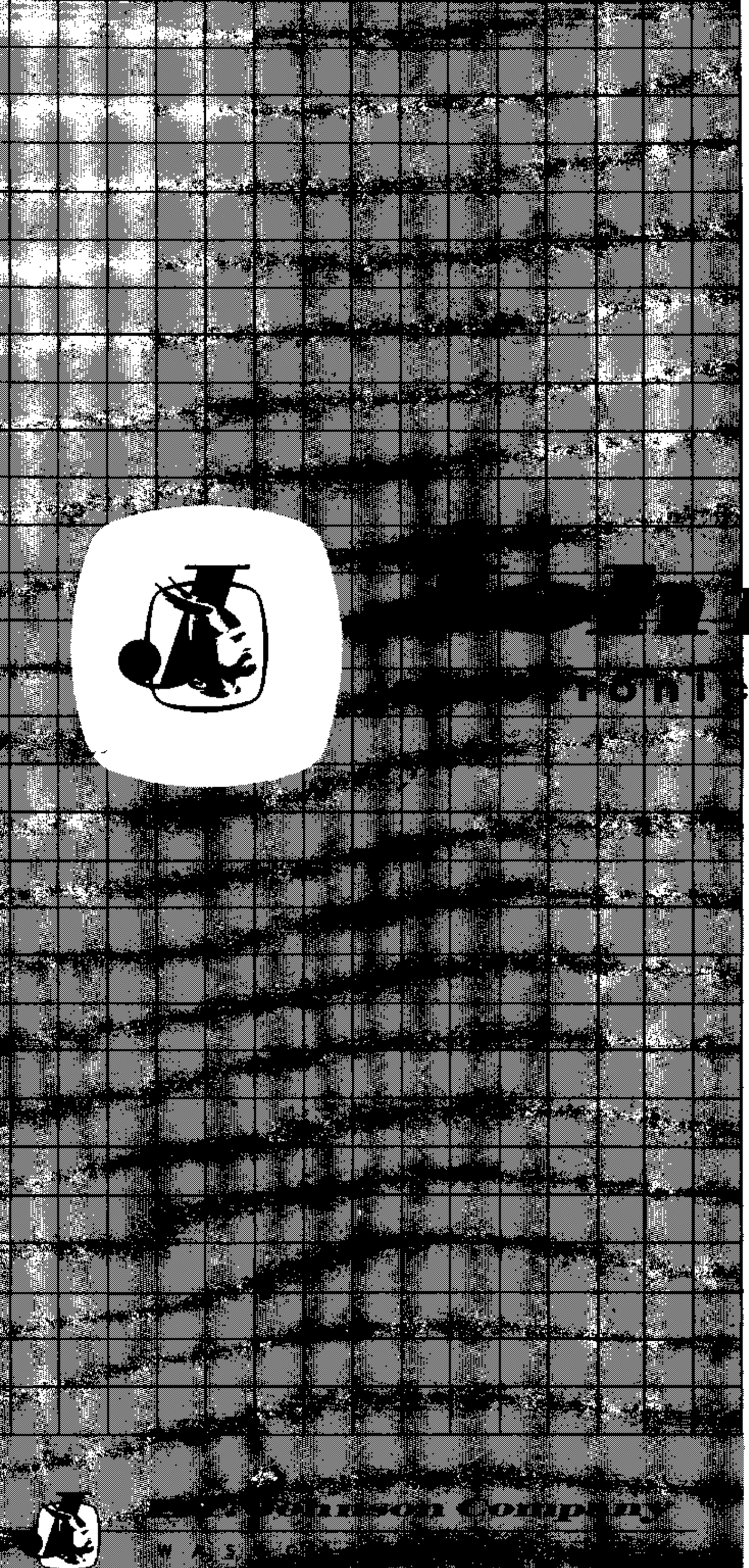


Tonic equipment

# OPERATING MANUAL

# VIKING THUNDERBOLT AMPLIFIER

# VIKING THUNDERBOLT OPERATING MANUAL

## A. INTRODUCTION

The Viking Thunderbolt is a self contained radio frequency power amplifier capable of CW and AM, SSB or DSB linear operation over a continuous frequency range of 3.5 to 30 megacycles. The amplifier employs two Type 4-400A tetrode tubes in parallel, bridge neutralized, which permits power inputs of 2000 watts P.E.P. linear with suppressed carrier, 800 watts AM linear, and 1000 watts class C continuous wave. Drive requirements are approximately 10 watts from a well regulated exciter for class $AB_2$ linear (SSB and AM) operation and 20 watts for class C (CW) operation. TVI suppression, spurious filtering, rigorous shielding, and parasitic oscillation suppression are included in the amplifier design.

The complete Thunderbolt amplifier including high voltage, regulated screen and regulated bias power supplies is contained in a cabinet 21" wide x 11 5/8" high x 16 7/8" deep. The total weight is 120 pounds.

CAUTION Operation of this equipment involves high voltages which are dangerous to life and the operator should observe proper safety precautions at all times. Always remove the power plug when the amplifier is out of the cabinet. Make a habit of using a grounding hook with an insulated handle which can be hooked on to the rectifier tube caps whenever working inside the amplifier.

## B. INSTALLATION

1. Observe all packages for damage due to mishandling or abuse during shipment.

2. Open all packages and inspect contents for hidden damage or missing parts. Remove amplifier from cabinet.

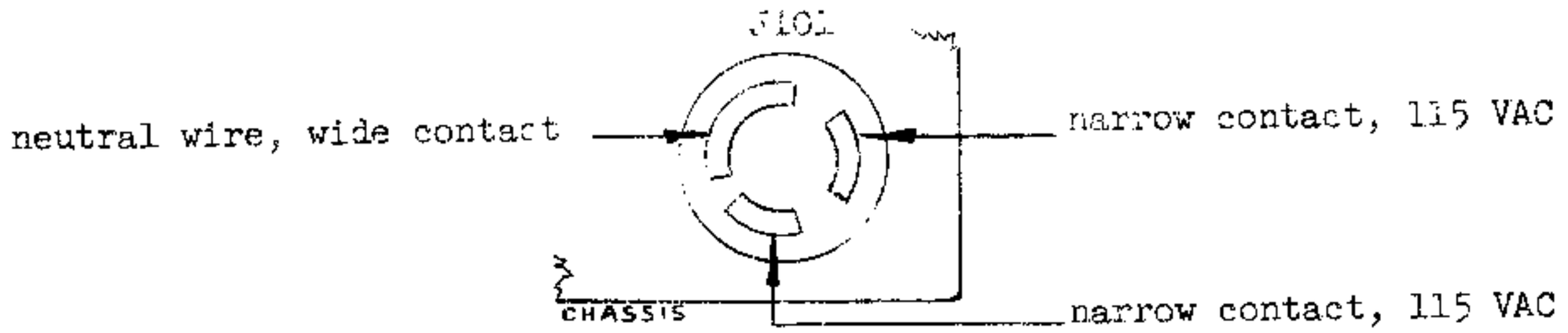
3. Report all claims for transportation damage immediately to the carrier and not to the E. F. Johnson Company.

4. Report any missing parts to the distributor.

5. Power Transformer Installation

   a. In wired units, the transformer was tested in the amplifier, removed, and shipped in a separate container to avoid shipping damage. All wired amplifiers are shipped wired for operation from a 3 wire, single phase 230 to 250 volt 50/60 cycle power source with a grounded neutral. It is preferable to operate this equipment from this type power source. If it is necessary to operate from a two wire, single phase 115 volt 50/60 cycle source, the amplifier may be converted from the 230 VAC circuit as described in section B5c.

The three wire cable connecting the Thunderbolt to the 230 VAC power should be Underwriter Laboratory approved with current rating of 15 amperes. The grounded neutral wire of the cable must be connected to the power plug P101 so that it contacts the wide contact of J101. The two other wires of the cable should each connect to a narrow contact in J101, as follows:




b. Disconnect the leads from the 8 mfd 2000 volt nominal W.V. filter capacitor and remove it from the unit. Install the power transformer in the rear left corner on the top of the chassis so the four mounting studs fit into the holes provided and the five leads feed through the 1 1/8" diameter hole near the back of the resistor board as shown in Figure A. Secure the transformer to the chassis with a 1/4" lockwasher and a 1/4-20 hex nut on each stud. Make the following connections:

1. Connect the red lead with yellow tracer to the screw terminal on the capacitor board CH9 (Figure C).

2. Connect the black wire with green tracer to terminal 1 of TS1 (Figures 1 and 7).

3. Connect the white wire to terminal 2 of TS1.

4. Connect the black wire to terminal 3 of TS1.

5. Connect the black wire with red tracer to terminal 4 of TS1.

c. Conversion to two wire 115 VAC operation is accomplished by making the following changes:

1. Disconnect the black wire with white tracer from terminal 1 of TS1 (lead from FH1C2), remove solder terminal, and solder to terminal 2 of FH1O1. Fuses F1O1 and F1O2 are now connected in parallel to carry the larger current.

2. Remove the jumper wire (white wire with black tracer) from terminal 2 of TS1 and connect this end to terminal 1 of TS1. Remove the white-black-brown #20 wire from terminal 2 of TS1 and connect it to terminal 3 of TS1.

3. Make two jumper wires like the one used above. Connect one jumper wire between terminals 2 and 4 of TS1. Connect the other jumper wire between terminal 1 of TS1 and the screw terminal at the end of TS1.

4. Connect the two narrow contacts of the power plug P1O1 together with a short length of No. 16 tinned wire (Be sure the power cord is completely disconnected from thepower source). The 115 volt power source has one lead at ground potential and the other lead 115 volts above ground and this polarity must be observed when connecting the power cord to P1O1. Connect the 115 volt power lead which is above ground to the two narrow contacts. Connect the grounded 115 volt power lead to the wide contact of P1O1.

d. Install the 8 mfd filter capacitor and reconnect the two leads.

B. 6. Tube Installation

Carefully install all vacuum tubes in the appropriate sockets as shown in Figures A and F.

Place the PLATE SWITCH at OFF, the FILAMENT SWITCH at ON, and allow the tubes to heat at least 30 minutes before the initial application of high voltage on the tubes. This filament ON time will permit the mercury in the 866A tubes, which may have splattered upon the filaments during shipment, to evaporate.

Subsequent operation of the Thunderbolt will require only 1 minute of filament heating time before application of high voltage. This period is sufficient to allow the bias supply to reach full voltage and the tube filaments to reach the proper temperature.

7. Plate Suppressor Installation

After the wired unit had been completely tested, the plate suppressors and plate connectors (including mounting hardware) were removed for shipment, utilizing separate packaging. The plate suppressors (E1 and E2) should be mounted on the neutralizing capacitor (C2) using the 6-32 x 1/4" binding head screw and #6 lockwasher (Figure A and F). The shorter suppressor goes to V1 (4-400A in the socket on the right side, viewed from the front) and the longer suppressor goes to V2 (4-400A on the left side). Place the plate connectors on the tube caps and adjust the suppressor assemblies so that the plate connectors do not impose undue stress on the tube caps. Carefully tighten the set screws on the plate connectors and then tighten the 6-32 screw on the neutralizing capacitor.

8. Neutralization

The wired amplifiers are shipped from the factory neutralized and need not be reneutralized.

Neutralization is adjusted with the amplifier operating in the CW mode with 20 ma. of grid current and a 450 ma. plate current loading on 14 megacycles (see Section D for tuning and loading procedure). At proper neutralization, the grid current should reduce when the tank is tuned off either side of resonance although a slight rise of 2 ma. or less of grid current is permisseble on one side of tank resonance. If the grid current increases on the high frequency side of tank resonance, increase the neutralizing capacity by turning the neutralizing capacitor (C2) clockwise. If the grid current increases on the lower side of tank resonance, decrease the neutralization capacity. Proper neutralization is usually secured with the neutralizing capacitor set at approximately 13 turns from the minimum capacity stop position.

9. Ground Connections

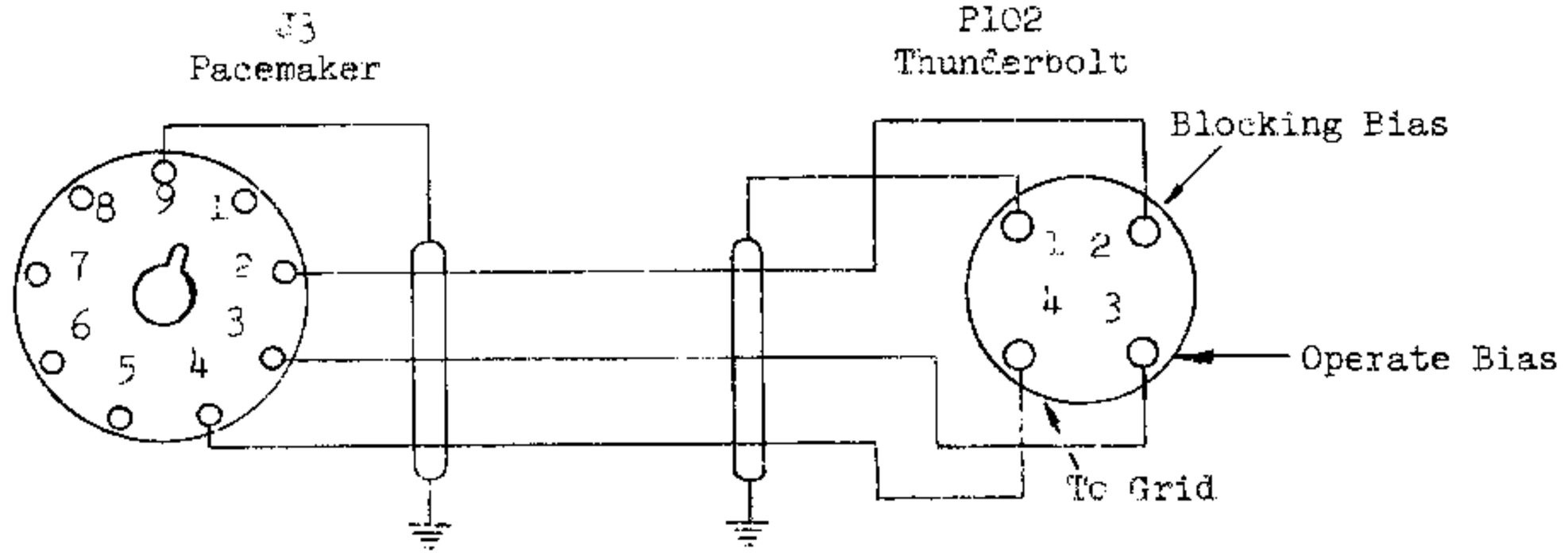
Both the Viking Thunderbolt and the exciter chassis should be bonded together by a heavy copper wire or strap. The same type wire or strap should be used to connect the chassis to an earth ground. The length of the ground wire should be as short as possible avoiding lengths which are a quarter wavelength long on any of the operating frequencies. If the ground lead must be long, it is desirable to make its length a 1/2 or full wave long on the operating frequencies. In some installations, it may be advisable to install more than one ground wire.

NOTE: Be sure the four cabinet tie rods and 20 screws (with lockwashers) attaching the cabinet are tightened securely.

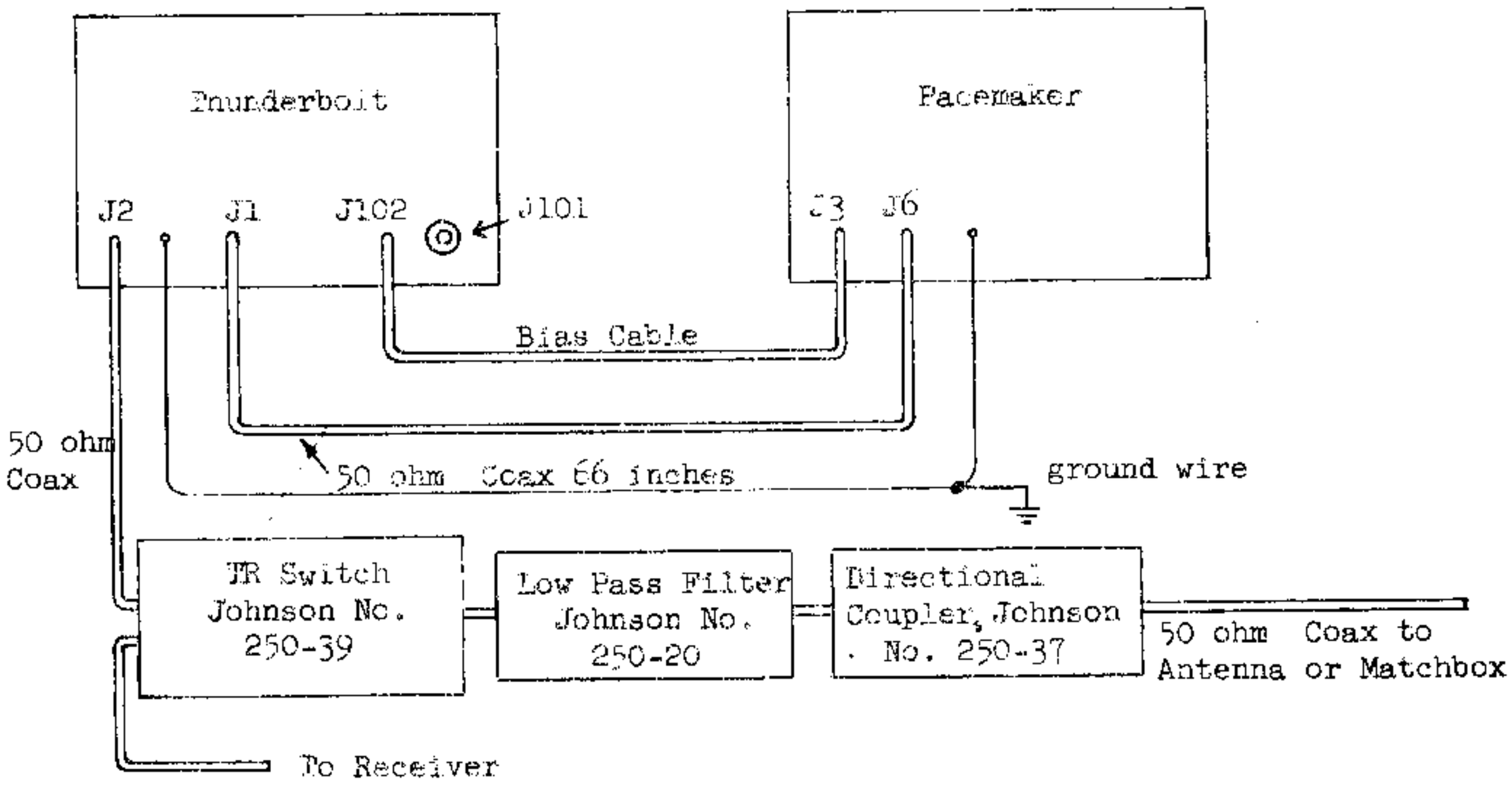
B. 10. Exciter and Thunderbolt Interconnection.

a. Pacemaker - Thunderbolt Interconnection

Make up interconnecting cables for interconnection of the exciter and Thunderbolt amplifier as shown in the sketches below. Avoid excessive lengths of coaxial transmission lines.




Bias Switching Control Circuit Shielded Cable-three #22 or larger stranded wires.

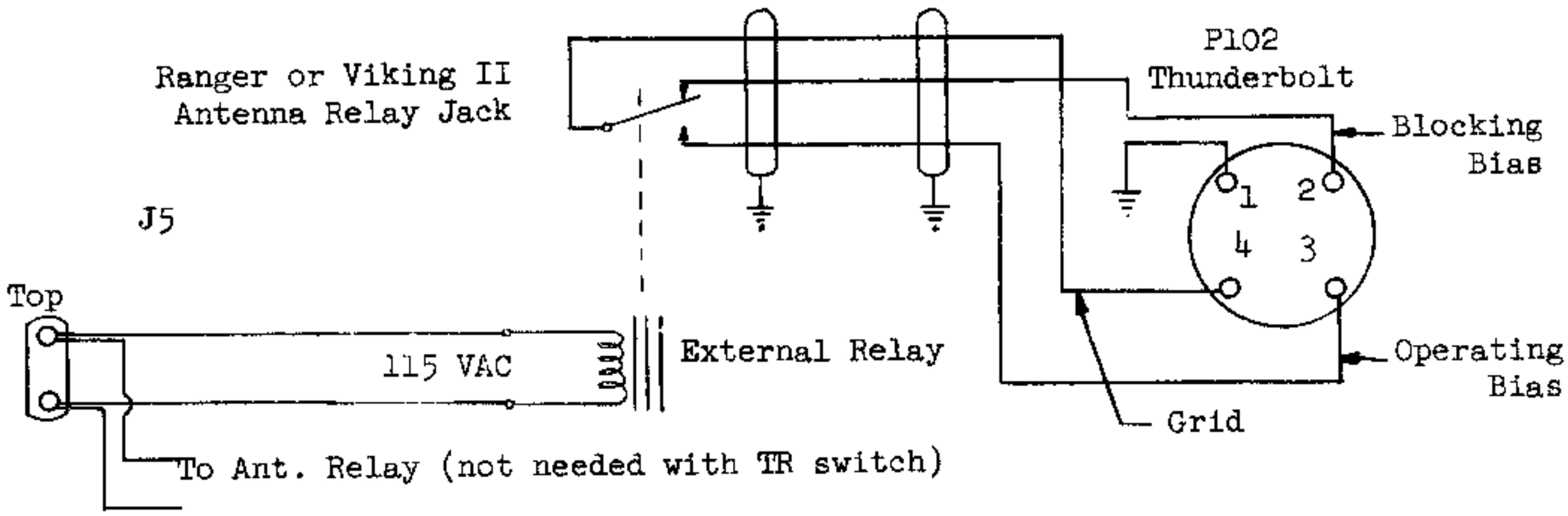



The output of the Pacemaker requires no external swamping for CW, SSB and AM linear operation. Proper loading for linear operation is provided by the 350 ohm grid loading resistor, R3, when the Thunderbolt grid switch is placed in the "RES" (resistive) position. This grid switch position requires no tuning of the grid circuit and is used for linear operation.

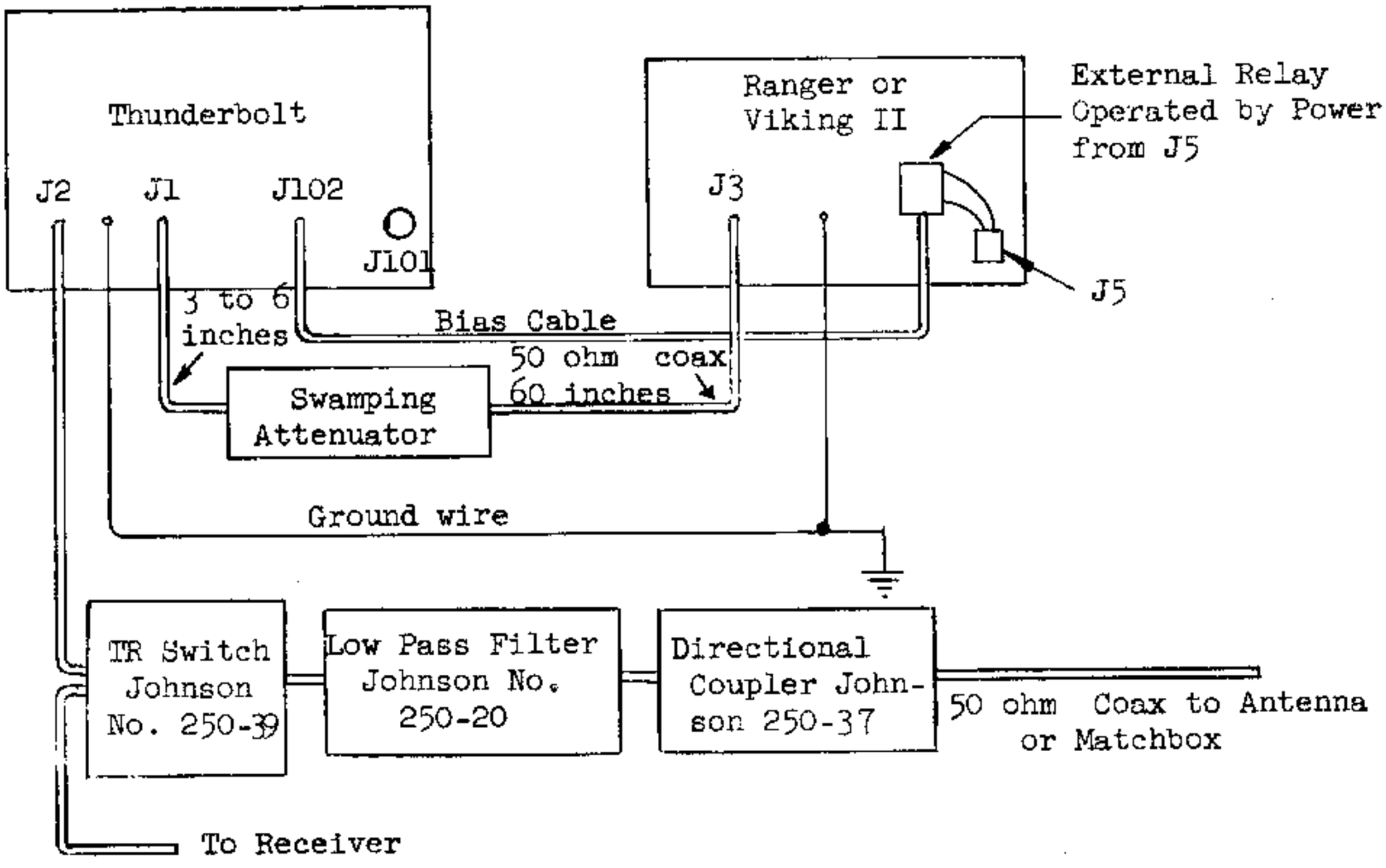
For CW operation the grid switch is turned to the operating frequency band, which switches the 350 ohm resistor out of the circuit.

B. 10. b. Ranger, Viking II or Similar Exciters - Thunderbolt Interconnections.

Make up interconnecting cables for interconnection of the exciter and Thunderbolt amplifier as shown in the sketches below. Avoid excessive lengths of coaxial transmission lines.

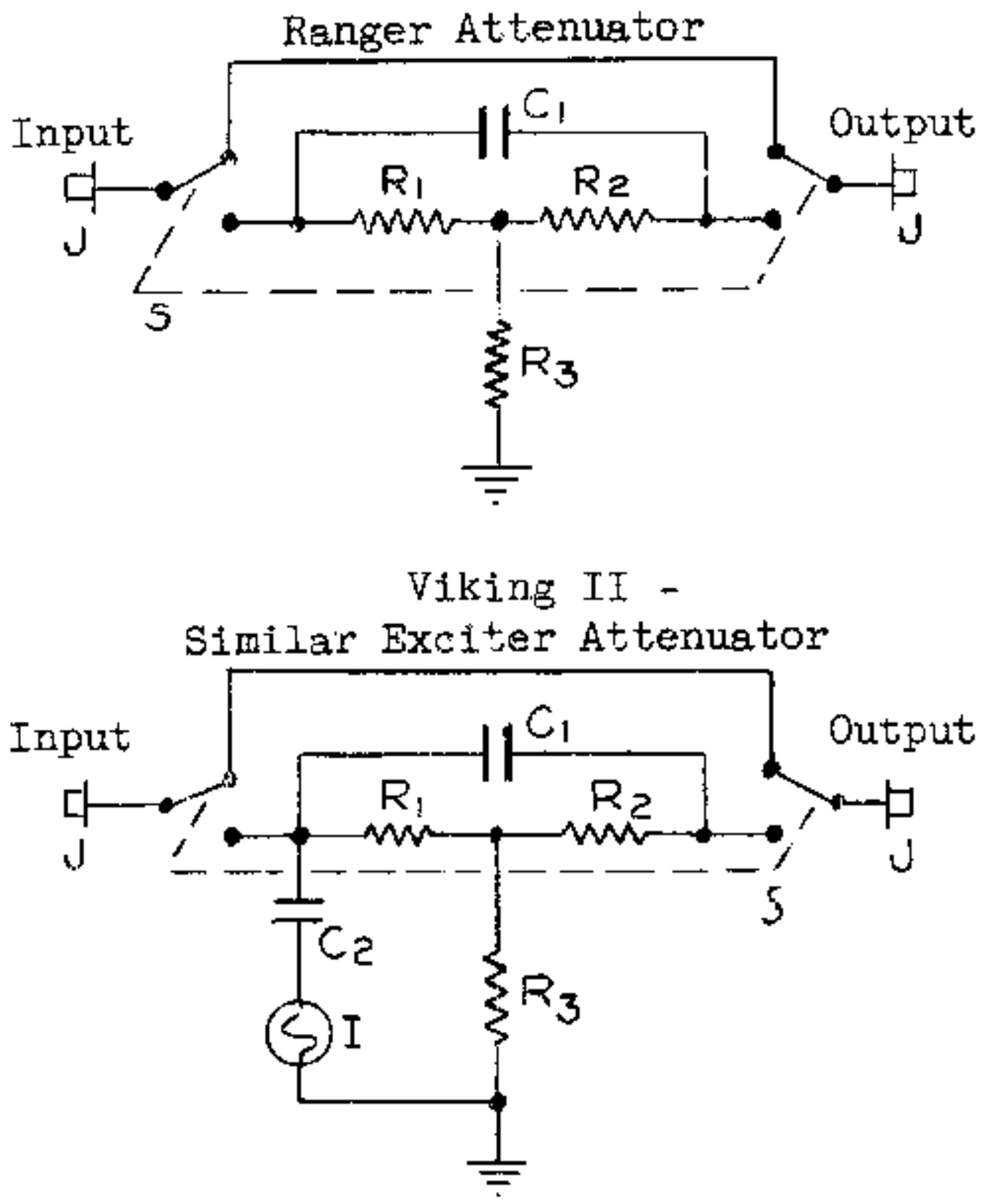



Bias Switching Control Circuit Shielded Cable - three #22 or larger stranded wires.




In AM linear operation, these exciters will require an external swamping attenuator in addition to the 350 ohm resistor provided in the Thunderbolt when the BAND switch is in the RES position. If the Thunderbolt is operated in the CW mode or TUNE position, the swamping attenuator must be switched out. Two swamping attenuators, JOHNSON Part No. 250-42-1 for the Ranger and JOHNSON Part No. 250-42-2 for the Viking II, will be available 15 March 1958.

B. 10. b. This 6db swamping attenuator may be constructed as shown in the diagram. The attenuator should be housed in a shielded enclosure to prevent radiation.




$R_1$ = ten 1200 ohm 2 watt non-inductive resistors in parallel.

$R_2$ = four 470 ohm 2 watt non-inductive resistors in parallel.

$R_3$ = ten 4700 ohm 2 watt non-inductive resistors in parallel.

$C_1$ = 47 mmfd 500 W.V. mica capacitor.

J = 83R-1 coaxial connector.

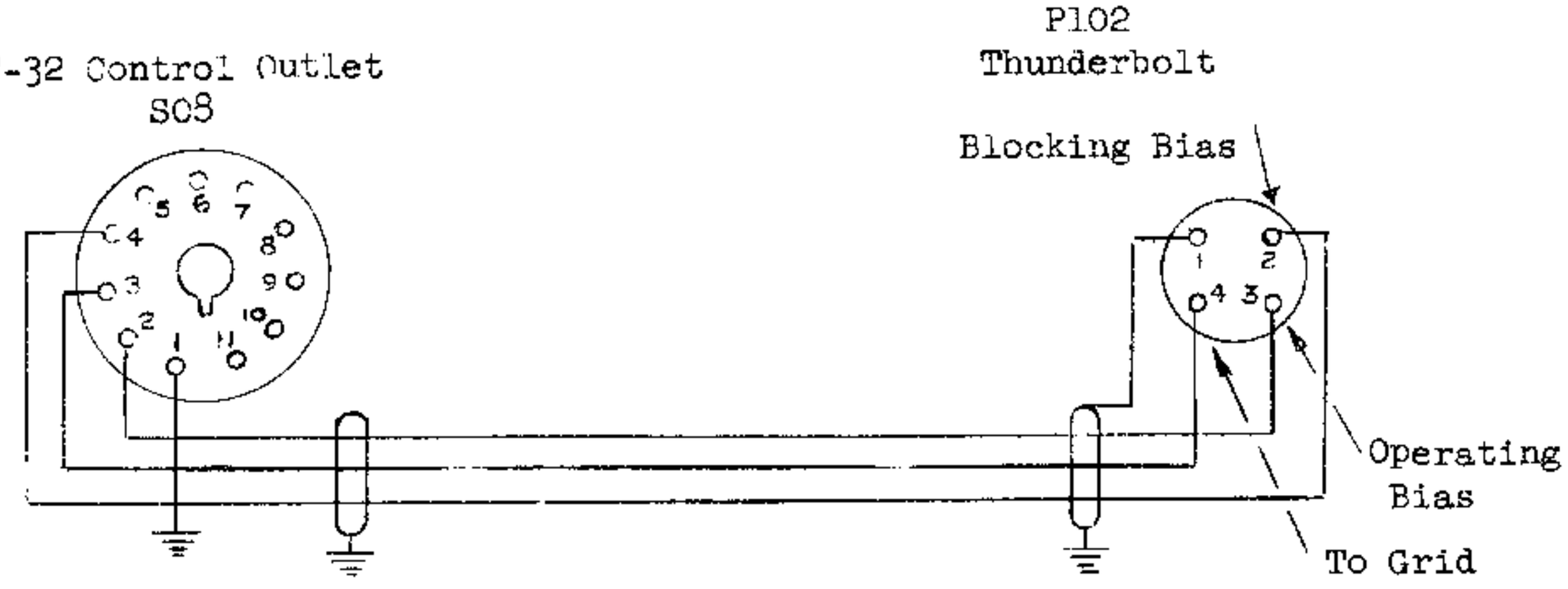
S = DPDT rotary switch.

$C_2$ = 150 mmfd 500 W.V. mica capacitor

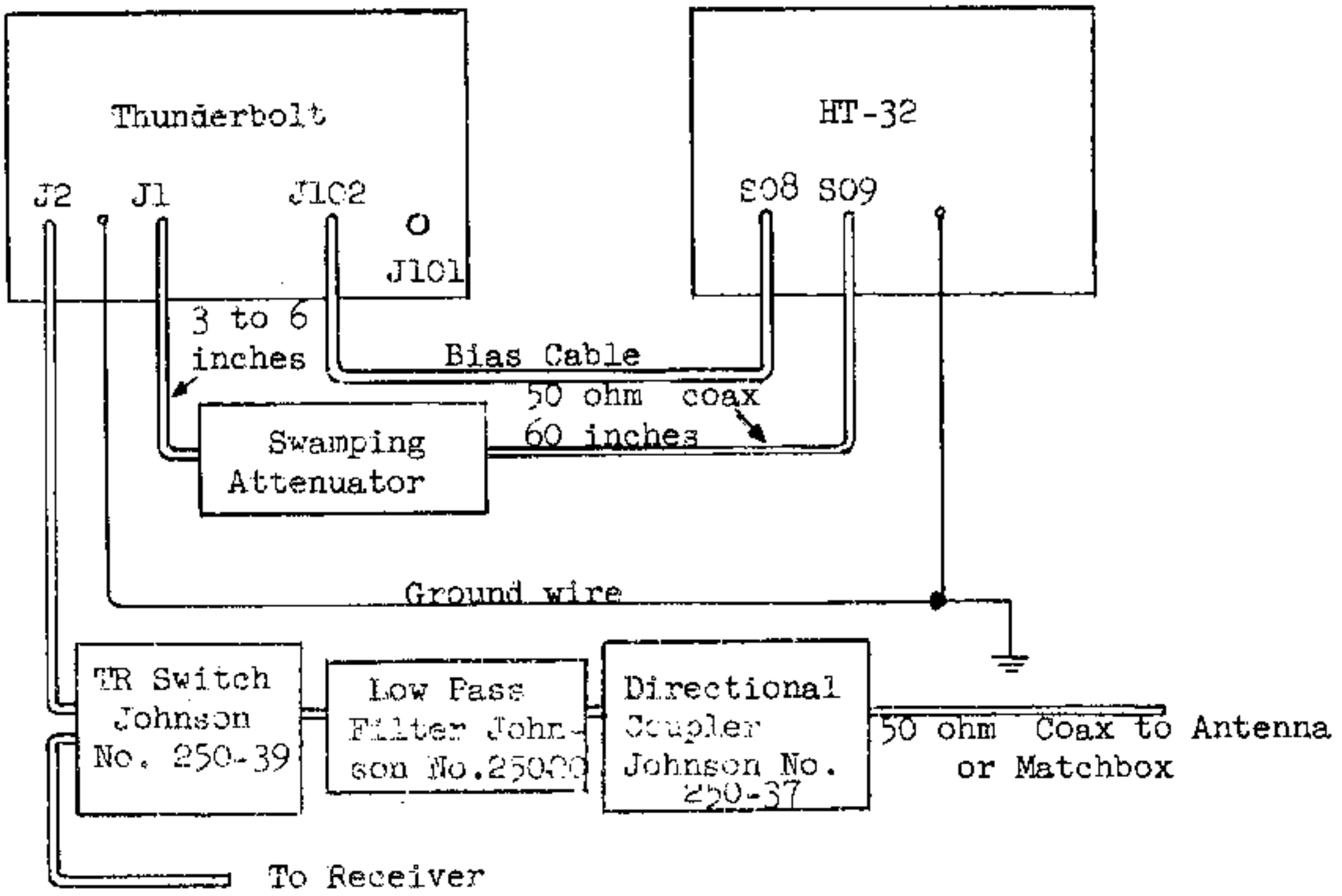
I = 75 watt 115 VAC light bulb.

c. Thunderbolt - HT-32 Exciter Interconnections

Make up interconnecting cables for interconnection of the exciter and Thunderbolt amplifier as shown in the sketches below. Avoid excessive lengths of coaxial transmission lines.

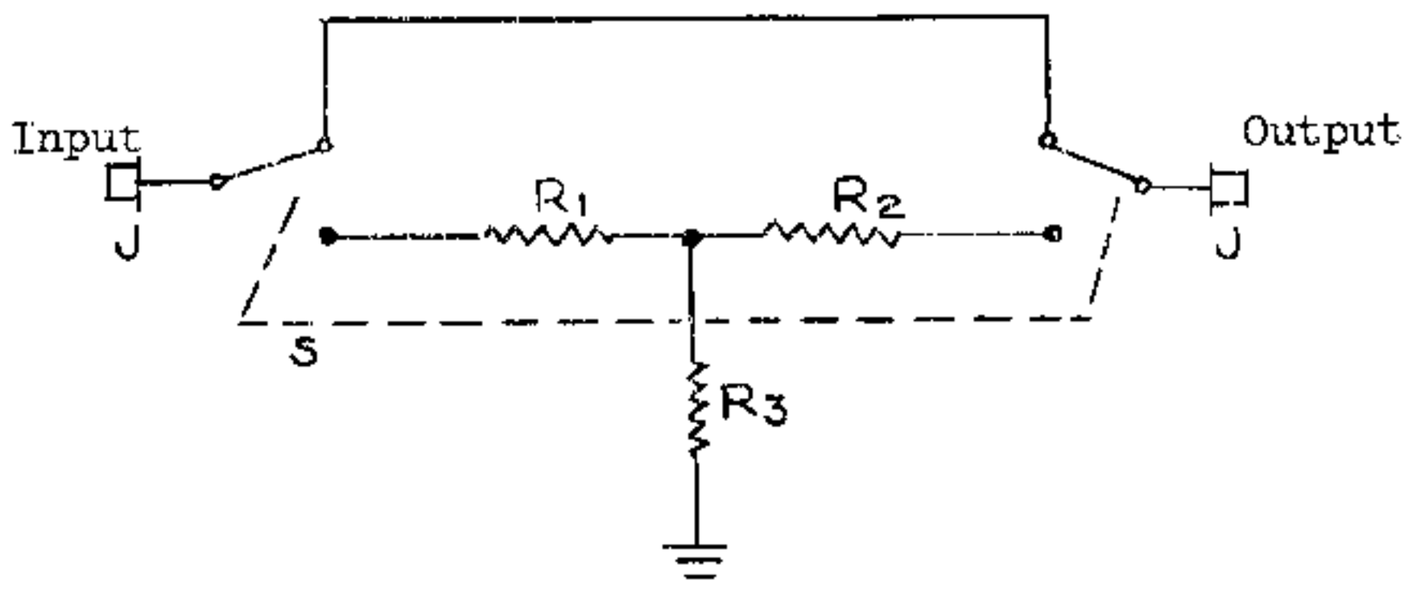



Bias Switching Control Circuit
Shielded Cable - three #22 or larger stranded wires




When an HT-32 exciter is used the Thunderbolt bias leads in the above circuit should be connected to pins 2, 3 and 4 of S08 in the HT-32. A swamping attenuator (JOHNSON Part No. 250-42-3, available 15 March 1958) should be used on the RF output of the HT-32 and should be switched out when driving the Thunderbolt in CW operation.

This 6db swamping attenuator may be constructed as shown in the diagram. The attenuator should be housed in a shielded enclosure to prevent radiation.




$R_1$ = twelve 220 ohm 2 watt non-inductive resistors in parallel.

$R_2$ = four 68 ohm 2 watt non-inductive resistors in parallel.

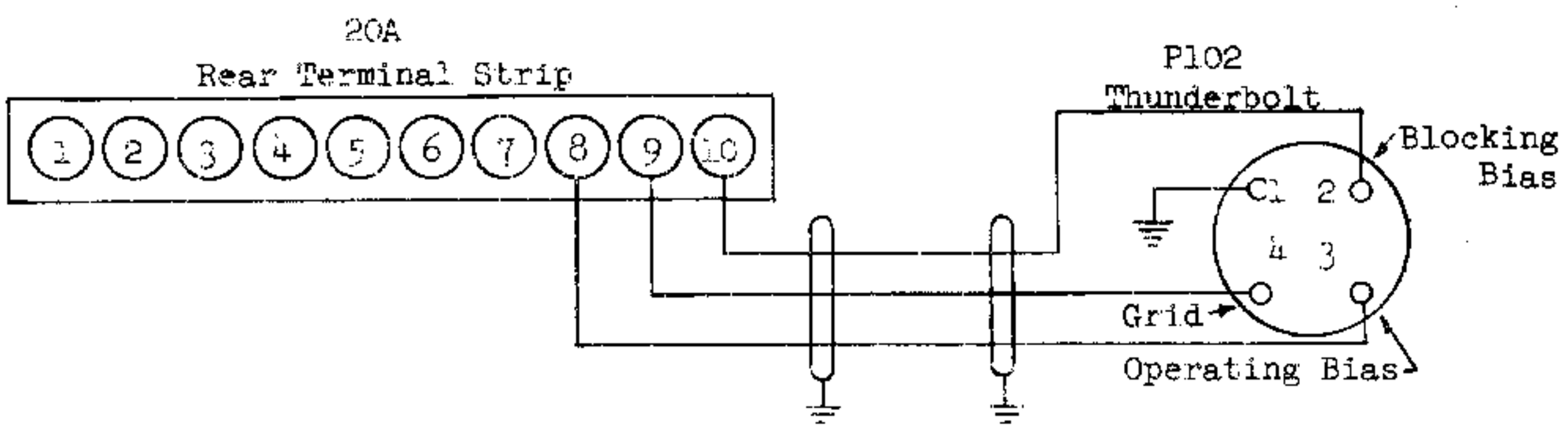
$R_3$ = twelve 820 ohm 2 watt non-inductive resistors in parallel.

J = 83R-1 coaxial connector.

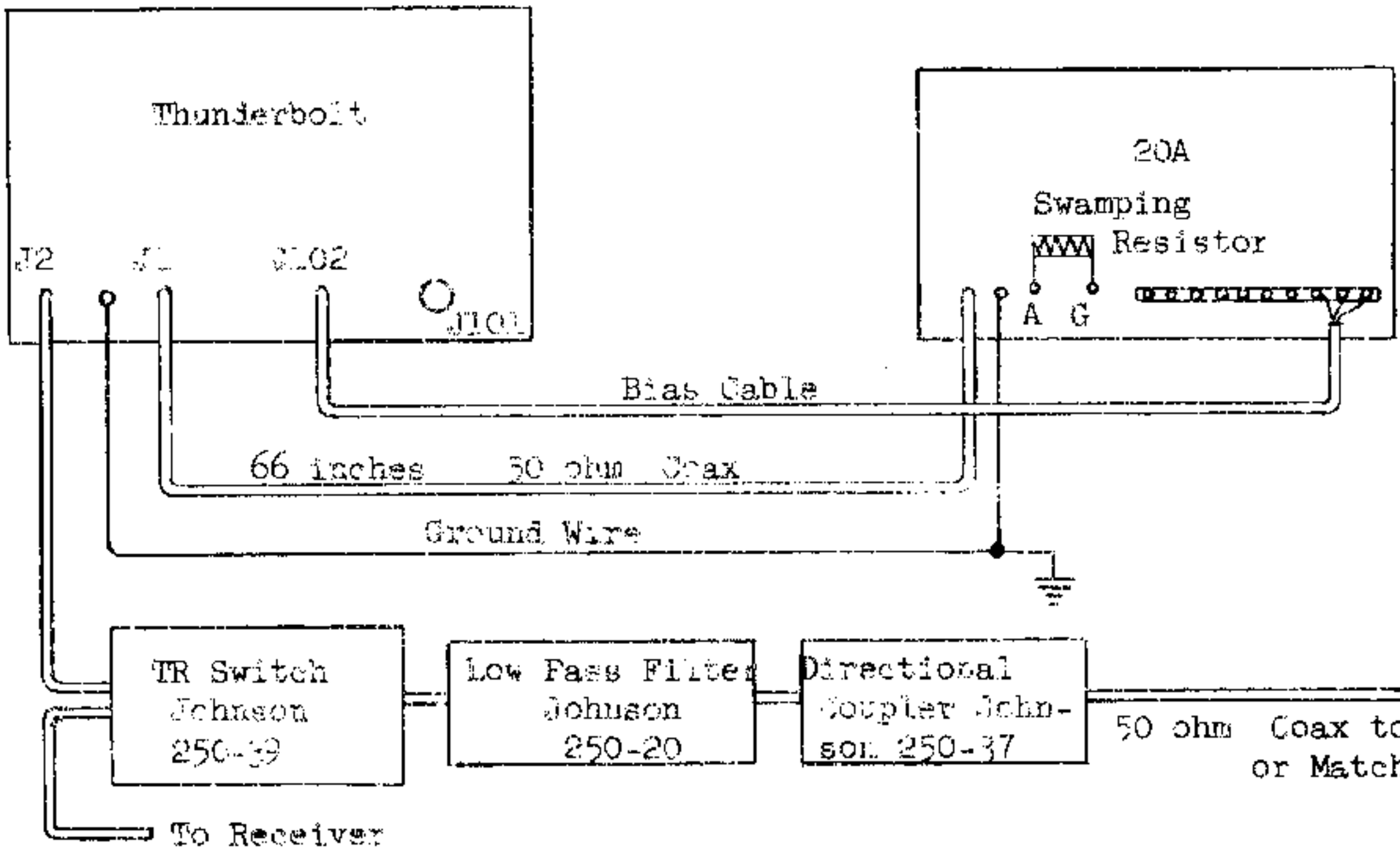
S = DPDT rotary switch.

B. 10. d. Thunderbolt - 20A Exciter Interconnections.

Make up interconnecting cables for interconnection of the exciter and the Thunderbolt amplifier as shown in the sketches below. Avoid excessive lengths of coaxial transmission lines.



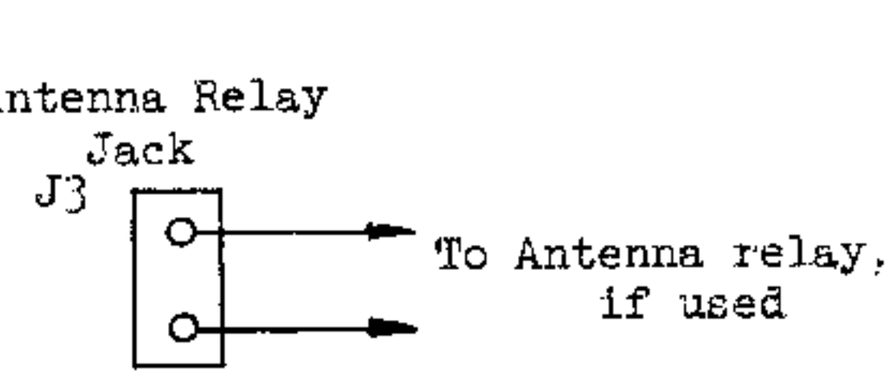

Bias Switching Control Circuit Shielded Cable - three #22 or larger stranded wire.

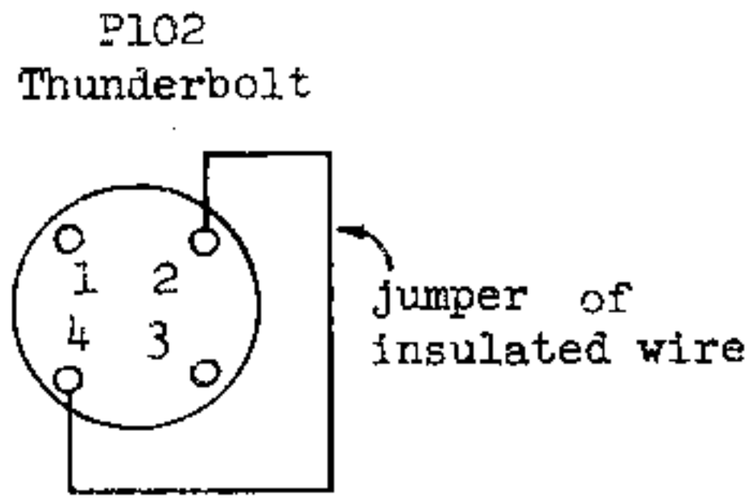



The Thunderbolt bias switching leads should be connected to terminals 8, 9, and 10 at the 20A exciter as shown in the above circuit. The output of the 20A should be swamped with 100 ohms of resistance (three 330 ohm, 2 watt non-inductive resistors in parallel). Due to the reduced output of the 20A on the 15, 11 and 10 meter bands, the exciter may not be capable of driving the Thunderbolt to full power on these bands. The swamping resistor will have to be removed to drive the Thunderbolt in CW operation.

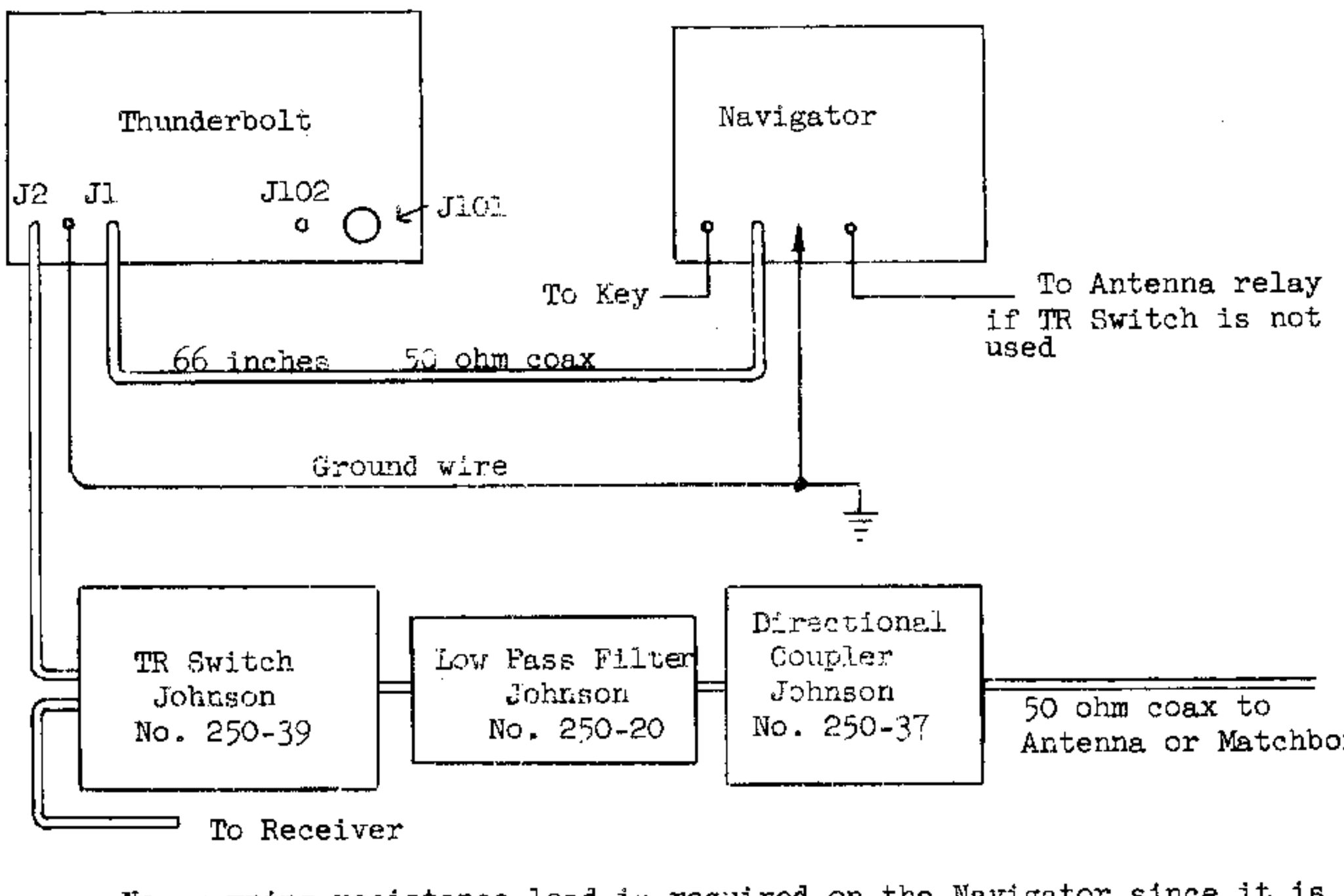
B. 10. e. Navigator - Thunderbolt Interconnection.

Make up interconnecting cables for interconnection of the exciter and the Thunderbolt amplifier as shown in the sketches below. Avoid excessive lengths of coaxial transmission lines.




Bias Control Switch




No swamping resistance load is required on the Navigator since it is only capable of CW operation. The tuning procedure is the same as described in section D1.

C. METERS, CONTROL AND FUSES

Refer to Figure K, Control Familiarization Chart.

1. PLATE CURRENT-POWER meter (M1) indicates the plate current of the amplifier and the power input for plate voltage of 2000 volts. If the plate voltage is other than 2000 volts, multiply plate current and plate voltage to obtain watts input.

2. The MULTI-METER (M2) indicates the grid current, screen current, and plate voltage as selected by the meter switch located below the meter. The top scale reads the grid current directly and the screen current when the scale is multiplied by 5. The plate voltage is read by the bottom scale and is in kilovolts.

3. The FILAMENT SWITCH controls the filament, bias and screen voltages. The filament switch must be turned on only when the plate switch is in the off position. Sufficient time must be allowed for heating of the 866A filaments and the bias and screen voltages to come up to value before the plate switch is placed in the ON position. One minute is sufficient.

4. The PLATE SWITCH controls the high voltage. It must be in the OFF position when the filament switch is turned on or whenever the mode or coupling switches are changed.

5. The MODE SWITCH selects the proper bias and screen voltage for CW, TUNE and LINEAR operation. The CW position is used for Class C operation of the Thunderbolt amplifier. The TUNE position is used only for the tuning and loading of the amplifier for linear operation. The LINEAR position is used for AM, SSB and DSB operation of the amplifier.

6. The BAND SWITCH selects the input coupling coil and grid tuning inductance for continuous coverage from 3.5 to 30 megacycles. The RES (resistance) position disconnects the tuned grid circuit and places a 350 ohm swamping resistor across the grid circuit of the 4-400A tubes. The RES position may be used with the PACEMAKER (AM and SSB operation), the Ranger and Viking II (AM operation) or any similar exciter whose output circuit will load into 350 ohms. For CW operation, the BAND SWITCH must always be in tuned circuit position for the desired operating band and not in RES position.

7. The GRID dial controls the grid circuit tuning capacitor.

8. The PLATE TUNING control provides single knob tuning of the plate circuit inductor and capacitor from 3.5 to 30 megacycles. The PLATE TUNING control also drives the slide rule type indicator.

9. The COUPLING controls provide switching of the fixed loading capacitors and adjustment of the variable loading capacitor to obtain the desired plate current (loading).

10. The Thunderbolt has three fuses (F101, F102, F103) located at the rear of the amplifier chassis and one fuse (F104) located on the Capacitor Board CH9. The fuses protect the following circuits.

    a. F101 protects all AC power primaries.

    b. F102 protects the high voltage transformer primary.

C. 10. c. F1C3 protects the filament and low voltage transformer primaries.

d. F1O4 protects the high voltage transformer secondary.

11. J1O2, the four pin socket on the rear of the chassis, provides control of blocking and operating bias. An external set of SPDT relay contacts (usually available in the exciter) transfers the bias from blocking to operate (See Section B1O). Blocking bias is used during standby periods to cut off the amplifier thus reducing power consumption and plate dissipation and eliminating diode noise in the receiver.

## D. ADJUSTMENT AND OPERATION

### 1. CW Class C Operation

The Thunderbolt Amplifier is operated as a Class C amplifier for CW by switching the MODE SWITCH to the CW position which selects the proper bias and screen voltages. For this type of operation, the BAND SWITCH must be placed in the operating frequency position and the GRID capacitor adjusted for resonance. The maximum permissible loading of the Thunderbolt is secured when the plate power input, at resonance, is 1OOC watts (plate current x plate voltage) with 20 ma. of grid current drive. The Thunderbolt may be adjusted to a lower power input by reducing the load coupling.

The Thunderbolt is adjusted for CW operation in the following manner.

a. Place the Thunderbolt PLATE at OFF, FILAMENT at ON, METER at GRID, MODE at CW, and BAND at the operating frequency.

b. Set the Thunderbolt dial positions to those given in Figure I.

c. Adjust the exciter and the Thunderbolt grid circuit to resonance (tune GRID for maximum grid current). Adjust the exciter output for 10 ma. of grid current in the Thunderbolt.

d. Place Thunderbolt PLATE at ON and adjust the PLATE TUNING for resonance, minimum plate current (dip).

e. Increase the output of the exciter (keeping the exciter final in resonance) for 2C ma. of Thunderbolt grid current. Adjust the COUPLING and PLATE TUNING until 1OOO watts input is secured at resonance. After each incremental adjustment of the COUPLING controls (coupling is increased with increasing dial numbers), the PLATE TUNING is adjusted for minimum plate current (dip). Tuning for dip should always be the last adjustment.

f. Keying of the exciter will operate the amplifier. Since blocking bias is provided on the grids of the 4-4OOA tubes, the plate current will be cut off during key up condition.

D. 2. Linear Operation

General

The Johnson Viking Thunderbolt uses voltage regulated bias and screen supplies and a well regulated plate voltage supply to assure good linearity and low distortion. Although the Thunderbolt is very "clean", the on-the-air signal can be no better than the signal supplied by the exciter. For example, a popular 20 watt exciter produces relatively high distortion at the rated output of 20 watts and, although it may be tolerable "barefooted", it may cause excessive splatter when the signal is of much greater intensity due to the use of a high-powered amplifier (The Thunderbolt gives a power increase of 60 times in this case!).

A SSB exciter should be loaded to rated input when it is used to drive a linear amplifier in order that the inherent signal-to-noise and suppression characteristics of the exciter be fully realized. This requires an attenuator or "swamping" load to absorb excessive power when the exciter produces more output than needed to excite the linear amplifier. The Thunderbolt operates in Class AB1 (zero grid current) up to a peak envelope power input of 1400 watts and is driven into the grid current region, Class AB2, to obtain the maximum rated power of 2000 watts. When grid current starts to flow, the Thunderbolt grid impedance drops thus presenting a variable load to the exciter. The exciter should be heavily loaded so that the changing grid load has relatively little effect upon the exciter. An exciter should have, preferably, an output of 40 watts or more, swamped down, when driving into the Class AB2 region. When in doubt, do not drive into the grid current region (limit audio level to the point where grid current just starts to flick upward) until careful checks are made to assure that there is no splatter.

AM linear operation requires that the exciter be loaded reasonably close to its normal operating level with the output then attenuated to prevent overdriving the Thunderbolt.

Appropriate attenuators for typical exciters are shown in Section B 10.

a. Loading Point

The linearity of any linear amplifier is largely dependent upon the loading and it is important, therefore, that a linear amplifier be properly loaded. The Viking Thunderbolt utilizes a unique loading procedure which compensates for differences in vacuum tubes and permits optimum loading without the use of an oscilloscope.

With exciter interconnections properly made (See Section B10), temporarily disconnect the coaxial cable from the input coaxial fitting, J1, on the Thunderbolt. Place Thunderbolt MODE switch in LINEAR position, PLATE OFF, FILAMENT ON. Turn on exciter, turn Thunderbolt PLATE ON and record the plate current, 250ma (should be between 200 and 300 ma). This value is the static plate current and will now be used to determine the proper plate current loading point per the following chart:

| Static Plate Current | Loading Point, MA |
|---|---|
| 200 | 325 |
| 220 | 340 |
| 235 | 350 |
| 250 | 360 |
| 275 | 375 |
| 300 | 390 |

D. 2. a. Pick the loading point nearest the static plate current previously recorded. Henceforth, this loading point plate current will serve on all bands as the proper loading point for linear operation. For example, a static plate current value of 250 ma calls for a loading point value of 360 ma.

b. Linear Operation Loading Procedure

The loading procedure for linear operation of the Viking Thunderbolt is simply this: In the TUNE position and with four (4) ma grid current, adjust the PLATE TUNING and COUPLING controls to obtain the proper load point current (360 ma in the example above). This establishes the proper load point and the amplifier can now be switched to LINEAR mode and linear operation commenced.

For the purpose of initial familiarization, a detailed step-by-step loading procedure is listed below:

1. With exciter interconnections properly made (See Section B10), set the Thunderbolt controls

| | | |
|---|---|---|
| MODE | to | TUNE |
| PLATE | | OFF |
| FILAMENT | | ON |
| METER | | GRID |
| BAND | | RES for Pacemaker, Ranger, Viking II and similar units. Appropriate band for HT-32, 20A and others. |
| PLATE TUNING<br>COUPLING | | Set per Figure I, Approximate Dial Positions. |
| GRID | | Tune for peak grid current in following step if RES position is not used. |

2. Turn on exciter and adjust exciter output for four (4) ma. grid current on Thunderbolt. During following adjustments, readjust exciter as necessary to maintain 4 ma grid current.

3. Turn PLATE ON and adjust PLATE TUNING for minimum plate current (dip) on upper meter.

4. Adjust coarse and fine COUPLING controls to increase plate current reading (clockwise adjustment increases reading) to desired load point current (See D2a, above). After each incremental adjustment of COUPLING, the PLATE TUNING should be adjusted for dip. Adjustment for dip should always be the last adjustment.

5. If the desired load point current cannot be reached in step 4, load just below the point where the plate current dip disappears.

ADDITIONAL COMMENTS ON LOADING OF THUNDERBOLT. Steps 4 and 5 above refer to Linear Operation Loading Procedure and in particular to "plate current dip".

6. When loading for linear operation, there should always be a 25 to 35 ma plate current dip when the Thunderbolt is fully loaded. In the example given, the load point current is 360 ma. If the 360 ma current is obtained but a 25 to 35 ma "dip" (25 to 35 ma difference between out-of-resonance plate current and dipped plate current) is not possible, decrease the coupling to the point where this amount of dip is present. Instead of 360 ma, the dipped plate current will be some lower value.

D. 2. b. 6. In other words, load to the specified plate current loading point whenever possible but in all cases decrease the loading (coupling) to secure a 25 to 35 ma dip whenever such dip is not present.

Excessive loading decreases the power output in the Thunderbolt or any other linear amplifier.

7. This completes the loading procedure. Reloading will only be necessary if bands are changed, if frequency is changed appreciably within a band, or different antenna systems used.

8. Turn PLATE OFF, switch MODE to LINEAR. Operation in the linear mode may now be commenced by placing exciter in proper mode and placing PLATE in ON position. In SSB operation, the peak plate current meter swing should not exceed a value which times the voltage equals 1000 watts (for example, 455 ma if plate voltage is 2200 volts) as 1000 watts meter reading is the maximum legal power permitted in the Amateur Service by the FCC. With average voices, and due to the fact that the inertia of the meter needle results in a reading considerably below the true plate current, the peak envelope power input will be 2000 watts. The plate current meter has a time constant of 1/4 second as required by the FCC.

c. Exciter Tuning

1. Johnson Viking Pacemaker

The Pacemaker exciter is fed directly into the Thunderbolt with the BAND switch in the RES position and no GRID tuning or external swamping is required on any band, SSB or AM (See Section B10a). Set Pacemaker controls:

| | |
|---|---|
| VFO and BAND | desired band and frequency |
| MODE | AM-HI |
| CARRIER INSERT | 0 |
| OPERATE | STANDBY |
| AUDIO | 0 |

Set Thunderbolt controls:

| | |
|---|---|
| METER | VOLTAGE (This position is used to avoid pinning the meter in GRID position during Pacemaker tuneup.) |
| MODE | TUNE |
| BAND | RES |
| PLATE | OFF |
| FILAMENT | ON |
| PLATE TUNING, COUPLING | Set per Figure I, Approximate Dial Settings |

a. Turn on Pacemaker and load it according to Pacemaker tuning instructions to 0.2 ma grid current and 115 ma plate current. Be sure that BALANCE MOD and EXCITER are tuned for maximum Pacemaker grid current.

D. 2. c. 1. b. Turn CARRIER INSERT to 0, Thunderbolt METER to GRID. Adjust CARRIER INSERT for Thunderbolt GRID current of four (4) ma (If grid current is above four ma with carrier insert at 0, adjust CARRIER BALANCE controls to bring current down within range of insert control).

c. Load Thunderbolt as described in preceding section, D2b. Turn PLATE switch OFF, MODE to LINEAR.

d. Turn Pacemaker MODE switch to desired sideband for SSB OPERATION AND ADJUST CARRIER BALANCE controls for minimum plate current on Pacemaker. Turn PLATE ON and advance AUDIO control while speaking into microphone. Maximum legal power is obtained when plate current meter peaks reach approximately 455 ma. The Thunderbolt plate current may serve as a more sensitive indicator for CARRIER BALANCE adjustment.

e. For AM OPERATION, tune up as in preceding steps. With CARRIER INSERT at 0, turn Pacemaker MODE switch to AM-LC. With PLATE ON, advance CARRIER INSERT until the Thunderbolt plate current is 375 ma. Advance AUDIO control, while speaking into microphone until the plate current kicks upward slightly (approximately 25 ma). Monitoring the signal and reports will indicate proper audio setting.

f. For CW OPERATION, the RES position is not used. BAND and GRID are adjusted on proper frequency and loading of Pacemaker (with 0.2 grid ma) need only be enough to obtain 20 ma grid current on the Thunderbolt as described in section E.

2. AM Linear Operation with Ranger, Viking II or Similar Exciters

Interconnect the exciter and Thunderbolt as shown in Section B10b. Set exciter on desired band with attenuator switched out (no attenuation). Set Thunderbolt controls.

| | |
|---|---|
| METER | GRID |
| MODE | TUNE |
| BAND | RES |
| PLATE | OFF |
| FILAMENT | ON |
| PLATE TUNING<br>COUPLING | Set per Figure 1, Approximate Dial Settings. |

a. With normal gird current on the exciter and with its output decoupled to avoid overdriving the Thunderbolt, increase the exciter coupling to obtain four (4) ma Thunderbolt GRID current. During following adjustments, readjust exciter as necessary to maintain 4 ma grid current.

b. Turn Thunderbolt PLATE ON and load as described in Section D2b. Turn PLATE OFF. Turn MODE to LINEAR.

c. Switch the attenuator into the circuit and increase the exciter loading to where the Thunderbolt plate current is 375 ma (Thunderbolt PLATE ON, MODE in LINEAR). Advance the audio gain while speaking into the microphone until the Thunderbolt plate current kicks upward slightly.

D. 2. c. 2. c. The exciter grid current should always be maintained at the normal operating value. Using the specified attentuator, the Ranger plate current will be approximately 75 to 90 ma and the Viking II 100 to 190 ma when properly loaded. Although these figures are below the normal loading for AM operation, the loading is still adequate and the waveform very satisfactory.

3. HT-32 Exciter

Interconnect the HT-32 and Thunderbolt as shown in Section B10c.

Set HT-32 controls.

| | |
|---|---|
| BAND and FREQUENCY | desired band and frequency |
| OPERATION | STANDBY |
| FUNCTION | DSB |
| RF LEVEL | 0 |
| METER COMPRESSION | 1 |
| AUDIO LEVEL | 0 |

Set Thunderbolt controls.

| | |
|---|---|
| METER | GRID |
| MODE | TUNE |
| BAND | desired frequency range |
| PLATE | OFF |
| FILAMENT | ON |
| PLATE TUNING | Set per Figure I, Approximate |
| COUPLING | Dial Settings |

For SSB Operation

a. Turn HT-32 OPERATION switch to MOX, advance RF LEVEL slightly and tune DRIVER TUNE and FINAL TUNE for peak meter reading.

b. Adjust Thunderbolt GRID tuning for maximum Thunderbolt grid current. Repeak HT-32 FINAL TUNE and adjust RF LEVEL for four (4) ma grid current on Thunderbolt. Maintain 4 ma in following loading steps.

c. Turn Thunderbolt PLATE ON and load as described in Section D2b. Turn PLATE OFF. This completes the loading of the Thunderbolt.

d. Turn METER to VOLTAGE on Thunderbolt to prevent pinning meter on the grid range during following HT-32 loading adjustment.

e. Adjust RF LEVEL, DRIVER TUNE and FINAL TUNE on the HT-32 for just under maximum output (peak on meter) and adjust METER COMPRESSION as described in HT-32 Operating Manual.

f. Switch FUNCTION to desired sideband, upper or lower, Thunderbolt MODE to LINEAR, METER to GRID, PLATE ON.

g. Advance AUDIO LEVEL, while speaking into the microphone, until Thunderbolt plate current meter peaks reach approximately 455 ma. The HT-32 OPERATE switch may be placed in the VOX position for voice-operate or used between STANDBY and MOX for manual operation.

D. 2. c. 3. For AM (DSB) Operation

a. Follow procedure as detailed above for SSB Operation, steps a through e.

b. Turn RF LEVEL to 0, Thunderbolt METER to GRID, MODE to LINEAR, PLATE ON.

c. Turn up RF LEVEL so that Thunderbolt plate current reads 375 ma.

d. Advance AUDIO LEVEL, while speaking into microphone, until a very slight upward kick of the Thunderbolt plate current is observed. Either VOX or MOX operation may be used.

For CW Operation

The attenuator should be switched out of the circuit and loading accomplished as described in Section D1.

4. 20A Exciter

Interconnect the 20A and the Thunderbolt as shown in Section P10d.

For SSB Operation

Set 20A for AM Operation on desired band, SPEECH LEVEL at 0. Set Thunderbolt controls.

| | |
|---|---|
| METER | GRID |
| MODE | TUNE |
| BAND | desired frequency range |
| PLATE | OFF |
| PLATE TUNING, COUPLING | Set per Figure I, Approximate Dial Settings |
| FILAMENT | ON |

a. Turn on 20A and tune MIXER and AMPLIFIER for maximum output.

b. Tune Thunderbolt GRID for maximum grid current, retune AMPLIFIER for maximum Thunderbolt grid current. Adjust CARRIER control for four (4) ma Thunderbolt grid current. Maintain 4 ma in following loading steps.

c. Turn Thunderbolt PLATE ON and load as described in Section D2b. Turn PLATE OFF.

d. Adjust 20A for SSB operation per 20A Instruction Manual. Turn Thunderbolt MODE to LINEAR, PLATE ON.

e. Advance SPEECH LEVEL, while talking into the microphone, until Thunderbolt plate current meter peaks reach approximately 455 ma. Either VOX or MANUAL operation may be used.

NOTE: The power output of the 20A falls off on the higher bands making it difficult to drive the Thunderbolt to full output. It should be possible to drive to the maximum Class AB1 (zero grid current) power of 1400 watts on all bands. In fact, on any band the 20A distortion should be checked when driving the Thunderbolt to 2000 watts or in the grid current region.

D. 2. c. 4. For AM Operation

a. Follow procedure as detailed above for SSB operation, steps a through c.

b. Turn Thunderbolt MODE to LINEAR, PLATE ON. Adjust CARRIER control for 375 ma plate current on Thunderbolt.

c. Advance SPEECH LEVEL control, while speaking into the microphone, until a very slight upward kick of the Thunderbolt plate meter is observed. VOX or MANUAL operation may be used.

For CW Operation

The swamping resistor should be removed from the 20A and tuning accomplished as described in Section D1.

# VIKING THUNDERBOLT AMPLIFIER

## Parts List

| Part No. or Drawing No. | Item No. | Qty. | Description |
|---|---|---|---|
| 22.1079 | B102 | 2 | Motor, 115 V, 60 cycles AC |
| 22.1358 | B103 | 1 | Blade, 4" fan |
| 22.1439 | B104 | 1 | Blade, 5" fan |
| 16.1343 | BKT1 | 1 | Bracket, final tank and loading switch |
| 17.754-11 | BKT2 | 1 | Bracket, final tuning capacitor mounting |
| 16.1001-11 | BKT3 | 1 | Bracket, component, 1 3/16" |
| 16.1001-12 | BKT4 | 1 | Bracket, component, 1 7/8" |
| 16.1345 | BKT5 | 2 | Bracket, H.V. capacitor |
| 16.1001-13 | BKT6 | 1 | Bracket, 2 7/32",component mounting |
| 16.82-27 | BKT7 | 1 | Bracket, 3 7/8", panel support |
| 16.1346 | BKT8 | 1 | Bracket, blower and resistor board mounting |
| 16.82-29 | BKT9 | 2 | Bracket, H.V. shorting switch |
| 16.82-28 | BKT10 | 1 | Bracket, H.V. grounding |
| 167-4 | C1 | 1 | Capacitor, variable, 75L15 |
| 159-125-3 | C2 | 1 | Capacitor, neutralizing |
| 154-38-2 | C3 | 1 | Capacitor, 320E30 variable |
| 22.1458 | C4 | 2 | Capacitor, 300 mmfd 2500 WV |
| 22.1427 | C5,6,7 | 3 | Capacitor, 620 mmf 2500 WV |
| 22.1112 | C8,19,20 | 3 | Capacitor, 500 mmf, 20 KV ceramic |
| 154-39-2 | C9 | 1 | Capacitor, variable 675E20 |
| 22.827 | C11,15,16,17,18, 106,108,110,111, 112,113,114,115, 116,117,118,119, 120,121,122,123 | 21 | Capacitor, .005 mf ceramic disc |
| 22.828 | C13,14,12,22, 23,24,25 | 7 | Capacitor, 1000 mmf, 1500 VW disc ceramic |
| 22.1048 | C10 | 1 | Capacitor, .001 mf mica |
| 22.1428 | C101 | 1 | Capacitor, filter, 8 mf,2000 VDC oil |
| 22.860 | C21 | 1 | Capacitor, 500 mmfd 500 VW |
| 22.962-2 | C102,103,104 | 3 | Capacitor, 30 mfd, 450 VW |
| 23.1301 | CH1 | 1 | Chassis |
| 23.1128-2 | CH2 | 1 | Cabinet |
| 17.853-2 | CH3 | 2 | Chassis rail |
| 23.1127-6 | CH4 | 1 | Panel |
| 17.1038 | CH5 | 1 | Sub chassis, VR tube |
| 17.1039 | CH6 | 1 | Shield, VR tube chassis |
| 22.1182-2 | CH7 | 2 | Bracket, meter shield |
| 22.1181-2 | CH8 | 2 | Shield, meter |
| 23.1290 | CH9 | 1 | Filter capacitor board assembly |
| 23.1291 | CH10 | 1 | Mounting board assembly |
| 18.750 | CH11 | 1 | Mounting board, resistor, transite |
| 23.1298 | CH12 | 1 | Plate, grid compartment bottom assembly |
| 32.64-4 | D1 | 1 | Escutcheon, dial |
| 23.1122-2 | D2 | 1 | Back plate and bracket assembly |
| 23.1120-1 | D3 | 1 | Pulley, 3" diameter |
| 23.909-1 | D4 | 1 | Pulley, outside hub, 1 3/4" diameter |
| 22.1137-2 | D5 | 1 | Pointer, dial |
| 115-256-15 | D6 | 1 | Bearing and shaft assembly |

# VIKING THUNDERBOLT AMPLIFIER

## Parts List

| Part No. or Drawing No. | Item No. | Qty. | Description |
|---|---|---|---|
| 22.1136-2 | D7 | 2 | Pulley |
| 23.1246-1 | D8 | 3 | Knob, 1 5/8" diameter |
| 23.907-12 | D9 | 2 | Knob, 100-0 skirted, 180° |
| 23.907-14 | D10 | 1 | Knob, line indicator |
| 13.123-12 | D11 | 6 | Bearing, panel, 3/8-32 |
| 104-250 | D12 | 1 | Shaft coupling, flexible |
| 14.139-2 | D13 | 1 | Shaft, 1/4" dia. 6 7/16" long, N.P. steel |
| 14.139-9 | D14 | 1 | Shaft, 1/4" dia. 6 1/4" long, N.P. steel |
| 14.139-10 | D15 | 1 | Shaft, 1/4" dia. 6 7/8" long, N.P. steel |
| 18.751-1 | D16 | 1 | Rod, 1/4" dia. phenolic |
| 14.568-1 | D17 | 1 | Rod, 1/4" dia. aluminum |
| 23.900-1 | D18 | 1 | Gear ass'y, final tank |
| 104-252 | D19 | 1 | Coupling, insulated shaft |
| 104-264-2 | D20 | 1 | Coupling, insulated shaft |
| 13.760-2 | D21 | 2 | Coupling, rigid metal shaft |
| 23.910-2 | D22 | 1 | Knob, spinner, 2 3/8" dia. |
| 23.544-2 | D24 | 1 | Jewel assembly, red |
| 23.909-2 | D25 | 1 | Pulley, inside hub, 1 3/4" dia. |
| 42.49-148 | D26 | 5 ft. | Cord, dial, .040 nylon |
| 23.1292-1 | E1 | 1 | Suppressor, plate assembly |
| 23.1292-2 | E2 | 1 | Suppressor, plate assembly |
| 23.1299 | E3 | 1 | Suppressor, grid |
| 23.1084 | E4,5 | 2 | Suppressor, screen |
| 22.747 | E6 | 2 | Hood, coax, 83-1H |
| 22.1309 | E7 | 1 | Hood, coax, UG177U |
| 10.19-1 | E8 | 2 | Insulator, 1" cone |
| 16.1347 | E10 | 1 | Strap, grid connecting |
| 16.1348 | E11 | 1 | Strap, filament grounding |
| 16.51-5 | E12 | 2 | Cap, plate (866A) |
| 16.313-4 | E13 | 1 | Strap, loading capacitor connecting |
| 10.19-5 | E14 | 1 | Insulator, 5/8" cone |
| 16.313-3 | E15 | 1 | Strap, blocking capacitor |
| 16.1352 | E16 | 1 | Strap, blocking capacitor |
| 22.1440 | F104 | 1 | Fuse, 1 ampere, Buss 3AGC-1A |
| 22.742 | F103 | 1 | Fuse, 5 ampere, Buss MTH5 |
| 22.1441 | F101,102 | 2 | Fuse, 10 ampere, Buss MTH10 |
| 22.739-2 | FH101,102,103 | 3 | Post, fuse extractor |
| 22.113-1 | G1,2,3,4 | 4 | Grommet, 9/16" rubber |
| 22.113-5 | G5,6,7,14 | 4 | Grommet, 5/16" rubber |
| 71.43-097 | G8 | 65" | Gasket, 3/16" round metaltex |
| 22.1475-2 | G9,10,11,12 | 4 | Button, polyethylene, rest |
| 22.994-2 | G13 | 1 | Gasket rubber |
| 23.1293 | H | 1 | Harness, cable |
| 16.895-2 | HW | 1 | Spring, shorting switch |
| 22.1272 | HW | 4 | Spring, dial cord |
| 22.21 | I101 | 1 | Lamp, 120 V., candelabra base #6S6 pilot |
| 22.375 | I102,103 | 2 | Lamp, 6.3 V., #44 pilot |
| 22.746 | J1,2 | 2 | Connector, 83R-1 coax. |
| 22.1429-1 | J101 | 1 | 10 amp. 3-wire male flush base |
| 22.1191 | J102 | 1 | Jack, 4 terminal |

# VIKING THUNDERBOLT AMPLIFIER

## Parts List

| Part No. or Drawing No. | Item No. | Qty. | Description |
|---|---|---|---|
| 23.1294 | L1 | 1 | Inductor, 10 meter grid and link |
| 16.1350-1 | L2 | 1 | Inductor, 15 meter grid |
| 23.1088-2 | L3 | 1 | Inductor, low freq. grid |
| 229-204 | L4 | 1 | Inductor, rotary |
| 23.1295 | L5 | 1 | Inductor, 10 meter final tank |
| 102-752-4 | L6 | 1 | Choke, R.F., static drain (without bracket) |
| 23.1085-2 | L7 | 1 | Choke, R.F., plate |
| 23.1000 | L106,107,108 | 3 | Choke, 4.7 uh R.F. |
| 22.951 | L8,9,10 | 3 | Choke, 2.5 mm R.F. |
| 16.1181-5 | L104,105 | 2 | Choke, R.F. line filter |
| 16.1181-3 | L109,110,111, 112 | 4 | Choke, R.F. filter |
| 22.1265 | L101 | 1 | Choke, 5-25 HY H.V. filter |
| 22.749 | L102,103 | 2 | Choke, .095 amp., 15 HY L.V. filter |
| 22.1400 | M1 | 1 | Meter, grid current - voltmeter |
| 22.1399 | M2 | 1 | Meter, plate current - watts |
| 22.1430-1 | P101 | 1 | Connector body, 10 amp. 3 wire female |
| 22.1190 | P102 | 1 | Plug, 4 terminal |
| 22.7077-10 | R1,2 | 2 | Resistor, 15 K 2 watt composition |
| 22.1457 | R3 | 1 | Resistor, 350 ohms |
| 22.1431 | R101,102,103, 104,105,106 | 6 | Resistor, 4000 ohms 50 watt |
| 22.1442-1 | R107, 108 | 2 | Resistor, 1.5 meg. 2 watt ± 1% |
| 22.1432 | R111 | 1 | Resistor, 20 K ohms 50 watt |
| 22.9594-10 | R110 | 1 | Resistor, 4 K ohms 10 watt |
| 22.1433 | R115 | 1 | Resistor, 2500 ohms 50 watt |
| 22.9504-10 | R116 | 1 | Resistor, 2000 ohms 10 watt |
| 22.1467 | R117 | 1 | Resistor, 1.724 ohms meter shunt ± 1% tol. 1/2 watt wire wound |
| 22.1480 | R4 | 1 | Resistor, 0.335 ohm meter shunt ± 1% tol. 1/2 watt wire wound |
| 22.1099 | R112 | 1 | Resistor, 20,000 ohm 10 watt |
| 22.7097-10 | R113,114 | 2 | Resistor, 100 K ohms 2 watt |
| 22.6073-10 | R109 | 1 | Resistor, 10 K ohms 1 watt |
| 22.1434 | SW1 | 1 | Switch, grid band |
| 23.1297 | SW2 | 1 | Switch, coupling |
| 22.1435 | SW101,102 | 2 | Switch, SPST |
| 22.1436 | SW103,104 | 2 | Switch, 3 pole 3 position |
| 22.1466 | T101 | 1 | Transformer, H.V. power |
| 22.1422 | T102 | 1 | Transformer, filament |
| 22.1421 | T103 | 1 | Transformer, L.V. power |
| 22.789-1 | TS1 | 1 | Terminal strip, 4 terminal barrier |
| 22.740-3 | TS2,3,4,5,6 | 5 | Terminal strip, 3 point |
| 22.837 | TS7 | 1 | Terminal strip, 2 point |
| 22.740-4 | TS8 | 1 | Terminal strip, 4 point |
| 22.790-1 | TS9 | 1 | Marker strip, terminal |
| 22.1243 | V1,2 | 2 | Tube, 4-400A |
| 22.212 | V101,102 | 2 | Tube, 866A |
| 22.1104 | V103 | 1 | Tube, 5U4G |

# VIKING THUNDERBOLT AMPLIFIER

## Parts List

| Part No. or Drawing No. | Item No. | Qty. | Description |
|---|---|---|---|
| 22.1332 | V104 | 1 | Tube, 6BY5GA |
| 22.1109 | V105,106 | 2 | Tube, VR150-0D3 |
| 22.1110 | V107,108 | 2 | Tube, VR105-0C3 |
| 22.1438 | V109 | 1 | Tube, VR75-0A3 |
| 71.32-170 | W1 | 11 7/16" | Cable, RG8U-coax |
| 71.32-178 | W2 | 10 1/2" | Cable, RG59U-coax |
| 42.24-107 | W3 | 3" | Tubing, plastic, .133 I.D. |
| 42.24-112 | W4 | 12" | Tubing, plastic, .187" I.D. |
| 23.546-2 | XI101 | 1 | Bracket, dial light, 115 V. candelabra base |
| 23.1047 | XI102,103 | 2 | Pilot light, snap-in type |
| 122-224-1 | XV101,102 | 2 | Socket, 4 prong steatite |
| 22.1274 | XV103,104,105, 106,107,108, 109 | 7 | Socket, molded octal |
| 122-275 | XV1,2 | 2 | Socket, 5 prong jumbo for 4-400A |

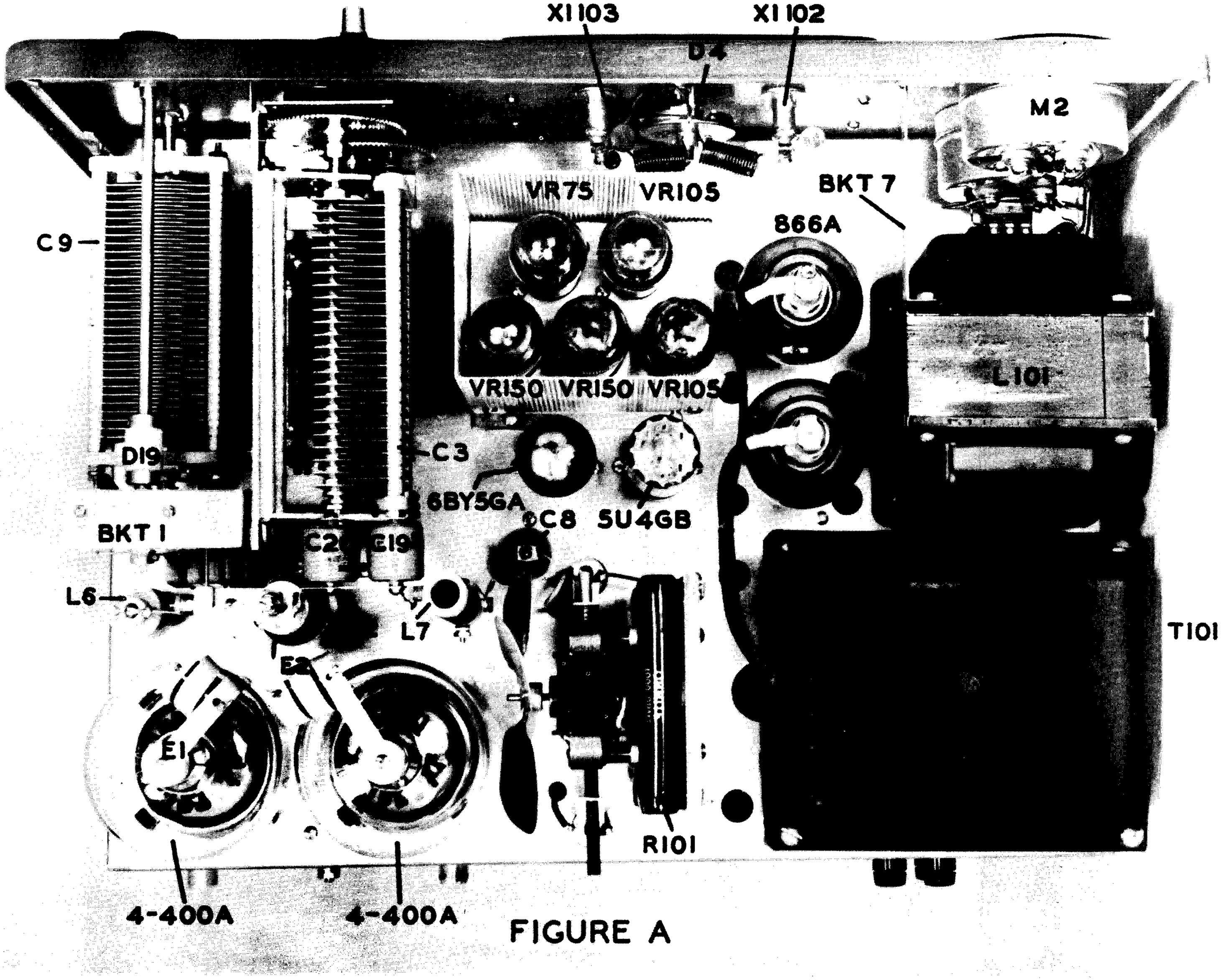

X1103
X1102
D4
M2
VR75
VR105
BKT 7
866A
C9
VR150
VR150
VR105
L101
D19
C3
6BY5GA
C8
5U4GB
BKT 1
C2
E19
L6
L7
T101
E2
E1
R101
4-400A
4-400A

FIGURE A

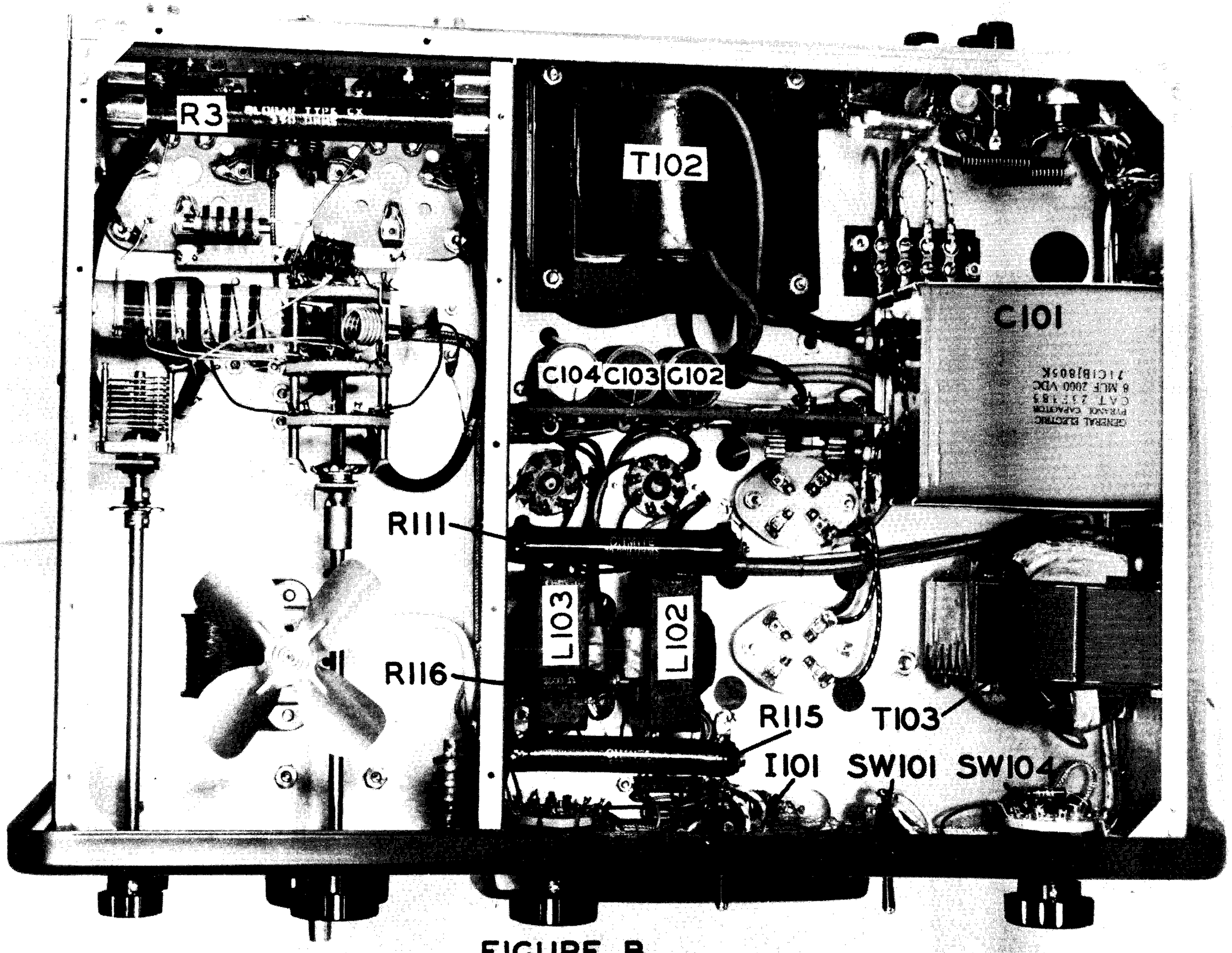

R3
T102
C101
C104 C103 C102
R111
L103
L102
R116
R115
T103
I101
SW101
SW104

FIGURE B

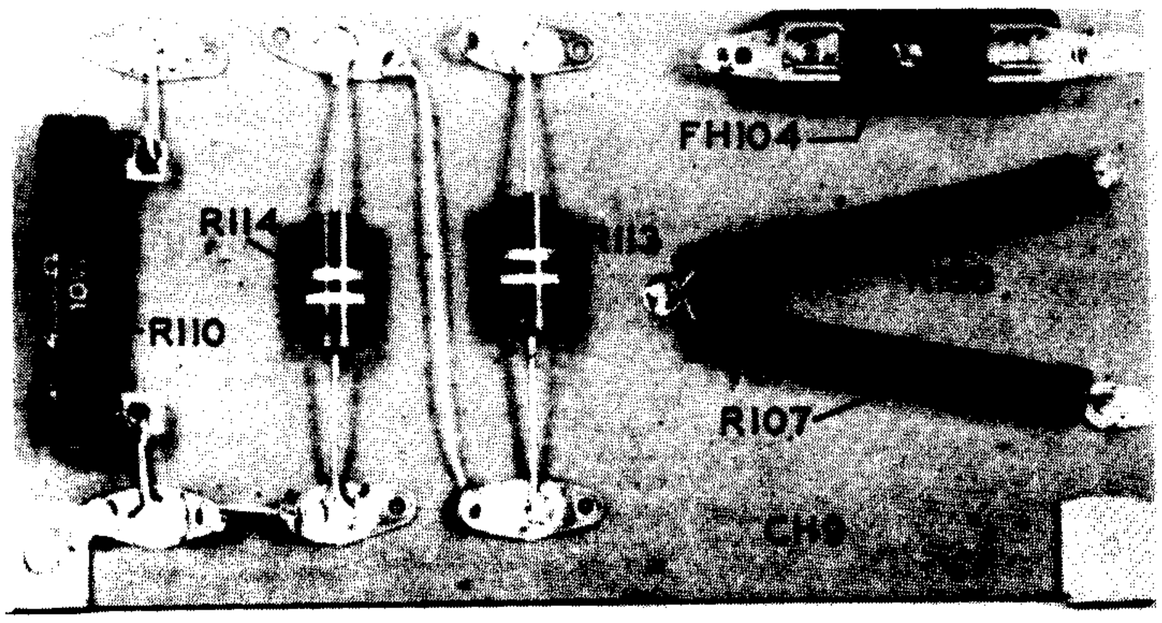



FIGURE C-A

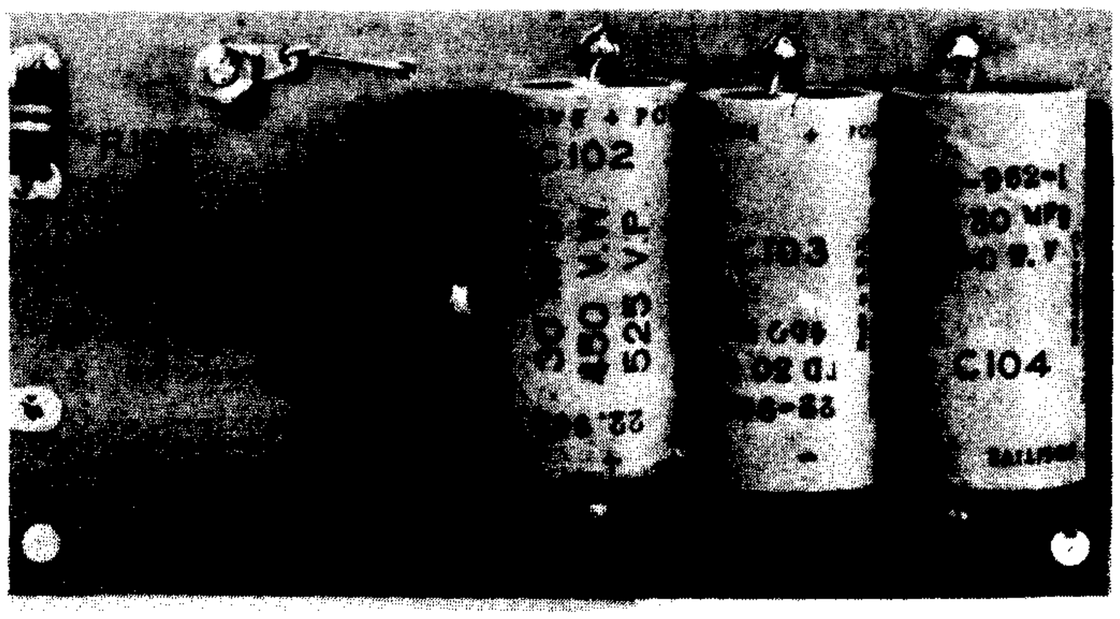
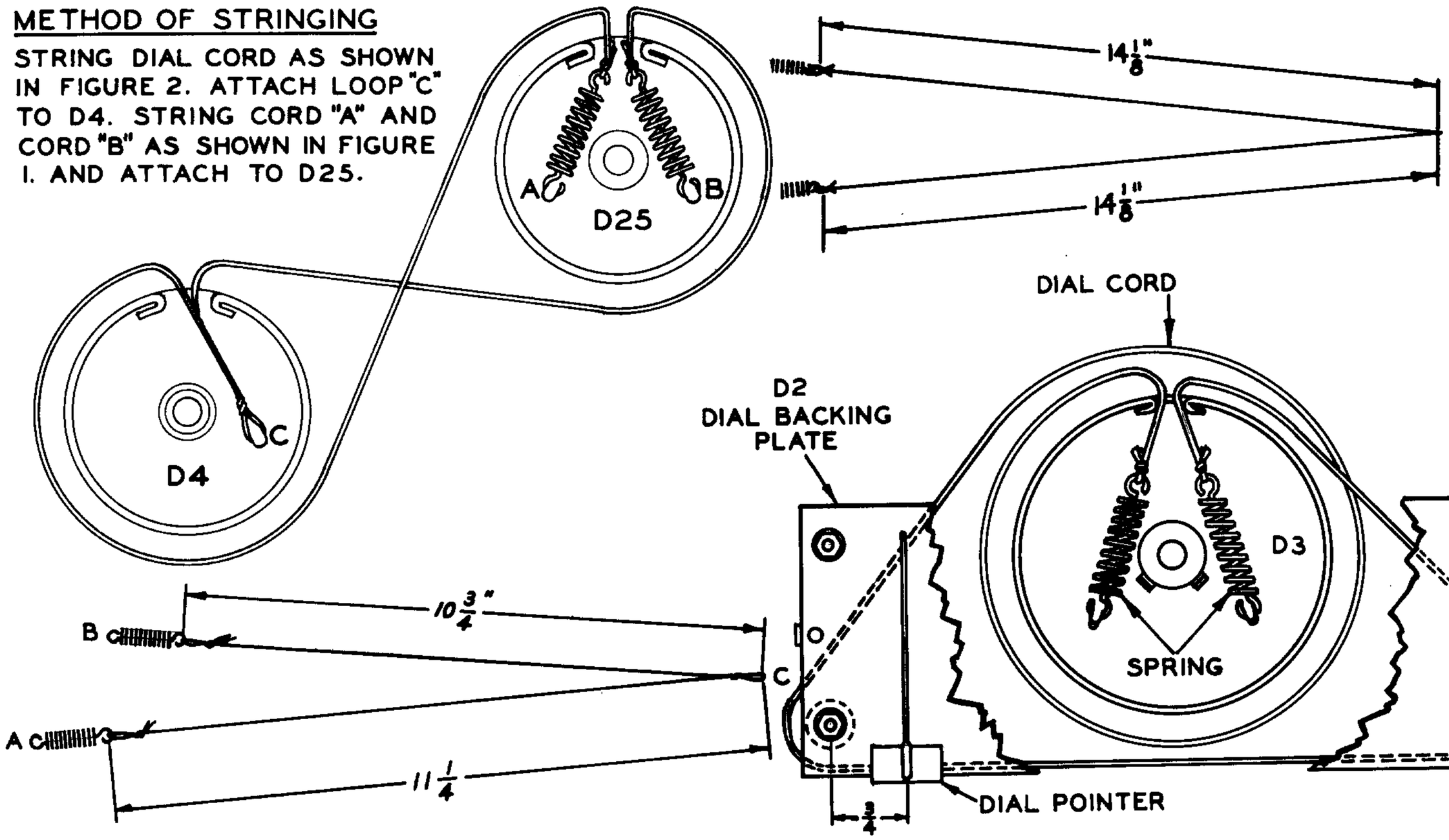



FIGURE C-B

## METHOD OF STRINGING

STRING DIAL CORD AS SHOWN IN FIGURE 2. ATTACH LOOP "C" TO D4. STRING CORD "A" AND CORD "B" AS SHOWN IN FIGURE 1. AND ATTACH TO D25.




DRIVE CABLE FOR DIAL MECHANISM.
FIGURE "D"




DIAL DRIVE ASSEMBLY
FIGURE "E"

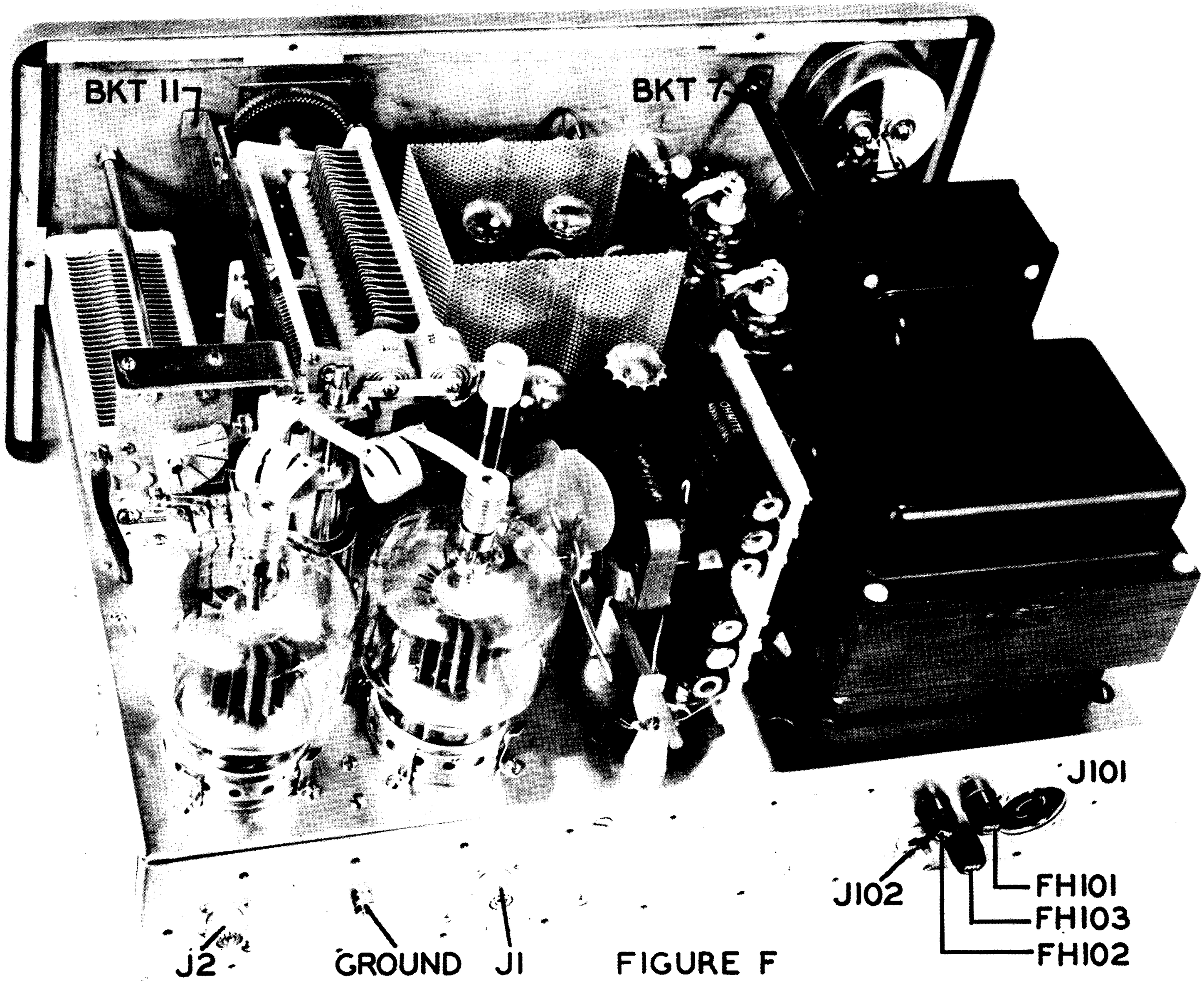



FIGURE F

FIGURE H

APPROXIMATE OPERATING VALUES

| | CW | | AM LINEAR | | TUNE | SSB or DSB | |
|---|---|---|---|---|---|---|---|
| | Trans. | No. Excit. | Trans. | With Block Bias | Trans. | Trans. | With Block Bias |
| Plate Voltage | 2200 | 2350 | 2200 | 2350 | 2200 | 2200 | 2350 |
| Screen Voltage | 465 | 510 | 510 | 510 | 360 | 510 | 510 |
| Bias Voltage | -165 | -165 | -75 | -142 | -75 | -75 | -142 |
| Plate Current | 455 | 0 | 375 | 0 | 360 | 250→455 | 0 |
| Screen Current | 45 | 0 | 0→5 | 0 | 0 | 0→2 | 0 |
| Grid Current | 20 | 0 | 0→0.5 | 0 | 4 | 0→3 | 0 |

FIGURE I

APPROXIMATE DIAL POSITIONS, CW MODE

50 OHM LOAD

| FREQUENCY, MCS. | 4.0 | 7.3 | 14.25 | 21.25 | 27 | 29 |
|---|---|---|---|---|---|---|
| Plate Tuning Dial | 18 | 53 | 76 | 86 | 92 | 94 |
| Coupling Capacitor | 75 | 76 | 49 | 58 | 42 | 47 |
| Coupling Switch | 3 | 4 | 5 | 5 | 5 | 5 |
| Grid Capacitor | 58 | 35 | 60 | 64 | 68 | 73 |
| Band Switch | 3.5-4.7 | 6.5-8.5 | 11.5-17 | 17 - 24 | 24 - 30 | 24 - 30 |

FIGURE J

VOLTAGE AND RESISTANCE CHECK LIST

1. Resistance Values, may be useful in trouble shooting.

All resistance measurements are to ground, unless otherwise noted, and may vary ±10% in value. Power plug P101 and bias control plug P102 removed from sockets. Refer to Figures A, B, F and G for location of measurement points.

| | |
|---|---|
| C102 (terminal nearest viewer) | 20,000 ohms |
| C104 (terminal nearest viewer) | 4,000 ohms |
| Terminal 2 of Mode Switch SW103 | 22,500 ohms |
| L7 Choke (H.V. shorting switch closed) | 0 ohms |
| L7 Choke (H.V. shorting switch open) | 24,000 ohms |
| PA Grid (terminal 3 of 4-400A socket) | |
| Mode switch in CW | 4,000 ohms |
| Mode switch in LINEAR | Infinite ohms |
| PA Screen Grid (terminal 2 of 4-400A Socket) | |
| Mode Switch in CW or LINEAR | 22,500 ohms |
| Bias Control plug socket. J102 | |
| Terminal 1, at all mode positions | 0 ohms |
| Terminal 2, at all mode positions | 4,000 ohms |
| Terminal 3, mode switch on CW | Infinite ohms |
| Terminal 3, mode switch on TUNE or LINEAR | 6,000 ohms |
| Terminal 4, at all mode positions | Infinite ohms |
| High Voltage Transformer, T101 | |
| Black wire to black-red wire | .6 ohms |
| White wire to black-green wire | .6 ohms |
| Red-yellow wire to red wire | 120 ohms |
| Red-yellow wire to red wire | 120 ohms |
| High Voltage Filter Choke, L101 | |
| Between two leads, max. | 65 ohms |
| Low Voltage Transformer, T103 | |
| Green to green wire, Yellow to yellow wire | practically zero ohms |
| blue to blue wire | 140 ohms |
| red to red-yellow wire | 350 ohms |
| red to red-yellow wire | 350 ohms |
| black to black wire | 2.2 ohms |
| Low Voltage Chokes, L102 and L103 | |
| black to black wire, ±15% | 290 ohms |
| Filament transformer, T102 | |
| brown to brown wire, green to green wire, yellow to yellow wire | practically zero ohms |
| black to black wire | 1.2 ohms |

2. Voltage Values

WARNING! The voltages encountered in this equipment are high enough to cause fatal injury. Exercise extreme caution when making the following checks. Place a grounding hook, with an insulated handle, on the rectifier tube caps whenever working inside the cabinet with the primary power plug in its socket and the PLATE switch OFF. All measurements are with respect to chassis ground, without grid drive or plate voltage, and may vary plus or minus 10 percent.

Remove F102, H.V. primary fuse, place power plug P101 in socket J101, turn PLATE switch OFF and FILAMENT switch to ON. Plug P102 not inserted into J102.

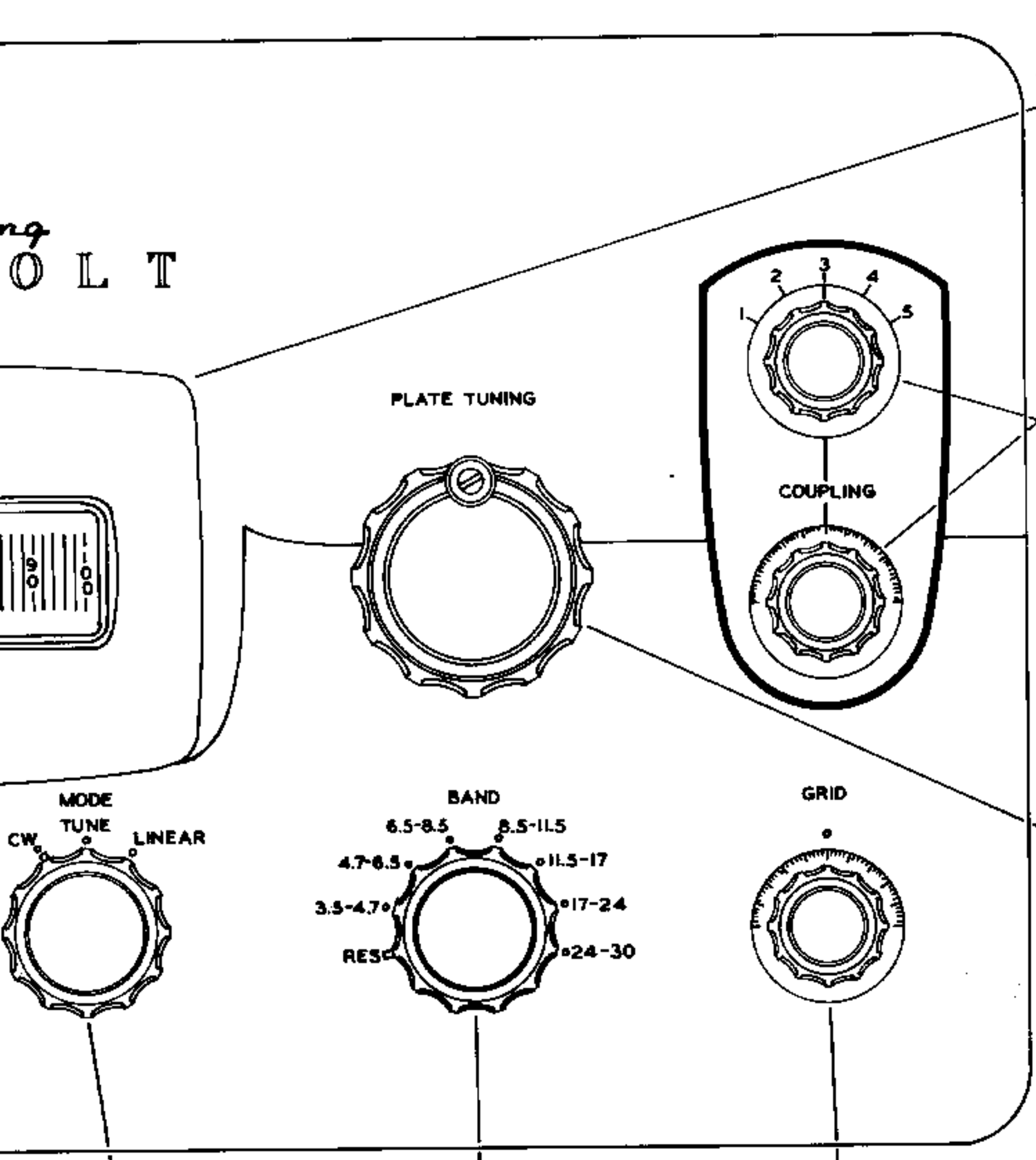
| | |
|---|---|
| C104 (terminal nearest viewer) | -150 volts |
| C102 (terminal nearest viewer) | +600 volts |
| PA Screen grid (terminal 2 of 4-400A socket) | |
| Mode Switch on CW and LINEAR | +510 volts |
| Mode Switch on TUNE | +360 volts |

Insert P102 into J102 so bias may be switched from operating to blocking.

| | |
|---|---|
| PA Screen grid (terminal 2 of 4-400A socket) | |
| Mode switch on LINEAR and blocking bias on grid (pins 4 and 2 of J102 connected) | +510 volts |
| PA grid (terminal 3 of 4-400A socket) | |
| Mode switch on CW | -150 volts |
| Mode switch on TUNE | -75 volts |
| Mode switch on LINEAR and blocking bias on grid (pins 4 and 2 of J102 connected) | -150 volts |
| Mode switch on LINEAR and operating bias on grid (pins 4 and 3 of J102 connected) | -75 volts |

Plate voltage: Place unit in the cabinet and make all connections. With the amplifier operating in the CW mode (20 ma. grid current and 1000 watts input) the plate voltage should read 2000 to 2300 volts depending upon the line voltage.

ng
O L T




INDICATES PLATE TUNING (TANK CIRCUIT) SETTING. DIAL LIGHT INDICATES FILAMENT ON.

ADJUSTED TO OBTAIN PROPER PLATE CURRENT READING. CLOCKWISE ROTATION INCREASES PLATE CURRENT. UPPER DIAL COARSE ADJUSTMENT LOWER, FINE ADJUSTMENT.

TUNES PLATE TANK CIRCUIT TO RESONANCE. ALWAYS TUNED FOR PLATE CURRENT DIP AFTER EACH INCREMENTAL ADJUSTMENT OF COUPLING CONTROLS.

SELECTS TUNE OR TRANSMISSION MODE AND SWITCHES BIAS AND SCREEN VOLTAGES

SELECTS INPUT CIRCUIT RES (NON-INDUCTIVE UNTUNED) OR TUNED (BANDSWITCHED)

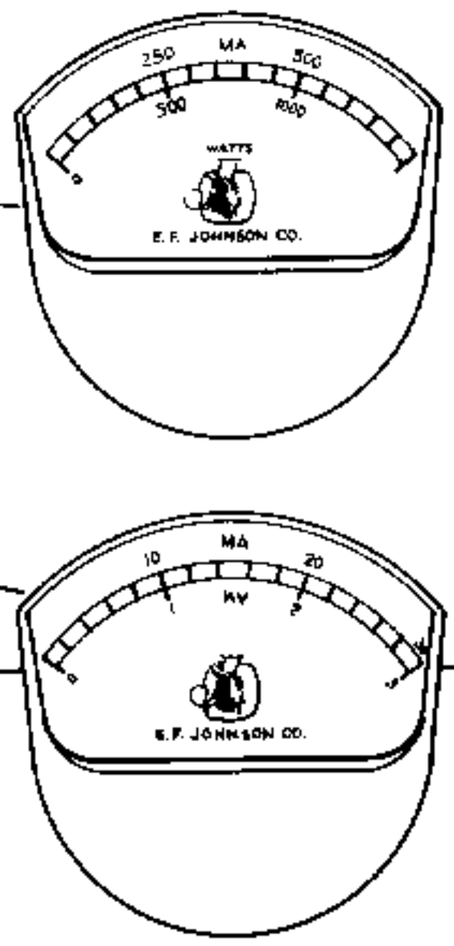
TUNES BANDSWITCHED GRID CIRCUIT (IS TUNED FOR PEAK GRID CURRENT READING WHEN "BAND" IS NOT IN "RES" POSITION)

RE K

IARIZATION CHART

ADS PLATE
URRENT
-750 MA.
AND
TTS POWER
INPUT
-1500 WATTS

ADS GRID
URRENT
-30 MA.
AND
REEN CURRENT
0-150 MA.
AND
ATE KILOVOLTS
0-3 KV.




Johnson Viking
THUNDERBOLT




METER
SCREEN
GRID
VOLTAGE

ON
FILAMENT

ON
PLATE

MODE
TUNE
CW
LINEAR

SELECTS METERED CIRCUIT

CONTROLS ALL FILAMENTS, BIAS AND SCREEN POWER SUPPLIES, AND ALL AC POWER TO AMPLIFIER

INDICATES PLATE VOLTAGE APPLIED

CONTROLS APPLICATION OF PLATE VOLTAGE

SELECTS TUNE OR TRANSMISSION MODE AND SWITCHES BIAS AND SCREEN VOLTAGES

FIGURE K
CONTROL FAMILIARIZATION CHART

**2000 watts P.E.P.***

**1000 watts CW**

**750 watts AM linear**

*with an auxiliary SSB exciter

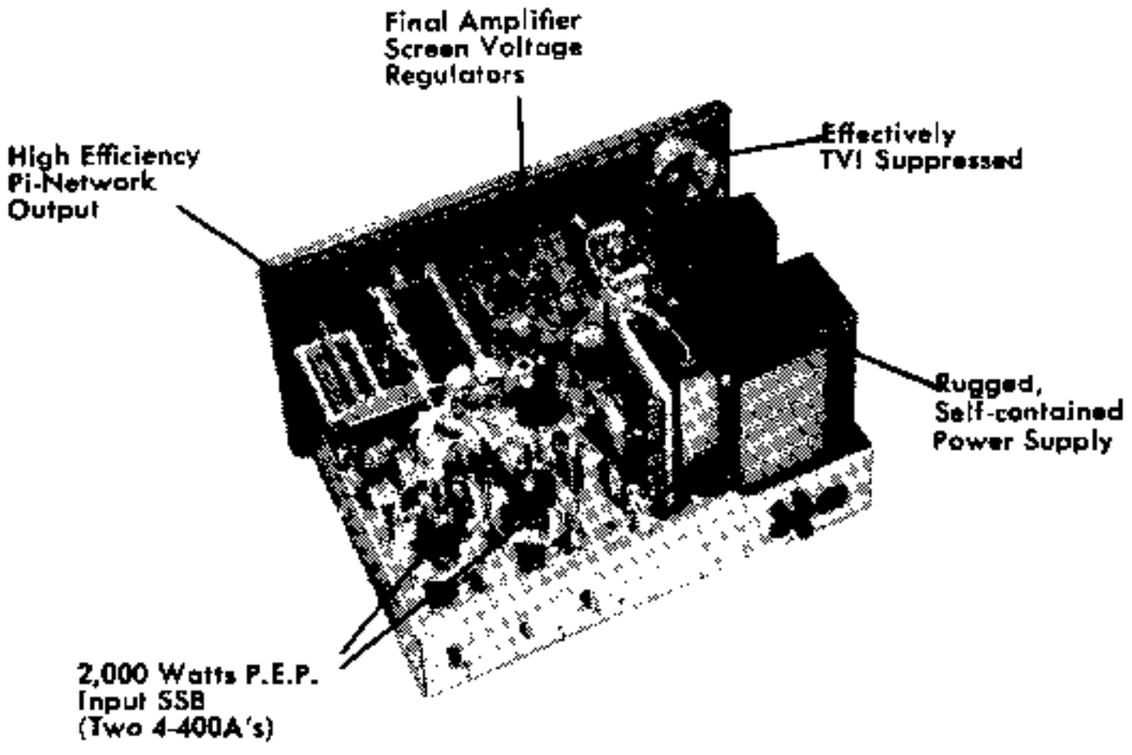
# *Viking* "Thunderbolt"

Introducing the Viking "Thunderbolt" — the hottest linear amplifier on the market today! Here's solid communication power — 2,000 watts P.E.P.* input; 1,000 watts CW; 750 watts AM linear; in a completely self-contained desk-top package. The "Thunderbolt" may be driven by the Viking "Navigator," "Ranger," "Pacemaker" or other unit of comparable output. Continuous coverage 3.5 to 30 megacycles (bandswitched) — wide range pi-network output circuit. The "Thunderbolt" has been engineered to provide maximum "talk-power" to smash through QRM — delivers a dominant signal on all amateur bands. Completely self-contained with internal blocking bias, voltage regulated screen and bias supplies, and plate power supply.

## "THUNDERBOLT" POWER GAIN

| Driver** | | Power increase-times |
|---|---|---|
| Adventurer | CW | 20.0 |
| Navigator | CW | 25.0 |
| Ranger | CW | 13.3 |
| Ranger | AM | 5.7 |
| Viking I & II | CW | 5.6 |
| Viking I & II | AM | 3.8 |
| Pacemaker | SSB | 22.0 |
| Pacemaker | CW | 11.1 |
| Pacemaker | AM | 18.7 |

**Proper wave shaping of the keyed signal, producing a clean, crisp CW note free of clicks and chirps, is essential in high-power operation. Information necessary to modify units without the famous Johnson Timed Sequence Keying System will be made available upon request.




**EXCITATION REQUIREMENTS** — Drive requirements are approximately 10 watts in class $AB_2$ linear, 20 watts class C continuous wave. When used with the Viking "Pacemaker" or similar exciter, the non-inductive input circuit of the "Thunderbolt" requires no grid tuning. Use of the Viking I, II or similar unit as an exciter for the Viking "Thunderbolt" requires use of the Johnson power reducer, **Cat. No. 250-29.**

**OPERATING CONTROLS** — The operating controls for the "Thunderbolt" are conveniently located on the front panel within easy reach of the operator. These controls include: grid tuning and bandswitch; plate tuning with slide rule indicator dial; coarse and fine coupling controls; filament; plate; "mode"; and meter switches. Two meters provide a constant visual check of operation. Plate current meter also reads watts input and the second meter will read either grid current or plate voltage.

**OUTPUT CIRCUIT** — The Viking "Thunderbolt" amplifier employs two Type 4-400A tetrode tubes in parallel, bridge neutralized. The pi-network output is designed to match nominal 40 to 600 ohm antenna loads and will tune out large amounts of load reactance as well. Two fans, located within the amplifier cabinet, cool filament and plate seals for extended tube life.

**TVI SUPPRESSION** — In addition to complete shielding and the use of double "L" section filters in all outgoing leads, the "Thunderbolt" cabinet is electrically sealed with flexible monel braid — cup-type shields seal the meters, and interior harness leads and filaments are by-passed. Careful by-passing of the final, and special circuit techniques minimize harmonics in the output circuit.

**POWER SUPPLIES** — The high voltage power supply uses 866-A rectifiers and delivers adequate voltage and current for the rated input power. The screen supply employs a 5V4 rectifier and uses four VR tubes for screen voltage regulation in Class $AB_2$ operation. A 6BY5 rectifier and VR 75 regulator comprise the bias supply for the two 4-400A final amplifier tubes.

The F.C.C. permits a maximum one-kilowatt average power input for the amateur service. In SSB operation under normal conditions, this results in Peak Envelope Power inputs of 2,000 watts or more depending on individual voice characteristics. The Viking "Thunderbolt" linear amplifier produces these higher powers and is the only equipment available to amateurs which can reach the maximum legal input of "talk-power," other than the Viking "Kilowatt."

## SPECIFICATIONS

**FREQUENCY RANGE:**

Continuous coverage 3.5 through 30 megacycles (Bandswitched).

**POWER INPUT:**

| | |
|---|---|
| 1,000 Watts CW | Class C |
| 750 Watts AM Linear | Class $AB_2$ |
| 2,000 Watts P.E.P.* Linear | Class $AB_2$ |

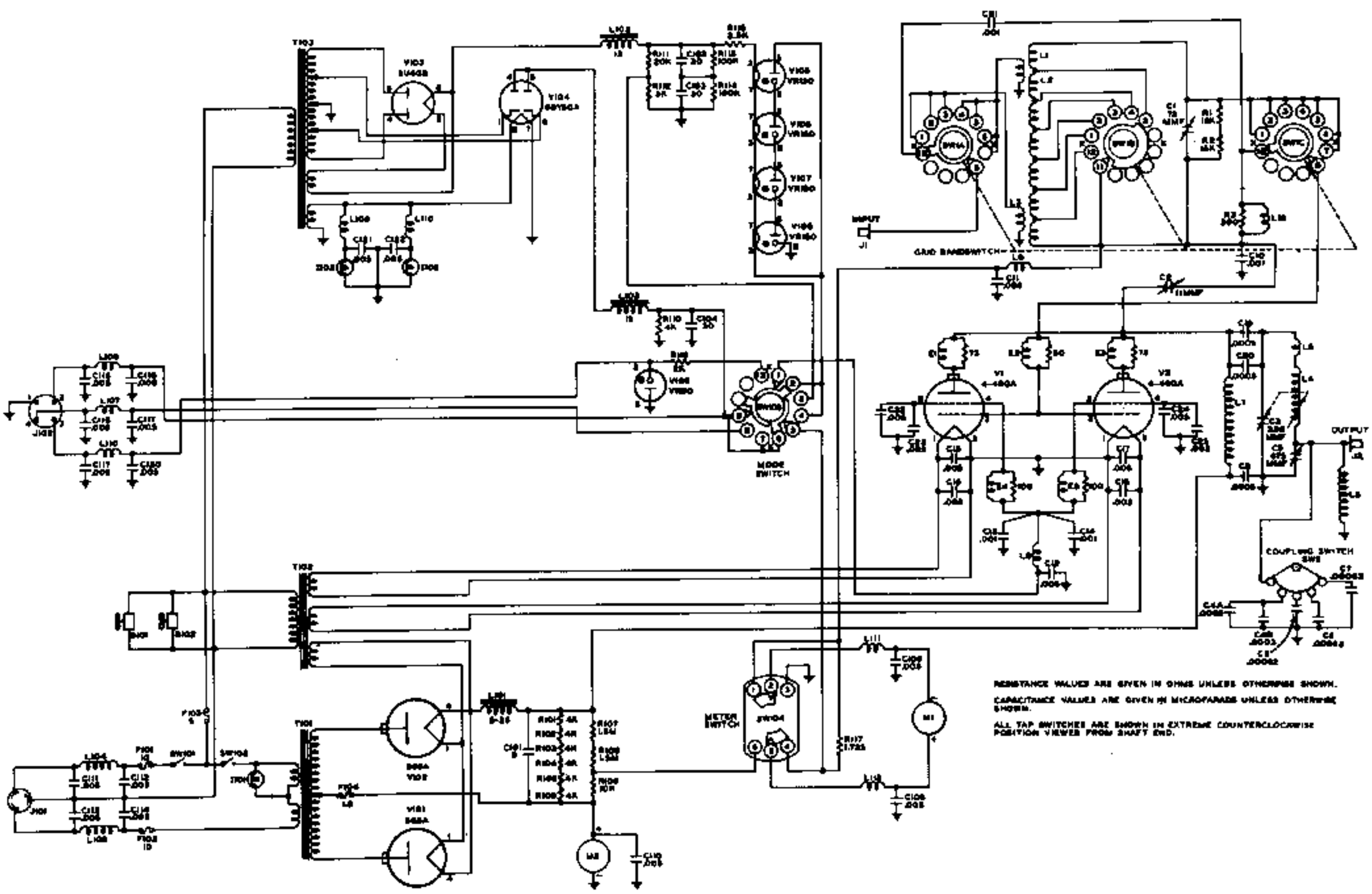
**POWER REQUIREMENTS:**

115 volts AC two wire or 230 volts AC three wire, 50-60 cycle single phase. Fuses accessible on rear of chassis.

## TUBE COMPLEMENT

(2) 4-400A tetrode—Final Amplifier
(2) 866A—High Voltage Rectifier
(1) 6BY5—Bias Rectifier
(1) 5U4—Screen Voltage Rectifier
(1) VR —Bias Regulator
(2) VR 105 } Screen Voltage
(2) VR 150 } Regulator

The Viking "Thunderbolt" is available completely wired and tested or as an easy to assemble kit. The 18 gauge steel cabinet is finished in attractive maroon and grey, with green nomenclature. Complete kit includes assembly instructions, photographs, diagrams and step-by-step wiring directions. Wiring harness, all necessary hardware furnished — no drilling or metal work necessary. Dimensions: 21" long x 11⅝" high x 16 7/16" deep. Net Weight: 120 lbs. Shipping Weight: 140 lbs.



# JOHNSON VIKING THUNDERBOLT AMPLIFIER

## OPERATING MANUAL CONTENTS

STANDARD WARRANTY

Adopted and Recommended by the

Radio - Electronics - Television Manufacturers Association

The E. F. Johnson Company warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part, except for electron tubes, in exchange for any part of any unit of its manufacture which under normal installation, use and service disclosed such defect, provided the unit is delivered by the owner to us or to our authorized radio dealer or wholesaler from whom purchased, intact, for our examination, with all transportation charges prepaid to our factory, within ninety days from the date of sale to original purchaser and provided that such examination disclosed in our judgement that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside of our factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture, nor to electron tubes.

Defective electron tubes should be returned directly to the tube manufacturer for adjustment at the following addresses·

(a) For RCA tubes to: Adjustment Service, RCA at the nearest of the following addresses:

| | | |
|---|---|---|
| 34 Exchange Place<br>Jersey City 2, N. J. | 3601 South Adams Street<br>Marion, Indiana | 6355 East Washington Blvd.<br>Los Angeles 22, California |

(b) For General Electric tubes to:

Adjustment Service
Owensboro Tube Works
General Electric Company
Owensboro, Kentucky

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products.

# ADDITIONAL COMMENTS ON LOADING OF THUNDERBOLT

Steps 4 and 5, Section D2b, Thunderbolt Operating Manual, refer to Linear Operation Loading Procedure and in particular to "plate current dip".

When loading for linear operation, there should always be a 25 to 35 ma. plate current dip when the Thunderbolt is fully loaded. In the example given, the load point current is 360 ma. If the 360 ma. current is obtained but a 25 to 35 ma. "dip" (25 to 35 ma. difference between out-of-resonance plate current and dipped plate current) is not possible, decrease the coupling to the point where this amount of dip is present. Instead of 360 ma., the dipped plate current will be some lower value.

In other words, load to the specified plate current loading point whenever possible but in all cases decrease the loading (coupling) to secure a 25 to 35 ma. dip whenever such dip is not present.

Excessive loading decreases the power output in the Thunderbolt or any other linear amplifier.

1-15-58

ADDITIONAL INFORMATION:

Page 2 B. 5. c. 2. After first sentence add:

Remove the white-black-brown #20 wire from terminal 2 of TS1 and connect it to terminal 3 of TS1.

Page 2 B. 5. e. The bias-screen transformer is normally wired for 115 VAC primary voltage. If the primary voltage is above 115 VAC, disconnect the black with yellow tracer wire from terminal 3 of TS3. Remove the black with red tracer wire from terminal 2 of TS3 and solder it to terminal 3 of TS3. Connect, but do not solder the black with yellow tracer wire to terminal 2 of TS3. Be certain none of the terminals on TS3 are shorted to each other.

Page 15 D. 2. c. 1. f. This section should read as follows:

For CW OPERATION, the RES position is not used and the BAND and GRID are adjusted to the proper frequency. Load the Pacemaker to a minimum of 50 ma. plate current (with .2 ma. grid current) and then reduce the CARRIER INSERT to obtain 20 ma. grid current on the Thunderbolt as described in section D1.

Page 5 B. 10. b. last sentence should read as follows:

A swamping attenuator, JOHNSON Part No. 250-42-1 for the Ranger and the Viking II, is available.

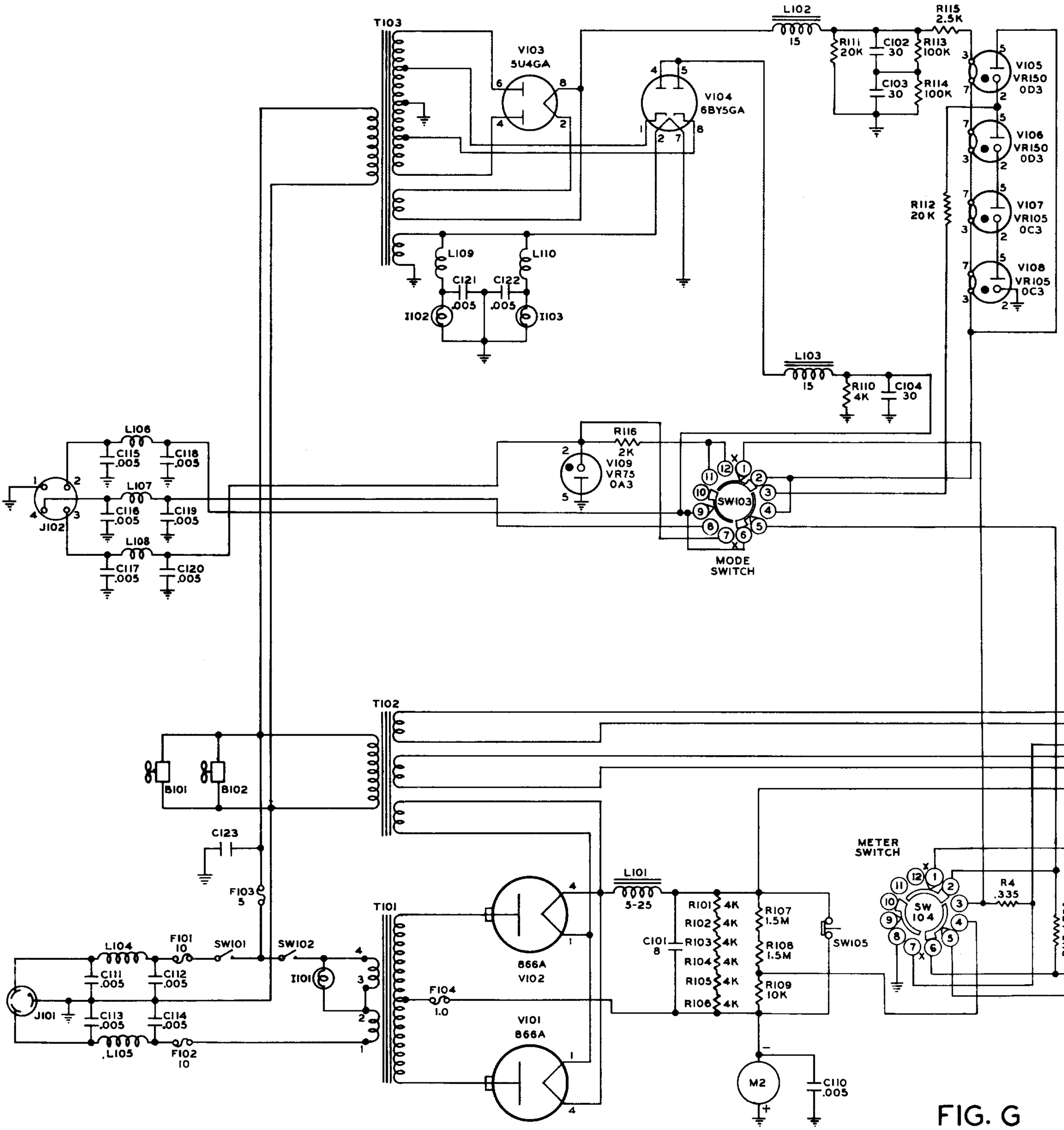
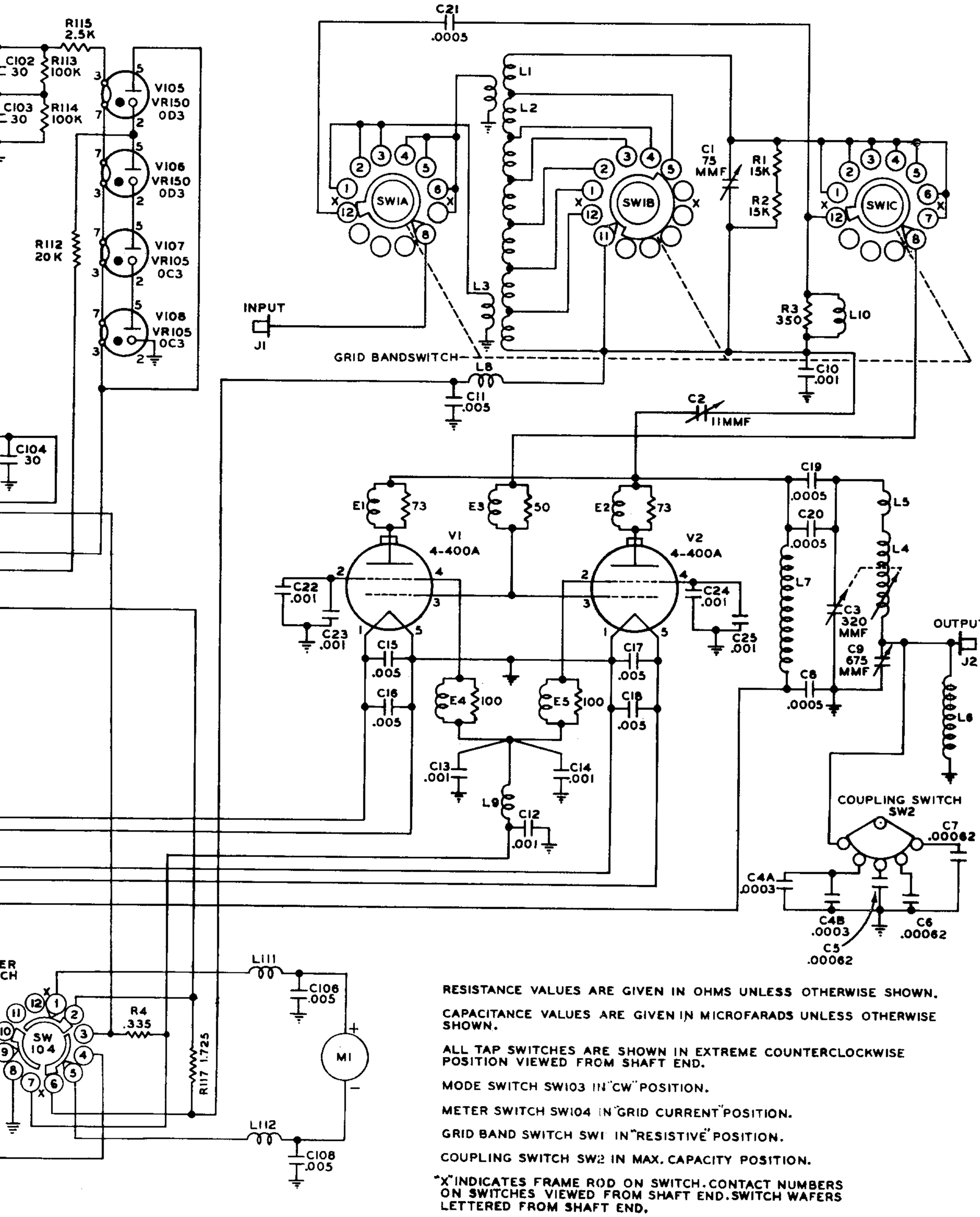

T103
V103
5U4GA
V104
6BY5GA
L102
15
R111
20K
C102
30
C103
30
R113
100K
R114
100K
R115
2.5K
V105
VR150
0D3
V106
VR150
0D3
V107
VR105
0C3
V108
VR105
0C3
R112
20K
L109
L110
C121
C122
.005
.005
I102
I103
L103
15
R110
4K
C104
30
L106
C115
.005
C118
.005
L107
C116
.005
C119
.005
L108
C117
.005
C120
.005
J102
R116
2K
V109
VR75
0A3
SW103
MODE
SWITCH
T102
B101
B102
C123
F103
5
T101
L104
F101
10
SW101
SW102
I101
C111
.005
C112
.005
J101
C113
.005
C114
.005
L105
F102
10
866A
V102
F104
1.0
V101
866A
L101
5-25
C101
8
R101 4K
R102 4K
R103 4K
R104 4K
R105 4K
R106 4K
R107
1.5M
R108
1.5M
R109
10K
SW105
METER
SWITCH
SW
104
R4
.335
R117 1.725
M2
C110
.005

FIG. G




RESISTANCE VALUES ARE GIVEN IN OHMS UNLESS OTHERWISE SHOWN.

CAPACITANCE VALUES ARE GIVEN IN MICROFARADS UNLESS OTHERWISE SHOWN.

ALL TAP SWITCHES ARE SHOWN IN EXTREME COUNTERCLOCKWISE POSITION VIEWED FROM SHAFT END.

MODE SWITCH SW103 IN "CW" POSITION.

METER SWITCH SW104 IN "GRID CURRENT" POSITION.

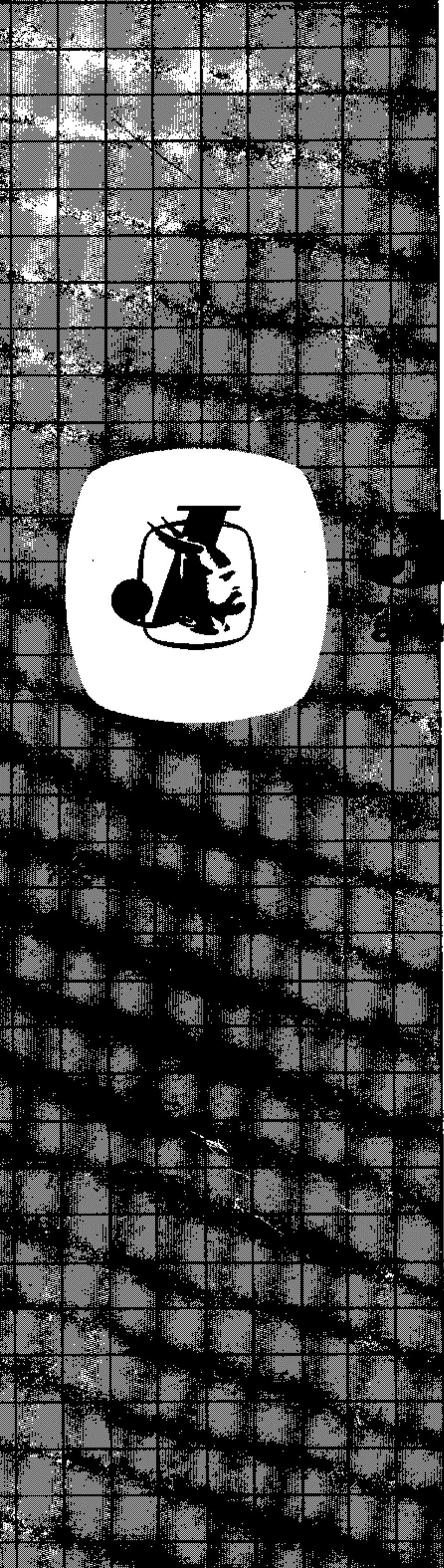
GRID BAND SWITCH SW1 IN "RESISTIVE" POSITION.

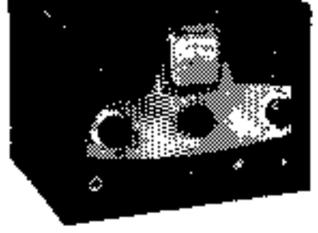
COUPLING SWITCH SW2 IN MAX. CAPACITY POSITION.

"X" INDICATES FRAME ROD ON SWITCH. CONTACT NUMBERS ON SWITCHES VIEWED FROM SHAFT END. SWITCH WAFERS LETTERED FROM SHAFT END.

FIG. G

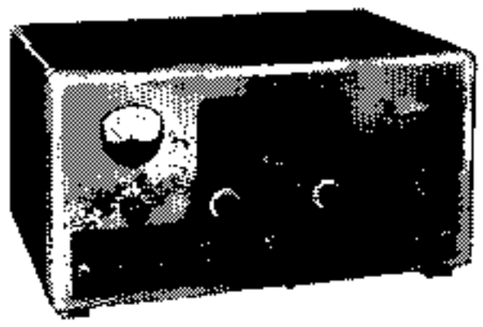
12-2-57



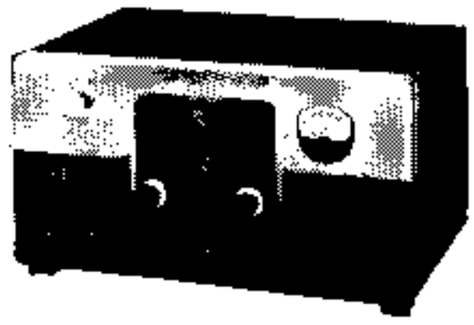


**VIKING "ADVENTURER"**—50 watts CW input. Easy to assemble and operate—used to earn first novice WAC! Bandswitching 80, 40, 20, 15, 11 and 10 meters.

**VIKING "RANGER"**—75 watts CW input, 65 watts phone—a flexible, TVI suppressed transmitter . . . also serves as an RF and audio exciter without modification! Bandswitching 160, 80, 40, 20, 15, 11 and 10 meters.



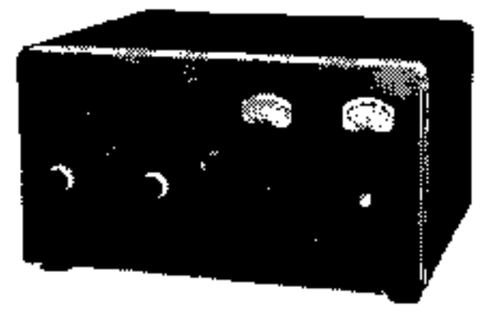
**VIKING "VALIANT"**—275 watts CW and SSB, (P.E.P. input with auxiliary SSB exciter) . . . 200 watts phone. Built-in VFO—a transmitter with power and flexibility! As an exciter will drive any of the popular kilowatt level tubes. Bandswitching 160, 80, 40, 20, 15, 11 and 10 meters.



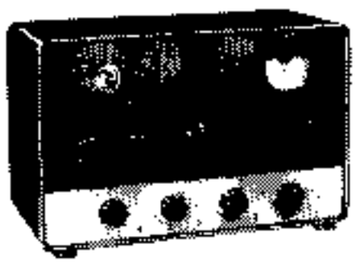
**VIKING "PACEMAKER"**—For Single Sideband—more than just an exciter. 90 watts CW and SSB (P.E.P.) . . . 35 watts AM. Rugged, stable VFO—"foolproof" voice control! Bandswitching 80, 40, 20, 15 and 10 meters.

# Johnson

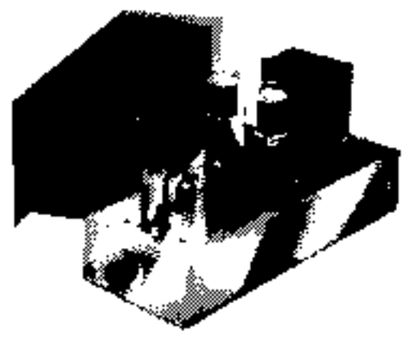
## Amateur equipment



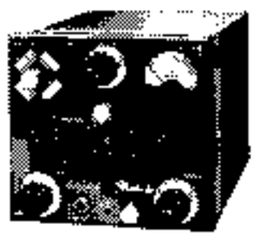
**VIKING "FIVE HUNDRED"**—600 watts CW input . . . 500 watts AM and SSB. (P.E.P. input with auxiliary SSB exciter.) VFO and all exciter stages gang-tuned! Bandswitching 80, 40, 20, 15, 11 and 10 meters.



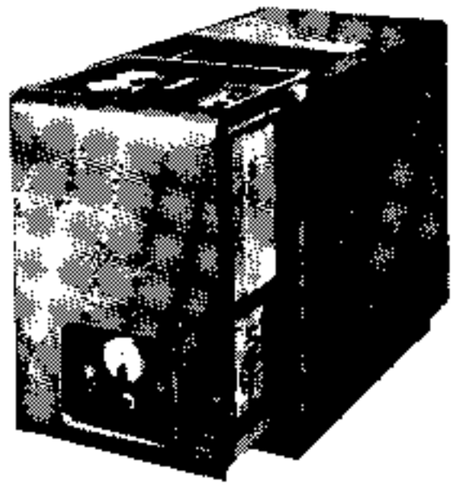
**VIKING "6N2"**—For VHF! 150 watts CW input . . . 100 watts AM. Rugged construction, thorough engineering—the same Johnson quality for 6 and 2 meters!



**AUDIO AMPLIFIER**—Self contained 10 watt speech amplifier complete with power supply. Speech clipping and filtering designed to raise average modulated carrier level . . . improves the performance and effectiveness of your AM transmitter!



**VIKING "MOBILE"**—Rugged 60 watt mobile transmitter with an enviable DX record—under-dash mounting—convenient to operate! Bandswitching 75, 40, 20, 15, 11 and 10 meters.



**VIKING "KILOWATT"**—Boldly styled kilowatt power amplifier. 1,000 watts CW, AM and SSB—the ultimate in styling and operating convenience. Continuous tuning 3.5 to 30 megacycles.

**KEYS AND PRACTICE SETS**—Johnson also makes a complete line of semi-automatic, high speed, standard, heavy duty and practice keys. See your distributor or write for complete information.

**E. F. Johnson Company**

WASECA, MINNESOTA