

TRIPOLIET



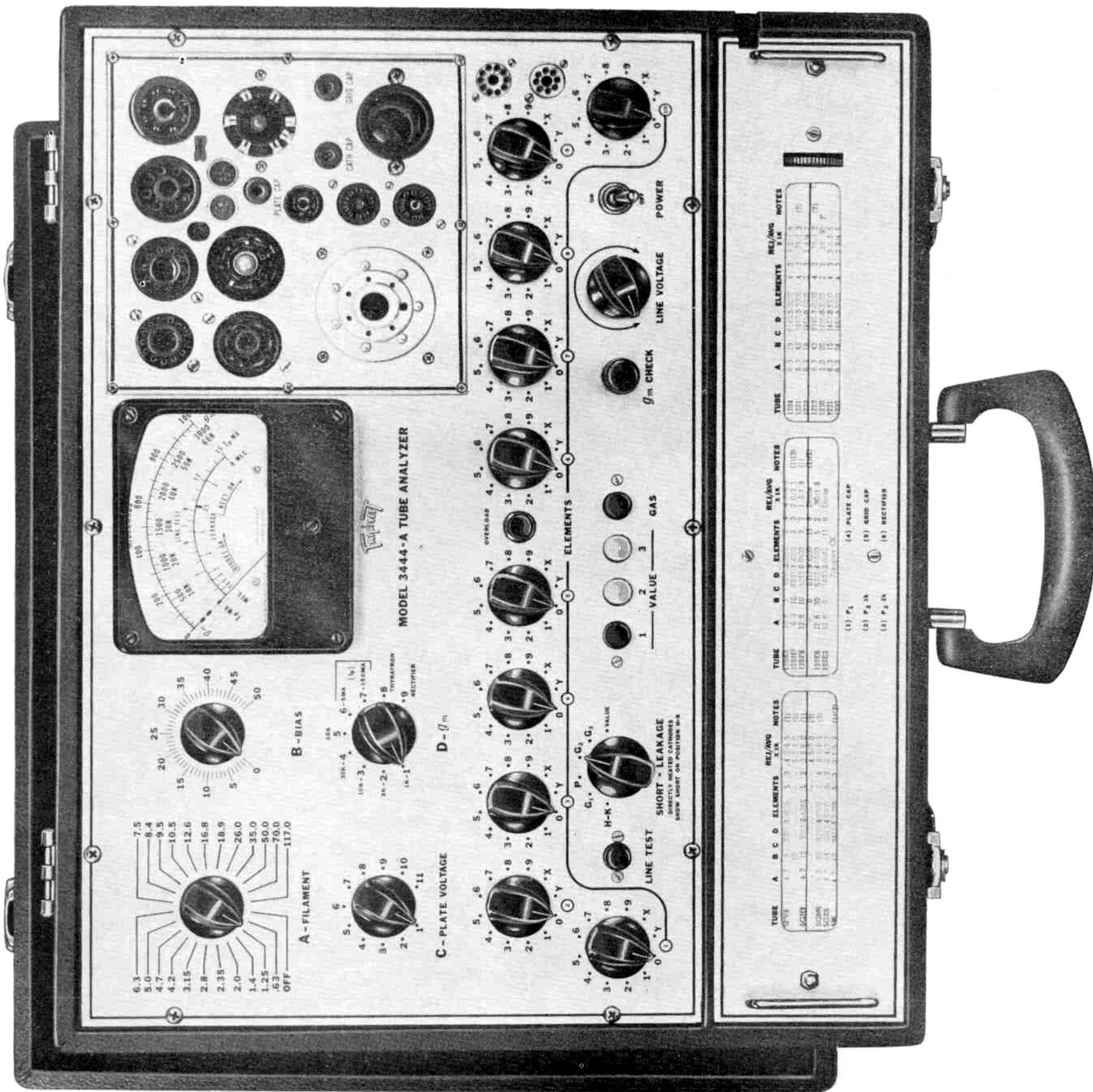
INSTRUCTION MANUAL  
MODEL 3444-A TYPE 1  
TUBE ANALYZER

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THE TRIPLETT ELECTRICAL INSTRUMENT CO.

Bluffton . . . . . Ohio



MODEL 3444-A TUBE ANALYZER

**A - FILAMENT**

6.3  
5.0  
4.7  
4.2  
3.15  
2.8  
2.35  
2.0  
1.4  
1.25  
.63  
OFF

7.5  
8.4  
9.5  
10.5  
12.6  
16.8  
18.9  
26.0  
35.0  
50.0  
70.0  
117.0

**B - BIAS**

15  
20  
25  
30  
35  
40  
45  
50

**C - PLATE VOLTAGE**

4  
3  
2

10  
11

5  
6  
7

8  
9  
10  
11

**D -  $f_m$**

5. .6 .7  
4. .8 .9  
3. .1 .2  
2. .3 .4  
1. .5 .6

5. .6 .7  
4. .8 .9  
3. .1 .2  
2. .3 .4  
1. .5 .6

5. .6 .7  
4. .8 .9  
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2. .3 .4  
1. .5 .6

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2. .3 .4  
1. .5 .6

5. .6 .7  
4. .8 .9  
3. .1 .2  
2. .3 .4  
1. .5 .6

| TUBE | A | B | C | D | ELEMENTS | REL./AVG | NOTES |
|------|---|---|---|---|----------|----------|-------|
| 6X4  | 1 | 2 | 3 | 4 | 5        | 6        | (1)   |
| 6X5  | 1 | 2 | 3 | 4 | 5        | 6        | (2)   |
| 6X6  | 1 | 2 | 3 | 4 | 5        | 6        | (3)   |
| 6X7  | 1 | 2 | 3 | 4 | 5        | 6        | (4)   |
| 6X8  | 1 | 2 | 3 | 4 | 5        | 6        | (5)   |
| 6X9  | 1 | 2 | 3 | 4 | 5        | 6        | (6)   |
| 6X10 | 1 | 2 | 3 | 4 | 5        | 6        | (7)   |
| 6X11 | 1 | 2 | 3 | 4 | 5        | 6        | (8)   |

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| 6X10 | 1 | 2 | 3 | 4 | 5        | 6        | (7)   |
| 6X11 | 1 | 2 | 3 | 4 | 5        | 6        | (8)   |

MODEL 3444-A (TYPE I)

# TECHNICAL DATA

## MODEL 3444-A TYPE I

### G<sub>m</sub> SIGNAL POTENTIALS AND RANGES

FIVE direct reading G<sub>m</sub> ranges

1. 1,000 micromhos
2. 3,000 micromhos
3. 10,000 micromhos
4. 30,000 micromhos
5. 60,000 micromhos

FIVE signal potentials @ 5 KHz

1. 1000 millivolts
2. 333 millivolts
3. 100 millivolts
4. 33 millivolts
5. 16 millivolts

### SHORT TEST

Filtered DC, 85 Volts. In accordance with EIA G-8 Committee recommendations.

### LEAKAGE

0 to 20 megohms at 85 volts (measurements made directly on the meter.)

### PLATE POTENTIALS AND CURRENT RANGES

Four DC plate potentials.

- 12 volts
- 30 volts
- 100 volts
- 250 volts

Two DC plate current ranges (can be used for plate current cut-off measurements and grid current readings to determine cut-off point of tube.)

- 15 ma } full scale
- 150 ma }

### BIAS

Two DC bias ranges (on 50 division scale so that actual bias voltages can be read directly.)

- 0 to 5 volts
- 0 to 50 volts

### SCREEN POTENTIALS

Five DC screen potentials

- 12 volts
- 30 volts
- 45 volts
- 100 volts
- 250 volts

### FILAMENT VOLTAGES

Twenty-three AC voltages, closely regulated:

- .63, 1.25, 1.4, 2.0, 2.35, 2.8, 3.15, 4.2, 4.7, 5.0, 6.3, 7.5, 8.4, 9.5, 10.5, 12.6, 16.8, 18.9, 26.0, 35.0, 50.0, 70.0, 117.0.

### G<sub>m</sub> CIRCUIT CHECK

Self checking G<sub>m</sub> circuit with 5 KHz solid state signal source and solid state microammeter.

### GRID CURRENT

Grid current test under operating conditions.

### PLATE CUT-OFF

Cut-off measurement on voltage amplifiers.

### RECTIFIER TEST

Test for rectifiers is made under load.

### DUAL PURPOSE TUBES

Single element switching set up for dual purpose tubes.

### THYRATRON TEST

Firing voltage, grid current and cut-off measurements in thyratrons.

### SOLID STATE MICROAMMETER

Sensitivity 33 mv full scale.  
Current degenerated and highly stable.

### SOLID STATE SIGNAL OSCILLATOR

Output 1.4 volts, 5 KHz.  
FET-RC oscillator circuit.

### REGULATED SUPPLY

Oscillator and microammeter are powered by zener controlled supply for stability.

### METER (Suspension)

Rugged 50 microammeter, illuminated, with 4" scale length and knife edge pointer.

### TUBE CHART

Roll chart illuminated and removable.

### SOCKETS (On removable panel)

Compactron; 9 pin novar; Octal; Loctal; 8 pin subminiature; 7 pin subminiature; 4-5-6 pin combination; 7 pin and pilot light socket; 5 pin nuvistor; 7 pin nuvistor; acorn; 7 pin miniature; 7 pin septar; 9 and 10 pin miniature; 10 pin decal; plate, grid and cathode jacks.

NOTE — Small protrusion at one end of 7 pin subminiature socket indicates No. 1 pin.

### PIN STRAIGHTENER DIES

7 pin and 9 pin straightener dies on panel.

### CASE

Wood, gray leatherette covered, 15-3/16" x 18-3/16" x 7 3/4".

### OVERLOAD INPUT

Red bulb lights with excessive overload.

### FUSE

3 amp, 250 volt, type 3AG in roll chart compartment.

### WEIGHT

25 pounds.

### POWER

117 AC volts, 50-60 Hz.

### ACCESSORIES

One black grid cap or cathode cap lead, one red plate cap lead.

# THEORY OF OPERATION

This Tube-Analyzer has been designed to provide a portable vacuum tube measuring device that will test and measure tubes under applied potentials and signal amplitudes similar or identical to those in standard laboratory  $G_m$  testers or the General Radio Bridge. Full wave filtered dc plate and screen potentials are selected from divider circuits in steps to fit the book values for these potentials listed by the tube manufacturers. The bias control is calibrated in volts, two ranges, zero to 5 and zero to 50, and can be read directly in volts from the dial. Plate current ranges of 15 and 150 milliamperes are available, and mutual conductance is measured in a self checking circuit on 5 independent ranges.

## MUTUAL CONDUCTANCE CIRCUIT

Steady state (non pulsating) dc voltages are applied to all elements of amplifier tubes except the heater. These potentials are selected to fit published book values for each tube under test, within the potential limits of 250 volts for plate and screen, and 50 volts for control grid. Heater voltage is available in 23 steps from .63 to 117 volts from a tapped transformer. The source of the grid signal is a 5000 cycle sine wave oscillator. This operates in conjunction with a solid state microammeter to read micromhos. Both the oscillator and electronic microammeter receive power from a regulated power supply. Solid state rectifiers are used in all circuits for long life and best regulation. All circuits are adequately by-passed for minimum circuit impedance at 5 KHz.

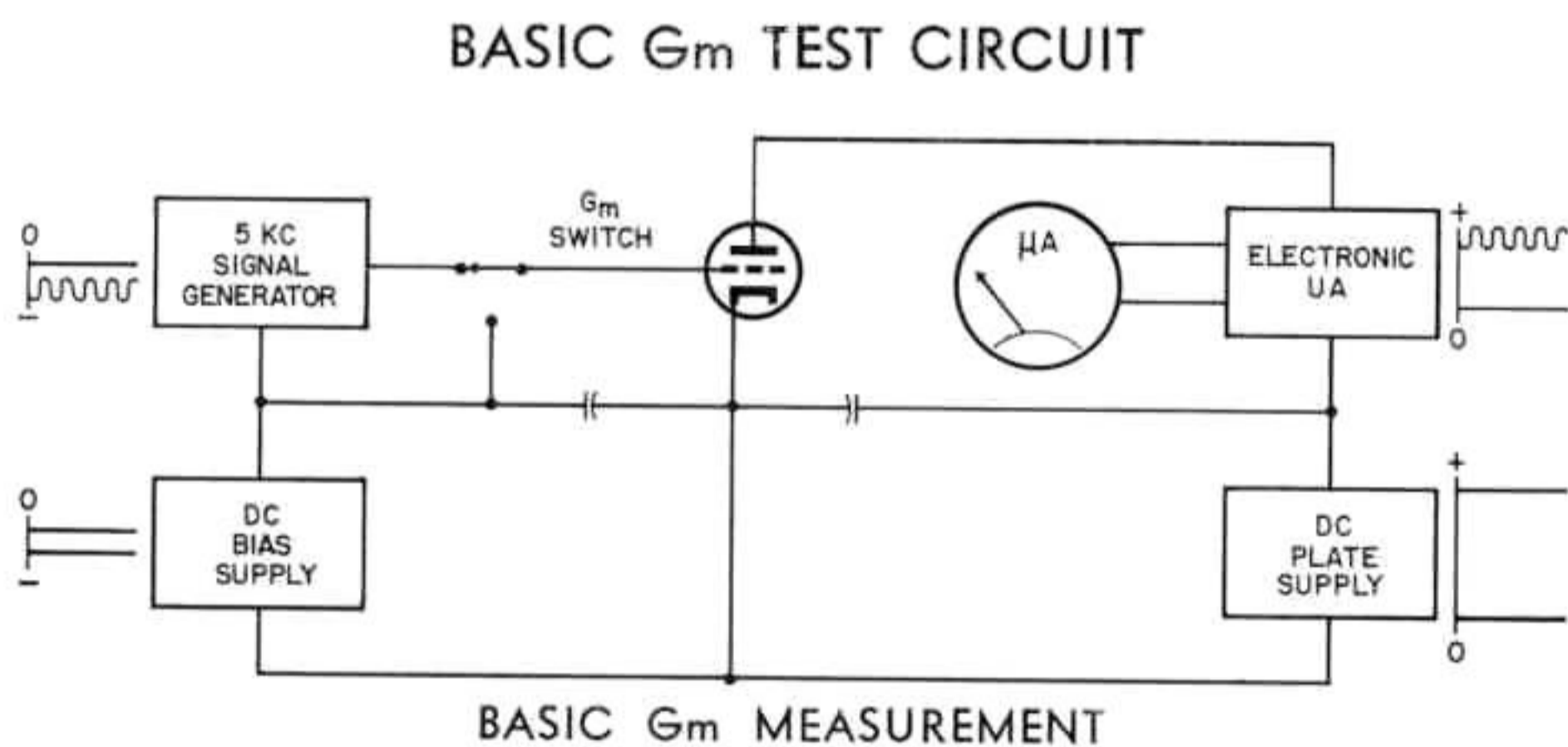


Fig. 1

When the  $G_m$  test switch is closed, the 5 KHz signal is applied to the control grid of the tube under test, and this produces a 5 KHz plate current component in the plate circuit. Before this component is measured, it must be separated from the DC plate current and 120 cycle supply ripple. This is done by means of a band-pass amplifier whereby only the 5 KHz current reaches the meter. This current is in microamperes per volt of input signal and is therefore in micromhos of transconductance at the applied set of plate, screen and grid potentials. As shown in the diagram the microammeter may also be switched in the signal circuit to measure the signal current flowing thru a precision resistance divider. It may be shown mathematically that by cross checking the output current against this input current a very high order of  $G_m$  accuracy can be obtained.

## LEAKAGE TEST CIRCUIT

The leakage test circuit is controlled by a SHORT-LEAKAGE SWITCH, which in its five designated positions disconnects all of the tube elements from the other testing circuits and connects them into the leakage testing circuit

(see Fig. 2). In each designated position a specific tube element is isolated and connected into a series circuit consisting of the isolated element, an 85 VDC source, a current limiting resistor, a microammeter and the other elements of the tube. The meter deflection in each position is determined by the insulation resistance existing between the isolated element and the other elements of the tube. Since this deflection is inversely proportional to the leakage resistance, a full-scale deflection indicates a low resistance short. The LEAKAGE scale of the meter is calibrated for a resistance range of zero to 20 megohms.

## SHORT TEST CIRCUIT

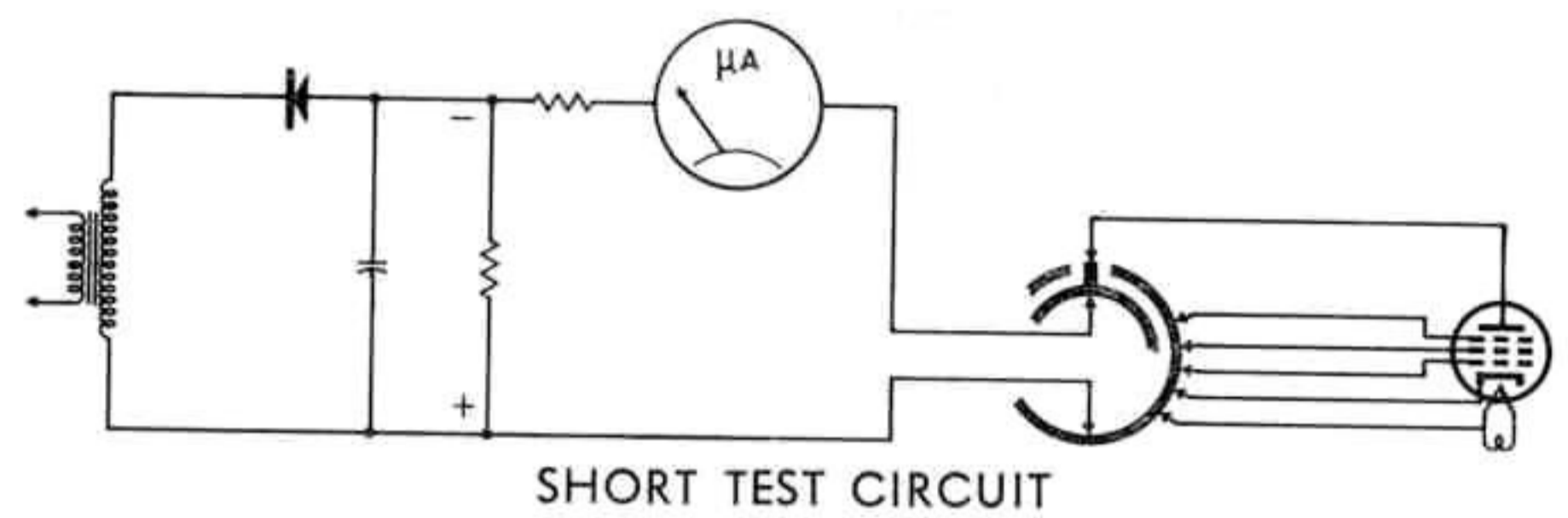


Fig. 2

Using the meter to measure insulation resistance provides a more accurate indication of tube condition, and is particularly useful for selecting tubes that have a high heater-cathode leakage resistance for critical applications. Tubes that have a heater-cathode leakage resistance of less than 250,000 ohms may still function satisfactorily in many circuits. However, leakage resistances as high as several megohms, not detected by the conventional neon bulb short test circuit, may prevent a tube from functioning properly in some applications.

## CATHODE EMISSION TEST CIRCUIT

The useful life of a diode or rectifier type tube ends when its ability to emit electrons falls below some level, the exact value of which may differ for each type. In Fig. 3 a dc milliammeter is connected in series with the plate of the tube under test. The meter is protected by a shunt resistor and the tube is protected by a load resistor.

## BASIC EMISSION CIRCUIT

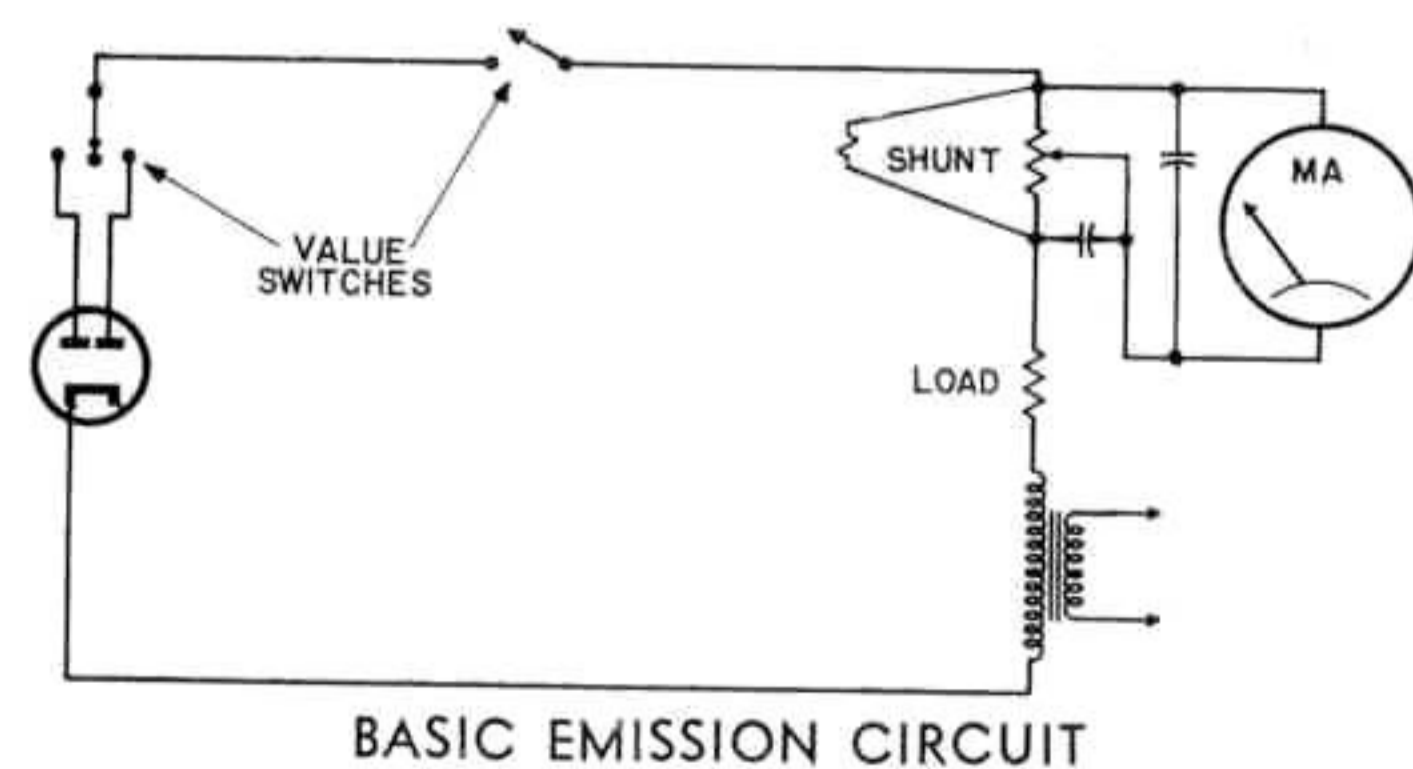


Fig. 3

With the D- $G_m$  RANGE switch in the RECTIFIER position, the quantity of electrons reaching the plate from the cathode is measured by the milliammeter in the plate circuit. Since rectifier and diode type tubes are rated in terms of emissive capacity, the loss of this capacity will be noted by failure of the meter pointer to reach the lo-limit value.

## PLATE CURRENT MEASUREMENT

Plate current is measured on either one of two ranges as shown in Fig. 4. The meter reads, directly in dc milliamperes, the plate current drawn by the tube at the grid voltage shown on the B-BIAS dial and the plate and screen voltages listed for the various positions of the C-PLATE VOLTAGE switch.

### PLATE CURRENT MEASUREMENT

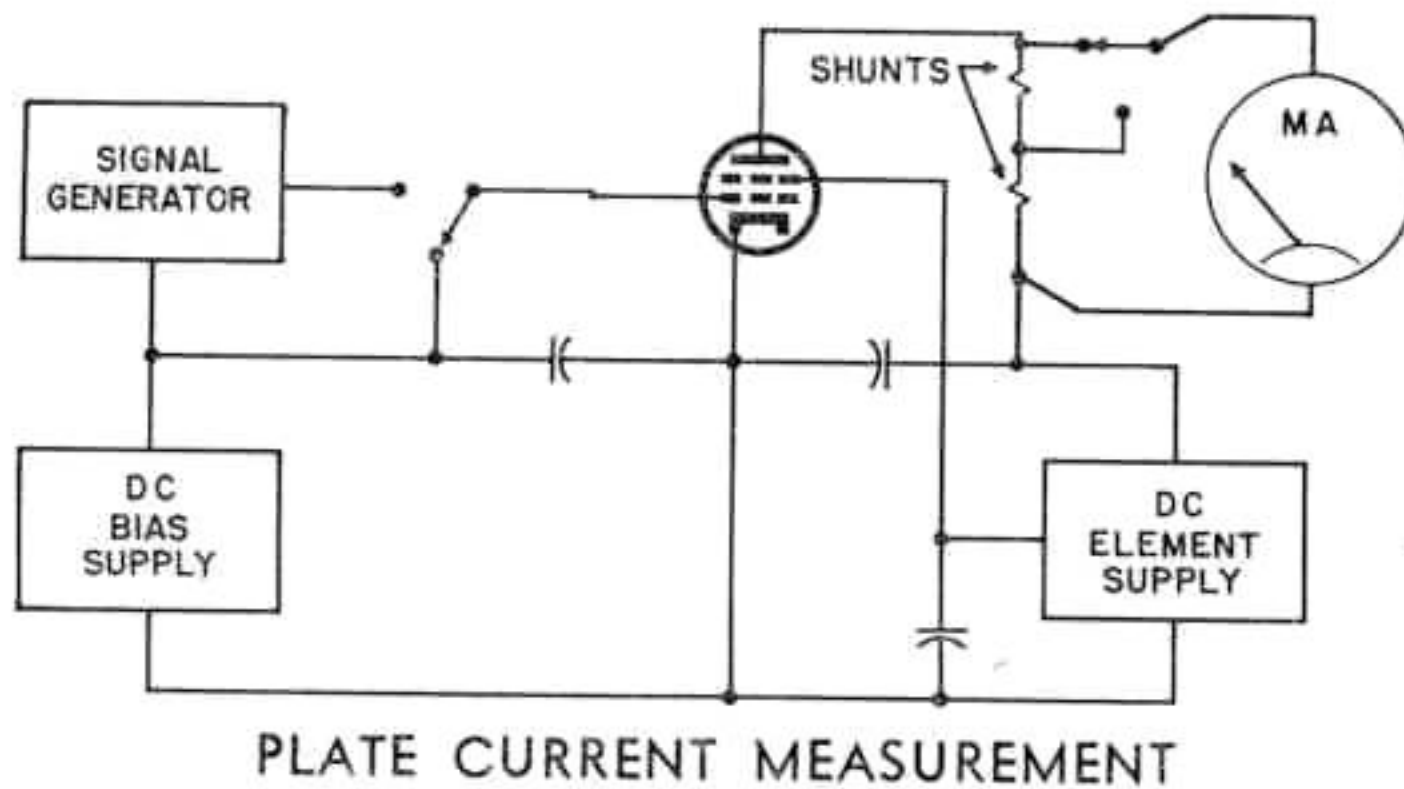


Fig. 4

## CUT OFF CHARACTERISTIC

On many tubes it is important to know the dc grid voltage required to "cut-off" or cause the plate current to be reduced to zero. This value can be determined, using the Plate Current circuit, by rotating the B-BIAS or bias control in a negatively increasing direction until the meter just reaches the zero line. The cut-off bias may then be read directly from the B-BIAS dial in volts. This is a particularly important measurement on dual triodes where balanced cut-off as well as normal characteristics are required, such as in computer flip-flop circuits, integrator and memory circuits.

## THYRATRON TEST CIRCUIT

In Fig. 5 a dc milliammeter is connected in series with the anode of the tube under test. AC voltage is applied to the plate of the tube by the element transformer, and the heater is energized by the filament transformer. When the dc bias is increased in a negative sense, a point will be reached where the tube will no longer conduct. This point is referred to as cut-off, and is indicated on the meter by a sudden deflection to zero. In operation, the B-BIAS control, is gradually increased between the limits specified in the REJ/AVG column of the tube data chart.

## THYRATRON TEST CIRCUIT

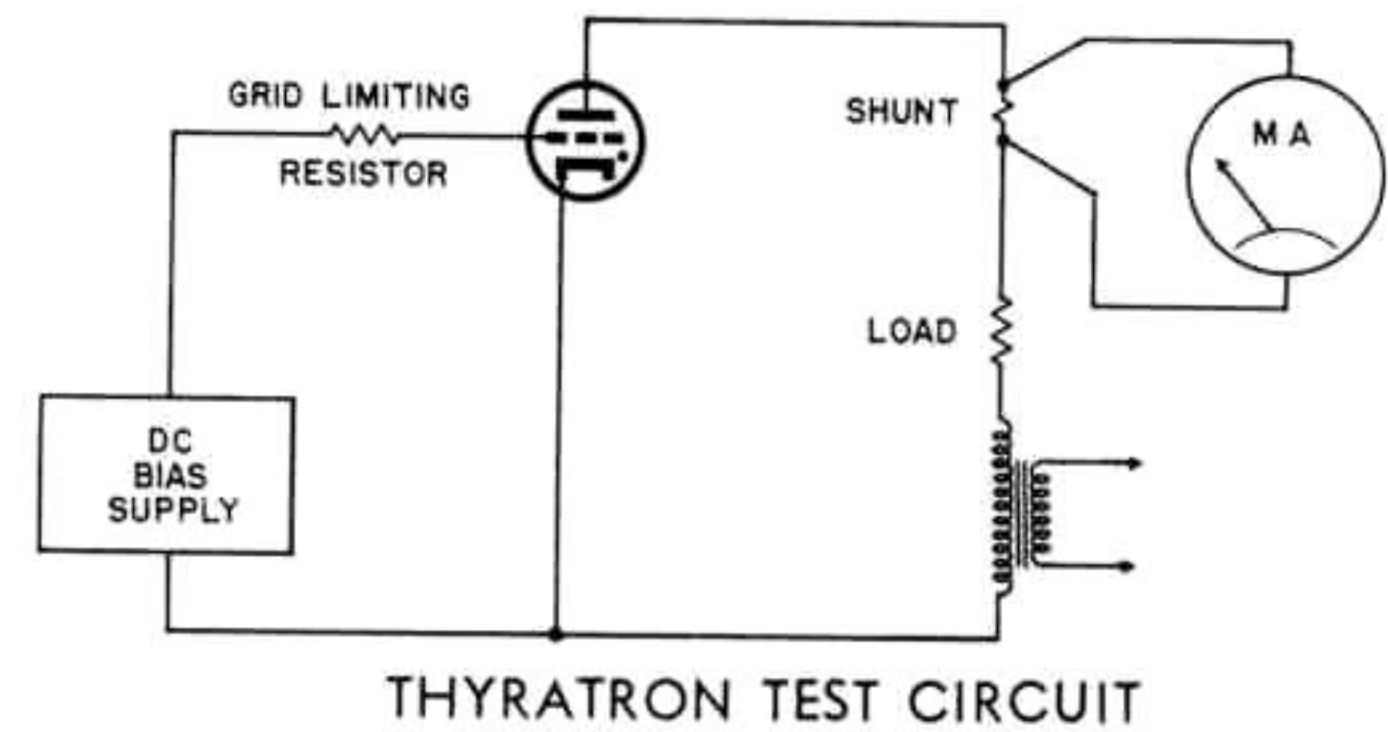


Fig. 5

Any thyatron which fails to cut-off within these limits does not have normal characteristics.

## VOLTAGE REGULATOR TEST CIRCUIT

Voltage regulators are checked with a DC potential applied to the anode and a super-imposed AC potential. The peak voltage is increased in steps until the minimum firing or ionizing voltage specified by the tube manufacturer is exceeded. The tube should fire or start to regulate within the limits specified in the roll chart if it is operating correctly. (See Fig. 6)

### VOLTAGE REGULATOR TEST CIRCUIT

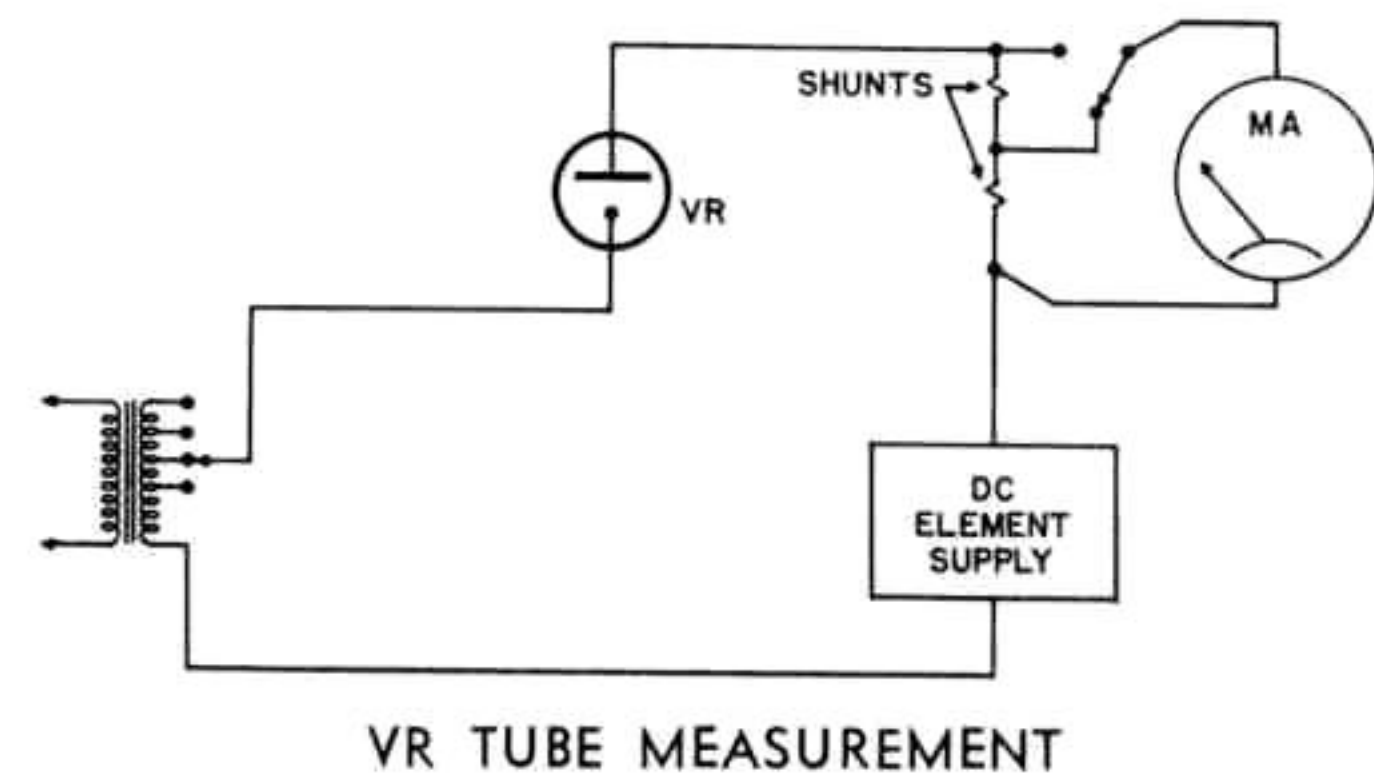


Fig. 6

## CATHODE RAY TUNING INDICATOR TEST CIRCUIT

Fig. 7 shows the basic tuning indicator circuit. The 1 meg resistor is used to drop the plate voltage so that the voltage directly at the plate will vary widely with grid bias and thus control the target shadow. The bias is then varied to control the shadow as noted on the roll chart.

### CATHODE RAY TUNING INDICATOR TEST CIRCUIT

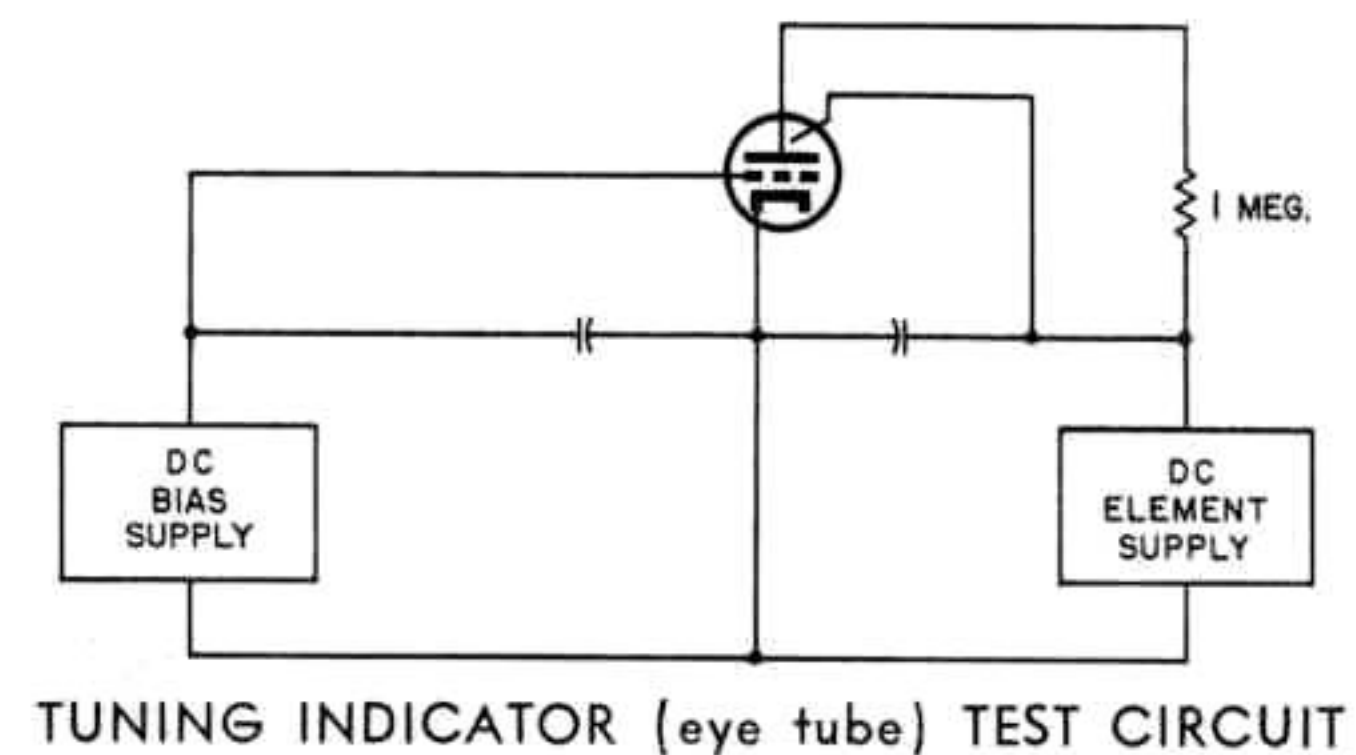


Fig. 7

# INSTALLATION AND INITIAL ADJUSTMENT

The Model 3444-A as received from the factory is ready for immediate use. Place the Tube-Analyzer on a solid bench or table within 6 feet of a 105-127 volt 50-60 cycle outlet.

Open the cover, take the line cord out of the accessory compartment and plug it into the AC line.

Set LINE VOLTAGE to its maximum counter-clockwise position.

Snap the ON-OFF switch to the ON position.

Set the SHORT-LEAKAGE switch to the VALUE position.

Press the LINE TEST switch and check to see that the instrument pointer can be set to the LINE TEST position by adjusting the LINE VOLTAGE control. The Tube Analyzer is now ready for operation.

To the right of the PUSH-BUTTON switches is located the Gm CHECK control. This is a combination push-button and variable potentiometer to check and adjust, if necessary, the 5 KHz signal voltage.

This check is made by first rotating and slightly pushing the Gm CHECK control until it engages the slot in the potentiometer, then with the VALUE (I) depressed, the control is adjusted until the meter reads full scale.

This check need only be made at periodic intervals to compensate for environmental changes.

To make the above check the SHORT-LEAKAGE switch must be in the value position and the D-Gm RANGE switch must be in positions 1, 2, 3, 4 or 5.

The regulated voltage supplied to the oscillator and microammeter makes it possible to check the output of the 5 KHz oscillator without removing tubes being tested from the analyzer.

On the tube socket panel, the GRID CAP, CATH. CAP and PLATE CAP jacks for top cap connection leads are located. These are used with the red and black leads found in the accessory compartment. Where it is necessary to test tubes having top cap connectors, one or both of these leads may be used. When not in use, these leads should be kept in the accessory compartment to avoid damage and to keep them out of the way of the various controls. Below the meter and between No. 5 and No. 6 element switches is the OVER-LOAD warning light which will light when an excessive load is placed on the tester. When this lamp glows at any time, the Tube-Analyzer should be turned off. All controls should then be carefully checked, and if no errors are found, the tube should be examined carefully for an intermittent short.

## THE CONTROLS

The A-FILAMENT switch is mounted in the top left corner and is clearly marked on the panel. In the tube data chart, under the column marked A, the correct setting is shown for each type of tube. Failure to make this adjustment correctly may result in burning out the filament of the tube under test.

To the left of the meter is mounted the control for the grid bias, B-BIAS. When testing amplifier tubes this control should be set for the correct bias condition specified on the tube data roll chart under the column marked B. This control is calibrated directly in volts, either 5 volts full scale or 50 volts full scale dependent upon the position of the C-PLATE VOLTAGE switch.

Located directly below the A-FILAMENT switch is the C-PLATE VOLTAGE switch which selects the plate and screen voltages for the tube under test, and also controls the range of the B-Bias control. Potentials ranging from 250 volts DC to 12 volts DC are available for amplifier tubes while AC voltages from approximately 300 volts to 15 volts are available for rectifier and diode types.

| C-Plate Voltage Position | DCV Plate | DCV Screen | Bias Range (DCV) |
|--------------------------|-----------|------------|------------------|
| 1                        | 250       | 250        | 0-5              |
| 2                        | 250       | 250        | 0-50             |
| 3                        | 250       | 100        | 0-50             |
| 4                        | 250       | 100        | 0-5              |
| 5                        | 100       | 100        | 0-5              |
| 6                        | 100       | 100        | 0-50             |
| 7                        | 100       | 45         | 0-50             |
| 8                        | 100       | 45         | 0-5              |
| 9                        | 30        | 30         | 0-5              |
| 10                       | 30        | 12         | 0-5              |
| 11                       | 12        | 12         | 0-5              |

Directly below the B-BIAS control is located the D-Gm RANGE switch.

The D-Gm RANGE switch has several functions. On positions 1-5 it selects full scale mutual conductance ranges from 1,000 through 60,000 micromhos. On amplifier types this switch must always be indexed to one of these ranges for a transconductance measurement. On the next two positions, No. 6 and No. 7, this switch provides full scale DC plate current, (Ip) readings of 15 and 150 milliamperes full scale respectively. These ranges are used for studying the plate current, grid current and cut-off characteristics of amplifier types. The eighth position is used for Thyratrons where a DC bias is applied to the control grid and an AC plate or anode potential used. Cut-off and control characteristics of these tubes are measured in this position. The ninth position is used for emission tests on rectifiers and diodes.

The ten element switches are located below the meter and across the panel from the lower left corner to the lower right corner. They are used to connect the tube base pins to the testing circuit. To set these switches correctly consult the roll chart under the column marked ELEMENTS. For example, numbers 03512-50040 will appear on the chart for the tube type 6S4. Working from left to right set the switches as indicated.

Located to the left of the PUSH-BUTTON VALUE switches is the SHORT-LEAKAGE switch, which when in the short test positions, disconnects all of the tube electrodes from the other tube testing circuits, and connects them into the leakage test circuit. By slightly tapping the tube under test at each of the five positions on this switch, leakage between the tube elements will be indicated by a deflection of the meter. If a filament type tube or a tube with internal heater-cathode connection is being tested, the meter should read full scale when the switch is in the H-K position. This is noted on the panel under the SHORT-LEAKAGE switch—"Directly Heated Cathodes Show Short on Position H-K".

| Switch Position | Leakage between                         |
|-----------------|---|
| H-K             | Heater to Cathode                       |
| G <sub>1</sub>  | Control Grid and other tube elements    |
| P               | Plate and other tube elements           |
| G <sub>2</sub>  | Screen Grid and other tube elements     |
| G <sub>3</sub>  | Suppressor Grid and other tube elements |
| VALUE           | Used for all other tests                |

Located in the center and at the bottom of the panel are the VALUE switches (1) (2) (3) and GAS push-button switches. Switch (1) when depressed activates the power supplies and measuring circuits necessary to check the tube,

or in the case of multi-section tubes, one section of the tube. Switch (2) when depressed disconnects P<sub>1</sub> and G<sub>1</sub> and connects P<sub>2</sub> and G<sub>2</sub> when testing multi-section tubes with common cathodes. (Note) Switch (1) must also be depressed when using switch (2). Switch (3) when depressed disconnects P<sub>1</sub>, G<sub>1</sub> and K<sub>1</sub> and connects P<sub>2</sub>, G<sub>2</sub> and K<sub>2</sub> when testing multi-section tubes with separate cathodes. (Note) Switch (1) must also be depressed when using switch (3).

The GAS switch is used in conjunction with the VALUE switches to check for grid current. (Note) When performing the gas test the D-Gm switch should be in positions 6 or 7.

To the right of the VALUE switches is the Gm CHECK control. The function and adjustment of this control is covered under "Installation and Initial Adjustment".

Between the Gm CHECK and the POWER switch is the LINE VOLTAGE control. Compensations for line voltage variations is accomplished by depressing the LINE TEST button, located between ELEMENT switch No. 1 and the SHORT-LEAKAGE control, and rotating the LINE VOLTAGE control till the meter pointer coincides with the line test mark on the meter. (NOTE) The SHORT-LEAKAGE switch must be in the VALUE position when adjusting the LINE VOLTAGE control.

## STEP BY STEP OPERATING INSTRUCTIONS

### TESTING AMPLIFIER TUBES

1. Set the LINE VOLTAGE control to the minimum voltage (extreme counter-clockwise position).
2. Plug the LINE CORD into a 105-127 volt, 50-60 cycle supply.
3. Set the SHORT-LEAKAGE switch to its VALUE position.
4. Locate the tube type number on the tube roll chart, and set the A-FILAMENT switch as specified in the A column.
5. Set the grid bias control B-BIAS as specified in the B column of the tube chart.
6. Set the ten ELEMENTS to their correct positions as specified in the ELEMENTS column of the tube roll chart.
7. Apply power by snapping the ON-OFF toggle switch to the ON position.
8. Plug the tube to be tested into the proper socket.
9. Rotate the C-PLATE VOLTAGE switch to the position specified in the C column of the tube roll chart.

10. Set the D-Gm RANGE switch to the position specified in the D column of the tube roll chart.

11. Press the LINE-TEST switch and turn the LINE VOLTAGE knob to set the instrument pointer exactly over the red LINE-TEST mark on the scale.

12. Check for a leakage indication with the SHORT-LEAKAGE switch in the H-K position. If a filament type tube is being tested, the meter will indicate approximately full scale deflection when the switch is in this position (no indication indicates open filament). Tap the tube lightly and observe momentary or sustained meter deflection changes.

13. Rotate the SHORT-LEAKAGE switch through the five leakage positions. While the switch is in each of these positions, tap the tube lightly and note any momentary or sustained meter deflection changes. On the H-K position the heater is isolated from the cathode, and all cathode to heater leakage resistance or intermittent shorts are measured in this position. On the G<sub>1</sub> position the Control Grid is isolated; on the P position the Plate is isolated; on the G<sub>2</sub> position the Screen Grid is isolated; and on the G<sub>3</sub> position the Suppressor Grid is isolated. If a multi-section tube is being checked, this procedure must be repeated for each section of the tube.



Refer to the NOTES column on the roll chart. This will usually indicate (1), (1&2) or (1&3) showing the tube has two sections to be tested. Depress the (2) or (3) switch, whichever is indicated in the NOTES column and repeat the short test procedure checking positions H-K thru  $G_3$  on the leakage switch for second section shorts. (Note) DO NOT depress switch (1) when performing short or leakage tests.

The abbreviations for the roll chart notes are:

- (1)  $P_1$
- (2)  $P_2$ 1K (one cathode)
- (3)  $P_2$ 2K (two cathodes)
- (4) Plate Cap
- (5) Grid Cap
- (6) Rectifier

F Indicates filament type tube (will show short on H-K position).

14. Set the SHORT-LEAKAGE switch to the VALUE position.

15. Depress the VALUE (1) switch. Read the mutual conductance of the tube on the range corresponding to the position of the D-Gm RANGE switch. On position 1 the meter reads directly in micromhos on the top or 1000 arc. On position 2 of this switch, the meter reads directly on the 2nd., or 3000 arc. On position 3, use the top, or 1000 arc, and add a zero, or multiply by ten for 10,000 micromhos full scale. On the 4th switch position, use the 2nd., or 3000 arc, and add a zero, or multiply by ten for 30,000 micromhos full scale. On the 5th position read directly off the 60 K scale.

Compare the reading with the figure listed in the roll chart or instruction book in the column headed REJ/AVG. The first figure X 1000 is the customary reject value in micromhos based on 65% of the average or published value for new voltage amplifiers and general purpose types, and about 50% of the average or "bogie" value for power amplifier and converter types. The second figure is the average or "bogie" value for that type tube.

#### EXAMPLE:

| Tube | A   | B  | C | D | Elements    | REJ/AVG<br>X 1K | Notes |
|------|-----|----|---|---|-------------|-----------------|-------|
| 6L6  | 6.3 | 21 | 2 | 3 | 01465-02300 | 2.4/4.7         | (1)   |

The reject value for a 6L6 is 2400 micromhos and the "bogie" value is 4700 micromhos.

16. If the tube has two plates, is a dual triode or has two sections more or less similar, the (1) and (1&2) notation will appear in the NOTES column. Refer to step number 13 where the short testing procedure is given for double section tubes, and be sure this procedure is followed before continuing with the Mutual Conductance measurement of the second section. If the tube has two separate cathodes such as is usually encountered in dual triodes, depress the (3) switch to the  $P_2$ 2K position and also depress the (1) switch. The instrument will then read the  $G_m$  of the second section. Where the two sections or plates of the tube share a common cathode, as shown in the NOTES column of the roll chart, use the  $P_2$ 1K position.

17. Tubes with unlike sections such as triode-heptodes, triode-pentodes and multi-diode-triodes are handled in one of two ways. Where it is practical, one setting of the ELEMENT switches programs the testing procedure for both sections. Here, different settings of B, C and/or D switches may be required for each section. Test the first section just as a single tube would be handled. Then make the settings for the B, C and/or D controls as required on the roll chart for the second position. Depress the (2) or (3) switch as indicated on the roll chart and depress the (1) switch to read the meter.

#### EXAMPLE:

| Tube | A   | B  | C  | D | Elements    | REJ/AVG<br>X 1K | Notes    |
|------|-----|----|----|---|-------------|-----------------|----------|
| 6T8  | 6.3 | 29 | 1  | 2 | 09812-03540 | .79/1.2         | (1)      |
|      | -   | 0  | 11 | 9 | - - -       | Diode           | (1&3)    |
|      | -   | -  | -  | - | 40012-93000 | Diode           | (1)(1&2) |

Where dashes (-) appear in the roll chart, the same setting of the controls is made as in the preceding test. The first test is made as in steps (1)-(15). The second test is made by changing B-BIAS, C-PLATE VOLTAGE and D-Gm RANGE switches only as noted, then note (1&3) on roll chart indicates to depress (3) in  $P_2$ 2K position while holding the (1) button in the depressed position and read the meter for good DIODE indication (should read above DIODE OK point on the scale.) The same procedure applies for the third test i. e. change ELEMENT switches only as noted on the chart leaving A, B, C, and D controls the same as the preceding (second) test, then note (1)(1&2) on roll chart indicates to use both  $P_1$  and  $P_2$ 1K so that two tests are made with one setting, both tests should indicate above DIODE OK point on the scale (the note DIODE under REJ/AVG column refers to this scale).

18. Some tubes with unlike sections may require two settings of the ELEMENT switches. In such cases each section should be treated as a separate tube. Make the first test as in steps (1)-(17). Make the new settings of the ELEMENT switches and then proceed with the second test as in steps (1)-(17).

#### GAS TEST

1. Where Gas or Grid Current readings are of interest, this test may follow the Mutual Conductance reading.

2. Switch the D-Gm RANGE control to position 7 with all other controls and switches remaining in the position listed on the chart for  $G_m$  readings.

3. Depress the indicated value switches and note the reading on the 3rd., arc from the top. This reads directly in milliamperes, zero to 150 ma. If the tube draws less than 15 ma., switch to position 15, but always try the 150 ma. range first to avoid any overload of the meter.

4. Check the plate current reading in ma., and then depress the VALUE (1) and the GAS buttons and again note the reading. The difference in milliamperes is caused by gas or grid current flowing thru a one megohm resistor introduced in the grid circuit. Grid or Gas Current varies widely for different tube designs, but on power amplifiers 2 micro-

amperes is often permissible. This is equivalent to 2 volt change in grid bias when the VALUE switch is shifted to the GAS position, caused by 2 microamperes multiplied by one (1) megohm. For a tube in the 2000 Gm region this would be about 4 ma. change in plate current for 2 microamperes of grid current; for a tube in the 5000 Gm region the change in plate current would be about 10 ma. for 2 microamperes of grid current.

5. The exact grid current can be determined by noting the grid current change as described above, returning the VALUE switch to the VALUE position, and by careful rotation of the B-BIAS control, find out how many volts of bias change cause the same change in plate current. Since the B-BIAS control reads directly in volts, either 0-50 or 0-5 volts, this bias change can be read directly. Multiply the figure in volts by  $10^{-6}$  to determine exact grid current. There is no signal applied to the tube on positions 5 thru 8 of switch D, so this Gas or Grid Current is the true value taken under operating conditions.

6. To determine the bias range of the B control, note the position to which the C switch is indexed, and refer to the following table or the one on page 6.

| C-PLATE-VOLTAGE<br>Switch Position | 0-5 DCV<br>Bias | 0-50 DCV<br>Bias |
|------------------------------------|-----------------|------------------|
| 1                                  | X               |                  |
| 2                                  |                 | X                |
| 3                                  |                 | X                |
| 4                                  | X               |                  |
| 5                                  | X               |                  |
| 6                                  |                 | X                |
| 7                                  |                 | X                |
| 8                                  | X               |                  |
| 9                                  | X               |                  |
| 10                                 | X               |                  |
| 11                                 | X               |                  |

### CUT OFF CHARACTERISTIC

1. On many applications of vacuum tubes, it is desirable to know the grid voltage necessary to reduce the plate current to zero, or "cut-off" the tube. This measurement can easily be made on the Ip or plate current positions of the D-Gm RANGE switch.

2. Use the roll chart settings for mutual conductance.

3. Switch the D-Gm RANGE to position 7.

4. Depress the VALUE (I) switch. The meter will read plate current on the 150 ma. range.

5. Rotate the B-BIAS control to increasing or higher bias voltage. The meter will indicate lower and lower plate current. Continue until the pointer just reaches zero.

6. Read the B-BIAS dial. Refer to the table above noting the C-PLATE VOLTAGE switch position and Bias range. This dial reads 0-5 or 0-50 approximate volts Bias depending on the position of the C-PLATE VOLTAGE switch. Read the cut-off bias in volts.

7. On dual triodes, this test is particularly important to determine balanced cut-off. Return B-BIAS control to its original position.

8. Repeat steps 1 thru 7 for 2nd section.

### TESTING RECTIFIER AND DIODE TYPES

1. All rectifiers and diodes are checked with the D-Gm RANGE switch in position 9 marked RECTIFIER.

2. In this position, the B-BIAS control is changed to a meter sensitivity or variable shunt to provide means for reading emission current over a wide range. It must be set correctly for each tube type.

3. Rotate the TEN ELEMENT switches to the correct positions.

4. Set A-FILAMENT and B-BIAS controls.

5. Plug tube in the correct socket.

6. Set C-PLATE VOLTAGE and D-Gm RANGE controls.

7. Set SHORT-LEAKAGE switch to VALUE position.

8. Press LINE-TEST button and adjust LINE VOLTAGE.

9. Check for shorts and leakage.

10. Depress VALUE (I) switch and read condition of Rectifier or Diode compared to the DIODE OK or RECT. OK arrows on the meter scale.

11. Repeat for dual tubes using the correct value switches as indicated on the roll chart.

### TESTING THYRATRONS

1. All thyatron tubes are tested with the D-Gm RANGE switch in position 8 marked THYRATRON. Here DC bias is applied to the control electrode, and AC potential at the power line frequency is applied thru a current limiting resistor to the anode. The most important measurements on thyratrons are control grid firing voltage, cut-off or extinction voltage and grid current.

2. Set A-FILAMENT and B-BIAS controls.

3. Index the TEN ELEMENT switches.

4. Plug tube in correct socket.

5. Set C-PLATE VOLTAGE and D-Gm RANGE controls.

6. Set SHORT-LEAKAGE switch to VALUE position.

7. Press LINE TEST button and adjust LINE VOLTAGE.

8. Check for shorts and leakage.

9. Depress No. (I) VALUE switch and hold.

10. Slowly rotate the B-BIAS dial to reduce the control grid bias until the instrument pointer suddenly deflects up-scale. Note the reading on the bias control.

11. From this position still depressing the VALUE switch, rotate the bias dial to increase the bias or negative control electrode voltage, and note the cut-off or extinction potential where the instrument pointer deflects to zero. The difference between these two bias dial readings is the firing range and should be within the limits shown in the chart. These readings may be converted to volts by referring to paragraph 6 under GAS TEST.

#### EXAMPLE:

| Tube | A   | B  | C | D | Elements    | REJ/AVG        | Notes                                     |
|------|-----|----|---|---|-------------|----------------|---|
| 2D21 | 6.3 | 40 | 1 | 8 | 53127-47000 | *Thyratron (I) |   |
|      |     |    |   |   |             |                | (* Fires from 40-10, cuts off from 10-40) |

Set up as indicated and while holding the VALUE switch down the tube should fire when rotating the B-BIAS control from 40 to 10 and should cut-off when B-BIAS is rotated from 10 to 40.

12. The tube may also be tested for grid current by repeating step 10. Note the exact value by checking the firing voltage two or three times.

13. Cut-off the tube.

14. Depress the VALUE (I) and GAS switches.

15. Slowly check the firing voltage. For most thyratrons, the low or 5 volt bias range is used on the B dial. Also the grid current limit usually published is not over 2 microamperes. This would be equivalent to 2 ua X 1 megohm or 2 volts. This is 20 divisions on the B-BIAS dial on the 5 volt range. Therefore if the tube has less than 2 ua grid current, the firing reading of the B-BIAS dial in the GAS position should not differ more than 20 divisions from the firing reading in the VALUE (I) position.

16. The anode current reading or magnitude of meter deflection should be over 9 on the Ip arc or above the Rectifier rejection limit unless otherwise noted.

#### TESTING VOLTAGE REGULATOR (VR) TUBES

1. Set the A-FILAMENT and B-BIAS controls.

2. Set the ELEMENT switches.

3. Set the C-PLATE VOLTAGE and D-Gm RANGE switches.

4. Plug the tube into the correct socket.

5. Rotate the A-FILAMENT switch to the position as noted on chart. Tube should fire when switch is at this position.

6. Read meter, it should read in RECT. OK section, unless otherwise noted on the roll chart.

#### EXAMPLE:

| Tube | A   | B | C | D | Elements    | REJ/AVG<br>X IK | Notes |
|------|-----|---|---|---|-------------|-----------------|-------|
| 0C3  | 1.4 | 0 | 5 | 7 | 02004-00000 | *               | (1)   |

(\* No leakage test. Increase A to 16.8, firing is indicated by upscale deflection.)

Make set up as noted and rotate A-FILAMENT control to 16.8 volts, tube should fire. The meter should now read in RECT. OK section, unless otherwise noted on the roll chart.

### INSTRUCTIONS FOR SETTING TUBES UP BY THE MANUFACTURERS TUBE DATA

Prior to starting this procedure, it is recommended the pages 4 through 8 in the 3444-A Instruction Manual be carefully read until familiar with their content.

1. In order to set a tube up by the manual, it is suggested that first of all, the maximum ratings of the tube elements be observed in the data given, and that they be kept in mind as the tube is being set up.

2. For familiarization with the procedure to be used, let us take a simple triode, the 6C4, and set it up. Refer to your tube manual, and pages 6 through 10 in the 3444-A Instruction Manual. Look for "Heater Characteristics" in the tube manual. The heater voltage indicated may be set up on the 3444-A by selecting the correct indicated value of the A-FILAMENT switch, in this case setting the arrow at the 6.3 volt mark.

3. The next two element settings are related, and must thus be considered carefully before selecting their values. Refer to the C-PLATE VOLTAGE chart at the bottom of page 6 on the Instruction Manual. You will note the three columns of voltages, and that selection of the proper Screen voltage, as well as the proper Bias voltage range, is dependent upon the selection of the correct C-PLATE VOLTAGE

### TESTING CATHODE RAY TUNING INDICATORS

1. Set the A-FILAMENT and B-BIAS controls.

2. Set the ELEMENT switches.

3. Set the C-PLATE VOLTAGE and D-Gm RANGE switches.

4. Plug the tube into correct socket.

5. Move B-BIAS control for 90° and for shadow closed as indicated on chart.

#### EXAMPLE:

| Tube | A   | B | C | D | Elements    | REJ/AVG | Notes |
|------|-----|---|---|---|-------------|---------|-------|
| 2E5  | 2.8 | 0 | 3 | 6 | 1Y543-20000 |         | (1)   |

B=0, 90 Degrees; B=11, Shadow Closed

Set up in normal manner following roll chart. With Bias (B) at "0" shadow will be open or 90 degrees, with (B) at 11 shadow should close.

### TESTING CATHODE RAY PICTURE TUBES

Cathode Ray Picture tubes can be tested with the TRIPLETT BV Adapter for duo-decal base picture tubes and Triplet CD & CE with BV Adapter for 110° picture tubes. These adapters are supplied on special order.

#### FILAMENT CONTINUITY TEST:

1. Plug a set of test leads into the Plate and Grid Cap Jacks.

2. Switch the Shorts-Leakage Switch to either P or G position.

3. Locate the tube type number on the tube Roll Chart and determine from the ELEMENT Setting which pins are connected to the filament of the tube.

(NOTE: Each switch position and its function is listed under LINE TEST CALIBRATION in the MAINTENANCE section of the Instruction Book.)

4. Clip one of the test leads to one of the filament pins. The meter will deflect to full scale when the other lead is connected to the second filament pin. If it does not the filament of the tube is open.

position. In the data for the 6C4 tube, refer to the "Typical Operation Characteristics." You may select either set of values given for Class A Amplifier. We will set the tube up using the 250 volt plate potential. Note also, the bias or control grid voltage specification, in this case — 8.5 volts. Now refer to the C-PLATE VOLTAGE chart on page 6 and note that positions #1, 2, 3 and 4 all will apply 250 volts plate potential, so obviously one of these four positions will be used for this tube. Next, observe that there is no screen grid on the 6C4, thus eliminating the Screen voltage as a factor of selecting the correct C-PLATE VOLTAGE position. You will next observe that there are two Bias voltage ranges available, 0-5 and 0-50 volts. Since we need — 8.5 volts bias, we must select the C-PLATE VOLTAGE position which will place the 0-50 bias voltage on the grid of the tube, and at the same time 250 volts on the plate.

The C-PLATE VOLTAGE switch must thus be on either position #2 or #3. Rotate to one of these positions.

4. Since the proper Bias range has been selected by the correct selection of the plate voltage switch, it is now necessary to adjust the B-BIAS control to the correct value. In the data, for the 250 volt plate operation a — 8.5 volt bias is needed. Set the B-BIAS control on 8.5 volts.

5. To select the correct value of D-Gm RANGE switch, refer to the manufacturers data, in this case for the 250 volt class A operation, the typical transconductance is 2200 micromhos. The D-Gm RANGE switch may thus be placed in the #2 (3K) position. In most cases it is desirable to set this switch one range higher to avoid possible past full scale meter deflections.

6. Next, the setting of the ELEMENT switches. Refer to the element schematic, and observe that there are seven pins which are used in the 6C4, which means that elements one through seven will be used. You will now refer to page 12 in the 3444-A Instruction Manual, where the ELEMENT switch positions and their circuit functions are indicated. It is best to make these selections by starting with the first pin of the tube, and working on around consecutively. You will note that pin number one is connected to the plate. Now refer to page 12, and note that the plate switch position is #4. You will thus, turn ELEMENT switch 1 to position #4. Proceeding, you see that tube pin #2 has no electrical connection, thus ELEMENT switch 2 should be placed on 0. Pin #3 of the tube shows an "x", which refers to the filament. Again referring to page 12 of the Manual, you will see that ELEMENT switch positions #1 and #2 are filament positions. Unless a tube specifies that one pin is to be positive and the other negative, polarity selection of the filament connections need not be noted. We may now set ELEMENT switch 3 in position #1. Pin #4 is next; note that the filament return is at that position. You must place the other side of the filament circuit on this pin, thus if you used position #1 on ELEMENT 3, you must use position #2 on ELEMENT 4, and set switch as such. Pin #5 indicates a connection to the plate, and as referenced on page 12, ELEMENT switch 5 is also placed at the #4 position, as this tube has only one plate. Tube pin #6 is connected to the control grid of the tube (G), which function may be obtained by setting ELEMENT switch 6 in the #5 position. Pin #7 you will see is connected to the cathode, and referring to page 12 again, you see that ELEMENT switch position #3 is the cathode position. Set ELEMENT switch 7 to position #3.

7. Check through your set up again to be sure switches have been positioned correctly. Plug the tube into the socket, and proceed with the testing as indicated in the STEP BY STEP INSTRUCTIONS on page 7 of the Instruction Manual.

This set up of a simple triode is merely to illustrate the manner in which a tube may be set up from a tube manual. More complex tubes may be set up by going through the same procedure and referring to the ELEMENT switch position functions, for instance, tubes with screen grids, suppressor grids, and dual section tubes. The dual section will use the separate functions for each side, that is plate #1, control grid #1, and cathode #1, for one side; plate #2, control grid #2, and cathode #2 for the second side. Use of the VALUE (2) (3) switches will be governed by the number of plates and cathodes in a tube, as described on page 8 of the Manual.

#### NOTES:

(a) Many tubes may be set up on the 3444-A at exact tube manual values. For testing those which do not have the same exact voltage values, such as plate and screen voltage, always observe the maximum rating of the tube. It is best to use the next lower value of plate and screen voltages than typical operation calls for if typical operation is not the exact voltage available on the 3444-A.

A representative indication of the condition of these tubes may be obtained by setting them up and switching the D-Gm RANGE switch to the "Plate Current" position applicable to the plate current requirements of the tube in typical operation. Next, pull the value lever, and adjust the B-BIAS control to the plate current value indicated as typical. Rotate the D-Gm RANGE switch back to the applicable Gm or transconductance range, pull the value lever, and read Gm on the tube.

(b) On tubes which require connections to external plate, grid, or cathode caps, it must be noted that the caps are connected electrically to the test circuit when the VALUE SWITCHES (2) (3) are in the up position. On dual section tubes which have caps, set up one section at a time, making two tests.

CAUTION: The maximum plate current which should be used on the 3444-A is 150 milliamperes. For tubes to be set up which exceed this value, it will be necessary to set the tubes up on a different portion of the curve, at 150 milliamperes plate current or less.

## PRECAUTIONS

### AGAINST HARM TO OPERATOR, TUBE AND TUBE-ANALYZER

1. Do not plug Model 3444-A into a DC line. Be sure the power line to be used is a 105-127 volt 50-60 cycle source.

2. Do not turn on Tube-Analyzer with LINE CONTROL near its extreme clockwise position.

3. Do not insert a tube in a socket before setting the A-FILAMENT switch and the ELEMENT switches.

4. Do not change the position of the A-FILAMENT switch when any tube except a VR tube is in one of the test sockets.

5. Consult the tube data roll chart before setting the C and D controls.

6. Observe OVERLOAD light, and immediately shut off the Tube-Analyzer if it lights up.

### TO AVOID FAULTY READINGS AND MISINTERPRETATIONS

1. Read the correct scale.

2. Understand the divisions on each scale.

3. Follow step-by-step instructions.

4. If the meter lamp or the roll chart lamps become excessively dim, a SHORT-LEAKAGE test should be made immediately to ascertain if the tube has developed a short, i. e., a shorted filament overloading the heater circuit without showing on the overload lamp. If so, the tube should be immediately removed from the socket to prevent damage to the tube tester.

# MAINTENANCE

## INPUT OVERLOAD

If the INPUT OVERLOAD lamp lights up, it indicates a short or overload condition exists somewhere in the tube analyzer, or in the tube being tested. It is in series with the primary of the power transformer, and as above, the condition causing this overload should be located before proceeding.

NOTE: Some tubes which draw a large current such as the 5U4 will cause a slight or dim glow. This is not an overload.

## FUSE

If a fuse has blown, remove the roll chart so that the bayonet-type 3 amp. removable fuse may be replaced. This fuse is located in the lower right corner inside the roll chart compartment.

## G<sub>m</sub> CHECK

To check the G<sub>m</sub> calibration, follow procedure outlined under INSTALLATION and INITIAL ADJUSTMENT on page 6. Be sure line test adjustment is exact before touching this adjustment.

## LINE TEST CALIBRATION

1. Set A-FILAMENT to 6.3 volts.
2. Set all ELEMENT switches to 0 position except Switch 1 which is to be set on position 1 and switch 2 which is to be set on position 2.
3. Set SHORT-LEAKAGE switch to VALUE position.
4. Set C-PLATE VOLTAGE switch to #1 position.
5. Set D-G<sub>m</sub> RANGE switch to #1 position.
6. B-BIAS dial not used.
7. Turn tester ON and allow to warm up for 15 minutes.
8. Use an accurate AC voltmeter ( $\pm 1/2\%$  or better) with sensitivity of at least 5,000 ohms per volt and connect across pins #1 and #2 in parallel with an 18 ohm, 5 watt load.
9. Note the meter reading while adjusting the LINE VOLTAGE control for LINE TEST.
10. If at 6.3 volts, the alignment of the LINE TEST is off, no attempt should be made to change the calibration resistor R4 unless absolute certainty of the accuracy of the voltmeter is known to be  $\pm 1/2\%$  at 6.3 volts.

NOTE—Due to the importance of this adjustment it is recommended that it be made only at the factory or Field Service Station.

## TO REPLACE ILLUMINATION LAMPS

Roll chart lamps may be replaced by first removing the roll chart from its compartment, then remove the lights by compressing the bracket of the socket so that it can be removed from the base plate of the roll chart assembly. Remove the defective lamp and replace with a 6.3V (GE #47 or equivalent) bayonet type lamp.

To replace the meter lamp, unscrew the four corner screws to remove the meter front. Replace the defective lamp with a 6.3V bayonet type lamp (GE #44 or equivalent.)

To replace the overload light, remove Analyzer from case by removing the 8 panel screws and the transformer support screw on the bottom of the case. The overload light is then replaced with a No. 43 or equivalent bulb.

NOTE: The ELEMENT switch numbers encircled on the panel refer to the tube socket pin numbers and the following switch positions indicate these functions:

| Switch Pos. | Function  |
|-------------|---|
| 0           | OFF   |
| 1           | FIL (—)   |
| 2           | FIL (+)   |
| 3           | K <sub>1</sub> (Cathode #1)                                       |
| 4           | P <sub>1</sub> (Plate #1)   |
| 5           | G <sub>1</sub> (Control Grid #1)                                  |
| 6           | G <sub>2</sub> (Screen Grid)                                      |
| 7           | G <sub>3</sub> (Suppressor)                                       |
| 8           | K <sub>2</sub> (Cathode #2)                                       |
| 9           | P <sub>2</sub> (Plate #2)   |
| X           | G <sub>1</sub> (Control Grid #2)<br><sup>2</sup> (Second section) |
| Y           | Plate for Eye Tubes   |

Note also that the combination 4-5-6 pin socket has the following pin element numbering:

| 4-pin<br>Use<br>ELEMENT |       | 5-pin<br>Use<br>ELEMENT |       | 6-pin<br>Use<br>ELEMENT |       |
|-------------------------|-------|-------------------------|-------|-------------------------|-------|
| Pin #                   | Sw. # | Pin #                   | Sw. # | Pin #                   | Sw. # |
| 1                       | 1     | 1                       | 1     | 1                       | 1     |
| 2                       | 2     | 2                       | 2     | 2                       | 2     |
| 3                       | 3     | 3                       | 3     | 3                       | 3     |
| 4                       | 6     | 4                       | 5     | 4                       | 4     |
|                         |       | 5                       | 6     | 5                       | 5     |
|                         |       |                         |       | 6                       | 6     |

## TRANSFORMER LUG VOLTAGES

| Lug No. | Voltage | Lug No. | Voltage |
|---------|---------|---------|---------|
| 1       | 195     | 17      | 7.5     |
| 2       | —       | 18      | 6.3     |
| 3       | 8.4     | 19      | 5.0     |
| 4       | 10.5    | 20      | 4.7     |
| 5       | 18.9    | 21      | 4.2     |
| 6       | 26.0    | 22      | 3.15    |
| 7       | 70.0    | 23      | 1.25    |
| 8       | 117.0   | 24      | 0       |
| 9       | 0       | 25      | —       |
| 10      | 18.0    | 26      | —       |
| 11      | 30.0    | 27      | —       |
| 12      | 83.0    | 28      | 2.8     |
| 13      | 9.5     | 29      | 2.35    |
| 14      | 12.6    | 30      | 2.0     |
| 15      | 34.0    | 31      | 1.4     |
| 16      | 50.0    | 32      | 0.63    |
|         |         | 33      | 16.8    |

## INSTALLING NEW ROLL CHART

From time to time there will be a new roll chart to install. This will be only a few minutes work if you follow these instructions.

1. Remove the roll chart assembly from tube analyzer.
2. Remove the two screws and take off the rear panel of the roll chart assembly.

3. Roll chart to the extreme end on the top roller. Remove tape holding chart to roller. Pull out chart and remove tape from top roller.

4. Thread new chart under bottom roller up to top roller and tape chart to roller. Take special care that the chart is taped straight on the roller. Roll chart on top roller fairly loose. Now tape bottom chart to the bottom roller. If the chart has not been rolled loosely on the rolls it will bind when rolled to the extreme ends.

# CROSS REFERENCE TO TUBE TYPES

| Tube Type | Listed Under | Tube Type | Listed Under | Tube Type | Listed Under |
|-----------|--------------|-----------|--------------|-----------|--------------|
| 2B22      | R6279        | DL92      | 3S4          | EN93      | 6D4          |
| 6AG6      | EL33         | DL93      | 3A4          | EQ80      | 6BE7         |
| 6F18      | 6EC7         | DL94      | 3V4          | EY80      | 6U3          |
| 6/30L2    | 6GA8         | DL95      | 3Q4          | EY88      | 6AL3         |
| 6GE7      | 6DL7         | DL96      | 3C4          | EZ35      | 6X5          |
| 10F18     | 10EC7        | DL98      | 3B4          | EZ90      | 6X4          |
| 12A/11A   | 12A          | DM70      | 1M3          | G84       | 2Z2          |
| 30F5      | 7ED7         | DP61      | 6AK5         | GZ30      | 5Z4          |
| 30FL1     | 9GB8         | E80CC     | 6085         | GZ32      | 5V4          |
| 30P4      | 25GF6        | E80CF     | 7643         | H63       | 6F5          |
| 30P12     | 12FB5        | E80L      | 6227         | HABC80    | 19T8         |
| 30PL1     | 13GC8        | E80F      | 6084         | HBC90     | 12AT6        |
| 5I        | 35           | E83F      | 6689         | HBC91     | 12AV6        |
| 57S       | 57           | E88CC     | 6922         | HD14      | 1H5          |
| X99       | 99           | E90CC     | 5920         | HD30      | 3B4          |
| 108C1     | 0B2          | E180CC    | 7062         | HF93      | 12BA6        |
| 150C2     | 0A2          | E180F     | 6688         | HF94      | 12AU6        |
| 150C3     | 0D3          | E182CC    | 7119         | HK90      | 12BE6        |
| 396A      | 2C51         | E188CC    | 7308         | HL92      | 50C5         |
| 403B      | 5591         | EA76      | 5647         | HL94      | 30A5         |
| 417A      | 5842         | EAA91     | 6AL5         | HM04      | 6BE6         |
| 482B      | 182B         | EABC80    | 6AK8         | HY90      | 35W4         |
| 483       | 183          | EB34      | 6H6          | KH183     | 3EH7         |
| 585       | 50           | EB91      | 6AL5         | KR1       | 1V           |
| 1003      | 0Z4          | EBC81     | 6BD7         | KR5       | 6A4          |
| 1649      | 6AC7         | EBC90     | 6AT6         | KR25      | 2A5          |
| 1662      | 3A4          | EBC91     | 6AV6         | KR98      | 6Z4          |
| 2523NI    | 128A         | EBF80     | 6U8          | L77       | 6C4          |
| 5913      | 6007         | EBF89     | 6DC8         | N14       | 1C5          |
| 6046      | 25L6         | EC80      | 6Q4          | N17       | 3S4          |
| 6187      | 6AS6         | EC86      | 6CM4         | N18       | 3Q4          |
| 6678      | 6U8          | EC90      | 6C4          | N19       | 3V4          |
| 6687      | E91H         | EC92      | 6AB4         | N144      | 6AM5         |
| 7034      | 4X150A       | ECC33     | 6SN7         | OE3       | 85A1         |
| 18042     | 6086         | ECC83     | 12AX7        | PC86      | 4CM4         |
| A2521     | 6CR4         | ECC85     | 6AQ8         | PCC85     | 9AQ8         |
| AX9903    | 5894         | ECC86     | 6GM8         | PCC88     | 7DJ8         |
| B152      | 12AT7        | ECC88     | 6DJ8         | PCF80     | 9A8          |
| B309      | 12AT7        | ECC91     | 6J6          | PCF82     | 9U8          |
| BPM04     | 6AQ5         | ECC189    | 6ES8         | PJ7       | 5742         |
| CIJ       | 5683         | ECF82     | 6U8          | PL81      | 21A6         |
| CK568AX   | 5677         | ECF86     | 6HG8         | PL82      | 16A5         |
| CK569AX   | 5678         | ECH81     | 6AJ8         | PL83      | 15A6         |
| CK1003    | 0Z4          | EF22      | 7G7          | PM04      | 6BA6         |
| DA90      | 1A3          | EF86      | 6267         | PY80      | 19X8         |
| DAC32     | 1H5          | EF93      | 6BA6         | QV03-12   | 5763         |
| DAF91     | 1S5          | EF94      | 6AU6         | QV06-20   | 6146         |
| DAF92     | 1U5          | EF95      | 6AK5         | RR3-250   | 3B28         |
| DAF96     | 1AH5         | EF183     | 6EH7         | U25       | 2L2          |
| DCC90     | 3A5          | EF184     | 6EJ7         | U78       | 6X4          |
| DDR7      | 6AM5         | EH90      | 6CS6         | UI47      | 6X5          |
| DF33      | 1N5          | EK90      | 6BE6         | V2M70     | 6X4          |
| DF60      | 5678         | EL37      | 6L6          | W17       | 1T4          |
| DF62      | 1AD4         | EL81      | 6CJ6         | X17       | 1R5          |
| DF91      | 1T4          | EL86      | 6CW5         | X155      | 55           |
| DF92      | 1L4          | EL91      | 6AM5         | XCC189    | 4ES8         |
| DF96      | 1AJ4         | EL94      | 3V4          | XFI84     | 3EJ7         |
| DH63      | 6Q7          | EL620     | 5672         | XL        | 7A4          |
| DH77      | 6AT6         | EL821     | 6CH6         | XXB       | 3C6          |
| DK91      | 1R5          | EM80      | 6BR5         | XXD       | 14AF7        |
| DL33      | 3Q5          | EM81      | 6DA5         | XY88      | 16AQ3        |
| DL35      | 1C5          | EN70      | 5643         | Z63       | 6J7          |
| DL36      | 1Q5          | EM84      | 6FG6         | ZD17      | 1S5          |
|           |              | EN92      | 5696         |           |              |

# REPLACEABLE PARTS

| REF. NO.                     | REQ. | DESCRIPTION                         | PART NO. |
|------------------------------|------|-------------------------------------|----------|
| M                            | 1    | Meter                               | 52-3914  |
|                              | 16   | Knob, Pointer Type                  | 34-64    |
|                              | 1    | Knob, Round                         | 2558-1   |
|                              | 1    | Socket Panel (Complete Assembly)    | 28-927   |
| X3, X4, X5, X6, X7           | 5    | Diode (Rectifier)                   | 2250-55  |
| X9                           | 1    | Zener Diode                         | 2250-63  |
| X1, X8                       | 2    | Diode                               | 2250-64  |
| X2                           | 1    | Rectifier                           | 2250-65  |
| Q1, Q2, Q4, Q5, Q6           | 5    | Transistor (2N3394)                 | 127-29   |
| Q3                           | 1    | FET (Motorola MPF 103)              | 127-26   |
| SW1 thru SW10                | 10   | Element Switches                    | 22-548   |
| SW11                         | 1    | Short-Leakage Switch                | 22-326   |
| SW12                         | 1    | Pushbutton Switch (Value and Gas)   | 22-549   |
| SW13                         | 1    | Pushbutton Switch (Line Test)       | 22-250   |
| SW14                         | 1    | Pushbutton Switch (Gm Check)        | 22-335   |
| SW15                         | 1    | Plate Voltage Switch                | 22-547   |
| SW16                         | 1    | Filament Switch                     | 22-334   |
| SW17                         | 1    | Plate Voltage Switch                | 22-325   |
| SW18                         | 1    | ON-OFF Toggle Switch                | 22-116   |
| BD2                          | 1    | Power Supply Circuit Board Assembly | 87-156   |
| BD4                          | 1    | Amplifier Circuit Board Assembly    | 87-157   |
| BD6                          | 1    | Main Power Supply Board Assembly    | 203-197  |
| BD8                          | 1    | Pushbutton Circuit Board Assembly   | 87-158   |
| R1, R8, R16                  | 3    | Resistor, 1 Meg. ohm                | 15-824   |
| R2, R47                      | 2    | Resistor, 2.2K ohm                  | 15-1188  |
| R3                           | 1    | Resistor, 825K ohm                  | 15-3818  |
| *R4                          | 1    | Resistor, 47K-91K ohm               |          |
| R5                           | 1    | Resistor, 588K ohm                  | 15-5193  |
| R6                           | 1    | Resistor, 2K ohm                    | 15-1012  |
| R7                           | 1    | Resistor, 47 ohm                    | 15-1538  |
| R9                           | 1    | Resistor, 33.3 ohm                  | 15-3075  |
| R10                          | 1    | Resistor, .67 ohm                   | 15-5081  |
| R11                          | 1    | Resistor, 6.02 ohm                  | 15-5082  |
| R12                          | 1    | Resistor, 466.8 ohm                 | 15-5083  |
| R13                          | 1    | Resistor, 133.4 ohm                 | 15-5084  |
| R14, R15                     | 2    | Resistor, 33.3 ohm                  | 15-3039  |
| R17                          | 1    | Resistor, 5K ohm, Variable          | 16-196   |
| R18, R37, R52, R53,          | 4    | Resistor, 4.7K ohm                  | 15-1687  |
| R19                          | 1    | Resistor, 5K ohm                    | 16-195   |
| R20                          | 1    | Resistor, 20 ohm                    | 15-3045  |
| R21, R22                     | 2    | Resistor, 10K ohm                   | 15-1272  |
| R23                          | 1    | Resistor, 2K ohm                    | 15-3056  |
| R24                          | 1    | Resistor, 5.6K ohm                  | 15-1483  |
| R25                          | 1    | Resistor, 150K ohm                  | 15-4836  |
| R26                          | 1    | Resistor, 75K ohm                   | 15-1166  |
| R27                          | 1    | Resistor, 1750 ohm, Variable        | 16-62    |
| R28                          | 1    | Resistor, 2K ohm                    | 3995     |
| R29                          | 1    | Resistor, 175 ohm, Variable         | 8595     |
| *R30                         | 1    | Resistor, 47K-91K ohm               |          |
| *R31                         | 1    | Resistor, 1K-5.1K ohm               |          |
| R32                          | 1    | Resistor, 30K ohm                   | 15-1115  |
| R33                          | 1    | Resistor, 3.16 ohm                  | 15-1256  |
| R34                          | 1    | Resistor, 1500 ohm                  | 15-2480  |
| R35                          | 1    | Resistor, 10K ohm                   | 15-5113  |
| R36                          | 1    | Resistor, 5K, Variable              | 16-193   |
| R38                          | 1    | Resistor, 64K ohm                   | 15-2296  |
| R39                          | 1    | Resistor, 2.7K ohm                  | 15-5091  |
| R40, R41, R42, R43, R44, R49 | 6    | Resistor, 33K ohm                   | 15-2507  |
| R45                          | 1    | Resistor, 100K ohm                  | 15-5044  |
| R46                          | 1    | Resistor, 270K ohm                  | 15-1885  |
| R48                          | 1    | Resistor, 1K ohm                    | 15-4835  |
| R50                          | 1    | Resistor, 500 ohm, Variable         | 16-197   |
| R51                          | 1    | Resistor, 1 Meg. ohm, Variable      | 16-173   |
| R54                          | 1    | Resistor, 470 ohm                   | 15-5087  |
| R55                          | 1    | Resistor, 150 ohm                   | 15-5088  |
| R56                          | 1    | Resistor, 1333.2 ohm                | 15-5085  |

\* Calibration Resistors



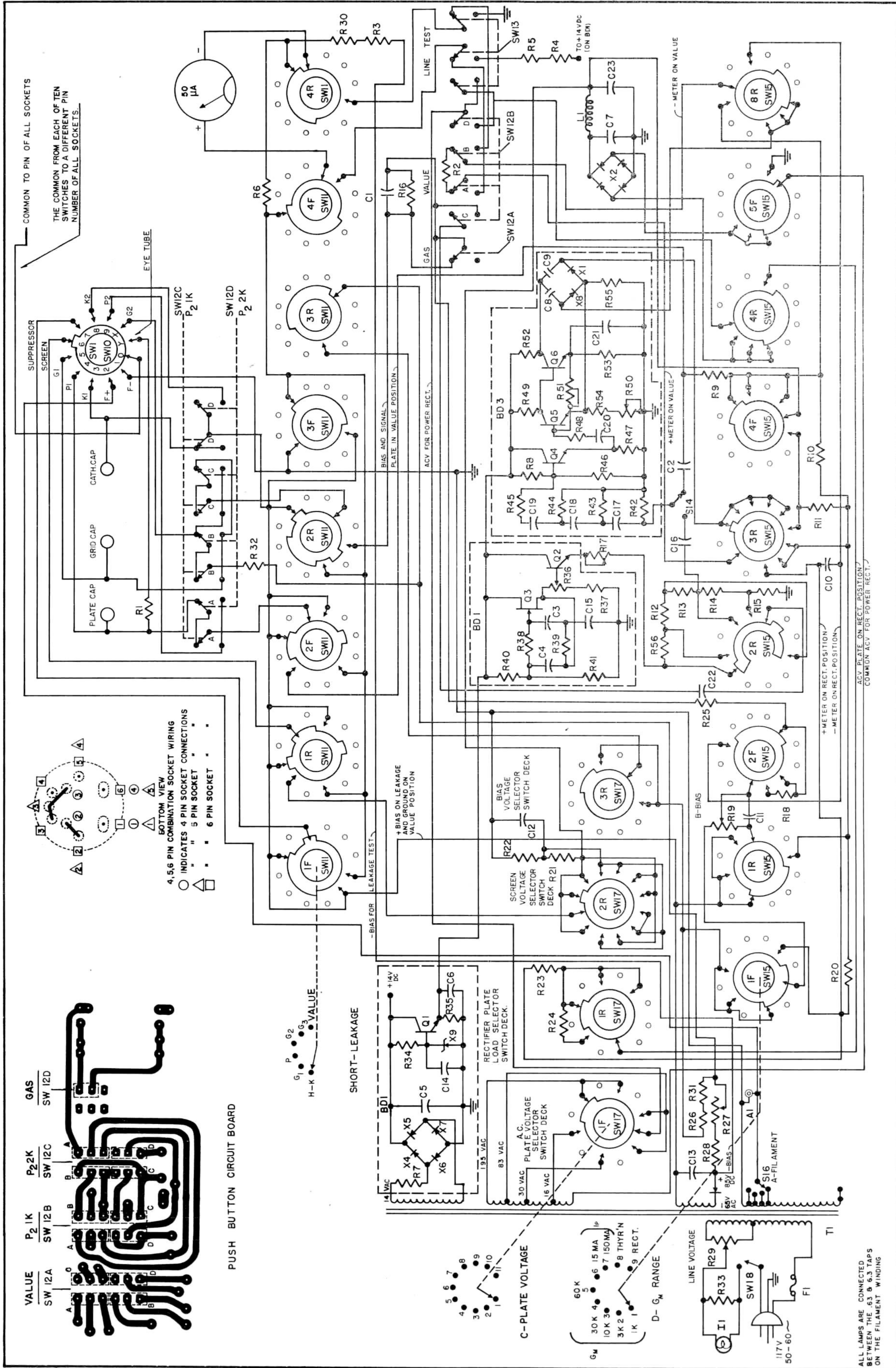
# REPLACEABLE PARTS

| REF. NO.           | REQ. | DESCRIPTION                       | PART NO. |
|--------------------|------|-----------------------------------|----------|
|                    | 1    | Socket, 4-5-6 Pin Combination     | 2455-202 |
|                    | 1    | Socket, 7 Pin With Pilot Socket   | 2455-165 |
|                    | 1    | Socket, 7 Pin Miniature           | 2455-59  |
|                    | 1    | Socket, 5-6-7 Pin Subminiature    | 2455-80  |
|                    | 1    | Socket, 8 Pin Subminiature        | 2455-162 |
|                    | 1    | Socket, Octal                     | 2455-164 |
|                    | 1    | Socket, 9 and 10 Pin Miniature    | 2455-234 |
|                    | 1    | Socket, 10 Pin Decal              | 2455-280 |
|                    | 1    | Socket, Loctal                    | 2455-163 |
|                    | 1    | Socket, 7 Pin Septar              | 2455-248 |
|                    | 1    | Socket, Acorn                     | 2455-159 |
|                    | 1    | Socket, 9 Pin Novar               | 2455-242 |
|                    | 1    | Socket, 12 Pin Compactron         | 2455-237 |
|                    | 1    | Socket, 5 Pin Nuvistor            | 2455-222 |
|                    | 1    | Socket, 7 Pin Nuvistor            | 2455-281 |
|                    | 1    | Socket, Lighthouse                | 2455-219 |
|                    | 10   | Capacitor, 470 MMFD               | 43-149   |
| C1                 | 1    | Capacitor, .03 MFD                | 43-222   |
| C2, C16            | 2    | Capacitor, .01 MFD                | 43-198   |
| C3                 | 1    | Capacitor, .001 MFD               | 43-289   |
| C4                 | 1    | Capacitor, .0033 MFD              | 43-290   |
| C5, C6             | 2    | Capacitor, 50 MFD                 | 43-277   |
| C7, C23            | 2    | Capacitor, 50 MFD                 | 43-221   |
| C8, C9             | 2    | Capacitor, 5 MFD                  | 43-281   |
| C10, C11, C12, C13 | 4    | Capacitor, 30 MFD                 | 43-103   |
| C14                | 1    | Capacitor, 30 MFD                 | 43-279   |
| C15                | 1    | Capacitor, .0022 MFD              | 43-291   |
| C17, C18, C20      | 3    | Capacitor, .01 MFD                | 43-244   |
| C19                | 1    | Capacitor, .0015 MFD              | 43-292   |
| C21                | 1    | Capacitor, 10 MFD                 | 43-282   |
| C22                | 1    | Capacitor, 1.0 MFD                | 43-199   |
| II                 |      | Lamp, No. 43                      | 67-105   |
| LI                 |      | Choke                             | 3022-55  |
| TI                 |      | Power Transformer                 | 23-187   |
| FI                 | 1    | Fuse, 3 Amp, 250 Volt 3AG         | 3207-12  |
|                    | 1    | Lead Assembly (1 Red and 1 Black) | 79-146   |
|                    | 1    | Carrying Case                     | 10-2388  |
|                    | 1    | Roll Chart Assembly               | 12086    |
|                    | 1    | Roll Chart and Data               | 84-177   |
|                    | 1    | Chart Supplement                  | 84-179   |





# WIRING DIAGRAM 3444-A TYPE 1



# WARRANTY

The Triplett Electrical Instrument Company ("TRIPLETT") warrants the products manufactured by it to be free from defective material or factory workmanship and agrees to repair or replace such products which under normal use and service, disclose the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing or replacing any product which proves to be defective when returned to us transportation prepaid, within ninety (90) days from the date of original purchase by the user.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons or service stations in any way so as, in our judgment, to injure their stability or reliability or which have been subject to misuse, negligence, an accident, or which have had the serial number altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, or adjusted otherwise than in accordance with the instructions furnished by us. Accessories including all vacuum tubes, transistors and batteries not of our manufacture used with this product are not covered by this warranty.

Triplett reserves the right to discontinue models at any time, or change specifications or design, without notice and without incurring any obligation.

Upon acceptance of the products the purchaser assumes all liability for any damages and bodily injury which may result from the use or misuse of the products by the purchaser, his employees, or others, and Triplett incurs no liability for direct consequential damages of any kind.

Parts will be made available for a maximum period of five (5) years after the manufacture of the product has been discontinued. Parts include all materials, charts, instructions, diagrams, accessories, et cetera, which were furnished in the standard or special models.

This warranty and conditions of sale are in lieu of all others expressed or implied and no representative or person is authorized to assume for us any liability other than stated herein.

## REPAIR AND SERVICE

The Triplett Company suggests when you send your tester in for repair or service you indicate the nature of service required. By supplying this information the Triplett Company or our service stations can serve you better and you will receive your tester back in less time.

THE TRIPLETT ELECTRICAL INSTRUMENT COMPANY  
Bluffton, Ohio 45817