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TT-5A

TELEVISION BROADCAST TRANSMITTING EQUIPMENT

RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION CAMDEN, N. J.

IB-36036-1

#2201

TT-5A

TELEVISION BROADCAST TRANSMITTING EQUIPMENT

INSTRUCTIONS

Manufactured by

RADIO CORPORATION OF AMERICA

ENGINEERING PRODUCTS DIVISION

Camden 2, New Jersey, U.S.A.

Printed in U.S.A.

IB-36036-1

SUPPLEMENT

FOR

TYPE TT-5A TELEVISION TRANSMITTER

INSTRUCTION BOOK

Manufactured by
RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DEPARTMENT
Camden 2, New Jersey

Printed in U. S. A.

IB-36012-c
and
IB-36036-b

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TT-5A SUPPLEMENT FOR

INSTRUCTION BOOK

SECTION I

VISUAL MODULATOR ADJUSTMENTS

DISPOSITION

To be inserted in and become a part of the TT-5A TV Transmitter Instruction Books, IB-36012 and IB-36036.

PURPOSE

The following material describes the recommended test methods and alignment procedures for the Visual Modulator portion of the TT-5A transmitter. These tests and adjustments supplement those contained in IB-36012 and/or IB-36036 and are intended to facilitate complete Visual Modulator adjustment.

REFERENCE

TT-5A Television Transmitter Instruction Books, IB-36012 and/or IB-36036, Modulator Adjustments, Visual, section.

The reference drawings are as follows:

> IB-36012, Figure 52, Type TT-5A Television Transmitter, Simplified Schematic Diagram, pages 119-120.
>
> IB-36036, Figure 91, Schematic Diagram, Channels 2 to 6, Transmitter Visual Section, pages 225-226.
>
> Figure 93, Schematic Diagram, Channels 7 to 13, Transmitter Visual Section, pages 229-230.

RECOMMENDED TEST EQUIPMENT

Oscilloscope, RCA Type 715-A/B or TO524D or equivalent.

Video sweep generator, RCA Type WA-21A/B or BW-5A (Side Band Analyzer).

Square-wave generator, Measurements Corp. Model 71 or Tektronix Model 105 or equivalent.

Wide-range BFO, General Radio Model 700-A or equivalent.

VTVM (2), General Radio Model 726-A or equivalent.

Video sweep detector as shown in Figure 13.

Decoupling circuit as shown in Figure 9.

Attenuator as shown in Figure 10.

The following additional parts will be required.

- 1 Capacitor, 1 mf, 1000 volts
- 1 Resistor, 22 ohms, non-inductive
- 1 Resistor, 100,000 ohms, 2 watt
- 10 Resistors, 2700 ohms, 2 watt

VISUAL MODULATOR AND MONITOR PICK-OFF

A. Power Supply Adjustment

Adjust the output voltage of the modulator according to the directions given in the instruction books (page 42 in IB-36012 and page 70 in IB-36036).

B. Sweep Video Alignment

1. Procedure:

Align the first (6AG7's) and second (807's) stages independently, then check them in cascade. Finally, adjust the modulator peaking during overall sweep video check. The video alignment should follow the adjustment of the constant resistance network. The final overall video response characteristic should be recorded.

2. Tolerance:

The output sweep envelope, when compared with the input sweep envelope, should be within the following tolerance: First or second stage alone, within ±5% to 5 mc. Stages 1 and 2 in cascade, within ±7% to 5 mc. Overall, including modulator, within ±10% to 5 mc. All of these tolerances are based on the response at 1 mc. being equal to 100%. No sharp irregularities should appear in the curve. For example, a 3% change in response at 0.1 mc. is not desirable.

3. Precautions:

Operate at about half normal video level of stages involved to avoid overload on the one hand and hum and noise on the other. Short out unused peaking coils. Do not place the 4E27's in their sockets with the 600 volt screen supply on and no plate voltage applied, as this would damage the tubes. Do not rely on the stated value of sweep generator precision. Be certain the output is reasonably flat and then make any necessary allowances by comparing the input and output of the circuit being adjusted. Soften the glyptal varnish which seals the alignment adjusting screws by using glyptal solvent or lacquer thinner before attempting to change any adjustment.

4. Detailed Procedure:

Since it is dangerous to attempt the video alignment of the modulator section with the power on, it is recommended that an incremental adjustment procedure be employed; removing the high voltage each time an adjustment is to be made.

a. First stage:

Connect the sweep generator to the input (J801) and adjust the video gain control, R922, so that the voltage on the grid (pin 4) of the first stage (6AG7's V801 to V803) is approximately 0.65 volt peak-to-peak. The AC-DC switch, S801, should be in the AC position. Shut down the transmitter, remove the 4E27's (V807 to V812) and short out the peaking coils (L803, L804) in the second stage with clip leads. Place the sweep detector across one of the 10-ohm resistors (R847 to R849) in the cathode circuits of the 807's. Adjust the oscilloscope gain so that the sweep envelope occupies twenty divisions vertically (2" or 4 cm). This is a convenient scale since each division is then 5% in amplitude. Use a 60-cycle sine-wave sweep. By adjusting the horizontal phase, amplitude, and centering, it is possible to obtain a frequency scale where each major division (1/2" or 1 cm) is equivalent to 1 mc. Adjust the shunt (L802) and series (L801) coils for a flat frequency response; that is, until the output matches the input. Figure 1 shows the typical results obtained when the method outlined in this procedure is followed. Figure 2 shows the effects of various maladjustments.

b. **Second stage:**

Remove the clip leads from the second stage peaking coils (L803, L804) and short out the coils (L801, L802) in the first stage. Couple the sweep generator to the grid (pin 3) of the second stage (V804 to V806) through a 0.1 mfd. capacitor and adjust the sweep generator to an output not to exceed 4 volts peak-to-peak. Select a balanced set of 4E27's as described in the instruction books (page 45 in IB-36012 and page 71 in IB-36036). Return the plate (cap) of the 4E27's to ground through a 1 mfd. capacitor and 22-ohm resistor as shown in Figure 3. Connect the sweep detector across the 22-ohm resistor. Set the blacklevel control, R908, for a modulator plate current of approximately one ampere. Adjust the peaking coils (L803, L804) in the 807 stage for a flat response.

c. Stages 1 and 2 in cascade:

Connect the sweep generator at the input to the video amplifier (J801) and reduce the input to about 0.2 volt peak-to-peak. Remove temporary ground from 4E27's and remove the clips from the peaking coils. Re-touch the peaking adjustments, if necessary, to make the response flat over the two stages.

d. Modulator Alignment:

The sweep generator does not have enough output to adjust the modulator directly because of possible errors due to hum from the modulator. This stage is aligned to make the overall response flat with the generator connected to the normal input. The monitor pick-off is used to observe the output and the video gain control, R922, is adjusted to give about 0.8 volt peak-to-peak when the monitor is terminated in 75 ohms. The test setup is shown in Figure 4. For this test, the monitor pickoff and the modulator will have to be adjusted concurrently as the indicated output depends on the fidelity of the monitor. A suggested procedure is to align the modulator approximately before checking the monitor. The sweep detector is placed across the terminated output (75 ohms) and the modulator peaking coils adjusted to give approximately flat frequency response.

Next, the monitor attenuator must be checked. The test setup for this is shown in Figure 5. Adjust the video gain (R922) until V_1 indicates approximately 90V. and V2 indicates approximately 1 volt at 100 Kc. Take readings at 1 Mc. and 4.5 Mcs. holding V_1 constant. Adjust the compensating device until the 0.1 Mc., 1 Mc. and 5 Mc. reading on V_2 are identical. Uncoiling the compensator and stretching it further along the globar resistor (R971) will increase the high frequency response. When the monitor response is flat as indicated by this test, re-connect the sweep generator and detector and if necessary, re-align the 4E27 (V807 to V812) peaking coils. When all peaking coils have been adjusted, seal the tuning screws with colored glyptal.

C. Square Wave Response

Connect a square wave generator operating at 50-cycles to the video input, J801. Set up to 0.5 volt peak-to-peak. Observe the waveform at points indicated in Figure 6. No adjustments are required, but the waveform should look substantially like that shown. If not, look for trouble. Accurate square wave reproduction is not achieved in this amplifier nor is it required since the black level pedestals are clamped at the grids of the 4E27's (V807 to V812). This action corrects for a moderate amount of low frequency distortion.

D. Clamp Circuit Operation

1. Precaution:

In measuring pulse voltage, when using the Type 715-A oscilloscope, allowance must be made for the uni-directional nature of the pulse and for any non-linearity of the scope. This can be done to a first approximation as follows: With no input, adjust the centering control to some convenient reference. Connect the scope to measure the pulse but make sure that the pulse does not exceed 1" deflection from the reference axis. Set the calibrating voltage for the same uni-directional voltage rather than for the same peak-to-peak voltage. Calculate the pulse voltage from the ratio of the pulse amplitude compared to the peak-to-peak calibrating signal amplitude. This would take into account the non-linearity of the scope if the non-linearity were symmetrical for positive and negative deflections. Actually, the non-linearity may be different for different polarities so the above refinement in calibrating technique is an approximation only. Oscilloscopes having direct-coupled amplifiers, such as the Type TO-524D, do not ordinarily have such errors.

2. Test Procedure:

The following test may be made with plate and screen voltage off the 4E27's (V807 to V812) and with the 1100V. bias pack off if desired. The screen voltage can be removed by disconnecting the screen lead terminal at R907.

Apply a composite video input signal with at least 25% sync, and set the gain (R922) so that the sync portion of the signal at the plate of the second stage (V804 to V806) is approximately 15 or 20 volts peak-to-peak. Remove V814 (6AG7) and ground terminal 4 of the pulse transformer, L805. The pulse at terminal 3 should be as shown in Figure 7. For this test, use the attenuation (low capacity) cable. Test limits are shown in Figure 8. If the second positive pulse is greater than 12% of the first, the damping resistor, R912, should be connected across the primary of the pulse transformer, otherwise it should be clipped out and discarded. If the pulse width is outside of tolerance, a defective pulse transformer is indicated.

With the 6AG7 (V814) replaced, pulses at the plate and cathode should be as shown in Figure Figure 8 with limits as shown. For this test, use the attenuating cable.

With plate and screen voltage on the 4E27's (V807 to V812) and the video input signal temporarily removed, place the oscilloscope direct cable on the 4E27 filament monitoring jack (J802) and adjust the hum bucking pot (R864) for minimum hum. This is a temporary adjustment to be corrected later as described in Section E. With the video signal reconnected, the change of blanking level during one frame should not exceed 2 1/2% of the peak-to-peak video signal. If the vertical blanking is not flat and in line with horizontal blanking pulses, try changing the 6H6 clamp tube (V815). Of course, the scope should be checked on the particular attenuator step used with a video signal of known quality or with a square wave of known quality. Reduce the video gain (R922) and simultaneously increase the scope gain until the blanking level is not straight but is modulated by the picture signal. This is a sign that the clamp circuit is no longer functioning correctly. The sync voltage at the plate of the second stage (V804 to V806), when the clamp circuit just takes hold, should not be greater than 10 volts. This corresponds to a video voltage of 40 volts peak-to-peak, or half normal.

E. Hum Bucking Adjustment

By means of an appropriate decoupling circuit such as shown in Figure 9, the scope should be connected to the plates of the 4E27's (V807 to V812). The switch in Figure 9 should be closed after the transmitter is turned on and opened before it is turned off to avoid a surge which might damage the oscilloscope. The filament center tap potentiometer, R864, should then be adjusted for minimum 60 cycle output with the video input signal disconnected.

F. Sync Stretch Operation

Adjust the synchronizing amplitude according to the directions given in the instruction books (page 46 in IB-36012 and page 77 in IB-36036).

G. Video Gain

With the sync stretch control, R904, at minimum, and the signal at the plate (cap) of the second stage (V804 to V806) equal to 70 volts peak-to-peak, the input to the grid (pin 4) of the first stage (V801 to V803) should not be greater than 1 volt peak-to-peak.

CONSTANT RESISTANCE NETWORK

A. Test Setup

The coupling capacitor, C803 -2200 mmfd., which connects to the modulator grids (4E27's, pin 4) should be disconnected and the square wave generator connected as shown in Figure 10. The scope is arranged for rapid comparison of input and output waveforms. Since some of the adjustments are most conveniently made with power on, a high voltage enclosure should be built around the high frequency network with suitable holes for insulated tuning sticks. The insulated tuning devices are not supplied with the transmitter.

B. Tolerance

The network must reproduce a square wave of any frequency up to 100 Kc. (test frequencies 50, 100, 1000 cycles; 10 Kc., 100 Kc.) to within ±1-1/2% (Total variation = 3%).

C. Precaution

Always compare the input and output waveforms. The problem is to match the waveform, with due allowance for the change in polarity in going through the one stage amplifier. Do not depend on the stated value of square wave fidelity of the scope or the generator. Determine the response beforehand and then use accordingly. Do not overload the scope. If the scope is in good condition, a deflection of 2" for a square wave or 1" for a uni-directional pulse is a reasonable deflection.

D. Procedure.

1. Low Frequency Sections:

Use a 50 cycle square wave to test these sections. Set the modulator coupling switch, S801, on AC. Adjust the blacklevel control, R908 to give a modulator plate current of approximately 1.1 ampere. This is an average picture plate current. The inductance of the iron coils (L502 to L504) in the network vary somewhat with changes in plate current and output voltage. The square wave generator should be set for approximately 25 volts peak-to-peak. Alter the taps on the iron core coils (L502 to L504) until the best 50 cycle response is obtained. Adjust for the flattest wave top but ignore the 1300 cycle ripple on the leading edge of the square wave which may appear due to a maladjustment of one of the sections in the high frequency constant resistance network.

Reduce the square wave frequency to 10 or 20 cycles and look for a 50 cycle damped oscillation super-imposed on the 10-20 cycle square wave. Alter the taps on L504 in the direction suggested by Figure 11.

2. Section Involving L8008:

After the low frequency section has been adjusted, increase the square wave frequency to 100 cycles and observe the 1300 cycle ripple. In the high frequency network, each section is provided with a variable inductance and resistance. The resistance can be varied in two 2 1/2% steps above and below the nominal 500 ohm value. The coils are variable by means of adjustable powdered iron cores. The resistance can be changed by shorting out the 12 ohm resistors (R8003, R8004, R8008, R8009, R8013, R8014) or connecting the 22, 000 ohm resistors (R8005, R8006, R8010, R8011, R8015, R8016) in the circuit using clip leads. The effect of varying R and L are shown in Figure 11.

After this section has been adjusted, a record should be made of the resistor circuit arrangement and the length of the adjusting screw projecting from the end of the coil.

3. Section Involving L8006:

This section depends on the capacity-to-ground of the bucking bias pack and associated wiring, as part of the network. A 0. 002 mf. (C8006) capacitor is paralleled with the capacity to ground of the pack. Since the bias pack is not a pure capacity, but includes such things as the inductance of the filter chokes and power transformer, the effective capacity is somewhat different when the bias pack is turned on and supplying current to the bleeder. The normal test setup and procedure calls for testing the network with the bias pack operating normally.

A 0. 001 mf. capacitor, C8007 is mounted on the panel and may be connected in parallel with or in place of the 0. 002 mf. capacitor, C8006, to vary the impedance of this section of the network in case the range of the inductance tuning is not great enough to obtain a good square wave.

The square wave frequency should be set at 10 Kc. The ripple to be tuned out in this section is approximately 80 Kc. As in the preceding section, adjust the resistance with clip leads and vary the inductance for the least 80 Kc. ripple. Record the settings.

4. Section Involving L8004:

Use a 100 Kc. square wave for aligning this section of the network, but apply this signal to the video amplifier input (J801) instead of to the modulator grid. This requires reconnecing the 2200 mmfd. coupling capacitor, C803, to the grid (pin 4) of the modulator (4E27's).

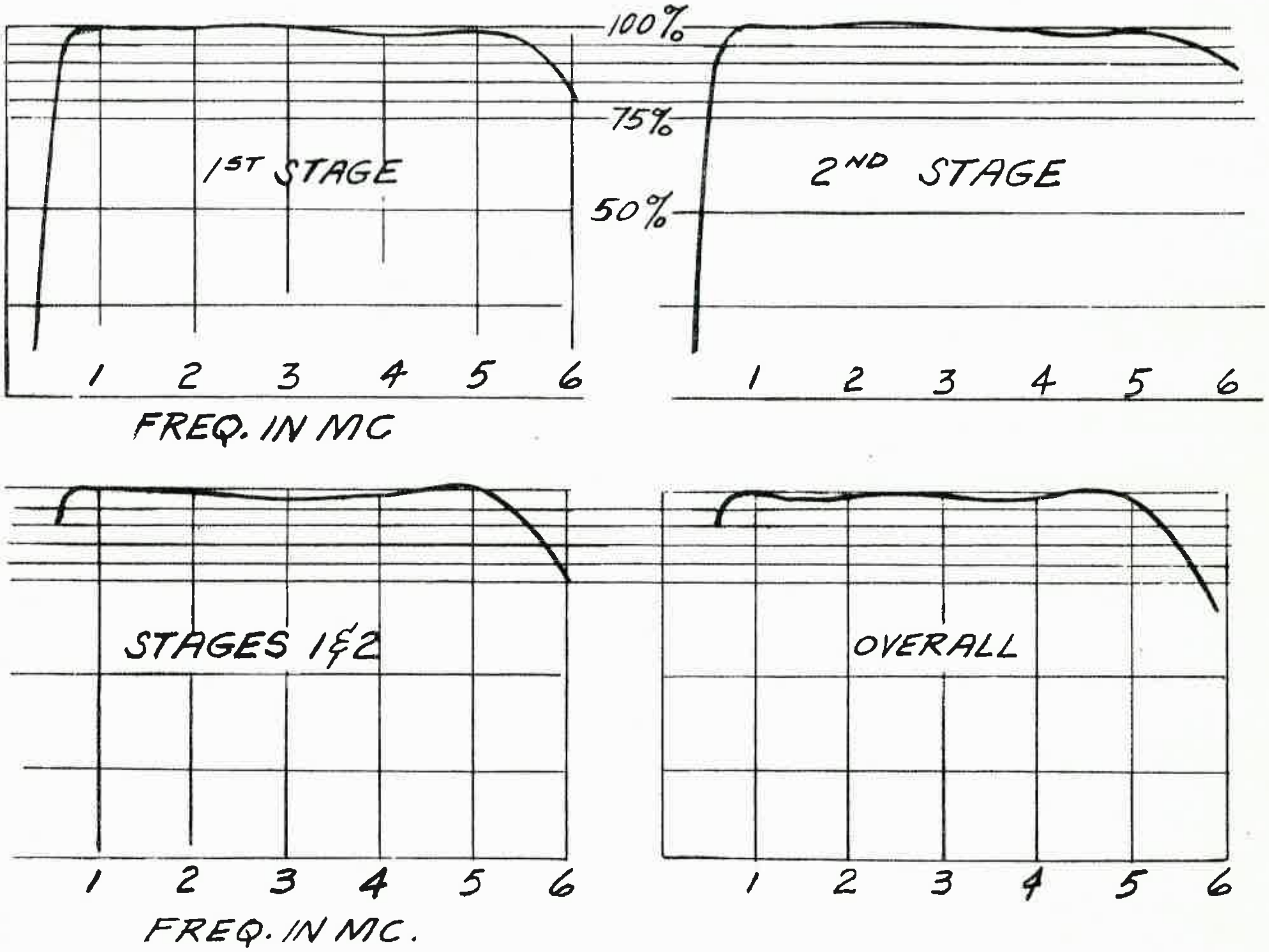
5. Final Adjustment:

Tighten the lock nuts on all the coil adjustments; apply colored glyptal to seal these adjustments, and replace all of the clip leads with the bus soldered in place.

The final typical adjustments are shown in Figure 12.

6. Cross Resonance:

In addition to the transients which may be tuned out as described in the preceding paragraphs, there will be several very small transients due to the 1, 2 and 10 mfd. coupling capacitors, C8001, C8002, C8003, and C8004, resonating with the coils in the network. These "cross resonances" have been affectively damped by arranging the resonant circuits for low surge impedance and damping the oscillations with 10 ohm resistors (R8020 to R8022). The technician may short out the damping resistors to exaggerate the transients due to these resonances in case there is any confusion between these residual effects and the transients which may be tuned out by proper adjustment of the network. The residual transients will be less than the ±1 1/2% tolerance.



FREQUENCY CHARACTERISTIC OF TYPICAL MODULATOR

FIG. - 1

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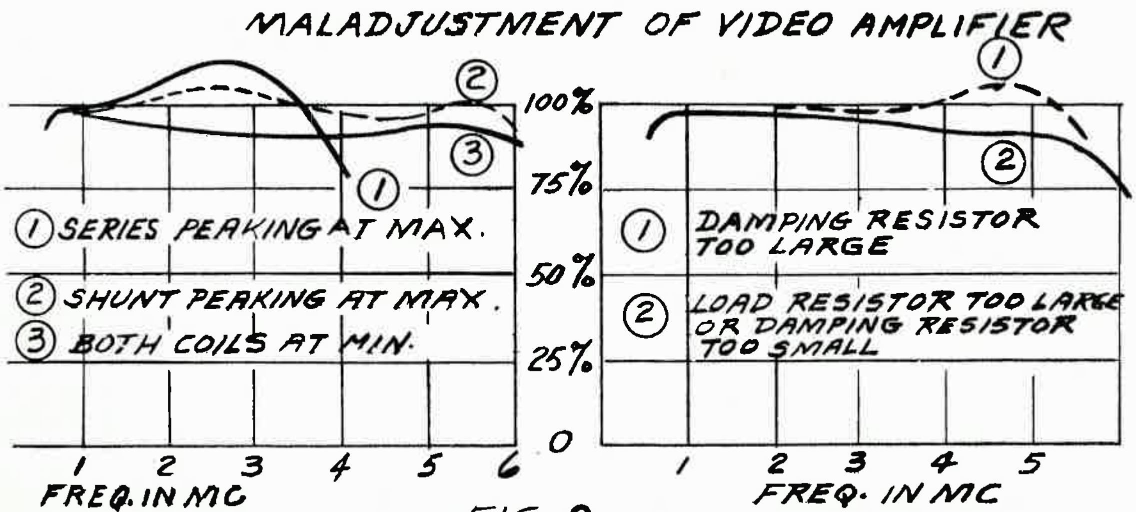
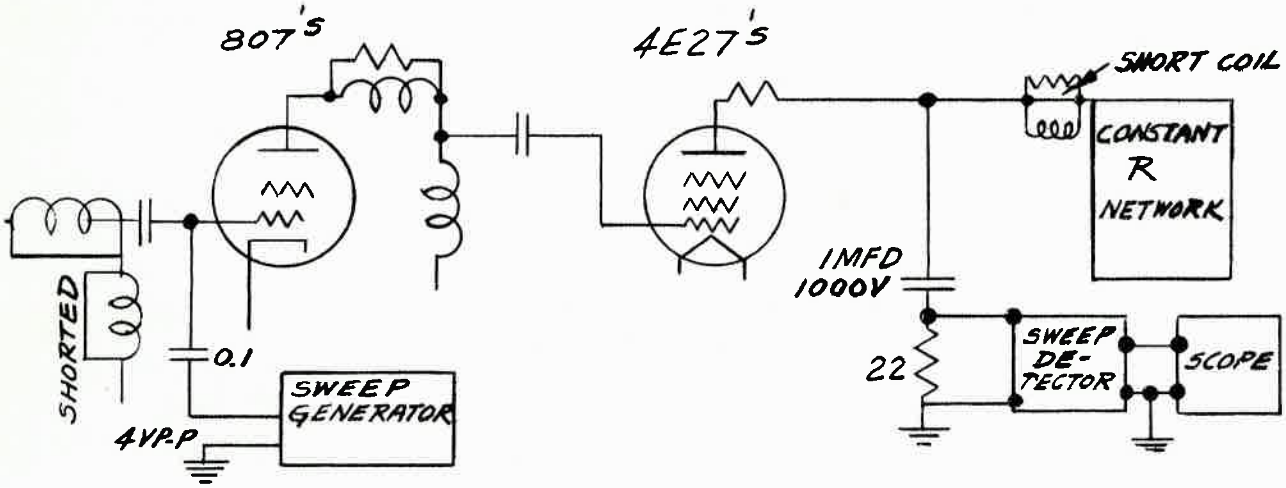


FIG. 2



CONNECTIONS FOR TESTING STAGE 2

FIG. 3

CONNECTIONS FOR TESTING MODULATOR

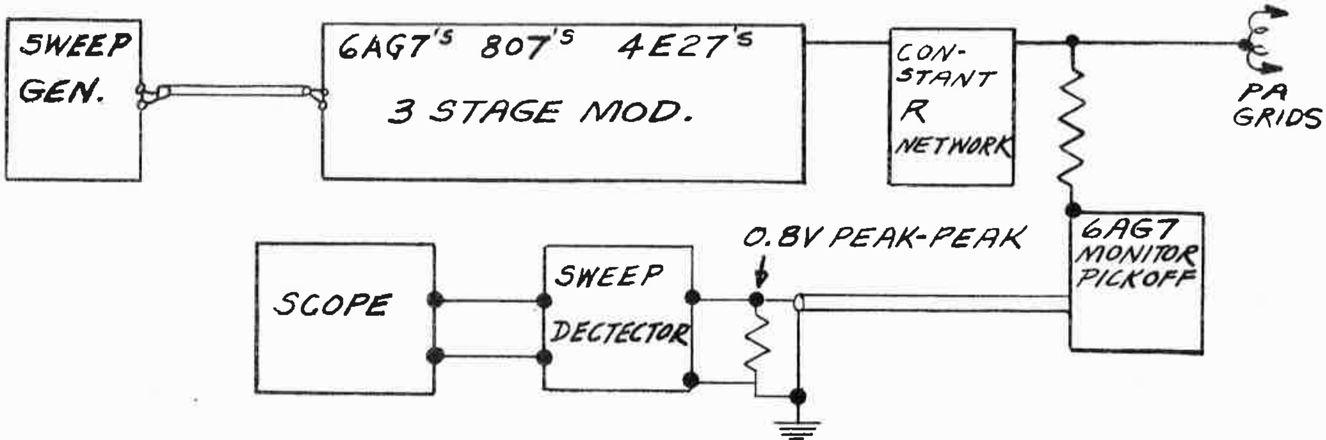
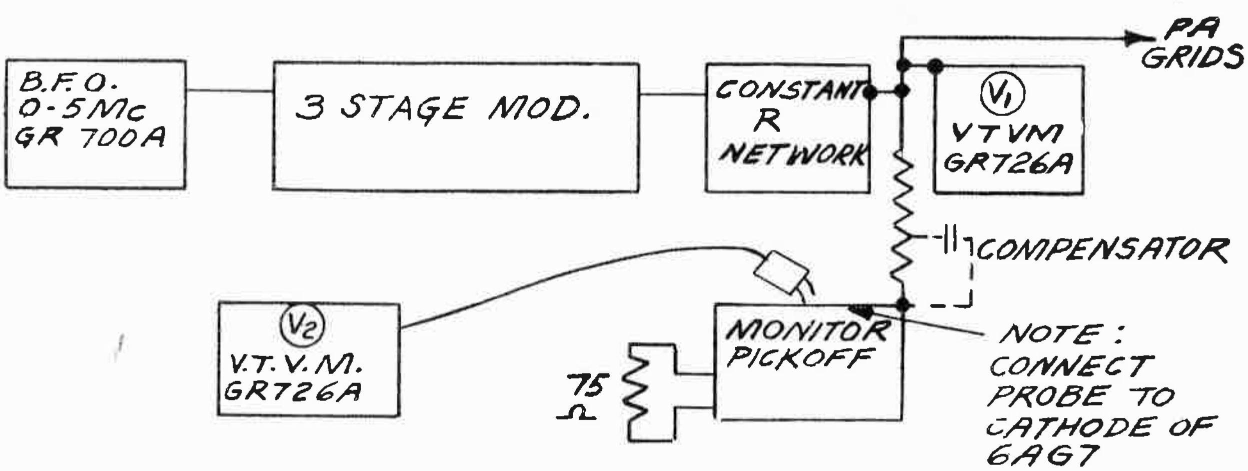
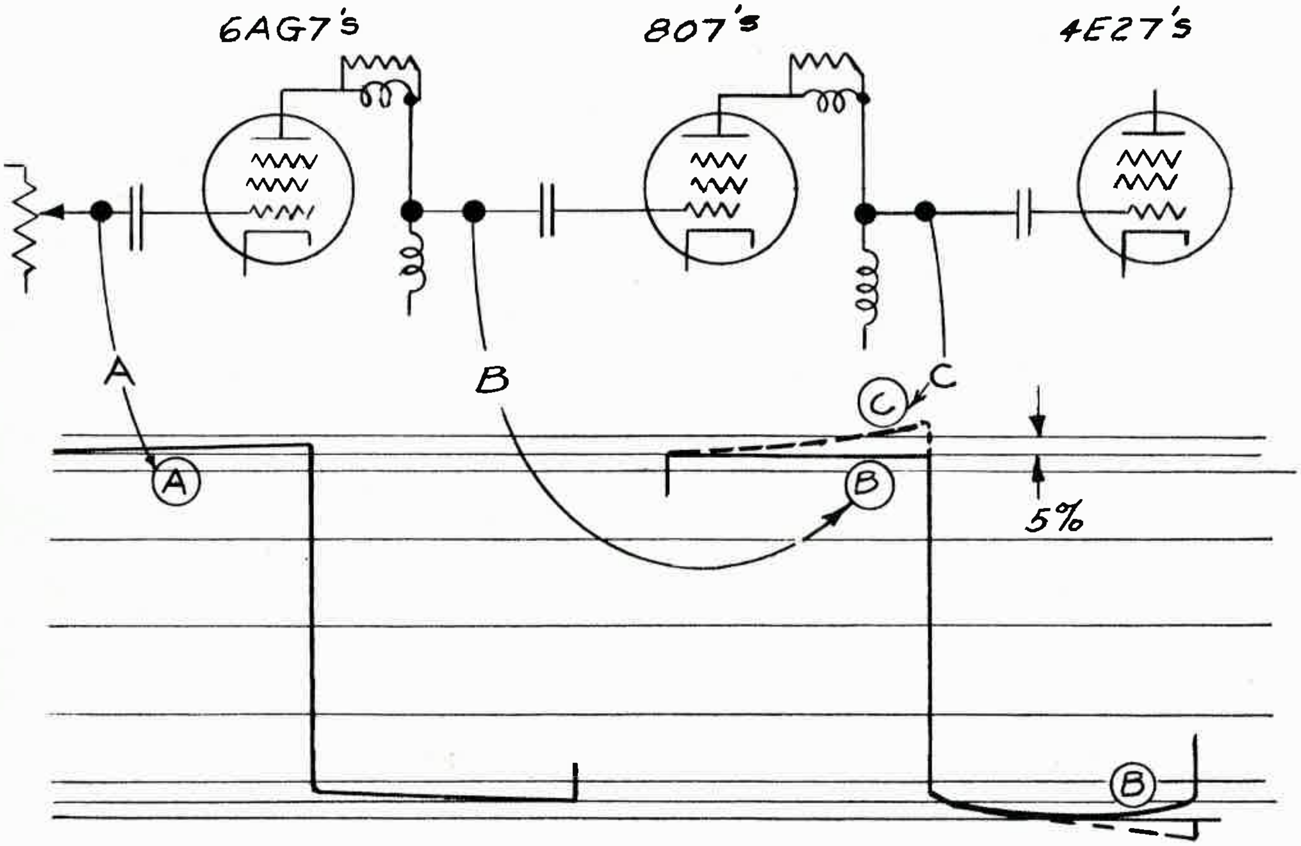


FIG. 4



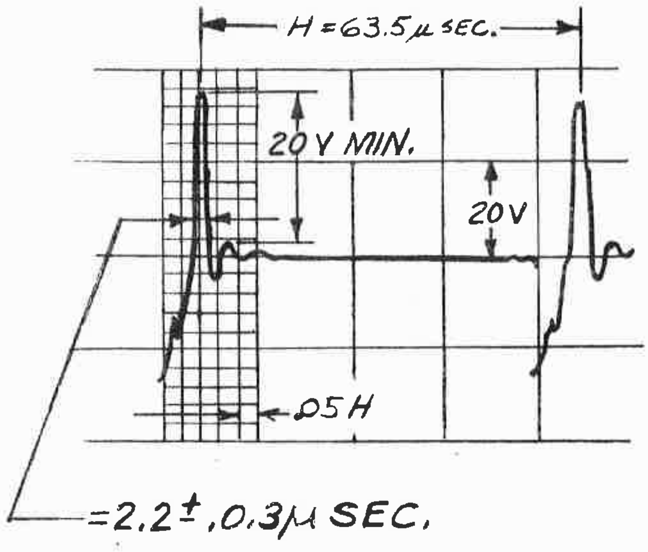
CONNECTIONS FOR ADJUSTING MONITOR PICKOFF.

FIG. 5



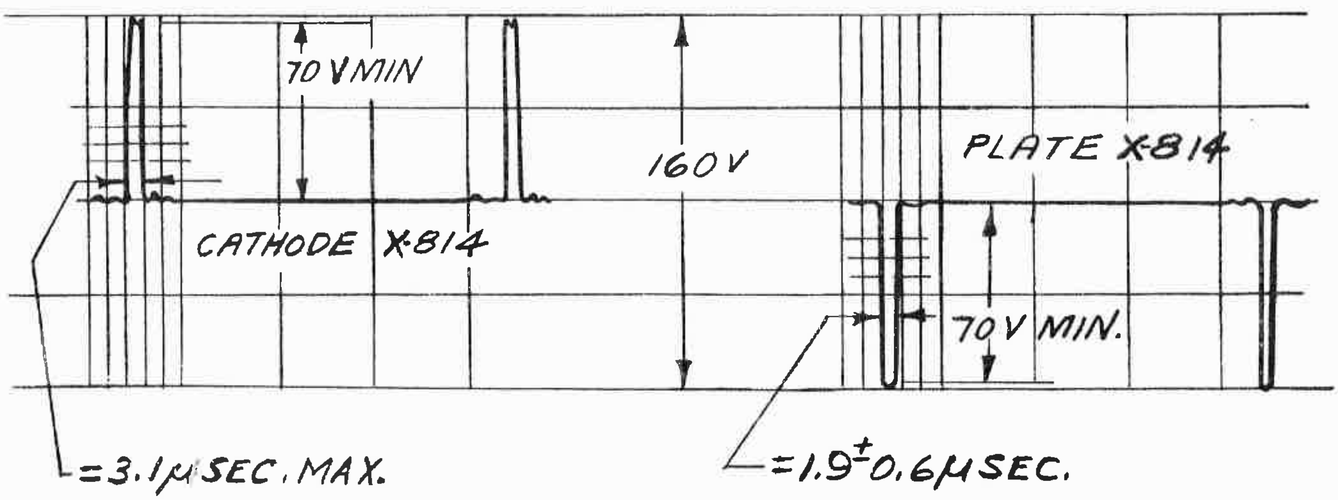
SQUARE WAVE RESPONSE, 50~

FIG. 6



SHAPE OF PULSE AND TOLERANCE OUTPUT OF L805

FIG. 7



PULSE SHAPE AND TOLERANCE OUTPUT OF X-814.
X-815 (6H6) MUST BE IN SOCKET

FIG. 8

CIRCUIT FOR HUM BUCKING ADJUSTMENT

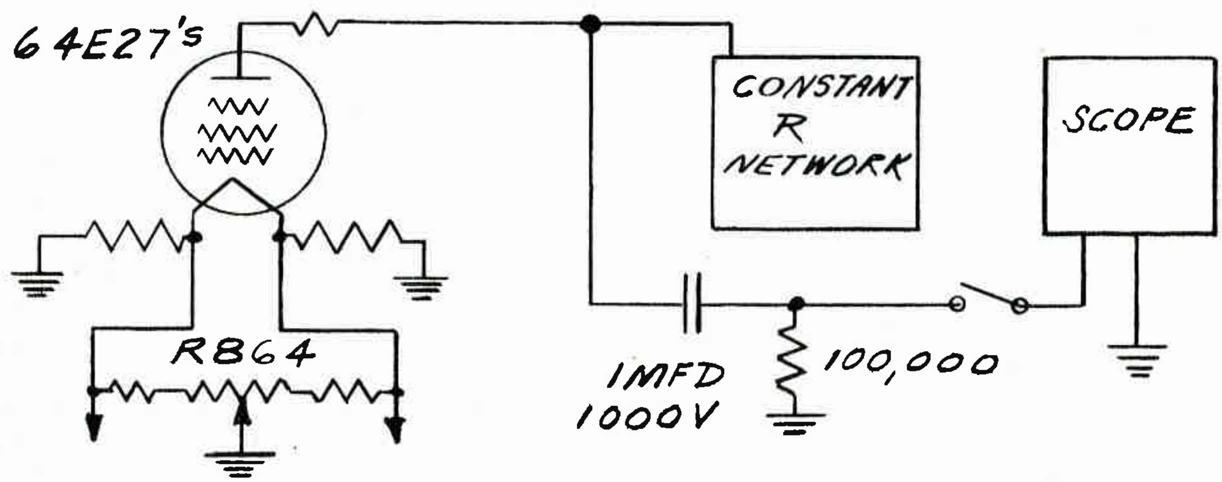


FIG 9

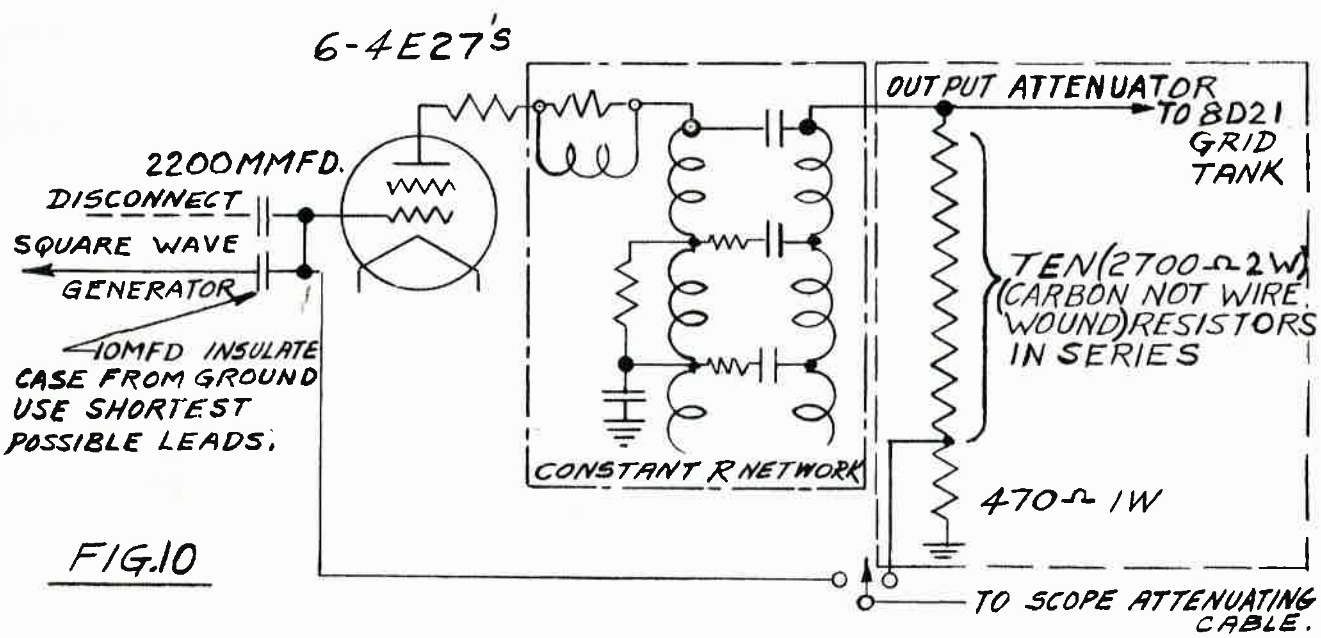
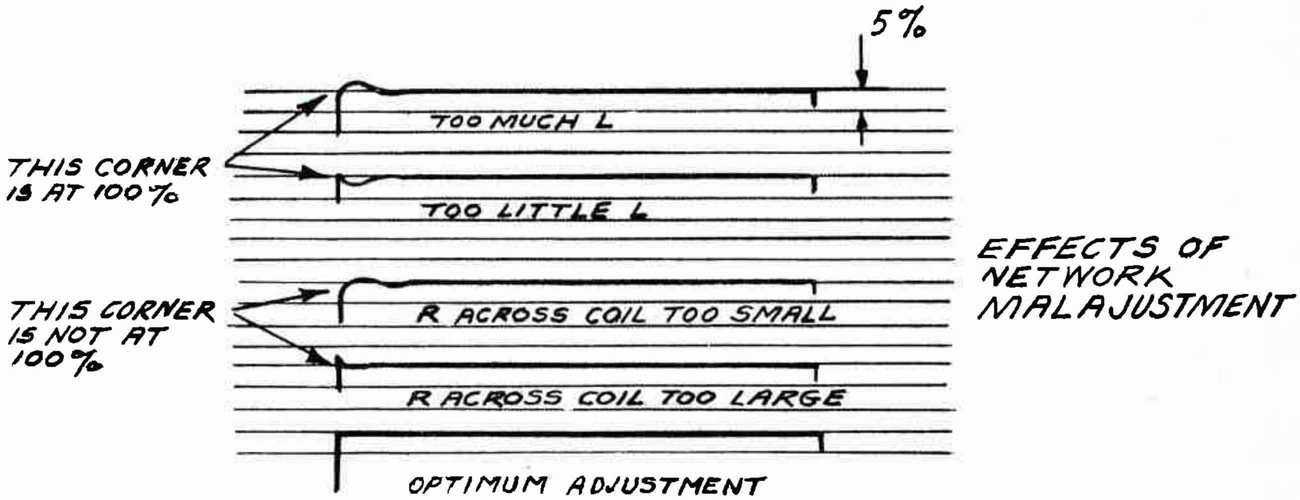


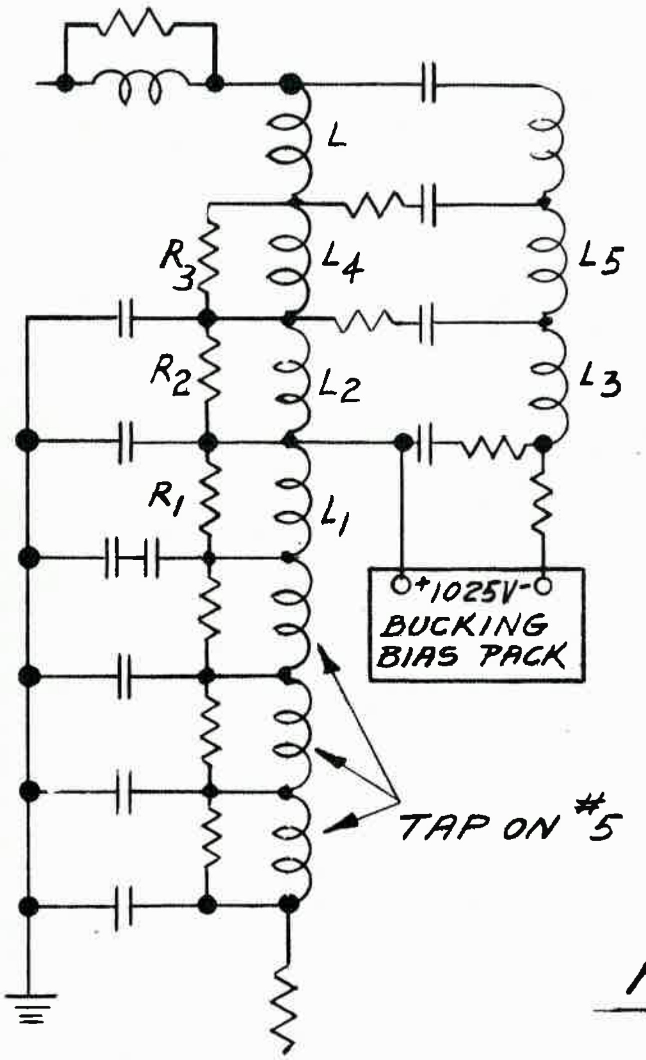
FIG.10



CONSTANT RESISTANCE NETWORK – RESPONSE TO SQUARE WAVE USING MEASUREMENTS MOD. 71 S.W. GENERATOR

WHEN USING TEKTRONIX OR EQUIV. GENERATOR A "RINGING OVERSHOOT" WITH A RIPPLE FREQUENCY OF 5 M.C. OR HIGHER WILL APEAR DUE TO LIMITED BANDWIDTH OF THE NETWORK AND AMPLIFIERS UNDER TEST. IGNORE THIS HIGH FREQUENCY RINGING WHICH IS DUE TO THE IMPROVED HIGH FREQUENCY OUTPUT OF THE TEKTRONIX GENERATOR. THE MEASUREMENTS GENERATOR DOES NOT HAVE A FAST ENOUGH RISE TIME TO EXCITE THE CUT-OFF TRANSIENTS IN THE MODULATOR CIRCUITS

FIG 11



TYPICAL ADJUSTMENTS OF CONSTANT RESISTANCE NETWORK.

L1 ADJ. SCREW AT 3 3/16

L2 ADJ. SCREW AT 17/32"

L3 ADJ. SCREW AT 9/32"

L4 ADJ. SCREW AT 11/16"

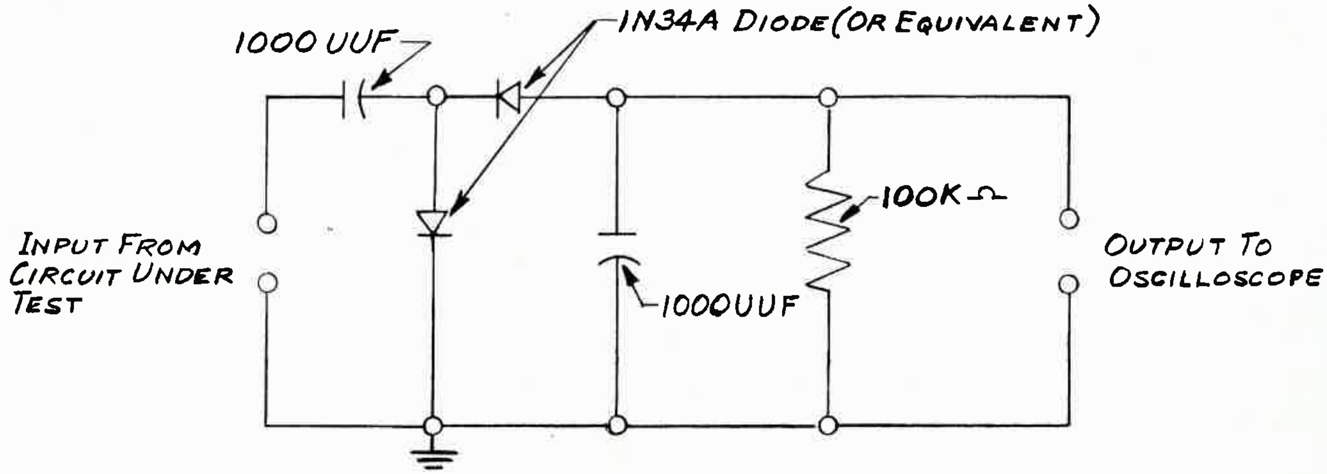
L5 ADJ. SCREW AT 13/16"

R1, 500 PLUS 22,000 Ω SHUNT

R2, 500 PLUS TWO 22,000 Ω SHUNTS.

R3, 500 PLUS TWO 22,000 Ω SHUNTS.

FIG. 12



CONSTRUCTION SHOULD MINIMIZE STRAY CAPACITY AROUND DIODES

NOTE:- IF PATTERN ON OSCILLOSCOPE IS UPSIDE DOWN THE OUT PUT POLARITY OF THE DETECTOR MAY BE REVERSED BY REVERSING THE CONNECTIONS OF BOTH DIODES

8863056

FIG. 13