E. F. JOHNSON COMPANY

Manufacturers of RADIO - ELECTRONIC PRODUCTS

WASECA, MINNESOTA
U. S. A.

April 22, 1953

Subject: Bulletin #3-J., Viking I Transmitter
Modification B - (1 - 4100)

Dear Viking I Owner:

Many Viking I owners have expressed a desire for improved low frequency audio response. Our Engineers have developed simple circuit modifications, easily installed, which will extend the usable low frequency response to 250 cycles and will attenuate high frequency response above 3000 cycles. Lowered distortion and reduced high frequency side bands also result from these changes and serve to improve audio quality.

If you would like to incorporate Modification B in your Viking I transmitter, the necessary components and detailed instructions will be mailed postpaid upon receipt of the order form below and your remittance of $1.00. Modification B for Viking I consists of:

1 - 1.0 megohm 1/2 watt resistor.
1 - 470,000 ohm 1/2 watt resistor.
1 - 22,000 ohm 1/2 watt resistor.
1 - 470 ohm 1/2 watt resistor.
2 - 22 ohm 1/2 watt resistor.

Qty = 1 - 10 mfd. 25 volt electrolytic capacitor.
1 - .01 mfd. 1500 WV ceramic disc capacitor.
1 - length of spaghetti tubing.
1 - instruction sheet

Very truly yours,
E. F. JOHNSON COMPANY

E. T. HERBIG, Jr.
General Sales Manager

MODIFICATION B FOR VIKING II TRANSMITTER

(Equally applicable to all VIKING I Transmitters)

Incorporation of Modification B in the VIKING transmitter will extend the usable low frequency audio range to 250 cycles and will further attenuate high frequency response above 3000 cycles.

The change is accomplished by converting V2, the 6AU6 audio driver to a triode, removing the feedback circuit and changing plate and screen resistors of V1, the first audio stage, to higher values. Total audio gain is slightly higher.

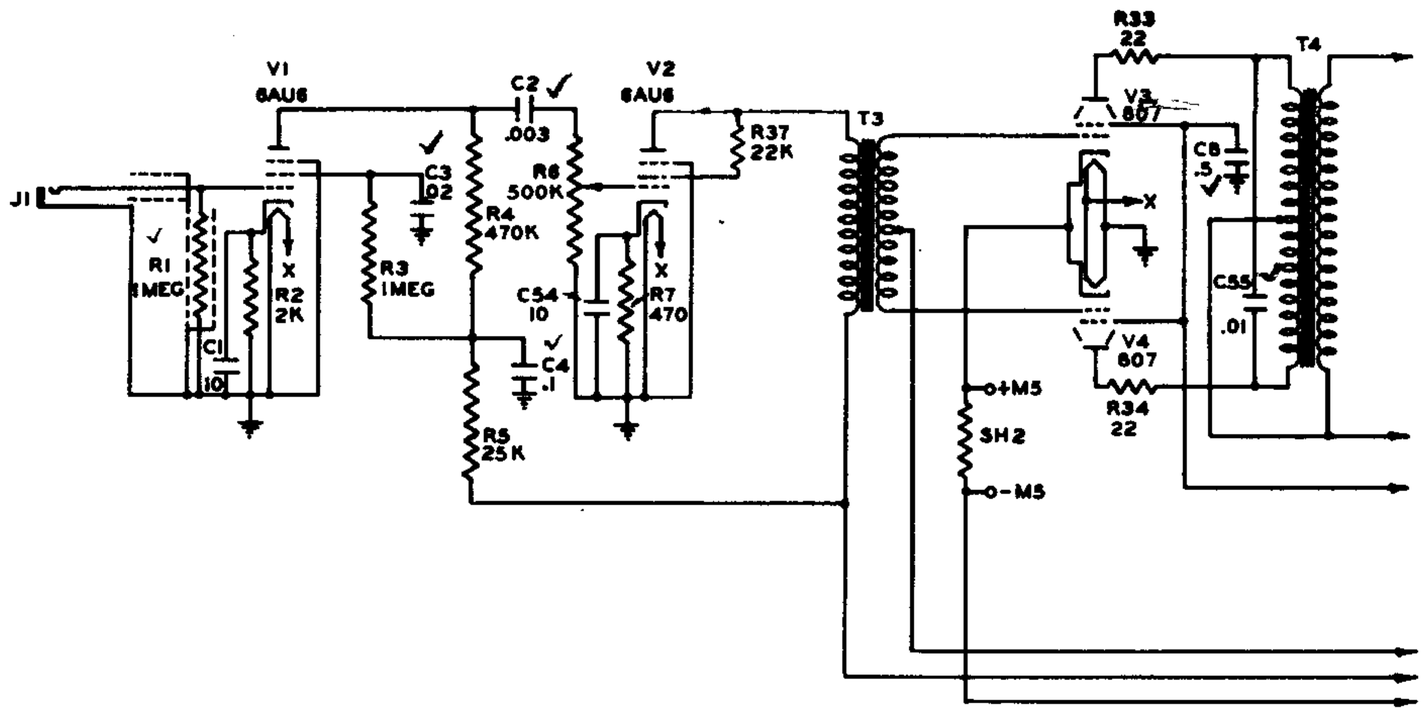
The 23.1033 modification kit consists of the following material:

- 1—470,000 ohm ½ watt resistor.
- 1—1.0 megohm ½ watt resistor.
- 1—470 ohm ½ watt resistor.
- 1—10 mfd. 25 volt electrolytic capacitor.
- 1—.01 mfd. 1500 WV ceramic disc capacitor.
- 2—22 ohm ½ watt resistors.
- 1—length of spaghetti tubing.
- 1—22,000 ohm ½ watt resistor

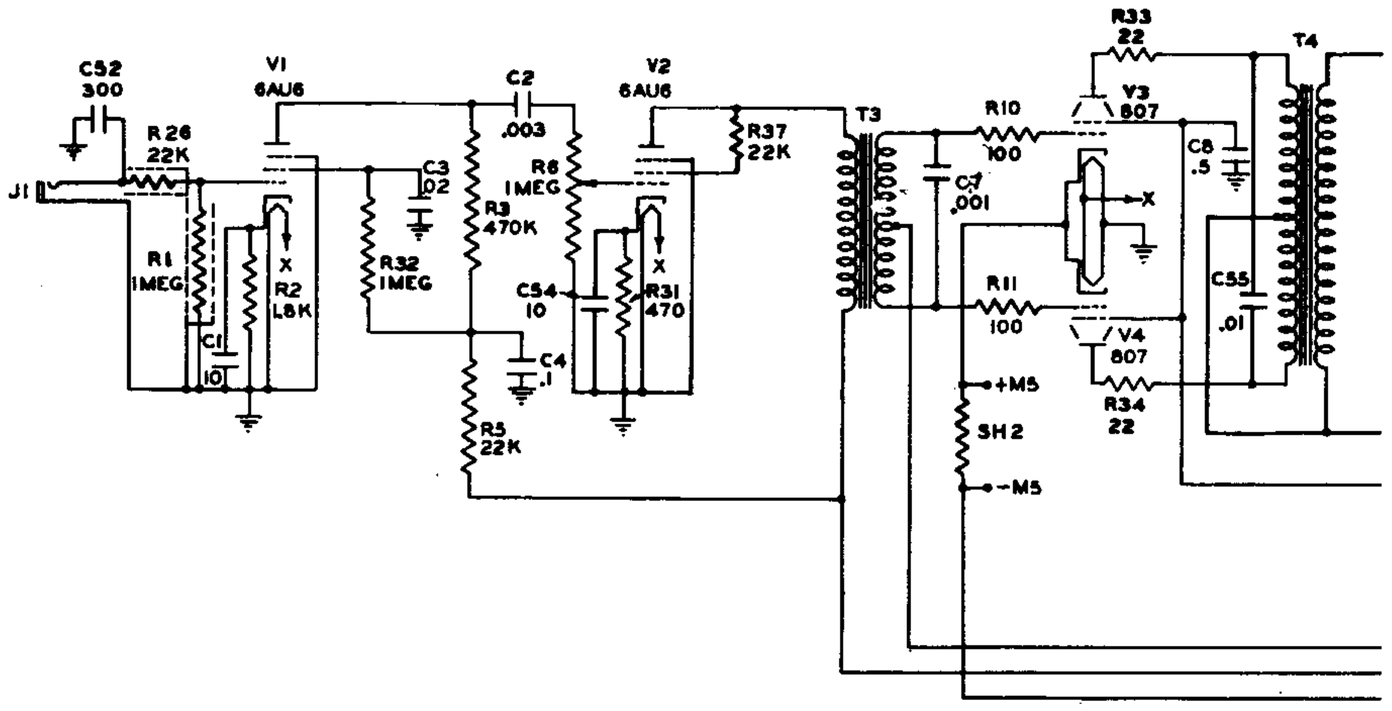
The following items furnished for Viking II Transmitters, are not required for Viking I:

- 1—56 ohm 1 watt resistor.
- 1—10,000 ohm 2 watt resistor.
- 1—.1 mfd. 400 volt tubular capacitor.
- 1—23.1301 relay plug.

Affected portions of schematic diagrams are shown below.



VIKING I AUDIO



VIKING II AUDIO

E. F. JOHNSON COMPANY WASECA, MINNESOTA

Detailed Instructions for Incorporation

1. Loosen the audio driver transformer T3 by removing its mounting screws.

2. Remove the black lead of T3 and wiring harness lead 22B (black) from terminal board X18. Slip a 1" length of insulated tubing over lead 22B. Solder lead 22B to the black lead of T3. After cooling, slide the tubing over the solder joint.

3. Remove R9, 220,000 ohm 1 watt resistor from terminal strip X18.

4. Remove C5, .01 mfd. capacitor connected between pin 7 of socket X2 and the terminal of X18 nearest the center of the chassis.

5. Remove R8, 47,000 ohm 1 watt resistor connected between pin 6 of X2 and the center terminal of terminal board X19.

6. Remove C6, .02 mfd. capacitor connected between pin 6 of X2 and ground.

7. Remove R4, 220,000 ohm 1 watt resistor connected between pin 5 of socket X1 and the terminal of X19 nearest the front of the chassis.

8. Remove R3, 470,000 ohm ½ watt resistor connected between pin 6 of socket X1 and the terminal of X19 nearest the front of the chassis.

9. Remove R7, 220 ohm ½ watt resistor connected between pins 4 and 7 of X2.

10. Connect the 1 ~~megohm ½ watt resistor from the modi~~fication kit between pin 6 of socket X1 and the terminal of X19 nearest the front of the chassis. Solder at pin 6 only.

11. Solder the 470,000 ohm ½ watt resistor from the modification kit between pin 5 of socket X1 and the terminal of X19 nearest the front of the chassis.

12. Connect the 470 ohm ½ watt resistor from the modification kit between pins 4 and 7 of socket X2. Solder at pin 4 only.

13. Connect the positive terminal of the 10 mfd. 25 volt capacitor from the modification kit to pin 7 of X2, the negative terminal to the ground lug at the rear of terminal board X19. Solder at both points.

14. Between pins 5 and 6 of X2 solder the 22,000 ohm ½ watt resistor from the modification kit.

15. Unsolder the plate cap connectors from the blue and brown leads of the modulation transformer T4. Pull the leads back through the grommet in the chassis.

16. Train the blue lead to the terminal of X18 nearest the center of the chassis, trim to length, strip ⅜" of the insulation and tin the lead with solder. Connect but do not solder to the terminal. Save the excess length of blue lead.

17. Train the brown lead to the terminal of X18 adjacent to the end terminal to which the blue lead was previously connected. Cut the brown lead to length, strip ⅜" of the insulation, tin with solder and connect to the terminal second from the end of X18 nearest the center of the chassis.

18. Connect the excess lengths of blue and brown lead to the corresponding terminals of X18 to which the transformer leads of the same color were connected. Do not solder.

19. Solder the .01 mfd. 1500 volt ceramic disc capacitor from the modification kit between the end terminal of X18 nearest the center of the chassis and the next adjacent terminal. Don't permit the capacitor to touch the chassis.

20. Run the blue and brown leads from X18 through the grommet between the 807 sockets. Slide a 1½" length of insulating tubing over each of the leads.

21. Strip ⅜" of insulation from the brown lead, tin with solder. Trim one of the leads of a 22 ohm ½ watt resistor from the modification kit to about ⅜", form a hook in the lead and solder to the brown lead. In the same fashion solder the other 22 ohm ½ watt resistor to the blue lead.

22. Solder an 807 plate cap to each of the remaining 22 ohm resistor leads. Shorten the resistor leads so that the plate cap connector is close to the body of the resistor. When the solder connections are cool, slide the insulated tubing over the resistors and the ends of the plate cap connectors.

    NOTE: It will no longer be necessary to observe polarity when connecting 807 plates.

23. Secure the audio driver transformer using the original hardware.

THE FOLLOWING INSTRUCTIONS APPLY ONLY TO VIKING II TRANSMITTERS

24. Remove L22, 4.7 microhenry choke connected between pin 3 of socket X17 and the end terminal of X25 nearest the crystal socket X15.

25. In place of L22 just removed, solder the 56 ohm 1 watt resistor from the modification kit.

26. Looking at the front deck of the bandswitch, SW4B, from the shaft end, refer to the upper left hand terminal as No. 1, the adjacent terminal No. 2 and the balance of the terminals in consecutive order in a clockwise direction, the last terminal being No. 7. The 10,000 ohm 2 watt resistor from the modification kit is to be installed between SW4B and the exciter shield. Cut to length and solder the resistor leads, one to terminal No. 4 of SW4B, the other to terminal No. 1 of SW4B.

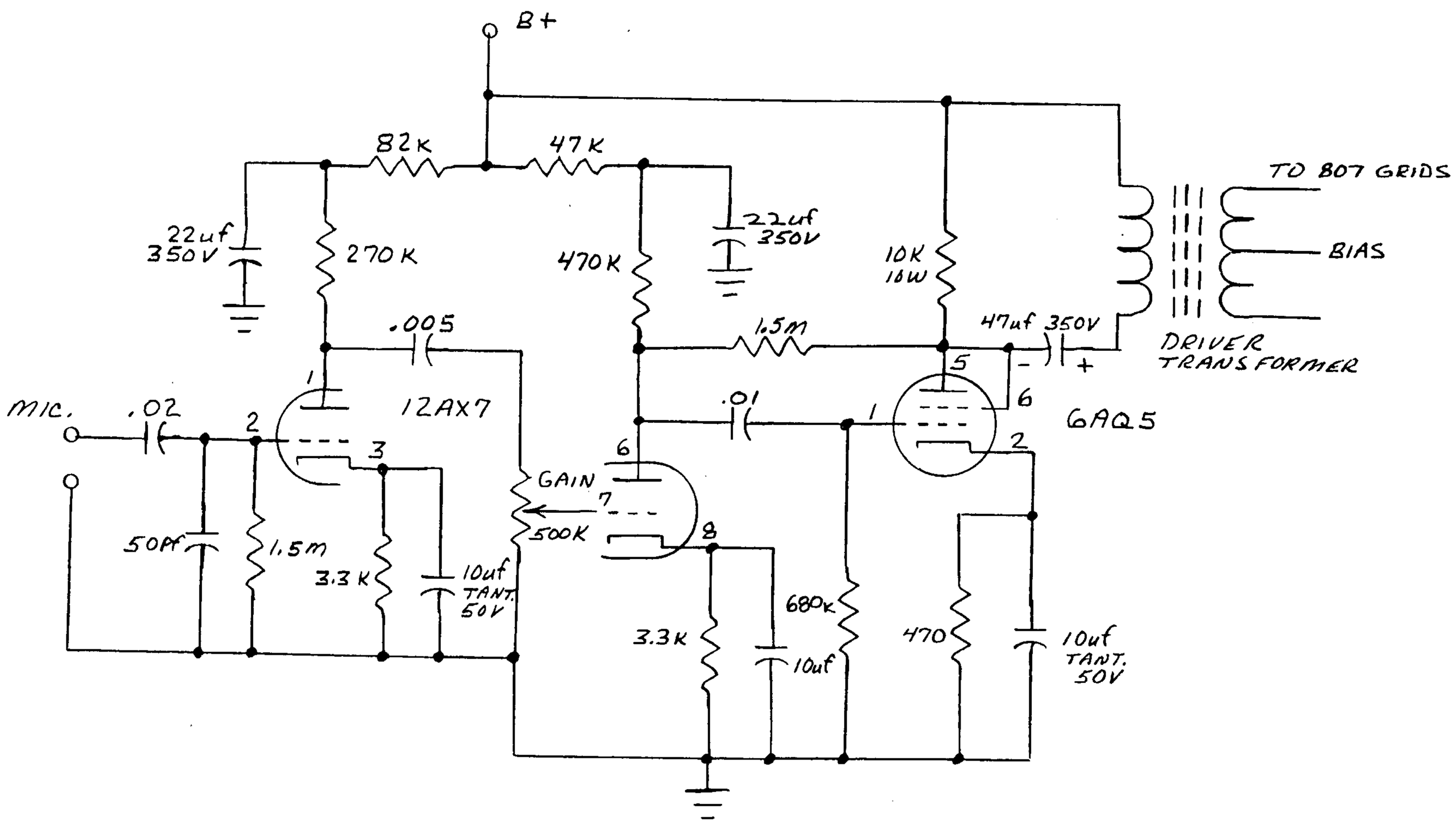
27. (It is assumed that Modification A has been installed or that the subject Viking II transmitter conforms to the Schematic Diagram, Figure 12, in which the 6AQ5 clamper tube V28 appears.) Connect the .1 mfd. 400 volt capacitor from the modification kit between pin 5 of socket X3 and the terminal of R30 to which R29 has been previously connected. The end of the capacitor marked "ground" or "outside foil" should be connected to X3. Solder at both points.

28. Remove L15, 4.7 microhenry choke connected between pin 7 of the VFO power socket X12 and the terminal of X24 to which the green harness leads are connected. Wind a self-supporting, single layer, close wound choke of No. 20 or No. 22 solid insulated wire, ¼" inside diameter, 15 turns. Solder this choke in place of L15 just removed.

    The connector 23,1031 will serve to connect an antenna changeover relay to the antenna relay socket J5 on the rear of the Viking II chassis.

VIKING AUDIO MODIFICATION

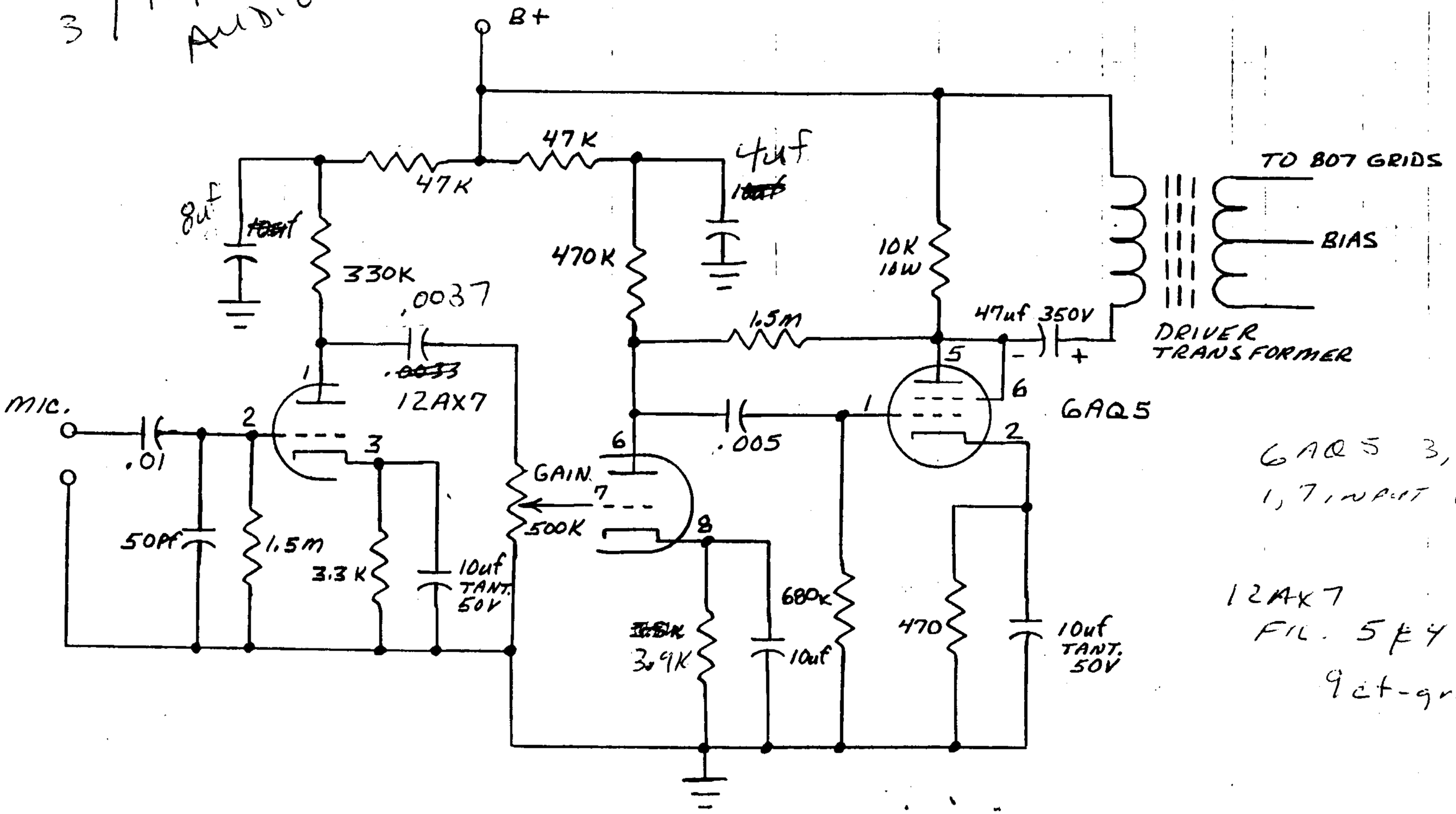
K8TV 3-26-92



VIKING AUDIO MODIFICATION

KBTV 3-26-92

2ND VIK
3/16/95
AUDIO MODS



6AQ5 3, 4 HEATER
1, 7, INPUT GRID

12AX7
FIL. 5 & 4 6.3V
9 & 1 - grids

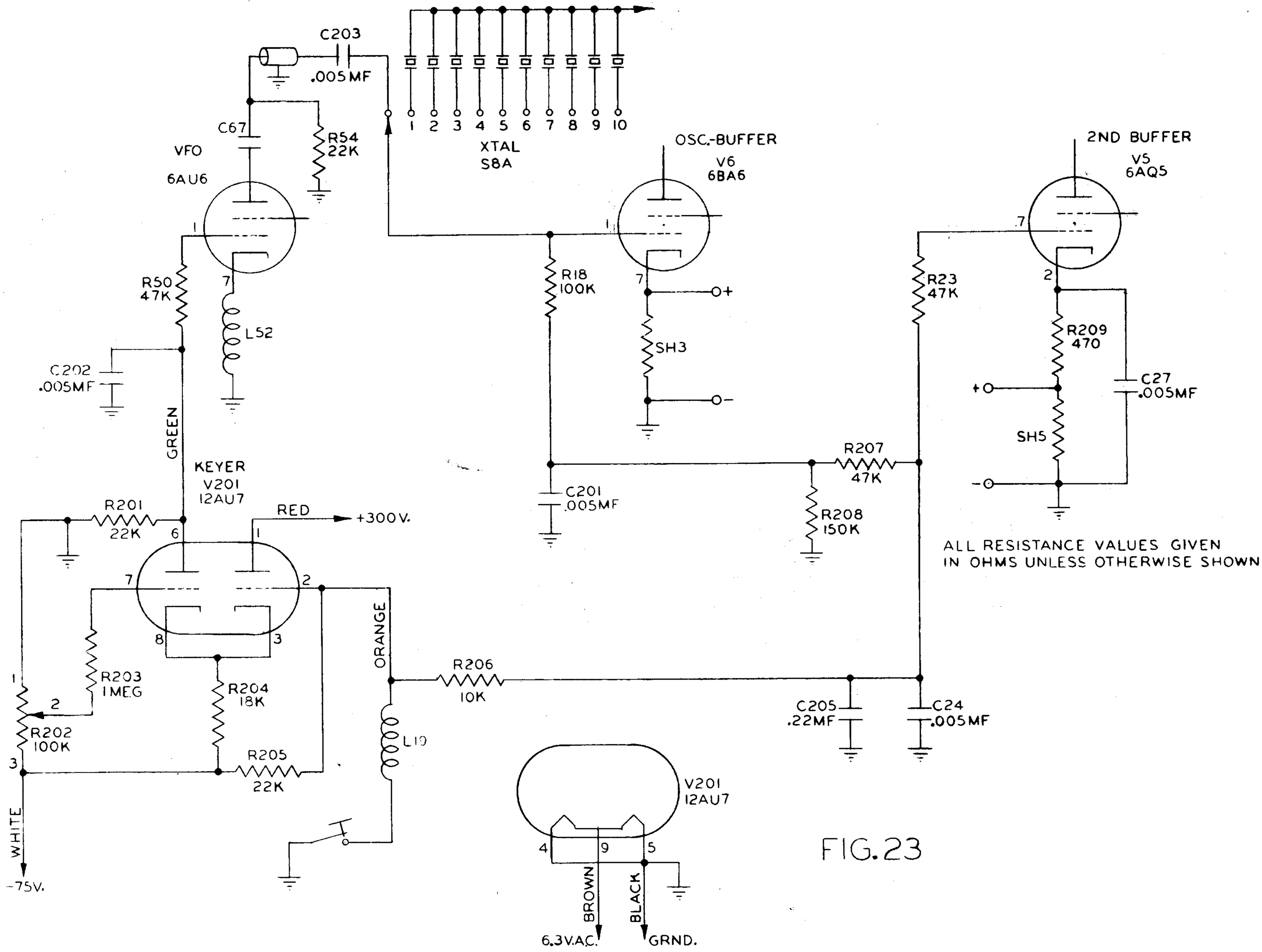
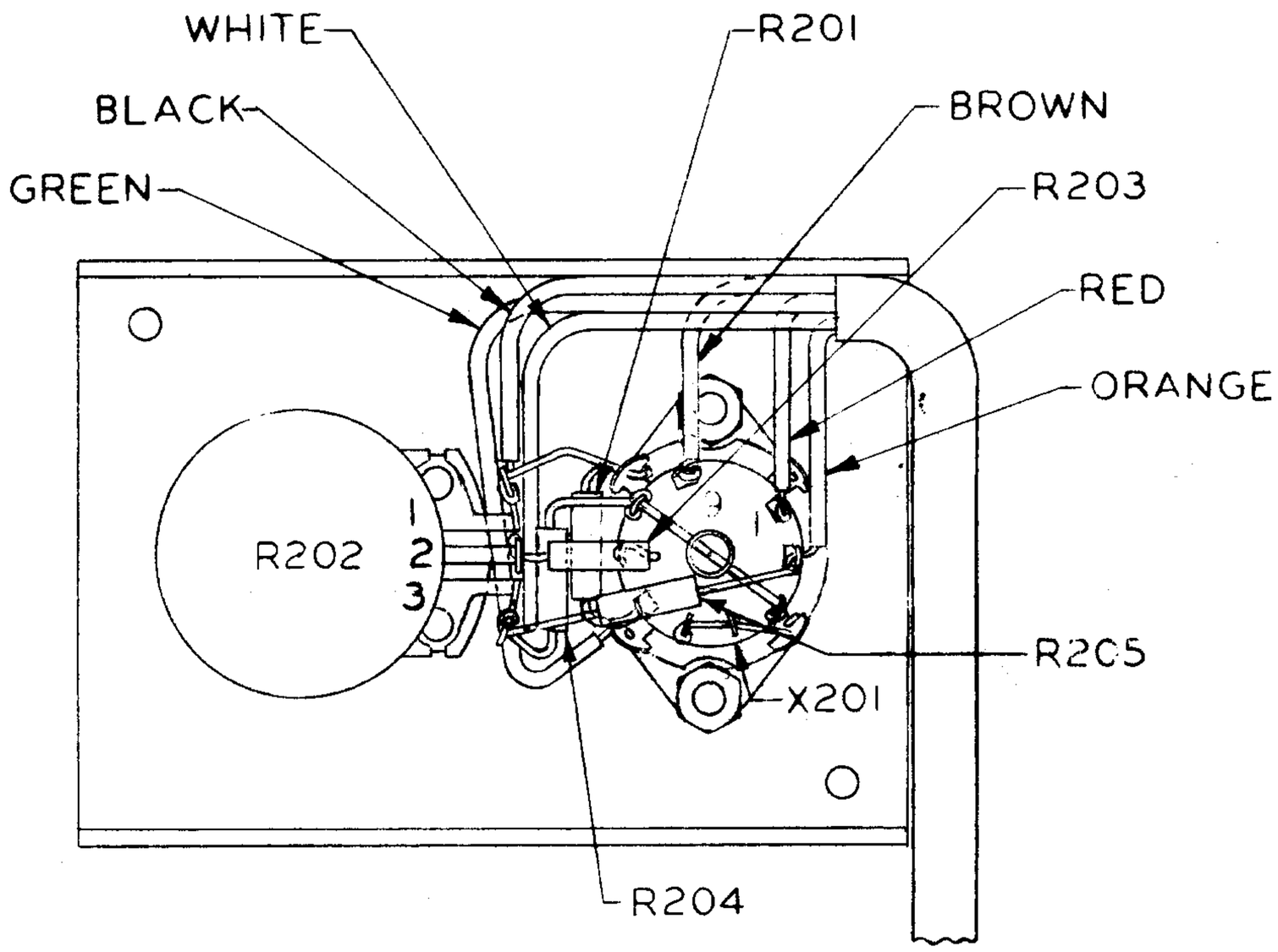
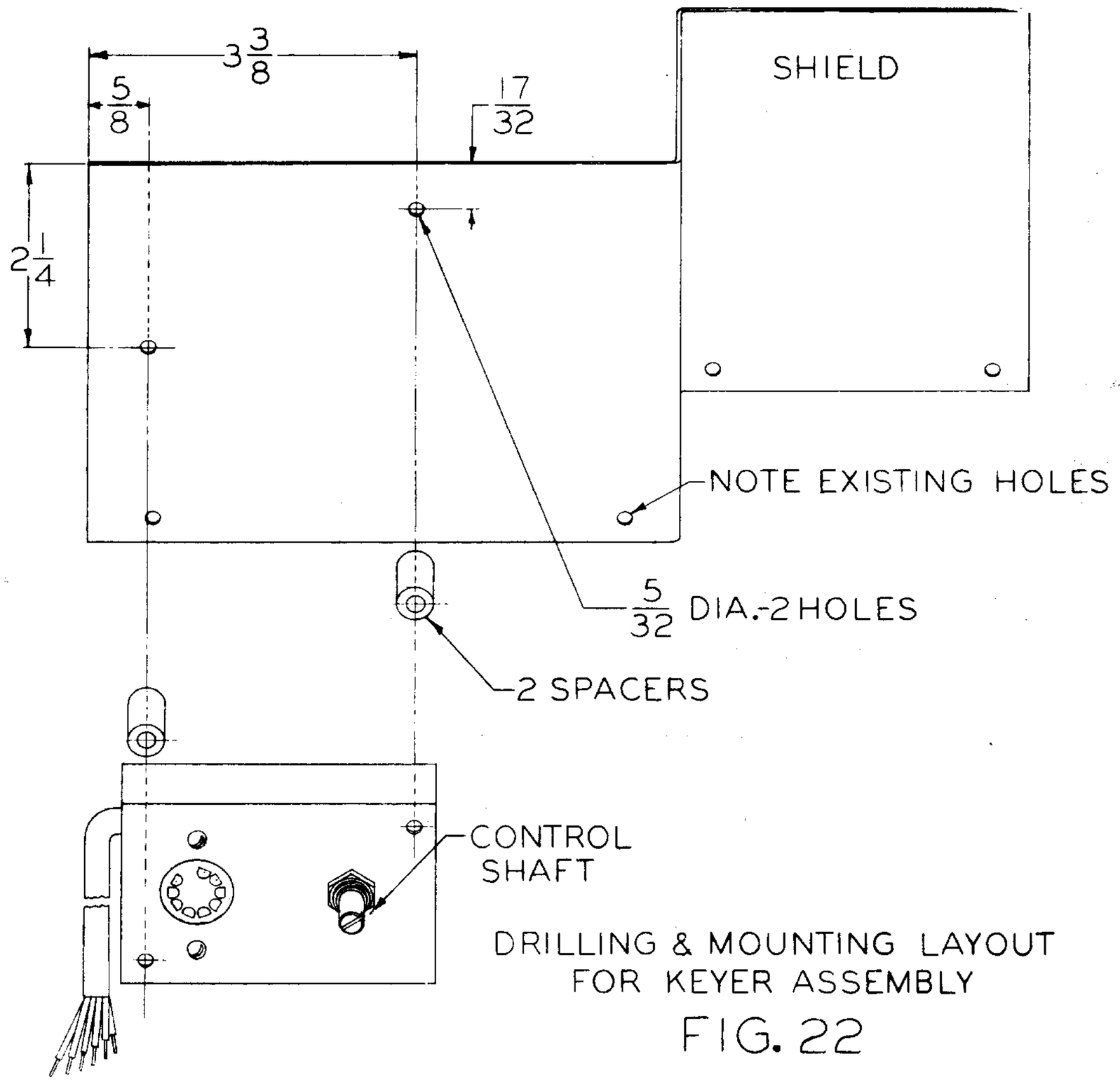

C203
.005MF
1 2 3 4 5 6 7 8 9 10
XTAL
S8A
C67
VFO
6AU6
R54
22K
OSC.-BUFFER
V6
6BA6
2ND BUFFER
V5
6AQ5
R50
47K
L52
R18
100K
SH3
O+
O-
R23
47K
R209
470
C27
.005MF
SH5
C202
.005MF
GREEN
KEYER
V201
12AU7
R207
47K
C201
.005MF
R208
150K
R201
22K
RED
+300V.
ALL RESISTANCE VALUES GIVEN
IN OHMS UNLESS OTHERWISE SHOWN
R203
1MEG
R204
18K
ORANGE
R206
10K
C205
.22MF
C24
.005MF
R202
100K
R205
22K
L10
WHITE
-75V.
V201
12AU7
BROWN
BLACK
6.3V.A.C.
GRND.

FIG. 23



BOTTOM VIEW
KEYER CHASSIS ASSEMBLY

FIG. 21



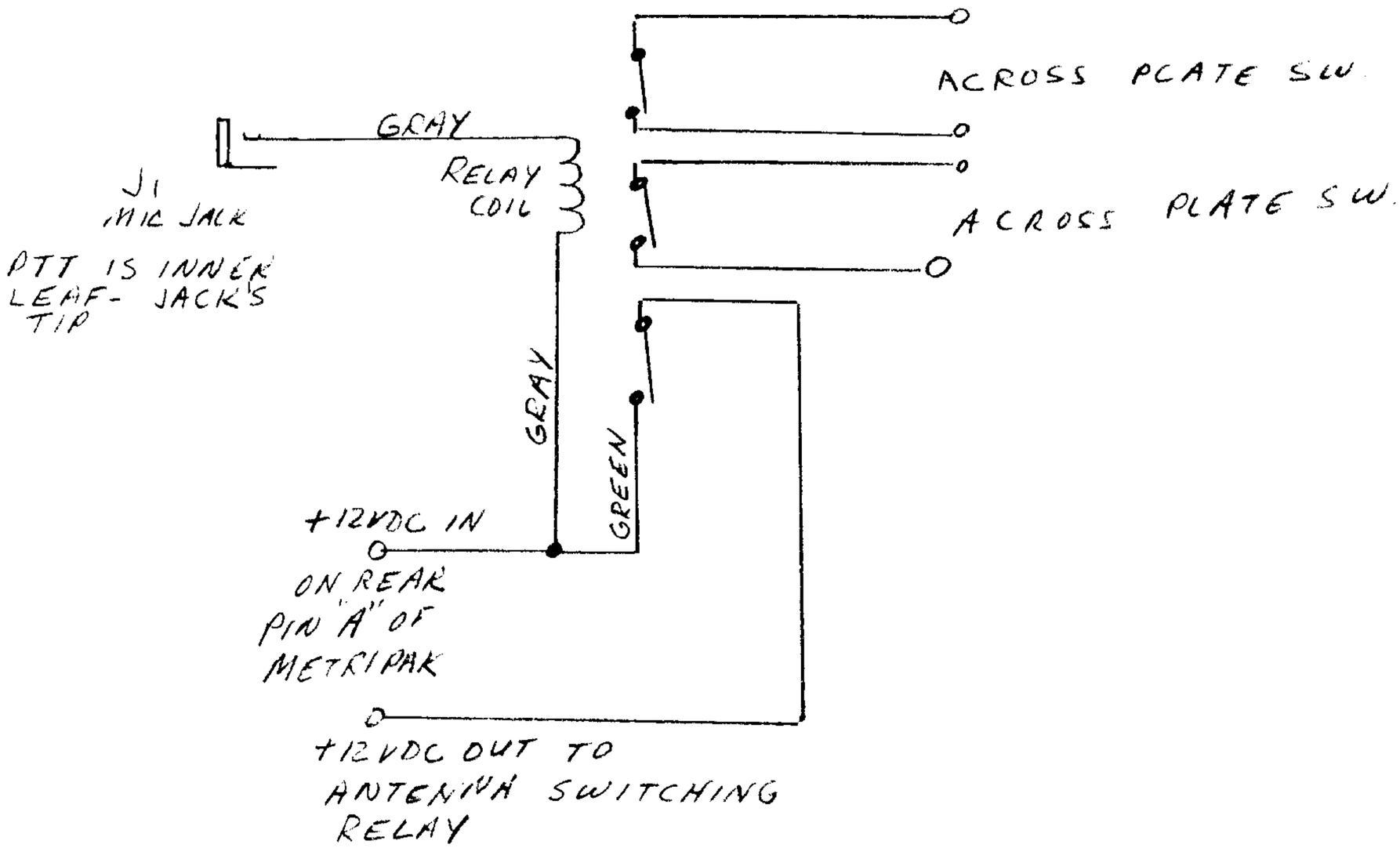
DRILLING & MOUNTING LAYOUT
FOR KEYER ASSEMBLY

FIG. 22

Viking metering information

Signal	Wire color +	Wire color -	Addt. info.
Modulator Cath.	Violet	Yellow	Shunt #2
Final Cath.	Black (Gmd)	Yellow	Shunt # 1
Grid Drive	White	Orange	Shunt # 4
Buffer	Gray	Black (Grnd)	Shunt # 5
Osc.	Blue	Brown	Shunt # 3

VIKING I 12V PTT MOD
NOV 29, 19[illegible]



NOTE: PLATE SWITCH DOES NOT KEY ANT. RELAY - ONLY PTT DOES

THE "SOUPED-UP VIKING I"

Front view of the author's "Viking I" after modification. Note the 660 holes that have been drilled in the top for heat dissipation. Unit on top of transmitter is a variable voltage adjuster. Refer to text.

By **JOSEPH W. SEMKOW, W7IIP**
Senior Field Engineer
Raytheon Manufacturing Company

How one ham "hot-rodded" his "Viking I" to provide increased power. A similar technique could be applied to other rigs.

MOST of us are not happy with our transmitters for very long, with the result that we are constantly striving to get the utmost out of our rigs. For the three years that the author has been operating his *Johnson* "Viking I" at an average input of 200 watts, he has been deluged with questions from other hams on how they, too, could duplicate this operation. A number of these questioners have adapted the circuitry to their own rigs and are enjoying similar performance. For the benefit of other "Viking I" owners, the changes will be described in this article.

Whenever it is possible to increase power 3 db (twice power) without too much expense or too great difficulty, the technique for accomplishing this increase is well worth investigating. The added power helps make up for other deficiencies that may exist in the ham station, such as poor antenna or location and QRM. Before going ahead with the suggested changes to your "Viking," certain principles and points should be understood by the reader. Facts will be presented and substantiated by meter readings.

The author's transmitter was purchased second-hand and has been in operation for over three years. Operating time averaged about 1500 hours per year at 200 watts. No major part failures have occurred. The original 4D32 tube is still in the circuit and has never shown any perceptible color on its plate. Plate voltages on the 4D32 and 807 modulators are 800 volts d.c. Plate current to the final amplifier averages between 275 and 285 ma. Static plate current on the 807 modulators averages 75 to 85 ma. On modulation peaks it increases to approximately 200 ma. Slight coloring of the plates is visible but does not hinder or harm any of the components.

Grid current is always adjusted at this station until no further increase in antenna power output is noted. Any current in excess of the necessary amount for optimum output is wasted in tube heating and harmonic generation.

The manufacturer of the "Viking" transmitter rates the power transformer and filter choke as capable of 350 ma. continuous duty at normal temperatures. Most transformers and chokes can sustain considerable overloading without any failure if some method of cooling is provided. This will be one of the modifications required. The transformers are encased in a dust shell which also protects the windings from getting scuffed or damaged. They are so well enclosed that the windings do not get ventilated and cooled. Directions are given in another part of this article for cooling the transformers. Before modification, the 4D32 operated conservatively at 600 volts d.c. and 250 ma. as suggested by the manufacturer, but extensive tests conducted by the author over a three-year period at inputs in excess of 200 watts (800 volts d.c. @ 250 to 300 ma.) have resulted in no apparent damage to the tube or other components.

To increase the audio power output of the 807 modulators and improve the general quality of the "Viking I" some changes are made to the speech amplifier and driver stages. In the original "Viking," as designed by the manufacturer, a 6AUC type tube was utilized to drive the 807 modulators. This was adequate when powers of 50 or 60 watts were desired for inputs of 100 to 120 watts. When the power to the final is "souped-up" to 200 watts input, this becomes inadequate. The following steps were taken. First, it was decided that it was poor policy to try to drive the 807 modulators with a high impedance driving source such as the 6AU6 tube. It is a much better voltage amplifier than a power driver. The author made up a small right-angle aluminum bracket and mounted a miniature socket on this bracket. This assembly was mounted underneath the chassis of the "Viking" near the speech amplifier circuits (see photo). A 6AQ5 was installed in the socket and wired as a triode. The former 6AU6 driver circuit, of course, was disconnected.

The original feedback loop from T_4, the modulation transformer, to the cathode of the former 6AU6 driver is removed and modified as follows: The new negative feedback loop consists of R_{41} and C_{9}. The feedback is now impressed on the cathode of the driver and helps correct for any distortion that may be created in either the driver or modulator stages.

The former 6AU6 is now utilized as a voltage amplifier to drive the 6AQ5. The screen resistor is changed to a 1 megohm, ½ watt unit similar to the first stage 6AU6. Both stages now have 1 megohm screen resistors. Additional filtering is added to the screens in the form of 20 μfd. capacitors (see schematic). The cathode resistor of the second 6AU6 (former driver) is now changed to a 2000 ohm, ½ w. unit. Degenerative feedback is encouraged at this point and no capacitor should bypass this cathode.

By shunt-coupling the driver tube to the driver transformer T_3 we improved the quality. No d.c. current on the primary results in the absence of magnetizing current and its associated ill effects on the transformer.

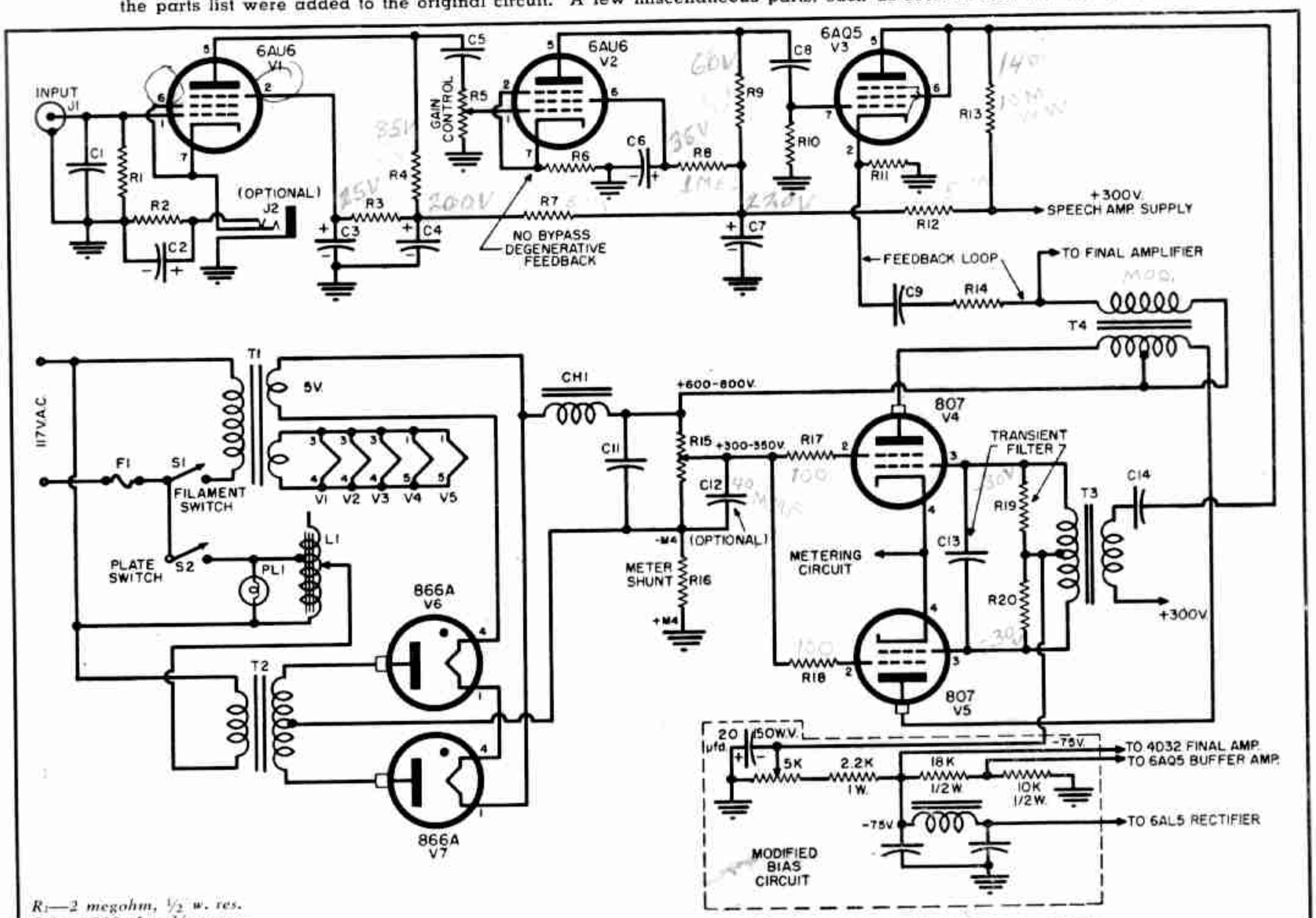
Now we increase the power output capabilities of the "Viking" transmitter. First, remove the 5R4G rectifiers and their associated octal sockets. Install two 4-prong *Amphenol* or equivalent sockets. Rewire the filament circuit so that it is in series across both of the sockets rather than in parallel. This provides 2½ volts a.c. across each tube socket. Install 866A type rectifiers of the 3B28 type. Do not try 816's or 866 Jr.'s as they cannot handle the current needed. Do not be concerned about the slight additional filament current requirements of the 866's. Bring the transformer high-voltage leads to the top caps of the 866A's and you have completed another step in the

modification. Just making this change alone without having done anything else to your transmitter will improve performance. It does two things. It eliminates the former high voltage internal drop of the 5R4G. This drop varies with load which makes the problem more severe. The modulator current does vary considerably under modulation, therefore, the internal resistance in the 5R4G rectifiers varies and provides poor regulation. You probably have already noticed that under 100% modulation, plate current in the final amplifier varies considerably under modulation. With the 866A installation you will note a stabilizing of this final amplifier current variation and also a decided increase in plate voltage. The voltage which previously was approximately 600 to 650 volts d.c. will now be from 650 to 720 volts d.c., with correspondingly increased current drawn by both the final amplifier and modulator.

With the change to 866A's and increased high-voltage output, static current on the modulators will have to be correspondingly reduced as suggested in the *Johnson* manual. Adjust the tap on R_{15}, the bleeder resistor, until you draw approximately 75 to 80 ma. At this point it might be mentioned that additional filtering, in the form of a 30 or 40 μfd., 450 v. capacitor, would not impair transmitter quality if it were installed from the tap to ground. This additional filter would tend to hold the screen voltage variations to a minimum under modulation. This is desirable but not necessary. Changing the bleeder to a higher value would be also desirable, although not necessary. It would help to reduce the heat caused by the increased voltage now across the bleeder

To further increase power so that you can operate at 200 watts input or better, another modification is necessary. The rectifier change will permit a power input of from 150 to 175 watts but the next change will permit a further increase in power. At the rear and center of the "Viking" chassis there is room to mount another *Amphenol* 4-prong socket. If you already have a line voltage adjuster then your expenses are minor. If you don't own such a unit you will have to "big deal," "beg," or buy one. A short cable connects the adjuster to the back of the "Viking" chassis *via* a 4-prong plug which plugs into the socket therein. The high-voltage primary is brought out to this socket. If one decides to sell his transmitter it is a simple process to insert a dummy plug with appropriate jumpers and restore the "Viking" to its original condition, less the adjuster. See schematic on this modification. The line-voltage adjuster provides a means of lowering the voltages for "tune-up" purposes and operation with lower power for local "rag-chewing." This provision is deemed neces-

Schematic diagram of the "Viking I" with the changes incorporated as suggested by the author. The starred items in the parts list were added to the original circuit. A few miscellaneous parts, such as sockets, etc., are not specified.



R_1—2 megohm, ½ w. res.
R_2—1500 ohm, ½ w. res.*
R_3, R_5—1 megohm, ½ w. res.*
R_4—250,000 ohm, ½ w. res.
R_5—500,000 ohm pot ("Gain Control")
R_6—2000 ohm, ½ w. res.*
R_7, R_{10}, R_{11}*—50,000 ohm, 1 w. res.*
R_8—330,000 ohm, ½ w. res.*
R_9—250,000 ohm, ½ w. res.*
R_{12}—1000 ohm, 1 w. res.*
R_{13}—10,000 ohm, 10 w. wirewound res.*
R_{15}—50,000 ohm tapped wirewound bleeder (original used 20,000 ohm unit, see text)*
R_{16}—Meter shunt
R_{17}, R_{18}*—100 ohm, ½ w. res.*
R_{19}, R_{20}*—15,000 ohm, ½ w. res.*

C_1—50 μμfd. mica capacitor (r.f. filter)*
C_2—20 μfd., 25 v. elec. capacitor*
C_3, C_4*—20 μfd., 450 v. elec. capacitor*
C_4, C_7*—30 μfd., 450 v. elec. capacitor*
C_5—.02 μfd., 600 v. capacitor*
C_6—.05 μfd., 600 v. capacitor*
C_9—.05 μfd., 1500 v. oil-filled capacitor*
C_{10}—Omitted
C_{11}—10 μfd., 1000 v. capacitor
C_{12}—40 μfd., 450 v. elec. capacitor*
C_{13}—.003 μfd., 500 v. mica capacitor*
C_{14}—1 μfd., 600 v. capacitor*
T_1—Filament transformer
T_2—Plate transformer

T_3—Driver transformer
T_4—Modulation transformer
S_1, S_2—S.p.s.t. switch
J_1—Microphone jack (input for crystal mike)
J_2—Closed-circuit jack (for optional carbon mike)
CH_1—Filter choke
PL_1—115 volt pilot light
F_1—Fuse
L_1—0-135 v. a.c. line-voltage adjuster (General Radio Type 200 CU or equiv.)
**Additional parts required for modification*
See also the parts listed in the modified bias circuit shown within dotted box on diagram.

sary since the "Viking" is now a "hot-rod" and must be operated as such. This is particularly important when changing bands where it is possible for the final amplifier to be far from resonance and operating with full grid drive. When the line-voltage adjuster is cranked wide open so that one has approximately 130 volts on the primary of the high-voltage transformer it causes a decided increase in exciting current of the primary. This appears in the form of heat and brings us to the problem of adequate cooling.

Although the author's "Viking" has been operated for over three years without cooling recently the following precautions have been adopted. Formerly it was impossible to touch the top of the transmitter case or any of the internal parts, especially the transformers. The heating was considerable. After some research into the possible harmful effects of heating on transformers and other components the following changes were made. See photos of perforated top of the transmitter case and transformer shells.

You may find some better means for mounting your blower or may decide to use another type; nevertheless, a blower is advisable. The author mounted a small 4-bladed blower just above the crystal holder and on the vertical aluminum shield which divides the crystal compartment from the final amplifier. See photo. The blade hangs over the vertical shield and part of the blast cools the 4D32 and the remainder moves the heat which collects at the upper part of the case. Transformers T_2 (high voltage) and T_1 (modulation) as well as CH_1 (filter choke) are dismantled. The shells are removed and drilled as indicated in the photographs. A number of holes are drilled into the upper top, sides, and bottom sides to provide a chimney effect for air movement near the windings. Some of the wind from the fan penetrates these holes for cooling. Six-hundred and sixty $\frac{1}{8}$" holes are drilled $\frac{1}{2}$" apart on the top case to further vent any heat. With this additional modification it was possible to operate at 250 watts input with room temperatures of 75 degrees for several hours and upon checking the temperature of the transformers and cabinet found that they were only comfortably warm. Cooling should be a "must" in the modification of the "Viking."

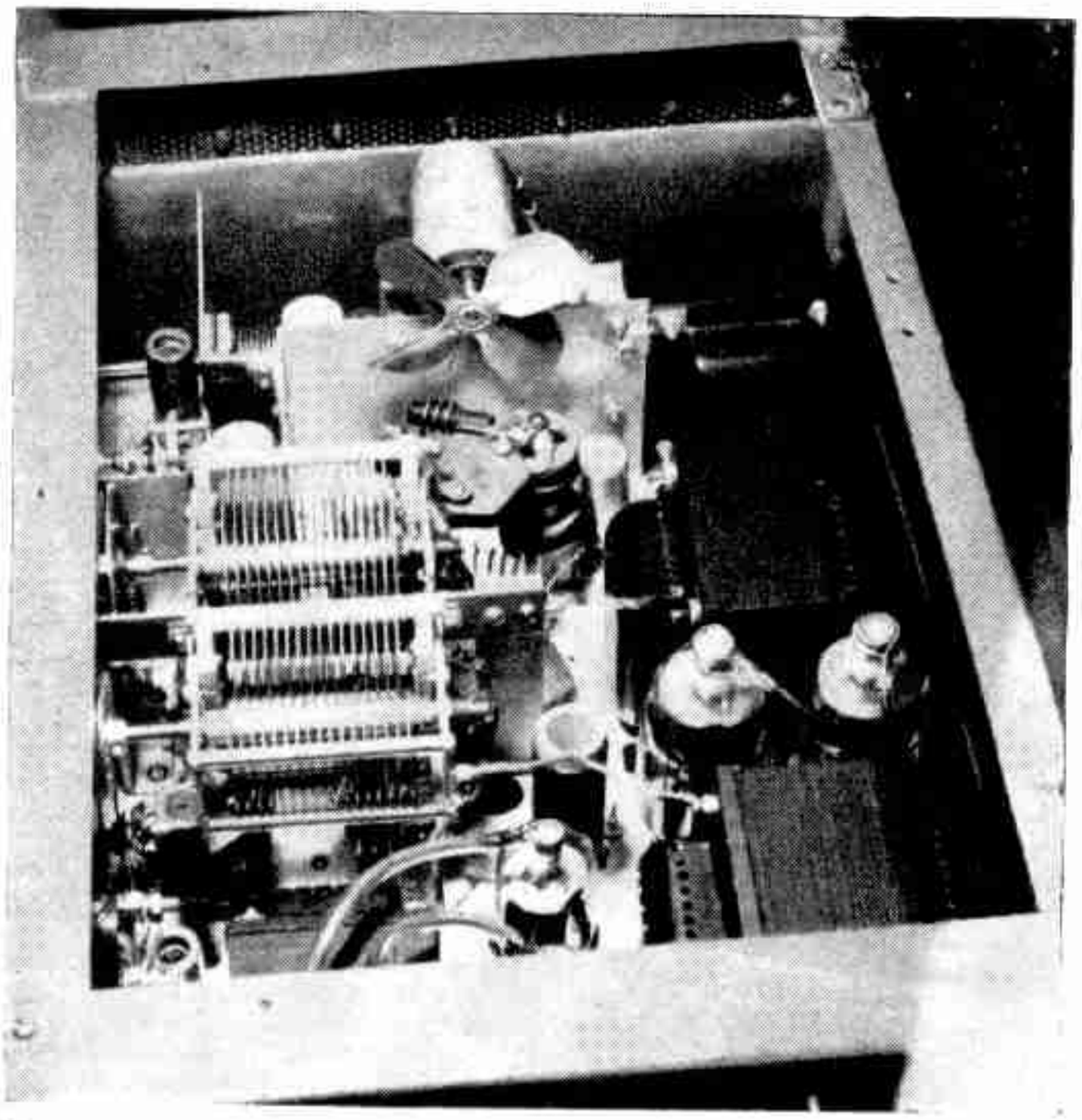
By the way, while you have the shell removed from the modulation transformer it is a good idea to bring the 807 plate leads out the top of the shell through $\frac{1}{4}$" grommets.

Another worthwhile modification is the adjustable modulator bias provision. With the increased plate voltage applied to the modulator one should correspondingly increase the negative bias to the 807's. This problem can be easily remedied by referring to the schematic and following information. Assuming the negative bias to be from —35 to —40 volts at full power, one can readily see that when the plate voltage is reduced in order to work some local or to operate at, say, 50 watts input, a condition arises where the bias voltage would be excessive and in the cut-off region of the 807's. This would cause excessive distortion at low power. By merely drilling a $\frac{3}{8}$" hole just above the "drive-control" on the front panel and mounting a standard 5000 ohm, 2 watt potentiometer, we can control the bias to suit any condition. Wire the control and bias circuits as per schematic.

We should take hints from our good friends in the high-fidelity business and use ample decoupling and filtering in the speech amplifier. This transmitter is capable of exceptional quality if wired in the manner indicated in the schematic. Contrary to general belief that all that is necessary is communications quality, the author of this article firmly believes that good quality will work more DX than restricted speech response. By nature and in our everyday life, we as individuals are accustomed to listening to a reasonably wide range of frequencies both extreme lows and the highs. When we endeavor to modify this to some limited range, we create a falsetto or unreal situation. How many times have you tried to listen to a phone signal when your receiver was switched into the crystal sharp position. All you saw was your "S" meter reading, possibly, an "S7" level but practically no audio was audible. Therefore, it behooves us not to cut out the lows excessively or we have no modulation when listened to by sharp receivers. Conversely, if we reduce highs excessively and encounter a great deal of QRM no intelligence is possible. A signal with a good share of highs can often be read when the receiver is considerably detuned from the carrier frequency. Too wide a bandpass, of course, takes up considerable room in the spectrum. To summarize, the author feels that too much stress is placed on reducing the lows because they consume too much power and too many restrictions on the highs likewise cause a dropping of intelligence.

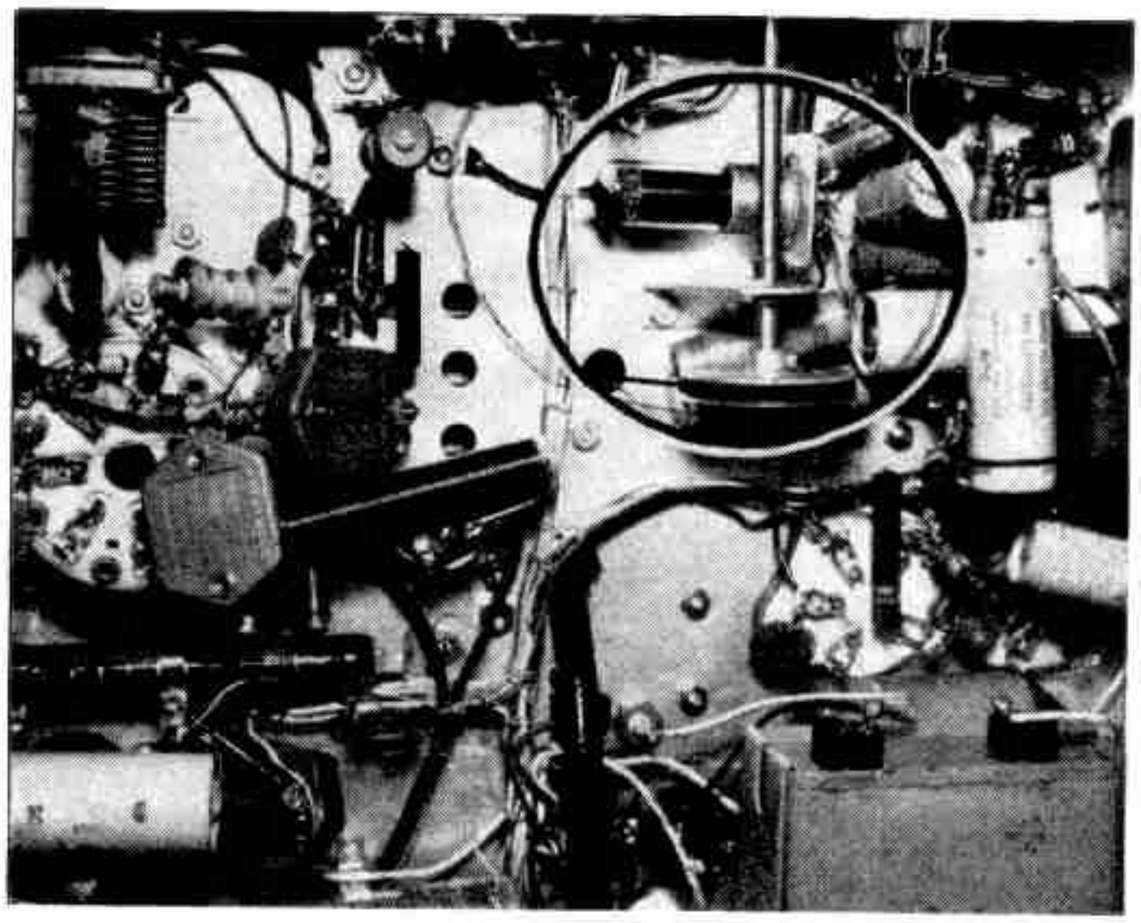
The modified "Viking" will give excellent audio response from 70 to 5000 cycles. The quality will be relatively free from excessive phase shift and distortion and should have clean sidebands. Transmitters equipped with clippers and limiters improperly adjusted can do more to mess up the amateur bands than transmitters not so equipped. Often we read articles claiming 3 db or more increased power output by just adding a clipper or limiter (audio), but careful listening and study will reveal that although 3 db more signal is available to the modulator it is of a type loaded with distortion. The human ear is accustomed to

(*Continued on page* 120)



Top view of the transmitter showing the cooling procedures adopted. Note holes drilled in transformer cases and in top and the four-blade blower mounted above the crystal section.

A portion of the bottom chassis view of the transmitter. The circled section shows how the new 6AQ5 driver tube is mounted.



"Souped-Up Viking I"

(*Continued from page* 68)

listening to words and syllables that have a *depth of amplitude.* That is what creates, in part, what we call intelligence of speech. If we take the same words and syllables and try to create a falsetto by making their amplitudes all equal or near so, then we no longer have good intelligence. It becomes a new "noise" or anything else you care to call it. Intelligence is often lost because of the "unnaturalness." Definitely, we hear a louder signal (noise) but is the readability any better? You may sound louder but not necessarily clearer.

So to all you "hot-rodders" may your transmitters take on a new zest for life. You now have a "new" transmitter and this should keep you happy for a few months until someone else finds a better way or has another thought. May your "Vikings" purr along as well as mine does for many years to come. —30—