OPERATING INSTRUCTIONS

FOR

Model 500

DYNA-QUIK

DYNAMIC MUTUAL CONDUCTANCE
TUBE TESTER

B & K MANUFACTURING COMPANY
3726 North Southport Avenue
Chicago 13, Illinois

Information on Your New DYNA-QUIK Model 500 Tube Tester

WHAT IT WILL DO

No. 1—The DYNA-QUIK Model 500 Tube Tester will check more than 95% of the tubes most widely used in television receivers. It will enable you to check these tubes in an incredibly short time because you only have to set a minimum number of controls.

No. 2—The tester will provide accurate results because it checks tubes for their Dynamic Mutual Conductance (Gm) in a true transconductance bridge. Diodes are checked for emission only, since they possess no mutual conductance.

No. 3—Each tube is automatically checked for short circuits and leakage up to 1 megohm. These tests are made between heater and cathode, grid and cathode, grid and plate, and screen grid and plate. Furthermore, this test is made before the Gm measurement.

No. 4—The DYNA-QUIK tube tester will permit you to judge the probable useful life remaining in a tube by means of a special life test.

No. 5—Gas, grid contamination, or even obscure grid-to-cathode leakage are all disclosed by an exceptionally sensitive grid current check. This test will reveal as little as 2 microamperes of current in the grid circuit.

General Information on Your DYNA-QUIK Model 500

TESTING TUBES FOR DYNAMIC MUTUAL CONDUCTANCE

In radio and television circuits practically all tubes (except for rectifiers and diodes) are used as some type of amplifier. Even oscillator circuits (i.e.— R.F. or horizontal oscillators) are just basically amplifiers with regenerative feedback. Therefore, the most important characteristic to be checked to determine how effectively any radio and TV tube will function in its circuit, is its ability to amplify. This, in turn, is governed by its mutual conductance.

The Mutual Conductance is the ratio of the change in plate current that results from a small change in grid voltage.

$$G_m = \frac{\Delta I_p}{\Delta E_g}$$

where:
ΔI_p = a change in plate signal current.
ΔE_g = a small change in grid signal voltage.

The amplification of a circuit is = $G m R_L$

Where R_L is the equivalent load resistance of the stage.

Since R_L is constant in any circuit, we see that the amplification depends directly on the $G m$ of the tube.

The $G m$ for a given tube can be measured accurately if a small given a.c. signal voltage is applied to the grid and the resultant a.c. plate current measured. This is done by means of a sensitive bridge circuit.

Measuring the mutual conductance of a tube provides the most accurate and all inclusive single test that can be made on any tube.

TESTING DOUBLE TRIODES AND OTHER MULTIPLE TUBES

In order to quickly test double triodes and other dual tubes, the Mutual **Conductance** of the two halves of the tube in parallel is measured. In Figure (1), **we see** that if the same signal voltage $\triangle Eg$ is applied to the grid of V_1

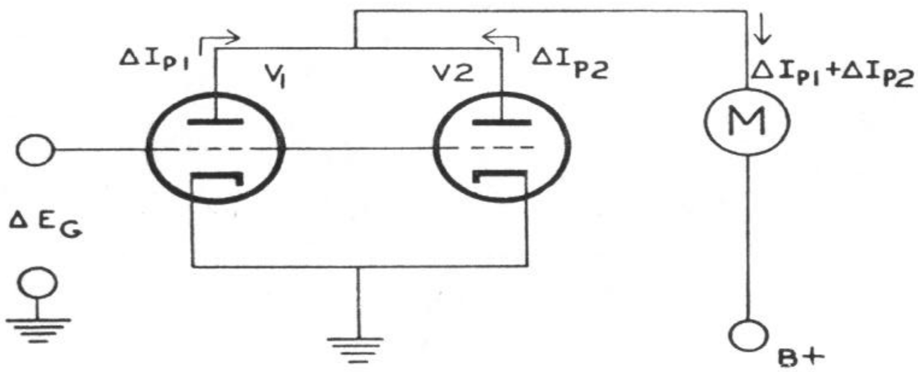


Figure (1) Measuring G_m of Dual Triodes

and V_2 in parallel, the resultant plate current change measured by the meter will be the sum of the $\triangle Ip$ of each tube.

$$G_m\left(V_1 + V_2\right) = \frac{\Delta I_{p1}}{\Delta E_{g1}} + \frac{\Delta I_{p2}}{\Delta E_{g2}}$$

Since $\Delta E_{g1} = \Delta E_{g2}$

Therefore: $$G_m\left(V_1 + V_2\right) = \frac{\Delta I_{p1} + \Delta I_{p2}}{\Delta E_{g1}}$$

then the Gm reading for the tubes in parallel is the sum of the Gm for each tube.

If either tube is down in Gm then the sum will be low, and the tube should be rejected. This way multiple tubes are automatically set up and tested in the DYNA-QUIK with one fast and accurate check.

LIFE TEST

Many manufacturers have found that testing tubes under reduced heater voltage conditions will give a strong indication of its probable useful life. A tube may show adequate Gm under normal test conditions; however, a reduction of 10% to 15% of heater voltage may be marked by a sharp slump in Gm reading. This slump or decay indicates that the space charge of the tube has been depleted to the point where the tube will have a short remaining useful life. While the amount of life remaining cannot be too closely estimated, you can be reasonably sure that a tube showing a sharp slump is not a good risk for continued trouble-free service.

The Grid Emission or Gas Test is an invaluable aid in TV servicing because it quickly picks out those tubes which can cause trouble in a.g.c. sync, I.F. **amplifier, and R.F. tuner circuits.**

In order to understand how a tube can have "grid emission" and "gas current" we must look into the theory of electron tubes.

There is normally some little evaporation of the cathode coating material on the grid of a tube. Some of this vapor tends to deposit on the grid and gives rise to what is known as "grid emission", where the grid itself emits electrons and draws current commonly known as "negative grid current". The flow of this "negative grid current" can be followed in Figure (2).

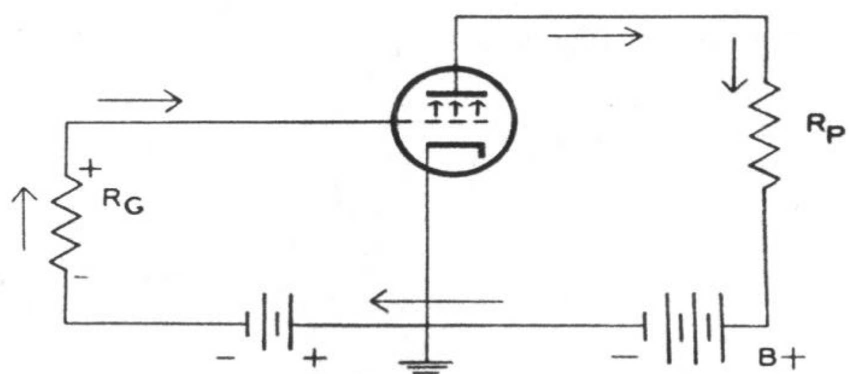


Figure (2) **Negative** Grid Current

The **electrons** flow from the **grid** to the plate then back through the power supply to the grid leak resistor Rg and up to the grid again. Notice that the voltage drop across the grid leak resistor Rg is such that it causes the grid to go more positive than it normally would with no grid emission.

If a slight amount of "gas" is present in a tube some of the electrons from the cathode will collide with molecules of the gas and may knock off one or more electrons, leaving positive ions (ionization). Some of these positive ions may then strike the grid, taking an electron from the grid to form a gas molecule again. The electron flow of this "gas current" is exactly the same as it is for the "grid emission current" and can be traced on Figure (2). Notice again that the grid is made more positive by this "gas current".

Now let us see what happens if an I.F. amplifier tube in a TV set has grid emission current or gas current (negative grid current). In Figure (2) we noted that the grid would tend to go more positive if negative grid current flowed.

In Figure (3), a typical I.F. stage, we see that if there is any negative grid current, the bias voltage in that stage and other associated stages will go more positive because of the flow of current through R_1. Making the grid more positive will drive the tubes to saturation, causing clipping or overloading.

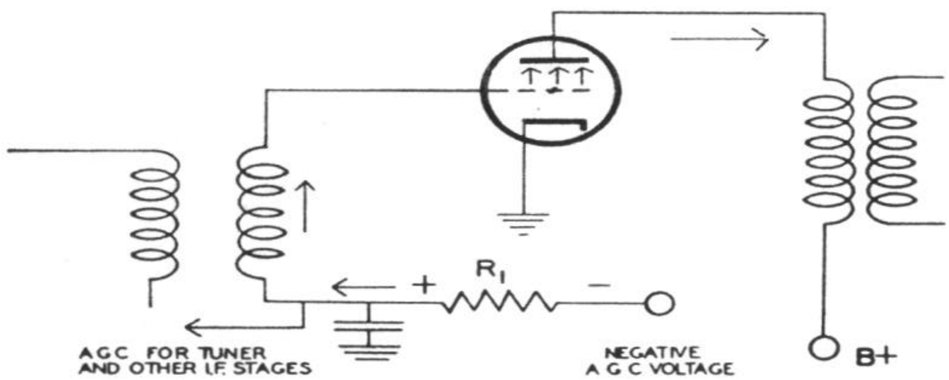


Figure (3) Typical I.F. Stage

After detection, a video signal normally appears as shown in Figure (4). If the signal is clipped in an I.F. stage it will look like Figure (5). Now the horizontal oscillator will try to synchronize both on the blanking signal (A) and on the very black portions of the video (B). This results in pulling or snaking of the picture.

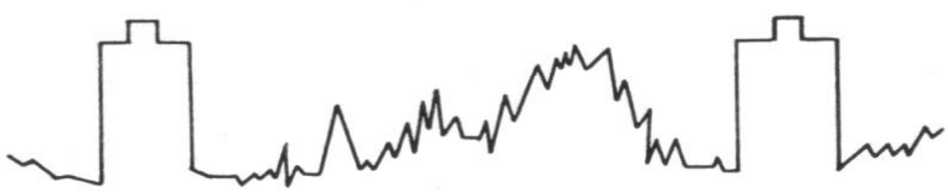


Figure (4) Normal Video and Sync Signal

Figure (5) Overloaded or Clipped Video and Sync Signal

To achieve this sensitive grid emission or gas test, the circuit shown in Figure (6) was employed.

The tube under test has its normal plate voltage applied, but the grid is biased beyond cut-off so that no plate current flows. This bias is applied through the 10 megohm resistor. The same 10 megohm resistor is also in the grid circuit of a 6AT6 d.c. amplifier and the conditions in this tube are such that it, too, is biased just beyond cut-off. Under these conditions, no plate current flows in the 6AT6 and no reading is obtained on the meter in its plate circuit.

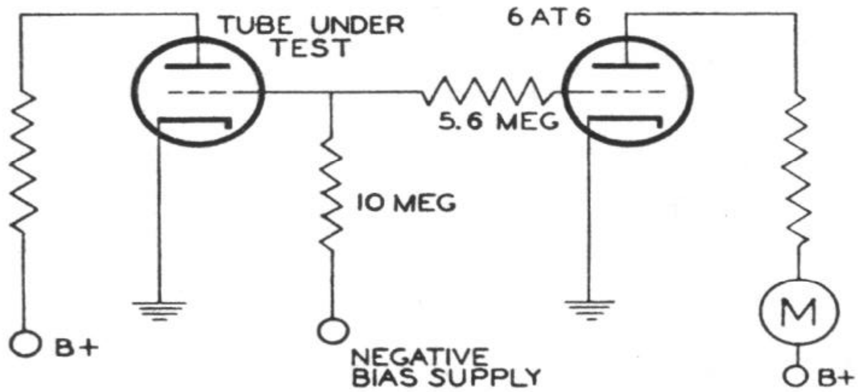


Figure (6) Grid Emission Test Circuit

However, if the tube under test is gaseous, or its grid is contaminated with some of the cathode coating, then current will flow from grid to plate and through the 10 meg resistor back to the grid again. This will produce a positive voltage drop across the 10 meg resistor, lifting the cut-off bias on the 6AT6 and producing a meter deflection. Upon seeing this deflection, the technician immediately knows that the test tube is defective and a replacement is indicated.

AUTOMATIC LINE VOLTAGE COMPENSATION

Every effort has been made to make the operation of this instrument as fast and simple as possible. Toward this end, automatic line voltage compensation has been incorporated into the tester. A voltage sensitive bridge monitors the line voltage at all times and automatically adjusts the sensitivity of the Gm bridge to compensate for these line voltage variations. This eliminates the necessity of readjusting the line voltage for different types of tubes and at different line voltages.

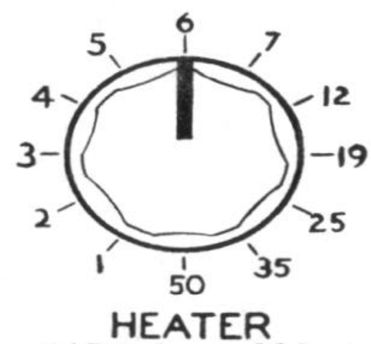
HOW TO OPERATE THE DYNA-QUIK TUBE TESTER

1. **Set HEATER switch to correct heater voltage.**
2. **Insert tube in correct socket.**
3. **Set SENSITIVITY control.**
4. **Test in sequence: SHORTS, G*m*, LIFE and GRID EMISSION.**

Test Procedure

The DYNA-QUIK Tester is designed for use on 105-125 volts 60 cycles AC only. Do not use on any other type of current. Plug the unit into an AC outlet and turn the power on by means of the "ON-OFF" switch in the lower left-hand corner of the front panel. The pilot light just above this switch will indicate when the unit is on.

On the socket panel itself, are listed only the most popular number of the tube type which is available in more than one filament voltage. For example: the 6AL5 is printed on the socket panel; however, the 3AL5 and 12AL5 tubes can also be tested in that same socket. The asterisk printed to the left of the tube type on the panel indicates that tubes of that type with other filament voltages are tested in that socket. The only difference in testing these tubes is that the Heater control is set to the correct filament voltage. The setting of the Heater switch position determines the filament voltage applied to the tube under test. For example: the switch is set to 3 for 3 volt filament tubes, and the switch is set to 6 for 6 volt filament tubes, etc. This setting is determined by the first number of the tube designation. Thus, for a 3AL5, the heater control would be turned to 3; for a 6AL5, it would be turned to 6; and for a 12AL5, the control would be set to 12.



CAUTION: THE HEATER CONTROL MUST BE SET TO THE CORRECT FILAMENT VOLTAGE BEFORE INSERTING THE TUBE IN THE SOCKET. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BURNING OUT A FILAMENT.

With the instrument in operation, locate the proper socket for the tube to be tested. This socket will have the tube number listed alongside of it. The 100 most popular tube types have been listed right on the socket panel. There are approximately 300 tube types which can be tested, however, and all of these tubes are listed on the chart on the inside of the top cover. The chart indicates in which socket the tube is tested and the filament voltage. Notice that the 7 pin sockets are labeled 7A, 7B, 7C, etc., and the 8 pin sockets are labeled 8A, 8B, 8C. etc., to make it faster and easier for the technician to find the correct socket. There are some tubes which have the plate connection coming out of the top of the tube. These tubes are tested by inserting the plate cap lead into the tip jack associated with that socket, and located just to the right and slightly below the sockets, 8C, 8D, 8I, and 9D.

Set sensitivity control and you are now ready to start the tube check. The setting of this control is determined by the number which follows the tube designated on the socket panel or chart.

Short Test

The TEST switch has four positions and the starting point is in the lowest position marked SHORT. In this test, any short or leakage between heater and cathode, grid and cathode, grid and plate, or screen grid and plate will cause the neon bulb marked SHORTS to light up. Shorts or leakage up to 1 megohm in value will be uncovered by this test and this detection will occur *before* the Gm check is made. Any tube which causes the neon bulb to light up is defective and should be discarded. It is generally desirable to tap the tube being tested during the SHORT test in order to bring to light any intermittent shorts. *Do not give further tests to tubes which are shorted.*

Gm Test (Mutual Conductance)

If the tube successfully passes the SHORT test, the TEST switch is moved to the second position, labelled Gm. Here, a conventional Dynamic Mutual Conductance check is made and the condition of the tube will be indicated on the large 4½ inch meter. For this test, using the SENSITIVITY control settings given on the socket panel, the meter reads in the *REPLACE*, *?*, *GOOD* portion of the dial. Any tube not indicating GOOD should be replaced.

The setting of this control, labeled SENSITIVITY is determined by the number which follows the tube designation on the socket panel. For example, the tube 6AU6 is followed by the number 80, viz.,

6AU6 - 80

and the latter figure represents the setting for the SENSITIVITY control.

The SENSITIVITY dial has 100 divisions and the small white line marker on the knob should be set to the indicated value as closely as possible.

NOTE: With these SENSITIVITY settings, the condition of the tube will be given on the portion of the meter scale marked, *REPLACE, ?, GOOD.* This is in accordance with conventional practice on *Gm* tube testers.

On testing diodes the tube is good if the meter reads over the line marked "diodes o.k."

Since the customers for whom you are testing the tubes can easily read the condition of the tube on a GOOD-BAD scale, this is the test you will normally make.

If the exact Gm value of a tube is desired, however, then the setting for the SENSITIVITY control must be obtained from the chart mounted inside of the top cover. Simply locate the tube you are checking and use the SENSITIVITY setting listed next to it in the column marked "TRUE Gm". There are two numerical scales on the meter for reading True *Gm;* 0 - 6,000 micromhos and 0 - 18,000 micromhos. The 0 - 6,000 micromhos scale is printed on the meter in black, and the 0 - 18,000 is printed in red. If the True Gm reading is to be in the 0 - 6,000 micromhos scale, the sensitivity setting in the "TRUE Gm" column will appear in BLACK. However, if the sensitivity setting in the "TRUE Gm" column is in RED, then the meter reading will be on the red scale; 0 - 18,000 micromhos.

The printed table also indicates the Standard Gm for a new tube. This is an average Gm value to be expected for that type of tube. This can be tested with the True Gm setting of the Sensitivity control.

The True Gm value of a tube is not needed to judge its condition. The relative *REPLACE, ?, GOOD* indication will serve satisfactorily. However, the facility for exact Gm determination is available and may be employed, if desired. It is useful for selecting tubes used in push-pull output stages, for example.

Life Test

The third position of the TEST switch is labeled LIFE and it will help the serviceman judge how much more probable useful life still remains in the tube being tested. This test will enable you to detect those tubes which show up as O.K. on the Gm test but which are in the process of gradually losing their Gm.

What the test does, in essence, is reduce the filament voltage by a predetermined amount. If the tube has sufficient capacity to continue operating normally, the decrease in meter reading will be nominal. (Of course, if the meter reading does not drop, the condition of the tube is excellent). But if the tube has a depleted space charge, a large drop will occur in the meter reading and the serviceman will thus be placed on notice that this tube should be replaced. A drop to 75% of its normal reading indicates the tube is reaching the end of its useful life.

Grid Emission and Gas Test

In the final position of the TEST switch, the tube is checked for gas, grid emission, and grid contamination. Grid current, which each of these three conditions will produce, can be detected when it is as low as 2 microamperes, which makes this an exceedingly sensitive test.

If the tube under test is gaseous, or its grid is contaminated with some of the heater coating, a meter deflection will result.

If the meter shows any reading other than zero, the technician immediately knows that the tube has this defect and a replacement is indicated, even if the tube seems to be functioning properly in the TV set. If the meter reads zero (after the pointer settles down), there is no gas or grid emission.

NOTICE: As soon as the switch is put in the Gas Test position, the meter will deflect upwards instantaneously even when testing a good tube which has no grid emission. This momentary deflection should be ignored.

The same test will also uncover high-resistance leakages between control grid and cathode that are not discovered by the SHORT test. The latter check revealed short circuits up to a maximum value of 1 megohm. Frequently, however, a grid-to-cathode leakage resistance in excess of this value will appear and lead to such troublesome defects as poor picture contrast, twisting, bending or pulling of the picture, vertical jitter or bounce, sync. buzz, etc. In the present circuit, Fig. 6, this grid-to-cathode leakage will be discovered because enough current will pass through the 10 megohm resistor to cause the 6AT6 to conduct and produce a meter deflection.

The importance of this test cannot be overstressed. Case histories of hundreds of tube failures, particularly those in the R.F., I.F., and video amplifier stages, revealed that a substantial number of failures were due to gas, grid contamination, or grid-to-cathode leakage. Every amplifier tube should be carefully checked in the grid emission position of the TEST switch and any observable meter indication should preferably be followed by tube replacement.

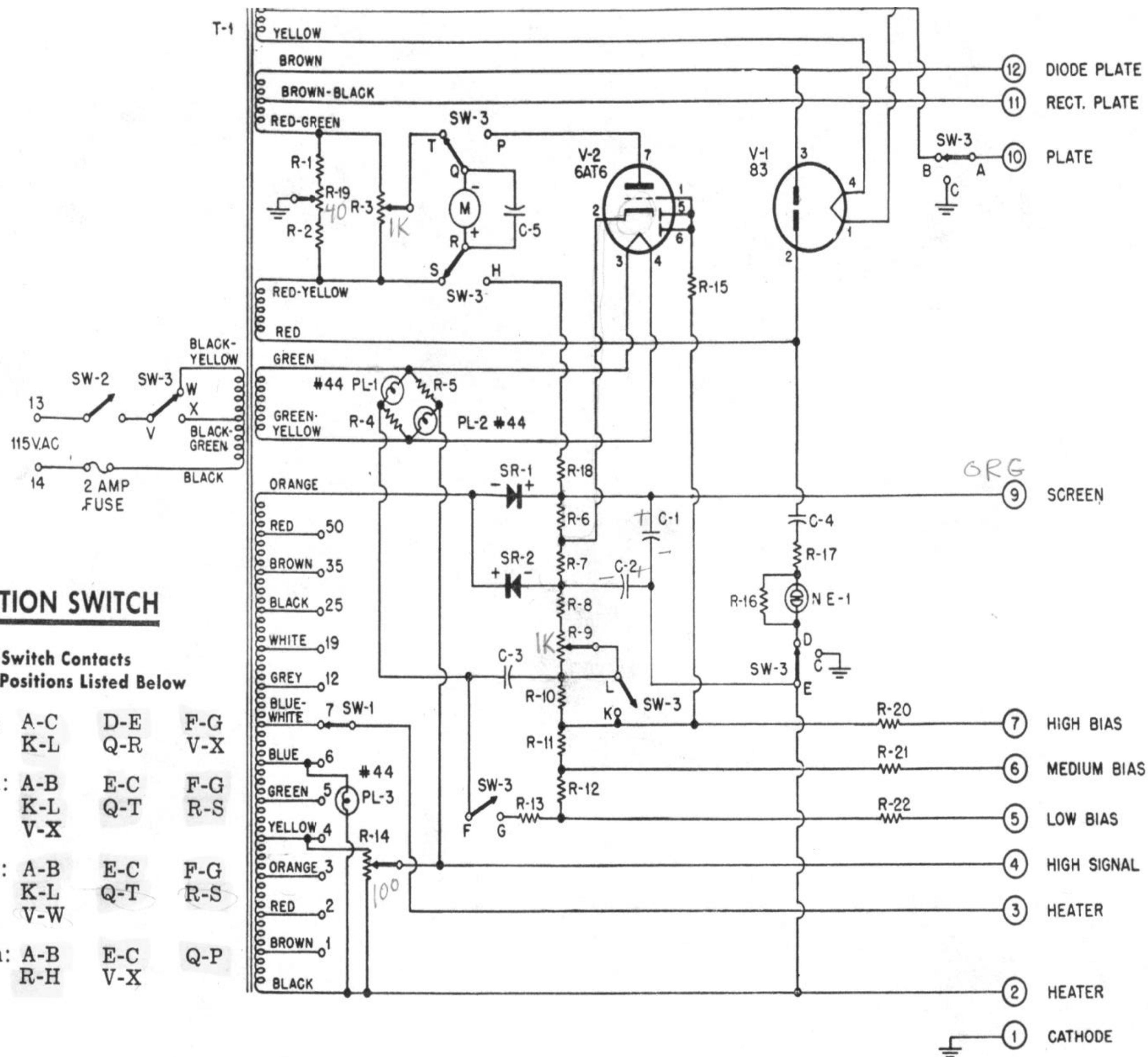
NOTICE:

The a.c. line fuse is a 2 ampere 3AG located beneath the socket panel.

If either of the No. 44 pilot bulbs beneath the socket panel goes bad, both bulbs must be replaced at the same time with the exact type.

If a tube shows shorted in the short test do not test the tube in the *Gm*, Life or Grid Emission positions as you may damage the instrument.

Some low *Gm* tubes (i.e. 6J5 and 12AX7) can not be tested on the *Replace, ?, Good* scale. They are tested only on the True *Gm* scale.



FUNCTION SWITCH

Test Switch Contacts
Make in Positions Listed Below

1st Position: (Short)	A-C K-L	D-E Q-R	F-G V-X
2nd Position: (G_m)	A-B K-L V-X	E-C Q-T	F-G R-S
3rd Position: (Life)	A-B K-L V-W	E-C Q-T	F-G R-S
4th Position: (Gas)	A-B R-H	E-C V-X	Q-P

DYNA-QUIK MODEL 500 PARTS LIST

DESCRIPTION		PART No.
R-1	130 ohms 2 Watt 5% Resistor	500-103
R-2	130 ohms 2 Watt 5% Resistor	500-103
R-3	1000 ohms 4 Watt Control	500-18
R-4	16 ohms 1 Watt Resistor 5%	500-89
R-5	16 ohms 1 Watt Resistor 5%	500-89
R-6	100K 1 Watt 20% Resistor	500-83
R-7	12K ½ Watt Resistor	500-84
R-8	12K 2 Watt 5% Resistor	500-76
R-9	1000 ohms Control	500-23
R-10	10 Meg. ½ Watt Resistor	500-80
R-11	510 ohms ½ Watt 5% Resistor	500-70
R-12	510 ohms ½ Watt 5% Resistor	500-70
R-13	220 ohms ½ Watt 5% Resistor	500-71
R-14	100 ohms Control	500-81
R-15	5.6 Meg. ½ Watt Resistor	500-85
R-16	470K ½ Watt Resistor	500-87
R-17	56K ½ Watt Resistor	500-86
R-18	180K ½ Watt 20% Resistor	500-88
R-19	40 ohms Control	500-90
R-20	12K 2 Watt 20% Resistor	500-82
R-21	12K 2 Watt 20% Resistor	500-82
R-22	12K 2 Watt 20% Resistor	500-82
C1	20 mfd. 250 Volts Capacitor	500-21
C2	20 mfd. 250 Volts Capacitor	500-21
C3	20 mfd. 250 Volts Capacitor	500-21
C4	.005 mfd. 600 Volts Capacitor	500-34
C5	250 mfd. 6 Volts Capacitor	500-95
SW1	Heater Switch	500-02
SW2	On-Off Switch	500-17
SW3	Test Switch	500-03
T1	Transformer	500-16
NE-1	NE-51 Neon Lamp	500-10
V-1	83	500-04
V-2	6AT6	500-66
M1	Meter	500-07
PL1	Miniature Lamp—Use only No. 44	500-64
PL2	Miniature Lamp—Use only No. 44	500-64
PL3	Miniature Lamp—Use only No. 44	500-64
SR-1	50 MA. Rectifier	500-06
SR-2	50 MA. Rectifier	500-06