Happy members of the Wheaton Community Radio Amateurs, with some of the 2-meter stations that were built during the club project. Working together toward a common aim turned out to be fine for both club interest and local 2-meter activity.

The "Club Saver" 2-Meter Portable

A Group Project That Put New Life in an Old Club

BY ROBERT F. TSCHANNEN, W9LUO*

THE NAME "Club Saver" seems appropriate to describe the compact two-meter transmitter-receiver detailed in this article because the construction project involving it was responsible for thoroughly revitalizing a sadly waning ham club. The end results of this project were the construction of 50 units, lots of new two-meter activity, and an increase of 300 to 400 per cent in club attendance. The success of the undertaking is attributed to the fact that it was a low-cost project which appealed to nearly all of the club members, and to their inherent interest in construction.

The maximum cost of the planned building project was voted upon by club members before the unit was designed. After a $30 upper price limit was determined, the equipment specifications were prepared. (The $30 figure does not include the power supply.) In the design of the unit, every attempt was made to split the cost between the transmitter and receiver in such a way as to provide a sensible amount of performance from each.

The units were individually built by club members in their homes. In order to maintain uniformity in the design, the kits supplied to the members included punched chassis, panels and brackets and insofar as possible, equivalent components. Photographs were supplied for component location. Assistance in alignment and "de-bugging" was given as required. Further discussion of the mechanics of the club project is omitted in favor of more electrical and constructional details.

*412 E. Maple St., Lombard, Illinois

General Description

Electrically the unit is quite simple. It consists of a superregenerative superheterodyne receiver with an r.f. stage, and a simple crystal-controlled transmitter in which the output stage is a plate-modulated doubler. A common audio system serves as receiver audio output amplifier or transmitter modulator. The unit was designed to operate from a 270–300 volt power supply having a current output capability of approximately 125 ma. With a 300-volt power supply, the plate input power to the 5763 runs 9 to 10 watts. Although the receiver is simple in design, it possesses sufficient sensitivity to provide satisfactory communication in conjunction with a low-powered transmitter. The complete unit is packaged in a 5 × 6 × 9-inch rectangular aluminum box (ICA 29844 or 29801.) The cadmium-plated steel chassis measures approximately 7¾ × 4¾ × 2 inches. Most of the major components may be identified from the chassis photos.

The Receiver Portion

A 6CB6 tube is used as a fixed-tuned r.f. amplifier. The antenna input circuit employs a single tuned circuit, L_6, which is fixed-tuned at approximately 147 Mc. The plate circuit, L_7, is tuned to 145 Mc. With the plate circuit of the staggered pair tuned to the lowest frequency,

the effective load looking into the grid circuit of the r.f. amplifier is capacitive in nature and regenerative tendencies are thereby reduced. By tapping the grid lead down on the antenna coil, the loading on this coil is reduced, the coil operating Q is increased and better image rejection is obtained.

A 12AT7 tube is the oscillator-mixer. The oscillator operates on the low side of the signal frequency. Its tank circuit is padded to reduce the tuning range so as to cover the two-meter band on C_6 with a moderate amount of leeway. The oscillator frequency range of 125.8–132.9 Mc. provides a signal tuning range of 143–150 Mc. with the i.f. at 17.2 Mc.

The 17.2-Mc. intermediate frequency was not an arbitrary choice, but was selected to provide a fair amount of selectivity with a minimum of birdies and image responses, when the receiver tunes the two-meter band.

The pentode portion of a 6U8 tube is the superregenerative second detector. Smooth regeneration control is obtained by varying the screen voltage. The triode portion serves as an audio amplifier in receiving and as a microphone amplifier when transmitting. In the receive position, grid bias is obtained from contact potential, plus rectified grid current which may be developed if the peak positive grid swing exceeds the contact bias. In the transmit position, the stage is a cathode-driven amplifier, with a small bias being supplied by the d.c. voltage drop across the secondary of the transformer T_1. The d.c. required for microphone current is supplied from the by-passed cathode of the 6AQ5 output tube.

The output stage autotransformer step-up arrangement permits a high percentage of modulation, as compared with a Heising modulation system used without a dropping resistor. The transformer design is such as to permit both modulator and final plate current to flow without core saturation. (This is sometimes the case when a small receiver type output transformer is used in this application.)

The send-receive switch is a miniature ceramic rotary with five of the six available poles of the switch used. This arrangement is simple and effective, and much less expensive than a push-to-talk relay.

Fig. 1—Schematic diagram and parts information for the 2-meter portable station. Unless otherwise stated, capacitors are ceramic. Values less than .001 are in $\mu\mu$f. Resistors are ½-watt carbon. Where polarity is shown, capacitors are electrolytic.

C_1, C_4, C_5—1–8-$\mu\mu$f. plastic trimmer.
C_2—25-$\mu\mu$f. variable.
C_3—25-$\mu\mu$f. ceramic trimmer.
C_6—2-plate midget variable, shaft type.
J_1—Coaxial chassis fitting, female.
J_2—Closed-circuit jack.
J_3—8-pin chassis fitting, male. Provision is made for either 6- or 12-volt connection; see text.
L_1—12 t. No. 26 enam., close-wound on ⅝-inch bakelite form, iron-slug tuned.
L_2—2 t. wound in same direction as L_1 and about ⅛ inch below it.
L_3—5½ t. No. 18, ½-inch diam., ⅝ inch long.
L_4—4 t. No. 14, ⅝-inch diam., ½ inch long, center tapped.
L_5—1¾ t. insulated hookup wire. Wind to fit snugly inside L_4.
L_6—4 t. No. 18, ⅜-inch diam., ⅞ inch long. Tap at 1¼ and 2¾ t. from ground end.
L_7—3 t. No. 18, ⅜-inch diam., ⅞ inch long.
L_8—15 t. No. 36 d.s.c., close-wound on ⅝-inch bakelite form, iron-slug tuned.
L_9—16 t. No. 32 d.s.c., close-wound at terminal end of form used for L_8. L_8 is directly below it. Wind both in same direction.
L_{10}—3 t. No. 18, ⅜-inch diam., ⅛ inch long. Tap at 1 t. from ground end.
RFC$_{1-4}$ incl.—R.f. choke, about 10 μh. May be 70 t. No. 38 enam. close-wound on ⅛- to ¾-inch diam. form or high-value resistor.
S_1—6-pole 2-position miniature ceramic switch (Centralab PA-2019).
T_1—Single-button microphone transformer.
T_2—Small modulation transformer, auto transformer type (Triad M-42).

The club-project 2-meter portable station described by W9LUO. Size may be judged from the 6-inch scale at the lower right. Power supply is a separate unit, and may be arranged to suit user's requirements.

Note: see Feedback on last page for corrections to Schematic - K2TQN

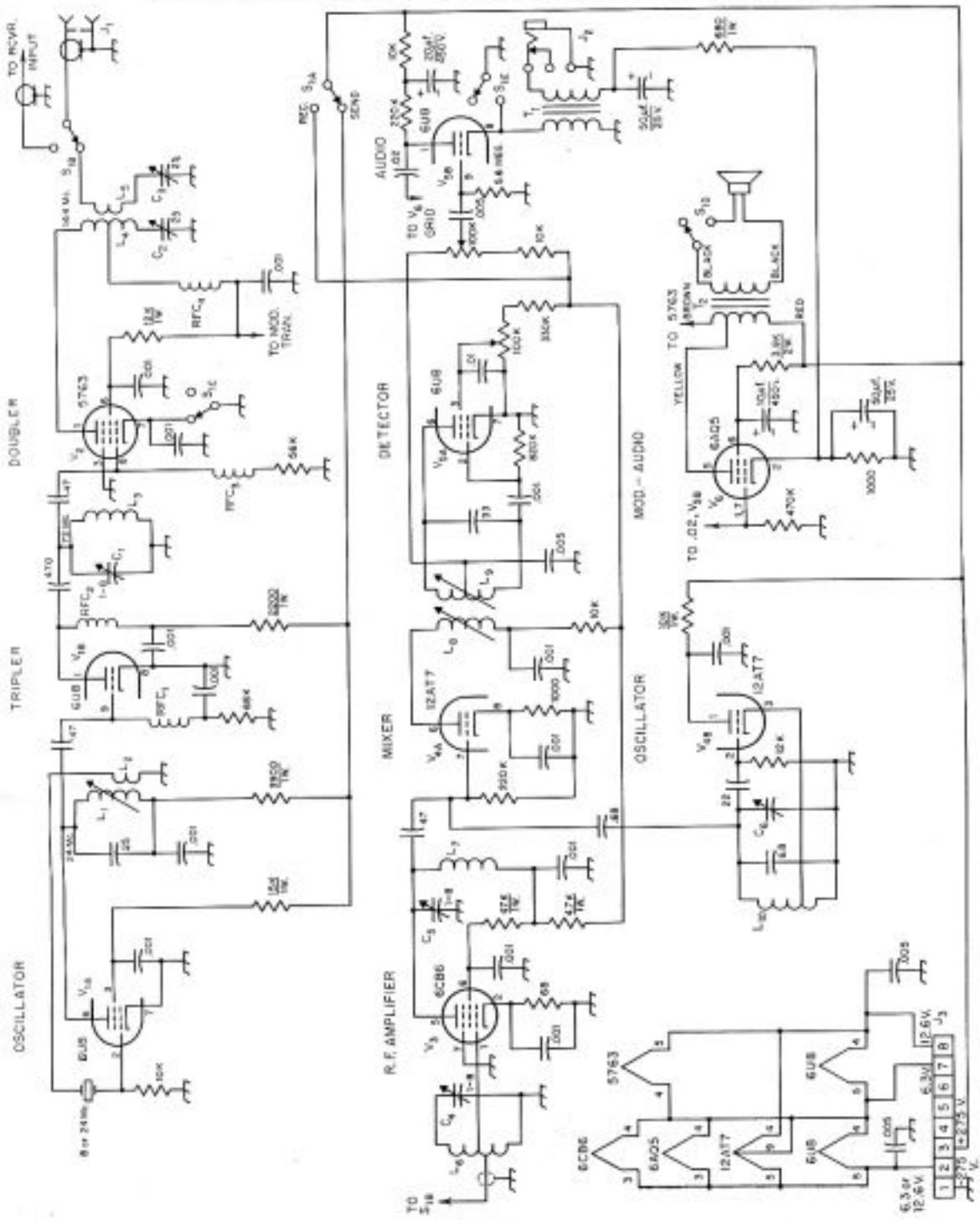


Fig. 1

The Transmitter

The first model transmitter designed for this project employed the same tube complement, but used a 48-Mc. crystal oscillator, tripling in the second half of the 6U8 tube. This arrangement provided straight-through amplifier operation of the 5763 stage. The input loading of the 5763 tube at 144 Mc. is considerably greater than at 72 Mc., however, and some difficulty was encountered in obtaining adequate drive, without excessive crystal current. The final design uses an 8-Mc. crystal oscillating on its third overtone at 24 Mc. The second half of the 6U8 triples to 72 Mc. and drives the 5763 plate-modulated doubler. An appreciable margin of drive capability is provided, and upward modulation with good linearity is obtained.

The heater connections of the unit are such that either a 6- or 12-volt supply may be used. For 12-volt operation, connect the source to Pins 2 and 8 of the input connector. For 6 volts, connect Pins 2 and 8 together with a jumper and connect the source between Pins 7 and 8.

Construction Hints

Best results may be expected if the layout and circuit are carefully followed. Principal components may be identified from the photos of the rear and bottom of the chassis. In the rear view the receiver portion is at the right. The tube in the right foreground is the 6CB6 r.f. amplifier. In line with it, near the panel, is the 12AT7 mixer-oscillator. The 6U8 and 6AQ5 are near the middle of the chassis. At the far left are the two transmitter tubes, the 5763 being the one at the corner of the chassis.

In general, the positions of various coils in both the receiver and transmitter should be as shown in the photos. Coils should be kept well away from the steel chassis. The position of the grid-plate shield on the bottom of the 6CB6 socket should be noted. This may be made of any shielding material which may be soldered into position readily. If desired, the crystal socket for the transmitter may be located on the side flange of the chassis and clearance holes punched in the case for quick crystal changing. Use a sturdy bracket to support the variable capacitor C_6 in order to prevent frequency shift due to panel pressure which may occur during use of the equipment.

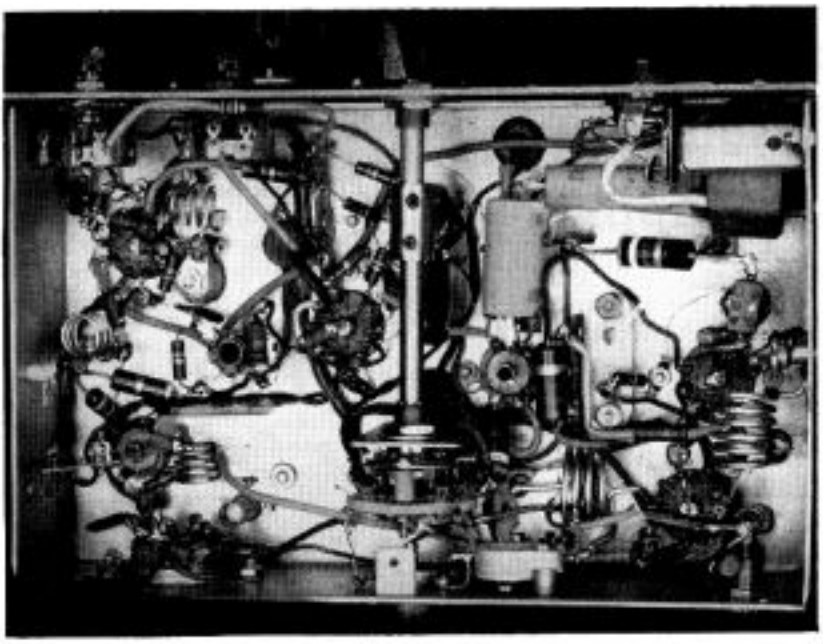
If a rear cover is used on the case of the unit, drill ventilating holes in the bottom and top of the cabinet and in the chassis, for "chimney" effect. The p.m. speaker should be spaced approximately 1/16 to 1/8 inch behind the plastic grill cloth, by means of washers, since at high audio levels the cone travel is otherwise sufficient to produce an objectionable buzz, as the outer ribs in the cone strike the grill cloth.

Alignment of the Receiver

After wiring is completed, check it over carefully. The receiver may now be connected to a power supply and warmed up. An accurately calibrated signal source and/or grid-dip meter is desirable for alignment purposes. An a.c. voltmeter, output meter or scope should be connected across the speaker voice coil terminals as an output indicator. A modulated 17.2-Mc. signal is loosely coupled to Pin 7 of the 12AT7 mixer. Set the volume control at maximum and the regeneration control for the cleanest output signal with least noise. The tuning slug in L_9 is then adjusted for maximum output indication across the speaker voice coil terminals. A reasonably strong signal must be used for this alignment, to override the noise developed in the superregenerative detector. If a modulated signal is not available, an alternate alignment technique is to use a c.w. input signal and tune L_9 for minimum noise output. Keep the input level sufficiently low to provide some noise for output indication.

The oscillator tuning range is adjusted next. This may be done by direct grid-dip meter pickup from the oscillator coil, L_{10}, or by insertion of an input signal to the antenna terminals. If direct grid-dip meter pickup is used, couple loosely to L_{10}, in order to minimize oscillator frequency calibration errors. The best method is by signal insertion to the antenna terminals. No oscillator interaction results from this method, so a more accurate calibration may be obtained. It is important in this case that the i.f. alignment be done first. An input signal tunable from 143 to 150 Mc. (preferably modulated) is used for this adjustment, and the oscillator tuning range is centered by spreading or squeezing turns of L_{10}. The coverage is then adjusted by bending stator

Interior view of the 2-meter station. Receiver portion is at the right side of the picture.



Receiver circuits are at the left side of this bottom view of the club-project portable.

or rotor plates of C_6 so as to tune the desired range. When the grid-dip meter is used for this adjustment, the oscillator coil and tuning capacitor are adjusted to provide an oscillator range of 125.8 to 132.8 Mc.

After the oscillator has been adjusted to cover the range, the r.f. alignment may be done. Using a modulated signal on 147 Mc., C_4 is tuned for maximum output indication. Similarly, C_5 is tuned for maximum output on a 145-Mc. signal. The tuning of these circuits is rather broad; care should be taken to adjust the input level to avoid overloading.

This completes the receiver alignment. Dial calibration markings should be made only after the receiver performs satisfactorily in all respects, as oscillator frequency calibration is influenced by changes in the r.f. plate and converter grid circuits, or by movement of components in the vicinity of the oscillator circuitry.

Transmitter Alignment

Transmitter adjustment is most easily carried out using a d.c. v.t.v.m. or a low-range d.c. milliammeter (0–5 ma.). The alignment basically consists of adjusting the tuned circuits for maximum grid current, starting with the oscillator. The tickler coupling of the regenerative oscillator must be adjusted to provide adequate but not excessive feedback, in order to assure crystal-controlled operation. Connect the v.t.v.m. from the junction of RFC_3 and the 68,000-ohm resistor to ground, or insert the d.c. milliammeter between the resistor and ground. This will read voltage or current developed in the tripler grid. Adjust the tuning core of L_1 until maximum voltage or current is read. There will usually be a sharp rise as L_1 resonates at the third-overtone frequency, 24 Mc. Listen to the character of the oscillator note at 24 Mc. on a receiver, and check if it is crystal controlled by bringing a metal object near L_1. If the note is clear and no frequency change is noted, the oscillator is crystal controlled. Back the tuning core out of the coil slightly and check to see that the oscillator starts rapidly. Feedback can be adjusted by changing the number of turns in L_2, or its spacing from L_1.

For tripler alignment, the v.t.v.m. is connected similarly in the 5763 grid circuit and the trimmer capacitor C_1 is adjusted for maximum indication.

Two No. 47 brown-bead pilot bulbs are next paralleled across the antenna connector to ground. The final amplifier tuning capacitor, C_2, is adjusted for maximum brilliance in the output-indicating bulbs. Adjustment of the series antenna capacitor, C_3, is made after the antenna system has been connected; this is commonly made by use of a crystal diode and milliammeter. With the final amplifier properly loaded, the unit will modulate upward with good linearity. If grid excitation is low, downward modulation will occur and poor efficiency will be obtained.

Conclusion

Most of the 50 kits supplied to club members and other interested parties have been completed and two-meter activity is steadily increasing. Credit is due to members of the club who have made the project successful; particularly, Don Hayworth, W9FYT, business manager of the affair, Bob Winston, W9WX, who did the chassis work, John Kullberg, W9YBG, for photographs, W9DLJ, W9IYL, W9FRE, W9NZM for components, W9FQ for bookkeeping, W9TVN for drawing, W9WKM for test equipment and Ken Guge for layout photos.

—···—

Robert F. Tschannen, W9LUO, reports that he has been swamped by letters and telephone calls regarding his "Club-Saver Portable" 2-meter station described in October *QST*. Several errors were drawn into the schematic diagram as published. Corrections are as follows:

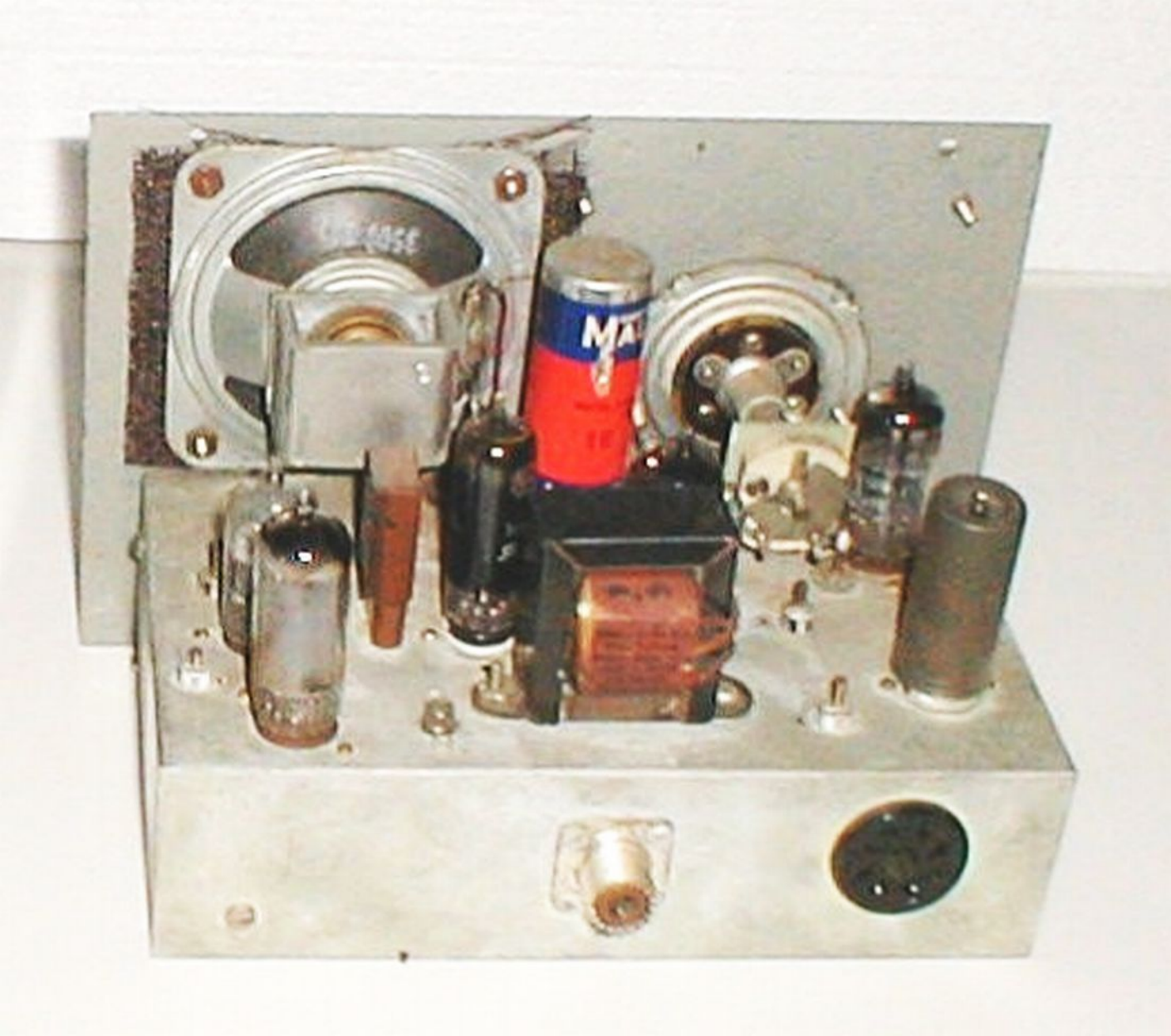
Add a 10-μf. 450-volt electrolytic capacitor to ground from the junction of the audio gain control and the 10K resistor. This capacitor is one section of the Mallory Type FP376.1 assembly used in the rig.

Coil L_9 is center-tapped. This is indicated on the drawing, but not mentioned in the cut label.

The 3900-ohm resistor in the oscillator plate lead, and the 2200-ohm resistor in the tripler plate lead will have a more satisfactory safety factor under mistuned conditions if the wattage rating is increased to 2 watts.

The two lower terminals of the microphone jack, J_2, should be connected together. This will give a somewhat better bias condition on the 6AQ5 when the microphone is not connected.


National
S - B



144 MC. TRANS.-RCVR.