AN INEXPENSIVE 75-WATT TRANSMITTER

The transmitter shown in Figs. 6-39 and 6-41 combines the efficiency and flexibility of plug-in coils with good shielding for TVI prevention. It is a two-stage transmitter using a 12BY7 crystal oscillator and an inexpensive 1625 tetrode amplifier. The latter tube is quite inexpensive in surplus and probably represents the least "dollars per watt" of any available tube. Provision is included for crystal-controlled operation, and terminals are provided for connecting a v.f.o. Construction has been simplified by holding the metal work to a minimum.

Referring to the circuit diagram of the transmitter, Fig. 6-40, a 12BY7 grid-plate type crystal-controlled oscillator is used. The output can be tuned to the crystal frequency or to multiples of it, depending upon the coil plugged in at L_1. Both 80- and 40-meter crystals are used; 80-meter crystals for 80- or 40-meter operation, and 40-meter crystals for 40-, 20-, 15- and 10-meter work. Output on 10 meters is obtained by quadrupling to 10 meters in the oscillator and running the amplifier at reduced input because the excitation is marginal.

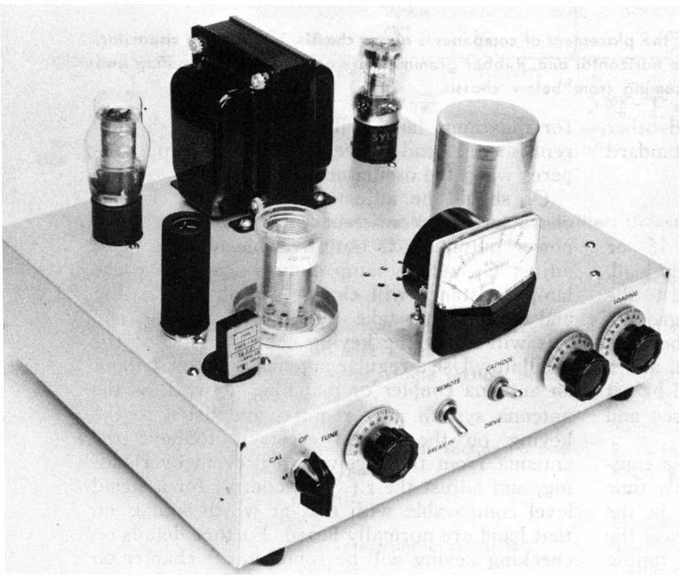

Fig. 6-39—The inexpensive 75-watt transmitter is a two-tube five-band crystal-controlled transmitter; v.f.o. control can be added at any time. To simplify construction and testing, plug-in coils are used, housed in the two shield cans (Millen 80011 or Miller S-42 with S-42C base). The crystal-oscillator tube, a 12BY7, is housed in the black tube shield at the left; the 1625 amplifier tube is mounted under the chassis. Two toggle switches under the meter select (left) remote oscillator control or break-in keying and (right) grid or cathode current of the 1625. Two voltage regulator tubes can be seen at the rear of the chassis; the key jack, antenna jack, remote oscillator control jack and line-cord outlet are at the rear of the chassis (not visible).

The amplifier tank circuit is a pi network designed primarily for working into a low impedance (50 to 75 ohms). A 140-pf. capacitor, C_2, is used for plate tuning on all bands; on 80 meters it is shunted by an additional 100 pf. This is done automatically by a jumper connection in the coil. The loading capacitor is a 3-section broadcast-tuning type capacitor (365 pf. per section) with all stators connected in parallel. On 80 meters it is shunted by an additional 470-pf. mica capacitor. The coils are ready-wound coil stock mounted in polystyrene coil forms. A piece of ferrite rod is mounted in the 80-meter output coil to increase the inductance of a small coil, since any coil of sufficient turns (without the ferrite) would of necessity be wound of wire too small to handle the r.f. current adequately.

Two methods of keying are provided. The oscillator and amplifier can be keyed simultaneously with switch S_2 in the "break-in" position, or the amplifier only can be keyed, with the oscillator running all the time, turned on by a switch connected at J_4. The latter keying system should be used if reports of a chirpy signal are received (a possibility on 10 and 15 meters with some crystals). However, good keying is provided for in the break-in condition through the inclusion of a 4-μf. "shaping" capacitor across the keyed circuit.

The switch S_1 provides "CAL" ("calibrate") and "TUNE" positions as well as the normal "OP" ("operate") condition. At CAL only the oscillator is turned on, so that listening in the receiver will show the location of the signal in the band. In the TUNE position, the oscillator and amplifier are both turned on, but the amplifier is operated at reduced input by grounding the screen grid. This allows tuning C_1 and C_2 without putting much of a signal out on the air.

A 0-1 milliammeter can be switched to either the grid or cathode circuit of the 1625; switched to the grid the meter has a full-scale deflection of 10 ma., and to the cathode the full-scale deflection is 200 ma. The meter is mounted outside the chassis, but the leads are bypassed by two small feedthrough capacitors, to minimize stray radiation from the transmitter.

For economy and simplification, no a.c. switch is included. The a.c. plug contains the fuses for the transmitter.

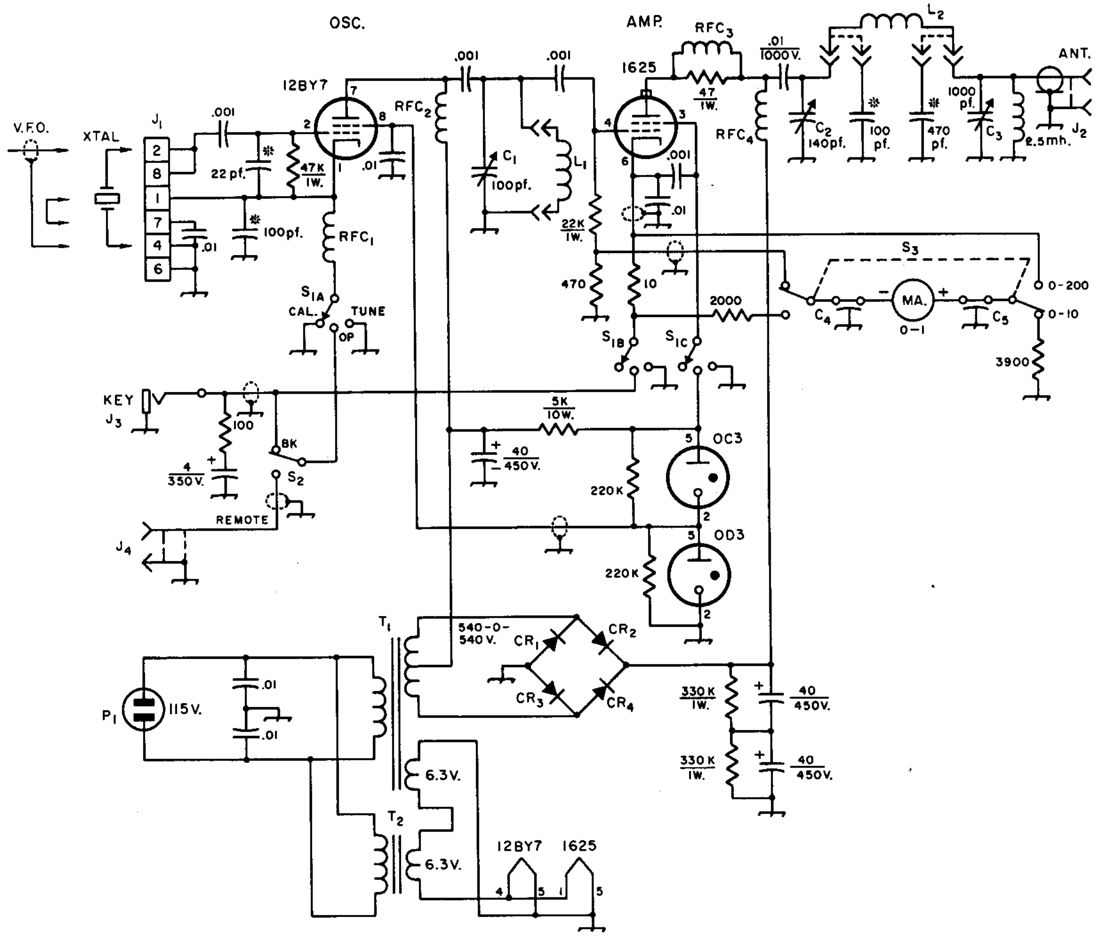

Fig. 6-40—Circuit diagram of the inexpensive 75-watt transmitter. Unless indicated otherwise, all resistors are ½-watt, all resistances are in ohms, all capacitances are in μf. Electrolytic capacitors are marked with polarity, mica capacitors are marked with *, other fixed capacitors under 0.1 μf. are ceramic.

C_1—100-pf. variable (Hammarlund HF-100).
C_2—140-pf. variable (Hammarlund HFA-140-A).
C_3—1100-pf. variable—triple b.c. capacitor (Allied Radio 60 L 726).
C_4, C_5—500-pf. feedthrough (Centralab FT-500).
CR_1–CR_4—1000 p.i.v. 300-ma. silicon (1N3563).
J_1—Octal socket (Amphenol 77MIP8).
J_2—Coaxial chassis receptacle, SO-239.
J_3—Standard phone jack.
J_4—Phono jack.
L_1, L_2—See coil table.
P_1—Fused line plug, 5-ampere fuses.
RFC_1, RFC_2—1-mh. 135-ma. r.f. choke (National R-50).
RFC_3—7 turns No. 20 space-wound on 47-ohm 1-watt resistor.
RFC_4—2.5-mh. 115-ma. r.f. choke (National R-100U).
S_1—3-pole 3-position rotary switch (Centralab PA-1007).
S_2—D.p.d.t. toggle (one pole used, see text).
S_3—D.p.d.t. toggle.
T_1—540 v.c.t. at 120 ma., 5 v. at 3 amp. (not used), 6.3 v. at 3.5 amp. (Knight 61 G 466).
T_2—6.3 v. at 1 amp. (Knight 62 G 030).

CONSTRUCTION DETAILS

Before drilling any holes for the components, it would be wise to study the arrangement of parts on the 10 × 12 × 3-inch aluminum chassis. While the location of components is not critical, some initial planning will permit leads to be made direct and as short as possible.

Two brackets of sheet aluminum are required, one for the 1625 socket and one for the meter. The bracket for the tube socket is held to the chassis by the 4-pin socket for L_1, and the tube socket is centered 1½ inches from the chassis. The meter panel is held to the chassis by the two feedthrough capacitors at the rear and by a 6-32 screw and nut at the front.

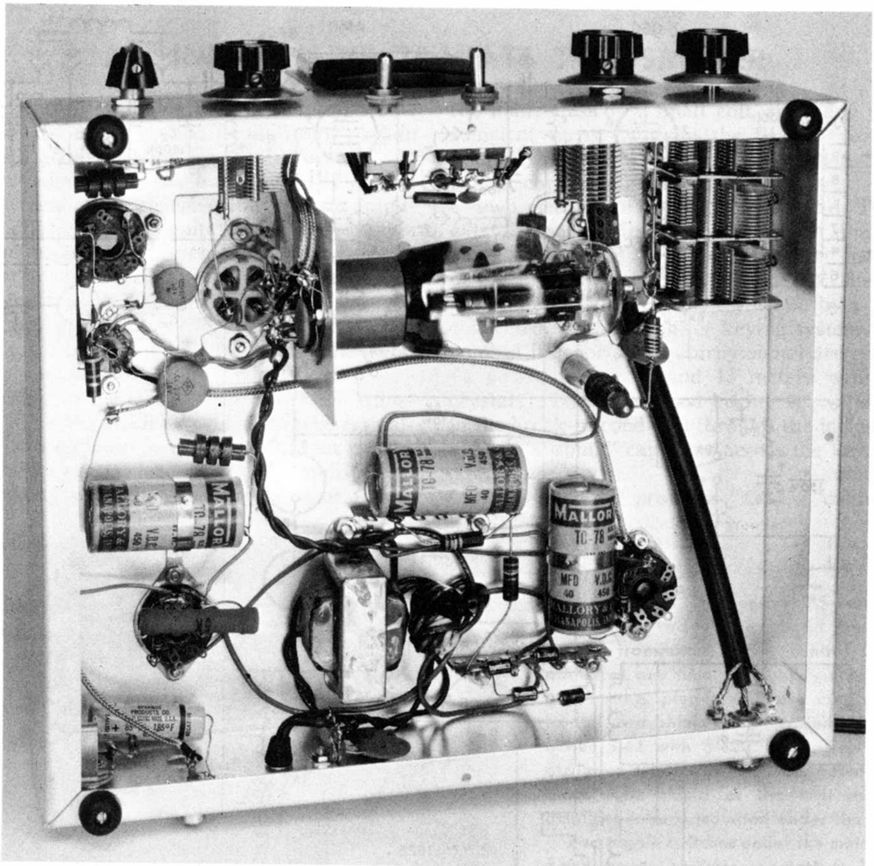

Fig. 6-41—A view underneath the chassis of the 75-watt transmitter with the perforated-metal bottom plate removed. The four silicon rectifiers are mounted on a multiple tie point strip (lower right); the center electrolytic filter capacitor has its metal strap removed, and the capacitor is supported by its two leads and another multiple tie point strip. The small electrolytic capacitor at the lower left is across the keying circuit. Ventilation of the chassis is obtained through the holes above the 1625 (see Fig. 6-39) and by raising the chassis above the table by the height of the rubber feet. The rubber feet and several sheetmetal screws normally hold the perforated-metal bottom plate in place. C_8 must have the three stators connected together to give the full 1100-pf. capacitance (upper right). A pair of the 8-32 mounting screws for T_1 also anchor T_2 (bottom center).

All other construction is straightforward assembly on the chassis, with 4-40 hardware for the 12BY7 socket and 6-32 hardware for everything else but the transformers, which are big enough to require 8-32 hardware. Multiple tie-point strips are used at several points to furnish mounting terminals for the silicon rectifiers and some filter and bypass capacitors, and chassis connections are made to soldering lugs held in place by the tube-socket hardware. The metal mounting strap around one of the 40-μf. filter capacitors is removed, and the capacitor is supported by its two leads and tie-points. This is the 40-μf. capacitor in Fig. 6-40 that has neither terminal grounded to the chassis. Pin 5 on the 1625 socket is used as a tie-point for the junction of the 22K and 470-ohm resistors, and an unused terminal on S_2 is used as a tie-point for the 10- and 2000-ohm resistors in the 1625 cathode circuit. Screen and cathode bypass capacitors are mounted and grounded close to their respective tube sockets.

The 6.3-volt windings of T_1 and T_2 must be connected "aiding" to furnish the 12.6 volts for the tube heaters. Connect the primary leads in parallel first, and then try the 6.3-volt windings connected in series, with one of the tubes connected across the "12.6-volt" leads. If the secondaries are aiding, the tube heater will light when the primaries are connected to the 115-volt line. If not, reverse the connections of *one* of the secondaries.

The construction of the coils is straightforward, and the only precaution one should take is to hold the pin of the coil form with a pair of pliers (to form a "heat sink") when soldering

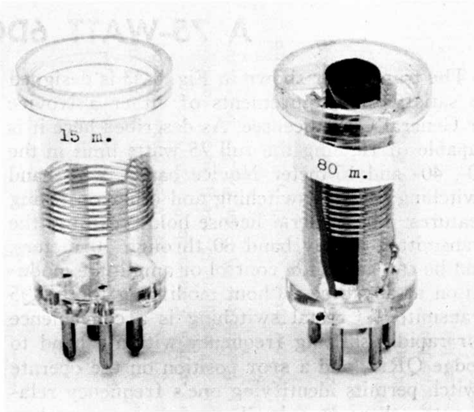

Fig. 6-42—The normal coil is simply a section of coil stock mounted inside a polystyrene coil form (left). The 80-meter amplifier inductor uses a length of ferrite rod within the coil to increase the inductance (right). Rod is held in place with transparent tape.

the end of the coil. If this is not done, the hot pin may move around in the softened polystyrene. It makes the soldering easier if the pins of the coil forms are cleaned out first with a suitable drill. The ferrite rod can be brought to size by first filing a notch around it with a three-cornered file, and then splitting it over the sharp edge of a cold chisel held upright in a vise. A sharp hammer blow on the ferrite while the rod is pressed against the cold chisel will usually result in a fairly clean break. The rod can be brought to exact size with a grindstone.

Tune-Up Procedure

For the initial testing, a 60-watt lamp bulb will make a suitable dummy load. Connect it at J_2 through a short length of cable or wires and a plug. Plug in an 80-meter crystal at Pins 2 and 4 (or 6 and 8) of J_1, and plug in a telegraph key at J_3. Plug in the 80-meter L_1 and L_2, and set C_1 at minimum capacitance. Plug in the tubes and set S_1 at OP. When the a.c. is turned on (by a wall switch or by plugging in P_1 to a "live" socket) the voltage-regulator tubes should glow immediately and the tube heaters should light. After a minute, turn S_1 to TUNE. With S_3 set to read grid current, turn C_1 through its range. If the crystal is oscillating, grid current will be indicated, and the amount can be controlled by the setting of C_1. Set for about 2½ ma., on the low-capacitance side of the setting that gives maximum reading. Flip S_3 to read cathode current and, with C_3 set at maximum capacitance, tune C_2 while watching the cathode current. A sudden dip in the current indicates resonance; leave C_2 at this position momentarily. Turn S_1 to OP and load the amplifier to a cathode current of about 120 ma. (0.6 on the meter) by reducing capacitance in C_3 and retuning to resonance (dip) with C_2. The plate voltage should be about 680, so with a screen current of about 10 ma. the plate input to the 1625 under these conditions is $0.11 \times 680 = 74.8$ watts. With the amplifier loaded, recheck the grid current; it should be about 2.5 ma. (0.25 on the meter). Observe the VR tubes when the key is closed; if the glow goes out entirely it indicates heavy screen current caused by excessive excitation, and the grid current should be reduced slightly by detuning C_1.

Operation on the other bands is similar. With an 80-meter crystal, 40-meter output is obtained with 40-meter coils at L_1 and L_2. With a 40-meter crystal, output can be obtained on 40, 20, 15 or 10 meters by the proper selection of coils and tuning. It will be found that the same coil at L_1 can tune to either 20 meters (near maximum capacitance) or 15 meters (near minimum capacitance). Be careful when first tuning to be certain the right band is tuned. When quadrupling in the oscillator for 10-meter operation, it will not be possible to obtain the 2½ ma. grid current required for high-efficiency operation. However, with ¾ ma. or so the input to the 1625 can be reduced to 100 ma. cathode current, for an output of about 20 watts. The tuning on 15 and 10 meters becomes a little critical, and an output indicator (r.f. ammeter or voltmeter) is a useful device for getting the most output for a given input.

The keying can be made "softer" by adding more capacitance across the 4-μf. capacitor in the key circuit, if it becomes desirable to do so.

Coil Table for the 75-Watt Transmitter

The L_1 coils are mounted inside 4-pin polystyrene coil form (Allied Radio 71 H 713); L_2 coils are mounted inside 5-pin form (Allied Radio 71 H 714). Coil stocks are (A) 1-inch diameter 32 t.p.i. No. 24, (B) 1-inch diameter 16 t.p.i. No. 20, and (C) ¾-inch diameter 16 t.p.i. No. 20. (B & W 3016, 3015 and 3011.)

Band	L_1	L_2
80 m.	42½ turns A	16½ turns C*
40 m.	20½ turns B	24½ turns B
20 m.	6½ turns B	12½ turns B
15 m.	Same as 20 m.	6½ turns B
10 m.	3½ turns B	5½ turns B

* With 2-inch length of ½-inch diameter ferrite rod (Lafayette MS-333). See text. Jumper leads to connect 100- and 470-pf. capacitors are also included in this coil.