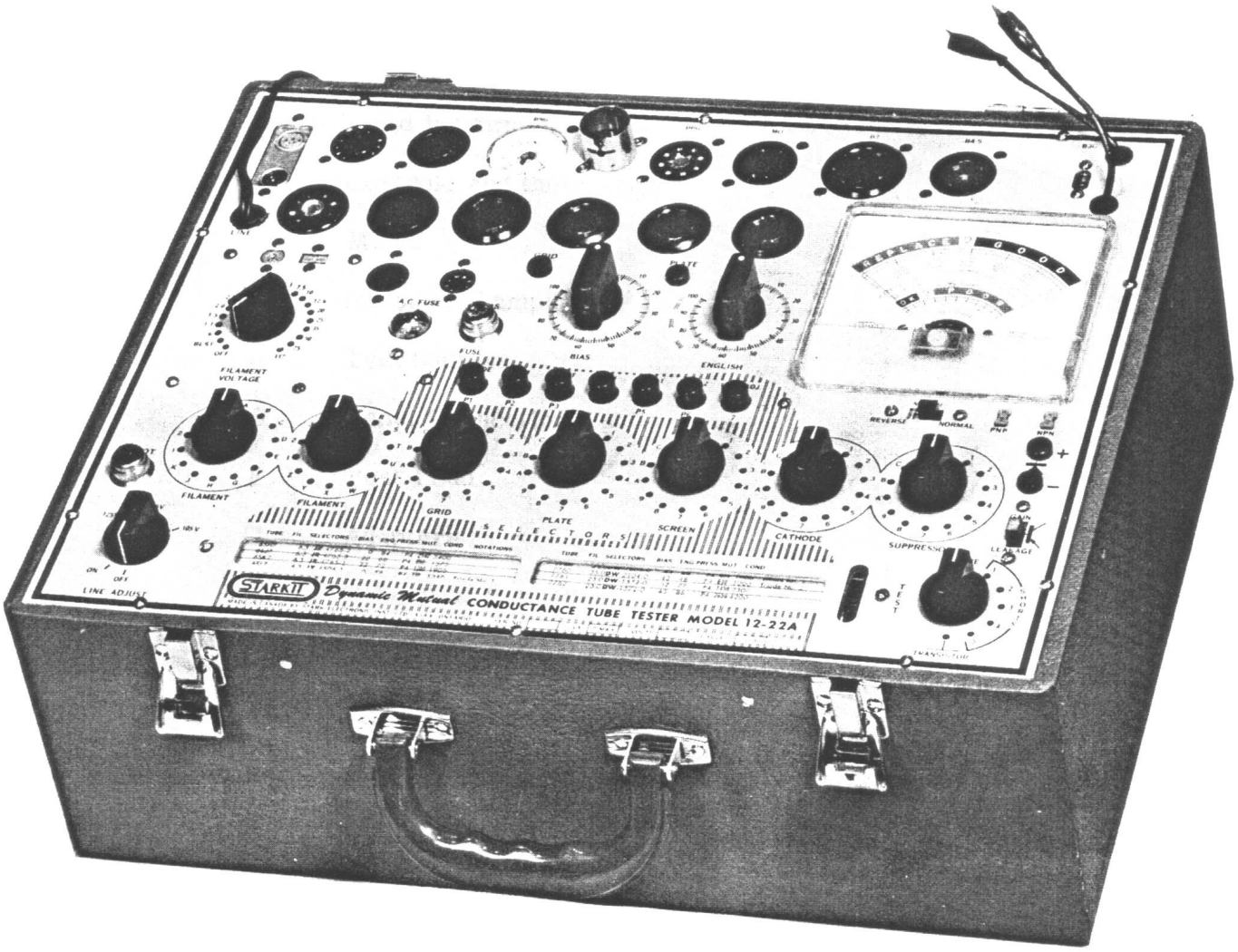
MODELS
12-22/12-22A

Dynamic Mutual Conductance
Tube Tester

STARK ELECTRONIC INSTRUMENTS LTD. AJAX, ONT.


STARKIT
Dynamic Mutual CONDUCTANCE TUBE TESTER MODEL 12-22A
FILAMENT VOLTAGE
A.C. FUSE
FUSE
BIAS
PLATE
ENGLISH
REVERSE
NORMAL
PNP
NPN
FILAMENT
FILAMENT
GRID
PLATE
SELECTORS
SCREEN
CATHODE
SUPPRESSOR
LEAKAGE
LINE ADJUST
ON
OFF
TEST

STARK ELECTRONIC INSTRUMENTS LIMITED

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SECTION 1

GENERAL

It has always been the belief of The Stark Electronic Instrument Company that the radio serviceman should have equipment that will make practically the same type tests as used by manufacturers. In order to make available such apparatus, Stark engineers have endeavored to design all their radio test equipment with this end in view. For example: the Starkit Model 12-22 employs the Dynamic Mutual Conductance test method. The mutual conductance of the tube under test is indicated on the meter scale in terms of micromhos.

Note: The terms, mutual conductance and transconductance are used interchangeably. Either term may be defined as the ratio of a change in plate current to the corresponding change in control grid voltage which produced it. The symbol Gm is used to represent Mutual Conductance or transconductance in various mathematical representations of tube characteristics and their relationship.

DYNAMIC - Pertains to motion. In measuring Dynamic Mutual Conductance a tube must be tested under conditions similar to its use in actual operation. In the Starkit 12-22 Tube Tester there is applied to the control grid, in addition to its regular DC bias, an alternating signal voltage which modulates the plate current.

MUTUAL - Pertaining to two or more related things. In the Starkit 12-22 Tube Tester, all elements of the tube are considered when measuring mutual conductance. The plate of the tube under test will pass current, but the value of the current will depend on the control, screen, and suppressor grid volts, as well as plate voltage.

CONDUCTANCE - The ease with which electrons flow, or the opposite of resistance. The term "Mho" (ohms spelled backwards) is used to indicate the degree of conductance. The Mho is too large a unit for convenient use in measuring the mutual conductance of tubes, so the term "Micromho" (one millionth of a "Mho") has been adopted. This term is usually indicated in tube manuals as "umho".

SECTION II

PERFORMANCE AND DATA

A. Tests that can be made on the Starkit Model 12-22 are as follows:

Dynamic Mutual Conductance test (for amplifier tubes)

Emission test (for rectifier tubes)

Short test

Gas test (amplifier tubes)

Continuity test (ballast tubes)

Transistor and diode test.

B. Technical Data:

Meter ranges : 0-3000-6000-15, 000 micromhos

Tube complement : 1 type 83, 1 type 5Y3GT

A.C. Line Fuse : 1 type 81 bayonet lamp (6-8 V)

Bias Fuse : 1 type 49 bayonet lamp (2 V)

Pilot : 1 type 44 bayonet lamp (6-8 V)

Power Consumption : 75 VA max. at 110V or 220V

Frequency : 50 - 60 cycles

Power Supply : 110 or 220 volts A.C.

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SECTION III

CONTROLS AND INSTRUMENTS

A. CONTROLS AND THEIR USES:

1. The LINE ADJUST rheostat adjusts the input voltage to the power transformer in such a manner that proper test voltages are supplied to the elements of the tube under test. The LINE ADJUST rheostat also controls the power Input ON-OFF.

2. The FILAMENT VOLTAGE switch provides an 18 step selection of filament or heater voltages from .6 volts through 117 volts A. C., a position marked BLST to permit the testing of ballast tubes, and an OFF position.

3. Selector switches, FILAMENT (1), FILAMENT (2), GRID, PLATE, SCREEN, CATHODE, and SUPPRESSOR, connect proper internal circuits to apply correct test voltages to the various pins of the tube under test.

4. BIAS Control adjusts to the proper value the bias voltage that is applied to the tube under test.

5. ENGLISH control dual potentiometers, adjusts the sensitivity of the meter circuit to the level or range required to test the tube under test for quality or Gm readings.

6. The TEST switch connects the proper circuits to apply correct voltages to the various selector switches when on TUBE test position. SHORTS positions 1 through 5 of the Test switch connect the various elements of the tube under test to the short test circuit which contains the meter for readings in form of ohms. When on Transistor Test, the Test switch connects the proper circuit in order to test transistors and silicon and germanium diodes.

7. Seven push button switches designated as follows: P1-Diode, P2-OZ4, P3-Rect., P4-Gm, P5-Gas 1, P6-Gas 2, P7-Line Adj.

   (a) The P1-Diode permit the testing of low-power diodes.

   (b) The P2-OZ4 is used to test cold cathode rectifiers such as the OZ4.

(c) The P3-Rectifier is used to test rectifier tubes.

(d) The P4-Gm is used to test amplifier tubes only.

IMPORTANT: The P4-Gm should never be used when rectifier tubes are tested.

(e) The P5-Gas 1 and P6-Gas 2 are used for gas test.

(f) The P7-Line Adjust test button is depressed when the line voltage is adjusted in conjunction with the meter reading (LINE TEST on meter scale).

8. METER REVERSE/NORMAL switch is used to reverse the polarity of voltage applied to the meter when certain types of tubes are tested, for which information is given in the tube chart or booklet.

9. LEAKAGE-GAIN switch is used to test transistors and diodes.

B. METER:

The meter indicates the quality of the tube in arbitrary deflection expressed as Good, Questionable and Replace. The Mutual Conductance of an amplifier tube is indicated in three ranges: 0-3000, 0-6000, 0-15,000 in terms of Micromhos. The leakage or shorts is indicated by the meter in actual ohms on the red scale. The section O.K., Questionable and Poor is used to evaluate the degree of leakage when testing a transistor. The last scale is used when testing the quality of silicon and germanium diode and also Copper oxide, Selenium and silicon rectifiers. The LINE TEST mark at mid scale is used to establish the correct input voltage to the power transformer for efficient operation of the tester. The DIODE O.K. mark indicates the minimum deflection acceptable when testing the diode tubes.

C. INDICATOR LAMPS:

1. PILOT indicator which glows when the power is switched ON.

2. The BIAS fuse protects the bias potentiometer in case an attempt is made to test a shorted tube.

3. The A.C. LINE fuse serves both as a protective fuse and an overload indicator. This lamp will flash brightly when an overload is placed on the tester or the tube under test. Turn off tester immediately. When an overload occurs, the fuse lamp will burn out and replacement will be necessary.

D. TEST SOCKETS:

The test sockets are grouped along the top portion of the panel.

1. The top row of sockets consists of American 5 pin nuvistor, 7 pin nuvistor, compactron, novar sockets and seven European sockets.

2. The second row of sockets are American sockets.

3. The two sockets for subminiature type tubes are located directly above the filament switch.

4. Immediately above the A.C. fuse are located the 7 pin-miniature socket, and a combination noval/10 pin-header socket. All 9 pin miniature tubes and 10 pin-header tubes are tested in this combination socket.

5. The two sockets for type PNP and NPN transistors are located at the extreme right side of the panel directly below the meter.

E. PANEL CONNECTIONS:

1. Two tip jacks, one black and one red marked - (minus) and + (plus) provide connections when testing silicon or Germanium diodes and selenium or silicon rectifiers.

F. TEST LEAD:

One test lead is provided to make connections from the Grid and Plate panel jacks to the top caps of tubes as required.

G. ADAPTERS:

1. The 12-22 Tube Tester will test most tubes encountered without any additional adapters.

   However, to test ACORN TUBES type numbers 6F4, 6L4, 954, 955, 957, 958, 959, 5731, 9004 and 9005 on the tube tester, requires the use of Stark EM adapter.

   To test tube type 429A (Western Electric) requires the use of Stark 429A adapter.

To test tube type 4X150A requires the use of Stark 4X150A adapter.

To test tube type 4-65A requires the use of Stark 4-65A adapter.

To test tube type 5894, 6252, 829A, 832A requires the use of Stark 832 adapter.

To test European tubes having P type base use Stark EH adapter.

To test European tubes having G8A type base use Stark EK adapter.

The above adapters are to be plugged into the 8 pin octal socket.

These adapters will be supplied on special order.

The particular adapter required is specified in the Notation column.

In general the tube to be tested is inserted in the corresponding sockets.

H. TUBE TEST DATA CHART AND BOOKLET:

A roll chart type TEST DATA is mounted on the under side of the panel. Information necessary to set the controls for the various tube types properly is tabulated in nine columns. Read the headings from left to right as follows:

1. TUBE TYPE: All type numbers which the 12-22 is designed to test are listed in numerical sequence in this column. For a quicker selection the very seldom used American loctal, 4, 5, 6, 7 pin, subminiature and European base type tubes are listed in the ADDITIONAL TUBE DATA booklet.

2. FIL.: Correct filament or heater voltages for the listed tube types are shown in this column. The filament Voltage switch must be set before a tube is inserted in any of the test sockets.

3. SELECTORS: The correct settings for the two FILAMENT selector switches and the GRID, PLATE, SCREEN, CATHODE and SUPPRESSOR selector switches are listed in this column. The settings are shown in the same order in which the switches appear on the panel, listing first the two FILAMENT selectors and then continuing from left to right with the other five selectors.

4. BIAS: This column lists the proper settings for the bias control. The bias voltage applied to the tube under test is controlled with the BIAS potentiometer

5. ENGLISH: This column lists the settings for the dial of the English potentiometer which controls the sensitivity of the meter circuit.

6. PRESS: Under this heading are listed the correct test push buttons that are used for the various tube types.

7. MUT. COND.: This column lists the average Gm and minimum Gm value. Any tube showing a Gm reading less than the minimum Gm value indicated in this column should be discarded. See Operational Procedure when testing a tube for Mutual Conductance.

8. NOTATIONS: Special information pertaining to particular tube types is listed under this heading.

NOTE:

In order to minimize the effect of any backlash of the English Control on the meter reading, always approach the required setting of the English Control in a clockwise direction.

SECTION IV

OPERATIONAL PROCEDURE

The operational steps outlined below are applicable to single section tubes and multi-purpose tubes (tubes having more than one set of elements housed in the same envelope). For multi-purpose types, however, test each section or group of elements individually.

CAUTION: DO NOT INSERT A TUBE IN A TEST SOCKET UNTIL ALL CONTROLS HAVE BEEN SET IN ACCORDANCE WITH THE INSTRUCTIONS BELOW.

NOTE: The seven switches that are located in the lower center of the panel and marked FILAMENT (left), FILAMENT (right), GRID, PLATE, SCREEN, CATHODE, and SUPPRESSOR, select the test socket connections to apply correct test voltage to the elements of the tube under test. For purpose of clarity and simplification, these seven switches will be in some instances referred to collectively as the SELECTORS in this manual. When referred to collectively, they are considered in the same order as shown below.

A. SETTING CONTROLS:

1. Locate the type number of the tube to be tested in the Test Data roll chart or booklet.

2. Turn the FILAMENT VOLTAGE switch to the voltage shown in the FIL. column of the Test Data Chart.

3. Set the selectors. The setting of these seven controls compares to dialing of a telephone number. In the test data chart the dial numbers are listed under the column headed Selectors. These numbers consist of two letters and five figures. Turn the knobs of the selectors until the letters and numbers indicated by the pointer knobs are the same, if read from left to right as those indicated in the roll chart.

EXAMPLE: The test data chart indicates EV-9673-8 under Selectors. Starting at the left, turn the knob of the first FILAMENT selector to the letter E. Turn the second FILAMENT selector to the letter V. Turn the GRID selector to number 9, the PLATE selector to number 6, the SCREEN selector to number 7, the CATHODE selector to number 3, and the SUPPRESSOR selector to number 8. The selectors are interconnected electrically in such a manner that two different voltages cannot be applied to the same tube pin at the same time. Therefore, accidental shorts are avoided.

4. Set the BIAS control to the value indicated in the Bias column of the Test Chart.

5. Set the ENGLISH control to the value indicated in the Eng. column.

6. Set the TEST switch to position TUBE.

7. Insert the tube to be tested in the proper test socket and, if the instructions listed in the Notations column require it, make connections from the panel connectors GRID or PLATE, to the tube caps with the test lead.

8. Set the LINE ADJ. control to the ON position. The pilot indicator will light. NOTE: Sufficient time for the cathode to read operating temperature must be allowed before the test can begin.

9. Press the push button, P7-Line Adj. The pointer of the meter will move up the scale.

10. Hold down push button P7-Line Adj. Turn the knob of the Line Adj. control until the meter pointer rests exactly on the LINE TEST mark located at the top of the meter scale. Standard voltages are thus established for the tube test circuits.

B. SHORT TEST:

1. Turn the TEST SWITCH on position 1 through 5; meanwhile tap the tube lightly with a finger or an eraser end of a pencil and watch the meter pointer on each switch position. The meter will indicate leakage in ohms up to 10 megohms on the red OHMS-SHORTS scale.

The 220K mark on the Shorts scale indicates the approximate value where a lamp in a conventional neon lamp short test would glow. Tubes showing leakage to the right of this value should be discarded without further test, unless specified otherwise, in Notations column. By using the meter to indicate leakage a more accurate test is provided. This is helpful in selecting tubes, especially those with heater to cathode leakage (position 1) for special applications.

IMPORTANT:

With tubes having more than one section such as the 12AV6, the Shorts test must be repeated for each section.

2. In the following chart, the mark "X" shown under any short switch position indicates what element might be in a shorted condition if the meter shows a short in that position of the SHORT switch.

KIND OF SHORT	1	2	3	4	5
Fil. - Cathode	X				
Fil. - Grid		X	X	X	
Fil. - Plate		X			
Fil. - Screen		X	X		
Fil. - Sup.		X	X	X	X
Grid - Cath.	X	X	X	X	
Grid - Plate			X	X	
Grid - Screen				X	
Grid - Sup.					X
Plate - Screen			X		
Plate - Sup.			X	X	X
Screen - Sup.				X	X

If the tube passes the short test, proceed as stated below.

C. MUTUAL CONDUCTANCE IN TERMS OF QUALITY:

1. Turn the TEST switch from SHORTS to TUBE TEST position.

This operation automatically puts the tube tester in condition to read the value of the tube in terms of GOOD & REPLACE, (upper Red and Green sectors of the meter scale). Good tubes will cause the meter pointer to read in the GOOD sector. Worn out tubes will read in the REPLACE sector. Those tubes which read in the sector marked QUESTIONABLE (?) have some useful life but should be replaced soon.

The GREEN (Good) sector is designed to make tubes read at the left edge when 20% below average for amplifier tubes and 35% below average for power tubes.

When using the GOOD & REPLACE scale the MICROMHO readings are disregarded.

2. Press the test push button that is indicated in the Press column of the Roll Data Chart or Booklet to read actual value of the tube under test.

NOTE: Tubes having less than 500 micromhos cannot be made to read in the GREEN sector of the meter scale. Such tubes list micromho readings only and are good if the reading is above a specified minimum as stated on the DATA Chart.

CAUTION: Do not press P4 when testing rectifier tubes.

NOTE: On the Data Chart a star (*) following P1, P2, P3 and P5 indicates that no MICROMHO readings are to be made.

NOTE: A crosshatch (#) in the BIAS column indicates the BIAS control should be set at 100 and proper button pressed while Bias control is rotated until tube strikes.

MUTUAL CONDUCTANCE IN TERMS OF MICROMHOS:

Micromhos are indicated in three ranges: 0-3000, 0-6000, 0-15,000.

1. On the ENGLISH dial are three dots stamped into the metal and filled with red lacquer. These dots are the points used in setting the micromho ranges.

2. The dot between 70 and 80 on the dial is the setting point for the 3, 000 micromho scale.

   The dot between 80 and 90 on the dial is the setting point for the 6, 000 micromho scale.

   The dot between 90 and 100 on the dial is the setting point for the 15,000 micromho scale.

   The range to be used is governed by the value of the Mut. Cond. stated on the Data Chart.

3. The push button switch P4 is used when testing for micromho readings.

4. When measuring micromhos in any of the three ranges listed above, set the BIAS control to the value stated in the BIAS column of the Data Chart.

5. Read the Gm in micromhos on the appropriate scale and compare with the value indicated in the MUT. COND. column of the Data Chart. The micromho values printed on the Data Chart are average values on the right and JAN minimum values on the left. If the value of the meter reading is less than the listed JAN minimum value, the tube is not suitable for use and should be replaced.

   NOTE: The average Mutual Conductance stated in the Data Chart is sometimes different from the value indicated by manufacturer tube manuals. This is due to the fact that the tube is tested under conditions somewhat different from the typical conditions shown on tube manuals.

E. RECTIFIER TUBE TEST:

   Rectifier tubes, including diode tubes and diode sections of multiple elements tubes, having no mutual conductance are tested for emission only.

1. 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 read above the mark DIODE O. K.

2. The 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 in the green (GOOD) sector of the meter scale.

3. The push switch P3 is used when testing ordinary rectifier tubes such as 5Y3. This switch 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.

F. GAS TEST:

The push switch P5 and P6 are used to test an amplifier tube for gas content.

1. Set the English dial at 3000 range.

2. 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 0-3000 scale.

3. Hold down P5 and press P6.

4. 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 a case turn the BIAS dial to 100 and test for gas.

5. 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.

G. 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 set 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.

H. 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.

I. 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 CANADA is about 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.

J. **EXTREME CONDITION TEST:**

The versatility of the Starkit 12-22 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.

1. Measure the mutual conductance in the ordinary way.

2. Press P4 and adjust the ENGLISH dial until the tube reads in the GREEN (GOOD) sector at 2000 on the 0-3000 scale.

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

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

5. 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
35.0	25.0
50.0	35.0

K. CONTINUITY TEST:

The model 12-22 Tube Tester can be used to test for continuity through resistances up to 10 megohms.

1. Set SHORTS switch on position 4.

2. Connect two leads having prods and pin tips to the jacks marked PLATE and GRID.

3. Touch the prods to the terminals through which continuity is to be determined.

4. The meter will indicate continuity.

L. FILAMENT CONTINUITY:

1. Turn tester on.

2. Set selectors as per chart for tube to be tested.

3. Set FILAMENT switch to BLST instead of voltage indicated on chart.

4. Set TEST switch on position SHORTS 5.

5. Place tube in proper socket.

If the meter reads the filament is good , a complete test should then be made on the tube by setting the filament switch on the proper tap, and while the tube heats, rotate the TEST switch several times thru all SHORTS position If no shorts are indicated, set the switch in TUBE TEST position and proceed to test the tube as per chart.

If the meter does not read, 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.

M. SERIES STRING HEATER CONTINUITY:

On the 12-22 it is possible to make a fast check of filament continuity on a complete set of tubes from a radio or T. V. set without resetting the selector switches.

For tubes with filament or heaters on pin 7 & 8, 4 & 5, 3 & 4, 2 & 7, 1 & 8*, 1 & 7, set the SELECTORS on BS34578; set the FILAMENT switch on BLST; and the TEST switch on position 4 SHORTS. Turn tester on and adjust the line test. Lightly insert each tube in tester socket just far enough for pins to make contact with socket contacts - it is not necessary to push tubes completely into sockets. If the filament is not open the meter will move up scale indicating filament continuity.

* For battery type tubes with filament on 1 & 7, set TEST switch on position 2 SHORTS.

TEST BALLAST TUBES:

1. Turn Tester on.

2. Set filament switch to BLST.

3. Set TEST switch on 5 SHORTS.

4. Referring to the following table 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. METER SHOULD INDICATE CONTINUITY IN POSITIONS NOTED.

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BALLAST TUBE CHART

TUBE TYPE	FIRST SELECTOR	METER SHOWS SHORT 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						
O3G	J			T				
4-5	J	R						
6-133	J			T				
6-6AA	J	R						
7-8-9	J	R						
10A-10AG	J			T				
10AB	J			T				X
K17B-M17C-BM17C	J			T				X
M17HG-M17H	J D	R	S					X
K23B-K23C-KX23B-KX30C	J			T				X
M30H	J D	R	S					X
30A-K30A	J			T				
K30D	J	R		T				X
33A-33AG	J			T				
K34B	J			T				X
36A	J			T				
K36B-BK36B-L36C-BM-L36C-KX36C	J			T				X

TUBE TYPE	FIRST SELECTOR	METER SHOWS SHORT IN THESE POSITIONS						
KX36A	J	R						
36D-L36D	J	R		T				X
L36DJ	J	R		T	U			X
K36H-M36H-M36HG	J D	R	S					X
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 D	R						X
42HA-K42HJ-M42H-M42HG	J E	R	S	T				X
KX42C	J			T				X
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

TUBE TYPE	FIRST SELECTOR	METER SHOWS SHORT IN THESE POSITIONS						
K49D-BK49D-L49D	J			T				X
L49F	J D	R						X
M49H-M49HG	J D	R	S					X
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				
50A2MF-50B2	J	R				V		
50X3	J	R						
K52H-M52H	J D	R	S					X
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			

TUBE TYPE	FIRST SELECTOR	METER SHOWS SHORT IN THESE POSITIONS						
K55C-L55C-KX55C	J			T				X
K55CP	J			T		V		X
K55D-L55D	J	R		T				X
L55E-M55E	J			T				X
L55F-M55F-BL55F	J D	R						X
K55H-M55H-M55HG	J D	R	S					X
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 D	R						X
KX87B-LX87B-L90B	J			T				X
K90F-M90F-K92F-M92F	J D	R						X
92A	J			T				
L92B-95K2	J			T				X
L99D	J	R		T				X
100R8	J			T				X

TUBE TYPE	FIRST SELECTOR	METER SHOWS SHORT IN THESE POSITIONS						
120R	J	R						
120RS-135K1	J			T				X
135K1A	J			T	U			X
140L4-140L8-L40R4-140R8	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

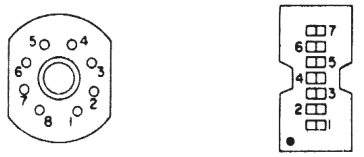
O. TESTING SUBMINIATURE TUBES:

1. Subminiature tubes of the round type with short wire leads or pins are tested in the approriate socket. This socket has eight numbered contacts (Fig. 1).

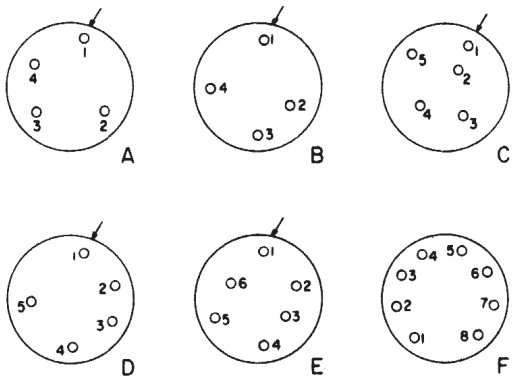
   (a) There are six basing arrangements used for these tubes from A through F. (Fig. 2).

   (b) The numbered leads or pins on the tubes are inserted in the corresponding contacts. If the leads are long enough, grasp each lead about 1/8" from its end, with the tip of a pair of long nosed pliers, and insert the leads in the proper socket contacts. Leads are numbered in a clockwise direction and lead No. 1 is identified by an arrow on the side of the tube.

2. Subminiature tubes of the flat or inline contact type with pins or leads are tested in the appropriate inline socket (Fig. 1). The tube pins or leads must be inserted in such a manner that the dot on the base of the tube is directly in line with the small molded dot on the socket.



SUBMINIATURE SOCKETS
FIGURE 1.



SUBMINIATURE 8 PIN SOCKETS (BUTTON)
BASING ARRANGEMENTS
FIGURE 2.

3. Subminiature type tubes are listed in the Additional Tube Data Booklet. The applicable basing for the various round types is indicated in the following table. The basing designation letter refers to the diagram shown in Figure 2.

STARK ELECTRONIC INSTRUMENTS LIMITED

SUB-MINIATURE TUBE TYPE LIST

TUBE TYPE	BASE	TUBE TYPE	BASE
1 AC5	F	SN 946	A
1 AD5	F	SN 947 C	E
1 C 8	F	SN 947 D	F
1 Q 6	F	SN 948	D
1 S 6	F	SN 949 C	F
1 T 6	F	SN 953 D	F
1 V 5	F	SN 954	B
1 W5	F	SN 954 B	F
6 AD4	C	SN 955 B	F
6 BA5	E	SN 957 A	D
6 BF7	F	SN 972 D	F
6 BG7	F	SN 973 B	F
6 K 4	C	SN 976 C	F
SD 828 A	E	SD 933 C	F
SN 838 E	E Top Lead =P	SD 955 B	F
SD 917 A	C	SN 1006	D
SN 944	E Top Lead =P	1247	F Top Lead =P

STARK ELECTRONIC INSTRUMENTS LIMITED

SUB-MINIATURE TUBE TYPE LIST

TUBE TYPE	BASE	TUBE TYPE	BASE
5633	E Top Lead =P	5902	F
5634	E Top Lead =P	5903	F
5635	F	5904	F
5637	C	5906	F
5638	E	5907	F
5639	F	5916	F
5640	F	5977	F
5641	B	5987	F
5643	F	6026	F
5644	D	6055	F
5645	D	6169	F
5646	D		
5647	A		
5718	F		
5719	F		
5840	F		
5897	F		
5899	F		
5900	F		

P. TRANSISTOR TEST:

1. Rotate the Test switch to TRANSISTOR TEST and set the slide switch GAIN-LEAKAGE on GAIN position.

2. Insert the transistor to be checked in the proper socket, PNP or NPN. Consult manufacturer's data to determine the type. Transistors can be damaged if inserted in wrong socket.

3. ENGLISH dial is adjusted until meter reads full scale (or to the maximum reading possible if transistor will not cause meter to read full scale). If meter fails to read, transistor is open or defective.

4. Push slide switch from GAIN to LEAKAGE position. Meter will now read Leakage current. If reading is in the POOR area, the transistor should be discarded.

Q. RECTIFIERS - COPPER OXIDE, SELENIUM AND SILICON TEST:

The red (+) and black (-) jacks, located near the transistor test sockets are used to check the forward to reverse conduction ratio of rectifiers. Rectifiers must be disconnected from their circuit when testing.

1. The positive terminal of the rectifier is connected to the black (-) jack. The negative terminal of the rectifier is connected to the red (+) jack. When connected this way the rectifier is biased in the forward direction.

2. Set the TEST switch to TRANSISTOR TEST.

3. Adjust the ENGLISH dial for full scale deflection of meter (100%).

4. Connections to rectifier are then reversed, rectifier is then biased in reverse direction. Rectifiers that read 10% or more in reversed direction are probably defective and should be replaced.

R. DIODES - SILICON AND GERMANIUM TEST:

1. Diodes are checked by the same procedure as testing rectifiers, because they rectify but do not handle large currents like power rectifiers.

Some knowledge of the characteristics of the diode being tested will help because some high conduction diodes, used in video detectors, can be rated good if they produce a 10:1 (10%) forward to reverse conduction ratio.

SECTION V

THEORY

I. BASIC THEORY OF MUTUAL CONDUCTANCE TEST:

(a) Examine first the simple full wave rectifier circuit shown in Figure 3. The two power transformer secondary windings have their inner ends connected to a d-c milliammeter. The centre-tapped resistor Rm is shunted across the milliammeter. The load resistance RL, is connected between the centre tap of the resistor Rm and the rectifier filament as any other full wave rectifier circuit. When rectifier Plate 2 is positive, electron flow is through the upper half of Rm and the meter tends to deflect in one direction. When Plate 1 is positive, electron flow is through the lower half of Rm, and the meter tends to deflect in the opposite direction. With the load resistance fixed and equal forces acting on the meter in both cases, the pointer of the meter indicates zero. It cannot follow the variations at the rate of the power line frequency because of the inertia of the movement.

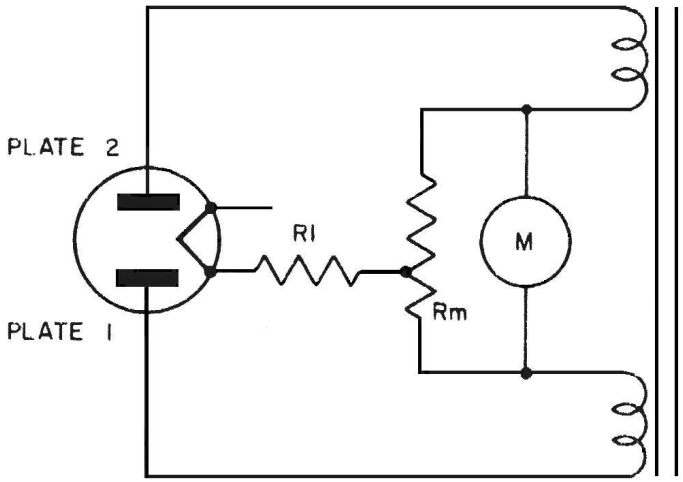
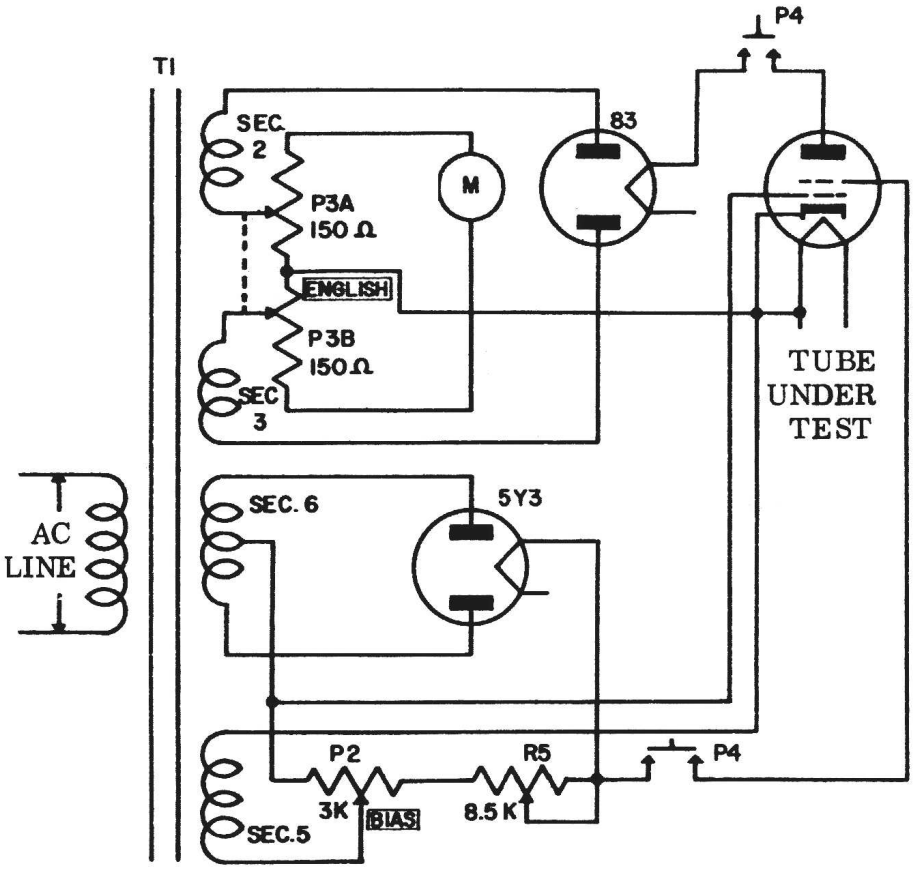


FIGURE 3

(b) If the tube to be tested is substituted for the fixed load resistance Rl and a fixed bias E is applied to the tube, the meter will still read zero because the tube under steady state conditions acts like a fixed resistance.

(c) If in addition to the d-c bias, an a-c potential is applied to the grid of the tube under test, the circuit becomes equivalent to the one that is employed for quality and mutual conductance test in the 12-22 testers. When the a-c potential swings the grid positive, the plate current of the tube is increased, the plate-cathode resistance is lowered, more current flows through Rm, and the deflecting force on the pointer of the meter is greater than before the a-c potential was applied. When the grid swings on the other half cycle the resistance of the tube under test is increased and the deflecting force on the pointer of the meter is smaller. With unbalanced currents on adjacent half-cycles and consequent unequal forces applied to the pointer of the meter, the resulting deflection of the meter becomes proportional to the difference in currents. Since this difference is created by the difference of a-c potential applied to the grid, the meter indicates the plate current changes produced by the applied grid voltage change; in other word the deflection of the meter gives a measure of the mutual conductance of the tube under test.



SIMPLIFIED MUTUAL CONDUCTANCE TEST CIRCUIT

FIGURE 5

The mutual conductance (Gm) or slope of an amplifier-type vacuum tube is an expression which represents the efficiency of performance of a tube. It is defined as the change in plate current divided by the change in grid voltage. The relation generally is written:

$$Gm = \frac{\Delta Ia}{\Delta Eg}$$

Transconductance is expressed in micromho units. Its value shows the effectiveness of the tube to convert a small change in grid voltage (grid signal) to a large change in plate current.

The three principal characteristics of a vacuum tube are mutual conductance, amplification factor and plate resistance. To measure the amplification factor or plate resistance alone will not give a measure of the value of the tube.

The following formulas illustrate the importance of the mutual conductance or slope of a tube when calculating amplifiers.

FORMULA 1 : The mutal conductance Gm of a tube is defined as follows:

$$Gm = \frac{\Delta Ia}{\Delta Eg} \quad \text{micromhos}$$

For anode voltage Ea constant.

FORMULA 2 : The internal resistance Ra of a tube is defined by:

$$Ra = \frac{\Delta Ea}{\Delta Ia} \quad \text{ohms}$$

For grid voltage constant.

FORMULA 3 : The amplification factor is defined as the ratio of a small change in plate voltage to a corresponding change in grid voltage necessary to keep the plate current constant.

$$\mu = \frac{\Delta Ea}{\Delta Eg}$$

FORMULA 4:

From $Gm = \frac{\Delta Ia}{\Delta Eg}$

And since $\Delta Eg = \frac{\Delta Ea}{\mu}$ from formula 3

And $\Delta Ia = \frac{Ea}{Ra}$ from formula 2

$$Gm = \frac{\Delta Ea}{Ra} : \frac{\Delta Ea}{\mu} = \frac{\mu}{Ra}$$

FORMULA 5: In order to collect an alternating voltage at the plate, an adequate load Rl must be introduced in the anode circuit, and the voltage amplification or stage gain is defined as follows:

Stage gain $= \frac{\mu \times Rl}{Rl + Ra}$

From Gm $= \frac{\mu}{Ra}$ $\mu = Gm \times Ra$

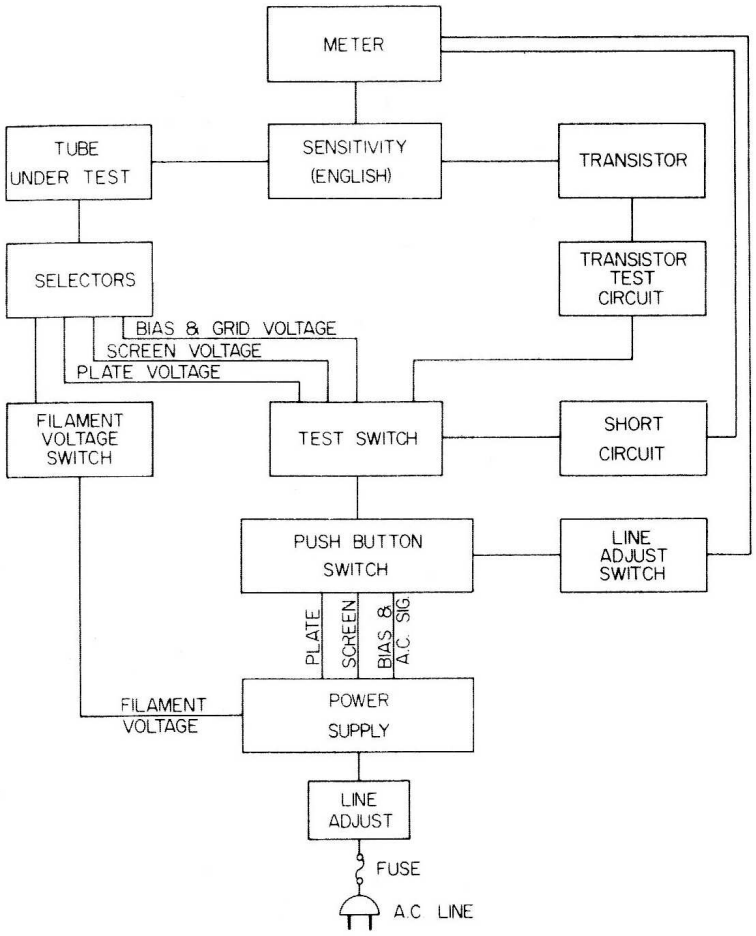
Stage gain $= \frac{Ra \times Rl}{Rl + Ra} \times Gm$

Examination of this result shows that if the tube has a very high plate resistance, particularly pentodes (usually of the order of a megohm), so that Ra is greater than Rl, the stage gain may be written:

Stage gain $= \frac{\mu}{Ra} \times Rl = Gm \times Rl$

II BLOCK DIAGRAM:

The block diagram (Figure 6) illustrates the major circuit sections of the tester and their relation to each other.



BLOCK DIAGRAM

FIGURE 6

III POWER SUPPLY:

1. The primary of the power transformer T1 is supplied from a voltage source of 117 volts or 220 volts + 10%,and a frequency of 50-60 cycles through the ON-OFF LINE ADJUST rheostat P1,and the fuse lamp PL3.

2. The secondary No. 1 consists of a multi-tapped winding designed to supply the various filament voltages for the tubes under test. It also supplies voltage for rectifier emission tests.

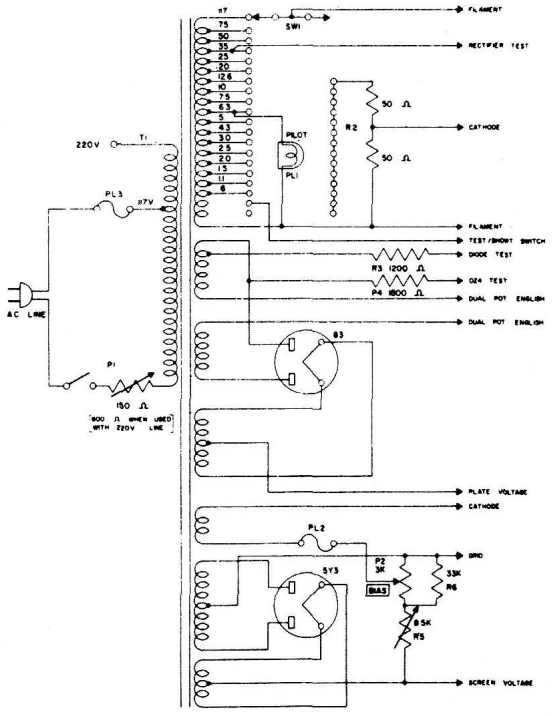
3. The secondary No. 2 and No. 3 supply the ac plate voltages for the 83 rectifier which supplies the dc plate voltage for the tube under test.

4. The secondary No. 4, a centre tapped 5 volt winding, supplies filament voltage for the 83 rectifier.

5. The secondary No. 5 supplies the signal voltage for mutual conductance tests, 5 volts ac.

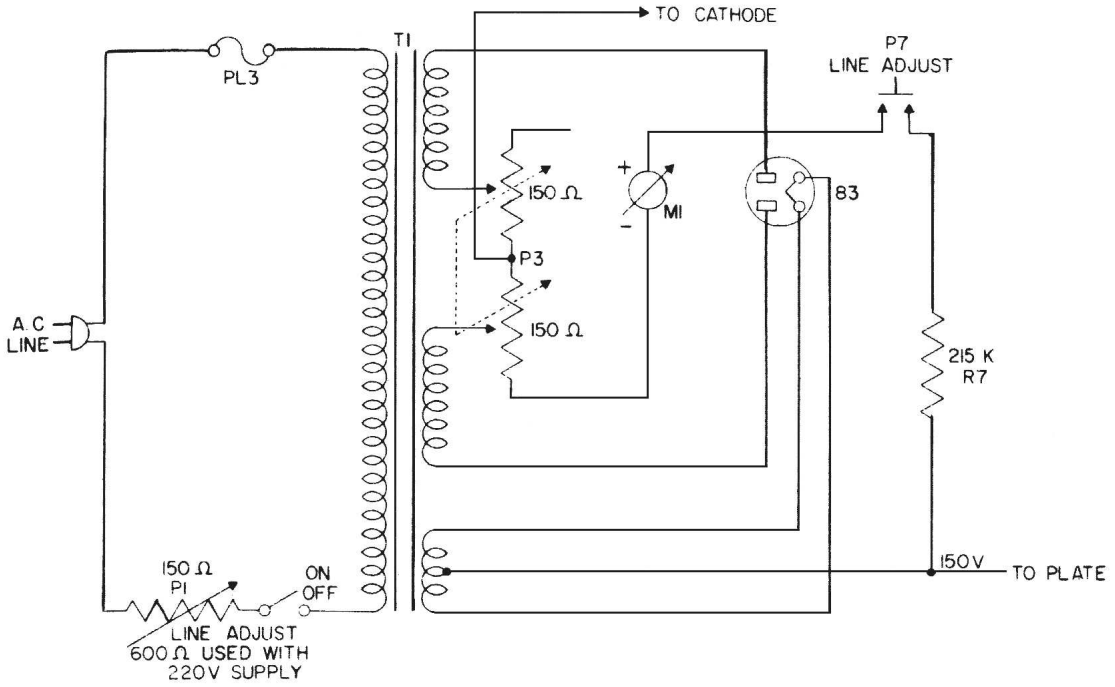
6. The secondary No. 6, centre tapped winding, supplies the plates of the 5Y3 rectifier , which supplies the screen and bias voltages for the tube to be tested.

7. Secondary No. 7, 5 volts centre tapped, supplies the filament of the 5Y3 rectifier.



POWER SUPPLY BASIC CIR
FIGURE 7

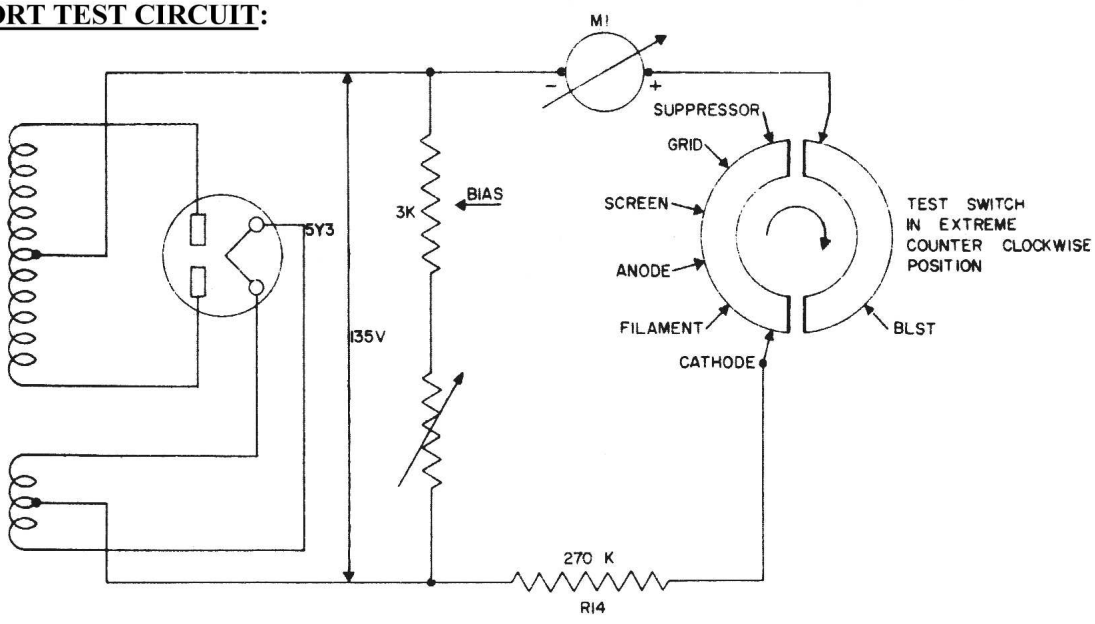
IV LINE VOLTAGE TEST CIRCUIT:



LINE VOLTAGE TEST
BASIC CIRCUIT
FIGURE 8

By pressing P7-LINE ADJ. push button,the meter is connected to the B+ which supplies the plate of the tube under test. The resistor R7, 215K,is calibrated to cause the meter to read at LINE TEST when correct setting voltages is obtained. The rheostat P1-LINE ADJ. in conjunction with the LINE TEST reading permits the adjustment of the voltage applied to the primary of the transformer, in order to obtain standard voltages on the elements of the tube under test.

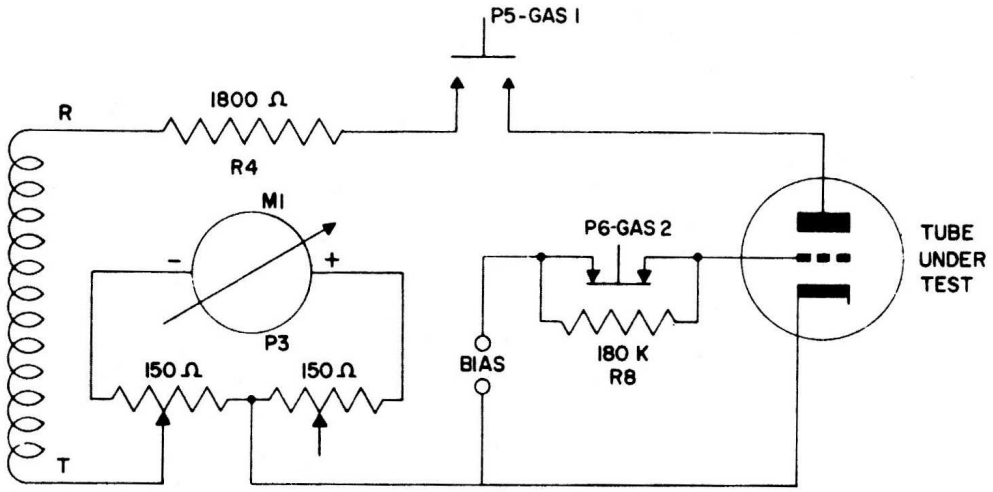
V SHORT TEST CIRCUIT:



BASIC CIRCUIT
FIGURE 9

A dc voltage of 135 volts is applied to the elements of the tube under test through resistor R14, 270K, and meter M1. The selector switches are set correctly for the particular tube. When the TEST switch is turned from position 1 through position 5, the various elements of the tube are connected between the meter and dropping resistor R14. Any shorted portion between the elements will complete the circuit and cause the meter to read the actual resistance of the short.

VI GAS TEST CIRCUIT:



BASIC CIRCUIT
FIGURE 10

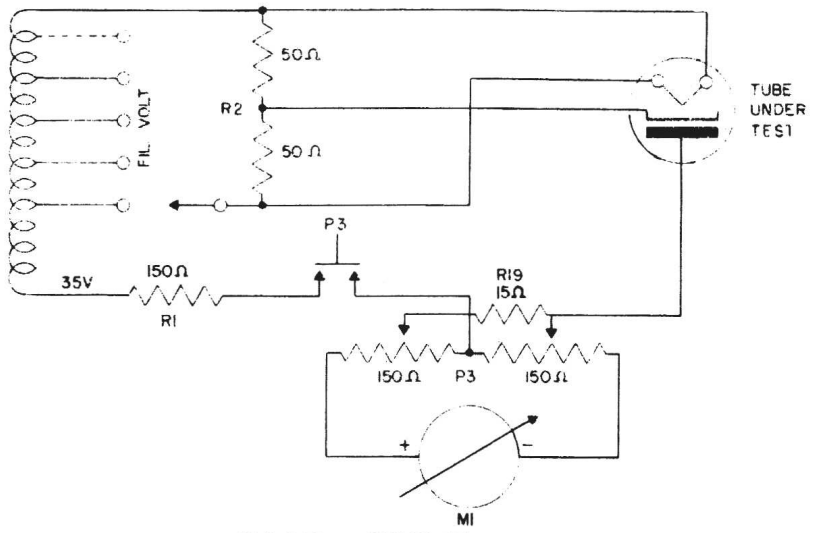
By pressing P5-GAS 1 push button, a definite value of plate voltage and grid bias is applied to the tube under test, and cause a definite value of plate current to flow. This current is indicated on the meter M1. While pressing P5, P6-GAS 2 is pressed, a 180K resistor R8 is inserted in the grid circuit. If grid current flows from the bias voltage source through the grid circuit to cathode, due to gas in the tube, the current will develop a voltage drop across resistor R8. This voltage drop reduces the negative bias on the grid and causes a corresponding increase in the plate current which is measured by the meter. If the tube contains gas, the pointer of the meter moves up scale. The increase in meter reading must not exceed one scale division.

VII RECTIFIER TEST CIRCUIT:

1. Rectifier tubes can only be tested for emission. The test circuit is quite simple: By pressing P3-Rect., an ac potential of 35 volts is applied between the cathode and the plate of the tube under test through resistor Rl, 150 ohms, and meter Ml, and rectified by the tube under test. The rectifying action of the tube will cause a pulsating current to flow through the meter, and the current indicated by the meter is proportional to the electron emission of the tube. The deflection of the meter is a measure of the efficiency of emission of the tube.

2. By pressing P2-OZ4, a circuit similar to Figure ll is set up, but a higher voltage is applied (330 volts ac) to test rectifiers of the cold type cathode such as OZ4.

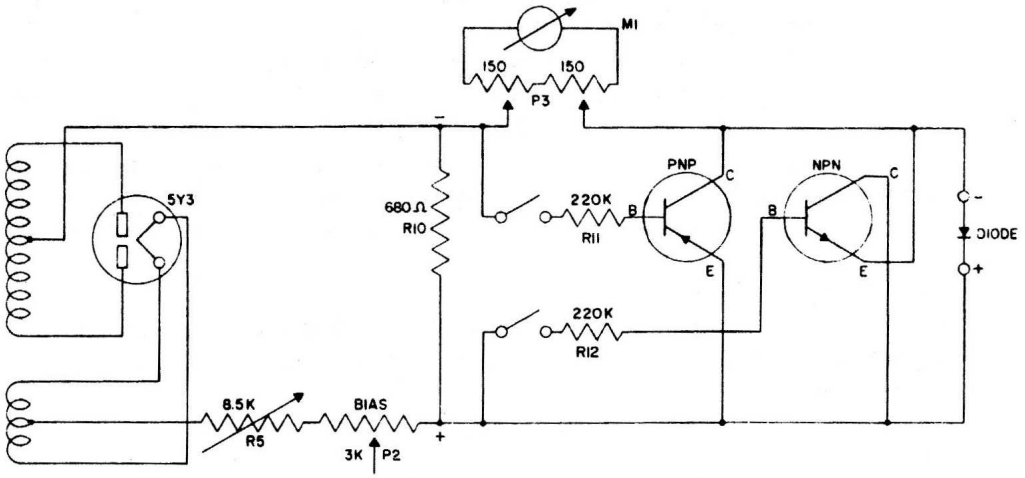
3. By pressing Pl-DIODE again a circuit similar to Figure ll is set up, but only a lower voltage (20 volts ac) is used to protect the delicate cathodes of diode detector type tubes.



BASIC CIRCUIT

FIGURE 11

VIII TRANSISTOR TEST:



TRANSISTOR AND DIODE TEST CIRCUIT

FIGURE 12

There are many tests that can be made on transistors to determine their quality. However, two basic tests are standard. These are, current gain and leakage test.

The current gain test made with the 12-22 shows the ability of the transistor under test to cause a current flow in the collector circuit when a very small current flows into the base. The 220K resistor is placed in the base circuit in order to limit the base current to a very small value.

When testing transistors for leakage, the base connection is left open and the meter reads the actual leakage, ICEO, of the transistor under test.

For pages 39 to 43 see "STARK 12-22 TUBE TESTER CALIBRATION" PDF

SECTION VII

PARTS LIST

The components listed in this parts list are those that have an electrical bearing on the operation of the STARKIT 12-22 Tube Tester. When ordering replacement parts be sure to list Model number of kit, serial number, as well as part number, symbol, and complete description. A complete parts list is included in the assembly instructions.

Part #	Symbol	Description	Quan.
112-3-7	C1	Capacitor, mica, 2700mmfd., 10%, 1000 volts, molded phenolic	1
112-9-74	C2	Capacitor, electrolytic, 50mfd., 6 volts, axial leads	1
120-3-8		Chart, data roll and booklet set	1
125-2-2	PL1	Lamp, bayonet, 6-8 volts, No. 44, type T3-1/4	1
125-9-1	PL3	Lamp, bayonet, 6-8 volts, No. 81, type G6	1
125-9-2	PL2	Lamp, bayonet, 2 volts, No. 49, type T3-1/4	1
134-2-5	P2	Potentiometer, 3000 ohms, special taper	1
134-5-16	P3A-B	Potentiometer, dual, 150-150 ohms, linear, 4watt, W. W.	1
134-5-23	P1	Rheostat, 150 ohms, 25 watts, with OFF position (used with 117V source)	1
134-5-77	P1	Rheostat, 600 ohms, 25 watts, with OFF position (used with 220V source)	1
144-5-8	SW12	Switch, push, 7 buttons	1
144-9-72	SW1	Switch, rotary, 2 poles, 20 positions (Fil. volts)	1
144-9-93	SW3-4-5-6-7-	Switch, rotary, 14 positions, (Selector F, F, G1, G2, A)	5
144-9-94	SW8-SW9	Switch, rotary, 14 positions (Selector C, S)	2
144-9-75	SW13	Switch, rotary, 6 sections, 7 positions (TEST)	1
144-9-76	SW10-SW11	Switch, slide, DPDT	2
148-9-51	T1	Transformer, power, 117/220 volts, 60 cycles, primary	1

Part #	Symbol	Description	Quan.
152-1-9		Index roller assembly, less chart	1
161-1-17	M1	Meter, model 245, 500 ua/224 ohms, scaled micromhos, ohms, quality	1
163-1-9	L2	Tube, electron, 5Y3GT/G	1
163-1-10	L1	Tube, electron, 83	1
163-1-24		Tube, electron, 50C5 (calibration)	1
	R19	Resistor, carbon, composition, 15 ohms, 1W, 5%	1
	R15-16-17	Resistor, carbon, composition, 47 ohms, 1/2W, 20%	3
	R10	Resistor, carbon, composition, 680 ohms, 1/2W, 10%	1
	R3	Resistor, carbon, composition, 1200 ohms, 1W, 10%	1
	R9	Resistor, carbon, composition, 15K, 1W, 5%	1
	R6	Resistor, carbon, composition, 33K, 1/2W, 10%	1
	R8	Resistor, carbon, composition, 180K, 1/2W, 10%	1
	R11-12	Resistor, carbon, composition, 220K, 1/2W, 10%	2
	R13	Resistor, deposited film, 124 ohms, 1/2W, 1%	1
		Resistor, deposited film, 120K, 1/2W, 1%(calibrated)	1
	R7	Resistor, deposited film, 215K, 1/2W, 1%	1
	R14	Resistor, deposited film, 270K, 1/2W, 1%	1
	R2	Resistor, wirewound, 50-50 ohms (100 ohms centre tapped) 10%, 1-3/4" long, terminal lugs	1
	R1	Resistor, wire wound, 150 ohms, 10W, 10%, 1-3/4" long, terminal lugs	1
	R4	Resistor, wire wound, 1800 ohms, 10W, 10%, 1-3/4" long, terminal lugs	1
	R5	Resistor, wire wound, 8500 ohms, 10W, 10%, adjustable, 1-3/4" long, terminal lugs	1