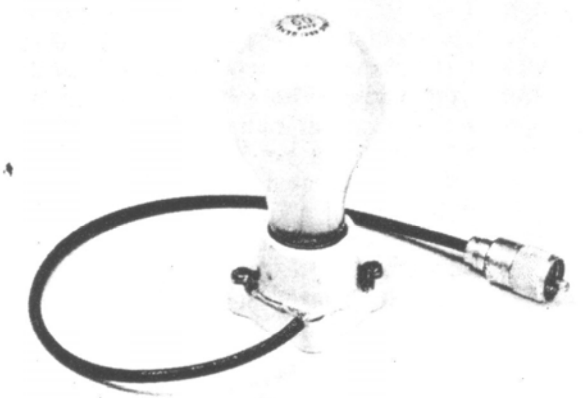

FIG. 11-18 — An incandescent lamp as a dummy antenna. Lamp rating should be selected to be approximately equal to the expected power output of the transmitter.

proportional to the actual rf current in the feeder, any tuning condition that results in maximum brightness is the one giving the greatest power output. The plate-meter reading is not always wholly accurate in this respect.

Dummy Antennas

A **dummy antenna** is a device for absorbing the power output of a transmitter. Using one lets you test the transmitter without putting a signal on the air, as you would if you used a regular antenna for this purpose. (Using a real antenna for transmitter testing is not permitted by the regulations, except very briefly, and is inconsiderate of others besides.) The basic ingredient of a dummy antenna is resistance, since resistance absorbs power.

An ideal dummy would be a pure resistance matching the characteristic impedance of coaxial cable, 50 or 75 ohms, approximately. Small composition resistors are fine at frequencies up to 150 MHz or even higher, but they can't handle much power. Two watts is the maximum for the largest commonly-available resistor of this type. Several resistors can be combined in series, parallel, or a combination of both series and parallel, for handling more power. However, it takes a great many of them to dissipate, say, 100 watts safely. Also, when a large number of them are wired together some of the good characteristics are lost – the wiring adds inductance and capacitance and the resistance is no longer pure.

Actually, most transmitter testing doesn't require a dummy of known resistance. Anything that will let you load up the final amplifier to normal input will do. The cheapest and most satisfactory resistor, in many respects, is an ordinary incandescent lamp. It will light up on rf just as well as on 60 hertz ac at frequencies below 30 MHz. Its brightness will give you a fair indication of your power output. Simply choose a lamp that will light up to about normal brightness on the output of your transmitter, and compare it with one of the same rating in a regular 115-volt socket. Beware of estimating power output when the lamp isn't close to being normally bright, though. Just a couple of watts will make a 60- or 100-watt lamp show color!

The lamp can be put in a dime-store socket, for convenience in changing sizes. See Fig. 11-18. Use a foot or so of coax, with a fitting on one end, to connect the socket to your transmitter. The coax braid should go to the shell connection and the inner conductor should connect to the center stud of the lamp.

One disadvantage of the lamp is that its resistance changes with the temperature of the filament. This represents a changing load as you tune up, so you have to be careful in adjusting your loading and tuning controls. One thing you can be sure of – when the lamp is as bright as you can get it with any possible tuning adjustment, your transmitter is delivering all the power you can expect to get from it.

Electronic Transmit-Receive Switching

While it is always good practice to use the same antenna for both receiving and transmitting, to do so you have to shift the antenna or feeder connections back and forth. This can be done by manual switching or with an antenna relay. However, neither of these can be operated rapidly enough to follow keying, so in either case break-in operation becomes impracticable. But if the switching is done electronically it can be practically instantaneous. A device which does this is called an **electronic T-R (transmit-receive) switch.**

Fig. 11-20 is the circuit of a simple switch of this type. The coax line from the antenna or from a transmatch is permanently connected to the transmitter through J1 and J2. The inner conductor of the coax is connected to the grid of the T-R switch tube, a 6AH6, through a small blocking capacitance. When the transmitter is idle (key up) incoming signals from the antenna reach the T-R tube's grid, and are coupled to the receiver from the tube's cathode through J3, so the receiver operates normally.

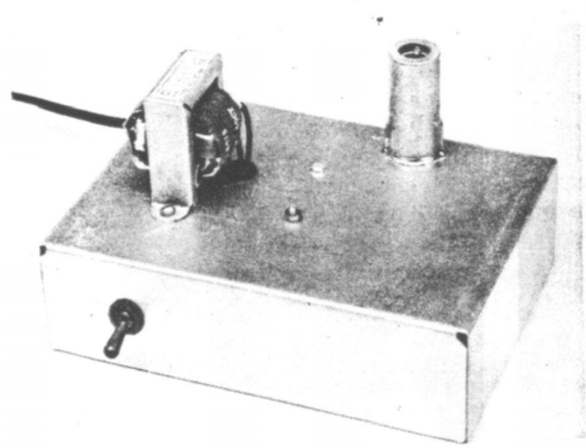

FIG. 11-19 — Electronic transmit-receive switch, with built-in power supply. The components on top of the chassis are the power transformer and the switch tube.

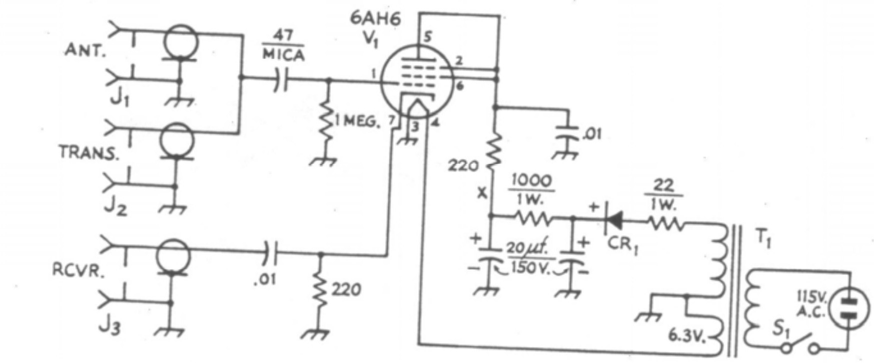

FIG. 11-20 — Circuit diagram of the T-R switch. Unless otherwise indicated, decimal values of capacitance are in µF, others are in pF, resistances are in ohms, resistors are 1/2 watt. Capacitors marked with polarity are electrolytic.

CR1 — Silicon rectifier, 400 PIV.
J1,J2,J3 — Coax chassis receptacles, or phono jacks.
S1 — Spst toggle.
T1 — Power transformer, 125 volts, 15 mA, 6.3 volts, 0.6 amp. (Stancor PS-8415, Knight 61G-410).

When the transmitter's key is closed the rf voltage on the transmission line is very much larger than the grid bias on the T-R tube. (This bias is normally only a volt or two, obtained from the voltage drop across the 220-ohm cathode resistor.) This causes grid current to flow through the 1-megohm grid resistor, developing a negative grid voltage practically equal to the peak value of the rf – far more than enough to reduce the tube's plate current to practically zero. Thus there cannot be enough rf output from the cathode circuit to cause any damage to the receiver. But immediately on opening the key the grid-leak bias disappears and the receiving system is back in operation.

Coax cable should be used between the T-R switch and the receiver, with the braid connected to the receiver chassis. This helps prevent stray pick-up of rf from the transmitter. If your receiver has doublet antenna terminals, ground one of them to the chassis and connect the inner conductor of the line to the other.

Figs. 11-19 and 11-21 show how the T-R switch can be constructed. The principal point to observe is that the antenna and transmitter connectors should be close together, with the tube mounted alongside them so the shortest possible grid lead can be used. This helps prevent stray coupling between the transmitter and receiver.

It is convenient to incorporate the power-supply circuit shown in Fig. 11-20, but if your transmitter has an accessory socket from which the power for the 6AH6 can be taken the built-in power supply isn't actually necessary. The tube's heater requires 0.45 ampere at 6.3 volts, and the plate supply should be about 100 volts. The current is about 10 mA. Plate voltage should be introduced at point X in the circuit if a separate supply is used.

Fig. 11-22 shows how the T-R switch is connected to the rest of the equipment, in one case using a coax-fed antenna and in the other using a transmatch. Either way, the coax line into which the switch is inserted should operate at a

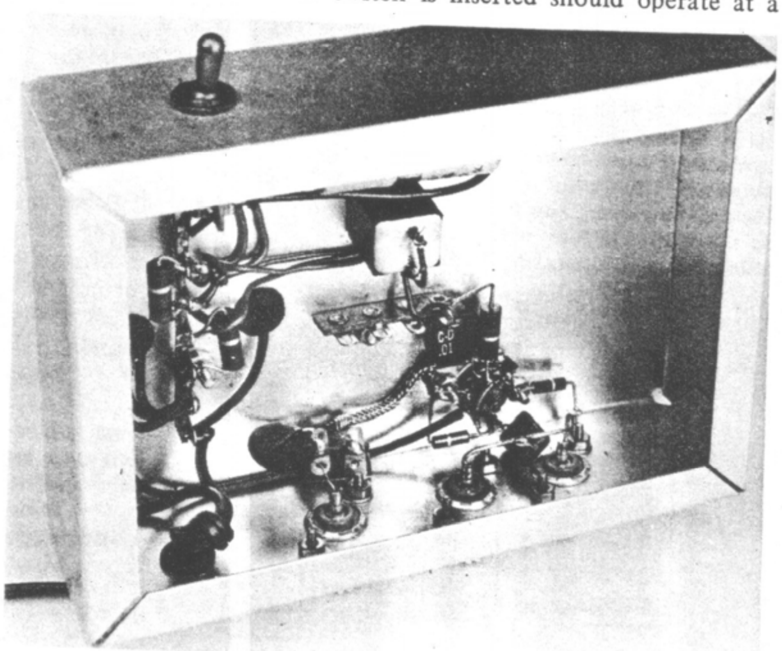

FIG. 11-21 — Underneath the chassis of the electronic T-R switch. The tube and coax connectors are mounted close together to keep the exposed rf leads as short as possible. The rectangular component near the upper edge of the chassis is the power-supply rectifier, CR1. The edge of the dual filter capacitor is just visible above it.

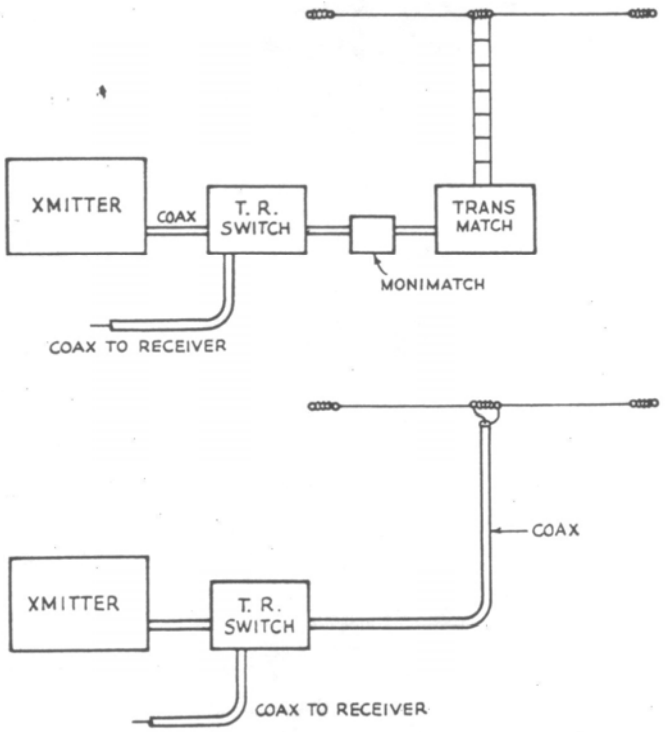

FIG. 11-22 — The T-R switch should be mounted closest to the transmitter when other equipment, such as a Monimatch, transmatch, or low-pass filter (not shown) is used.

standing-wave ratio of less than 2 to 1, for output power of the order of 100 watts. With a higher SWR the voltage on the line may be too high for the safety of the switch tube.

Finally, the grid circuit of the tube is a rectifier when the transmitter is on, and like all rectifiers it will generate harmonics of the output frequency. It can be the cause of TVI on that account. If so, a low-pass filter should be used on the antenna side of the T-R switch.

A Handy Crystal Switch Assembly

Many Novice transmitters have only one crystal socket, or at most offer switching for no more than two or three crystals. Plugging and unplugging crystals and storing them so the right one can be found quickly is a chore. Fig. 11-23 shows an easily-made gadget for selecting the desired crystal from an assortment merely by turning a switch. As made up, it has provision for four crystals of the FT-243 holder type, plus a socket for the larger crystal holders. Obviously this arrangement can be varied to suit your own needs. As many as 12 crystals of the usual type can be accommodated by using six octal sockets and a 12-point switch, the largest number of points available on a standard rotary switch.

By using the socket pin connections shown, two FT-243 holders can be fitted into each octal socket. The 5-prong socket will take one holder having 3/4-inch pin spacing. To add more sockets, simply continue the same plan of wiring. A 300-ohm line plug is used to connect the assembly to the crystal socket on the transmitter. The leads – 300-ohm line can be used – should be kept as short as possible.

Before making the chassis ground connection shown in the diagram, check your transmitter's oscillator circuit. In some transmitters neither side of the crystal is grounded; in such case, omit the chassis connection. If one crystal socket pin *is* grounded in the transmitter, make sure that the chassis connection in this unit is led to the grounded side of the crystal socket.

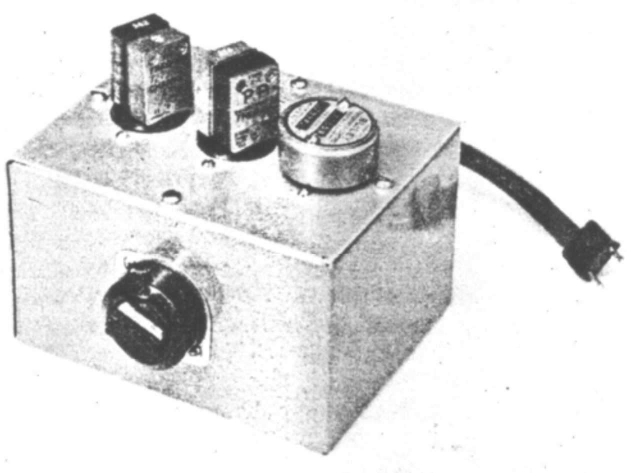

FIG. 11-23 — Crystal-switching assembly. It can be used with any transmitter having a crystal-controlled oscillator, simply by inserting the 300-ohm line plug in the transmitter's crystal socket. However, the lead to the plug should not be more than a few inches long, in order to ensure reliable crystal operation.

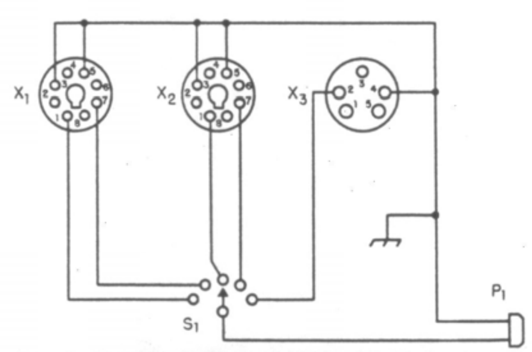

FIG. 11-24 — Circuit diagram of the crystal-switching assembly. Other sockets can be added in parallel if a switch with more contacts is used.

P1 — Plug for crystal socket (Millen 37412, Mosley type 301).

S1 — Single-pole rotary, as many positions as needed.

X1,X2 — Octal socket.

X3 — 5-pin socket.

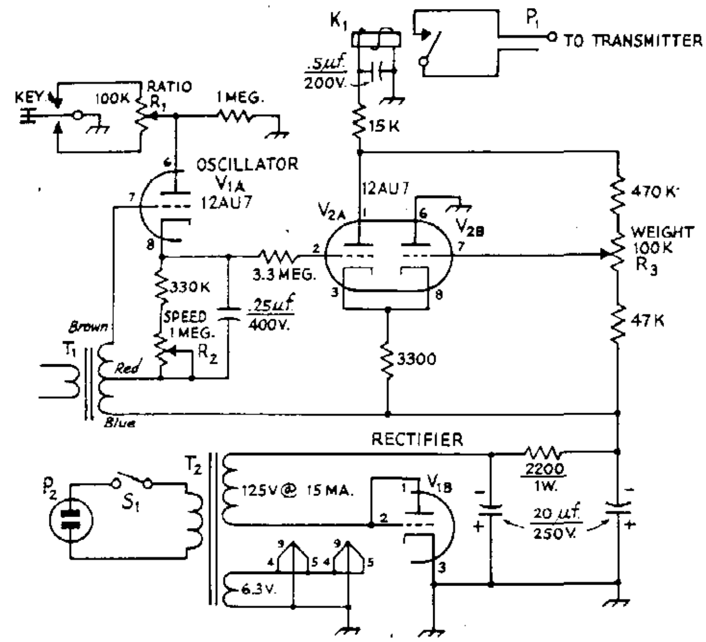

Fig. 8-13—Circuit diagram of the electronic speed key. Unless otherwise specified, resistors are ½ watt. Polarity-marked capacitors are electrolytic, others are tubular paper.

K_1—5000-ohm 3-ma. relay (Sigma 41F-5000S-SIL).

P_1—Phone plug.

P_2—A.c. line plug.

R_1, R_3—100,000-ohm potentiometer, linear taper.

R_2—1-megohm potentiometer, linear taper.

S_1—S.p.s.t. toggle.

T_1—5-watt 25,000-to-4-ohm output transformer, secondary not used (Stancor A-3857).

T_2—125-v. 15-ma. and 6.3-v. 0.6-amp. transformer (Stancor PS-8415 or similar).

the relay is set by the position of the arm of R_3.

Except for the tubes, the keyer circuit is housed in a grey Hammertone 6 × 5 × 4-inch Minibox (Bud CU-2107), as shown in Fig. 8-14. The tube sockets are mounted so that the two tubes project outside at the rear of the unit. The power transformer is mounted on the rear wall, and the toggle switch and the three controls are mounted on the "front" panel. The power line to P_2, the two-wire cable to P_1, and the three-wire cable to the key leave the cabinet at the rear through individual rubber grommets. Use multiple tie points generously for the support of the fixed resistors and capacitors.

To make the key, first remove the keys from their bases and strip the bases of their remaining hardware. The four support legs for the key are formed from the original tie strips and shorting switch arms. At the front they bolt to the key frame at the countersunk holes; at the rear they make up to the binding posts. The three-wire cable connects to two binding posts and a supporting leg. A heavy base of ½-inch thich steel adds weight to the structure, and rubber or cork feet glued to the steel prevent its scratching the table.

Adjustment of Electronic Speed Key

In operation, the three controls will serve as their labels indicate. There is a unique (but not highly critical) combination of settings of the weight and ratio controls that will give automatic dots and dashes at the same speed; this setting can only be determined by ear and will be dependent on how well the operator can recognize good code. If the operator taps his foot to count groups of four dots or two dashes, the dots and dashes will have the same speed when the beat is the same. It is easy to determine whether dots or dashes are too heavy or too light. Connect an ohmmeter to P_1; holding the dot lever closed should make the ohmmeter needle hover around half scale, and holding the dash lever closed should make the ohmmeter hover around 75 per cent of the short-circuit reading. Lacking an ohmmeter, the transmitter plate milliammeter can be used; dots and dashes should give 50 per cent and 75 per cent of the key-down value when the keyer controls have been properly adjusted.

QST articles describing other types of electronic speed keys include:

Bartlett, "Compact Automatic Key Design," Dec., 1951.
Old "Transistorized Electronic Key and Monitor," May, 1959.
Kanda, "The 'Ultimatic'——Transistorized," Sept., Oct., 1960.

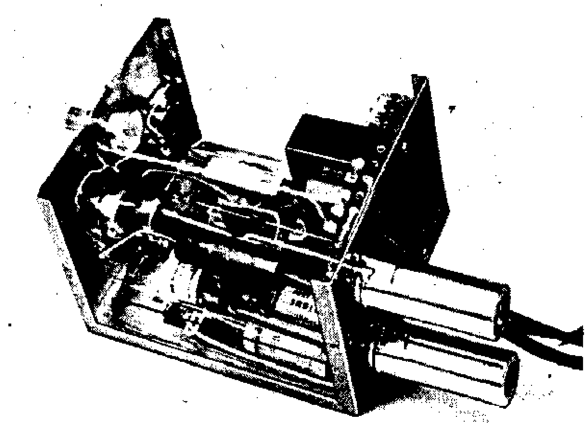

Fig. 8-14—Components for the electronic speed key are mounted on the three walls of a Minibox section, with the tubes projecting out the back. Keep wires away from screw holes, to prevent short circuits when the box is assembled.

ELECTRONIC TRANSMIT-RECEIVE SWITCHES

No antenna relay is fast enough to switch an antenna from transmitter to receiver and back at normal keying speeds. As a consequence, when it is desired to use the same antenna for transmitting and receiving (a "must" when directional antennas are used) and to operate c.w. break-in or voice-controlled sideband, and electronic switch is used in the antenna. The word "switch" is a misnomer in this case; the transmitter is connected to the antenna at all times and the t.r. "switch" is a device for preventing burn-out of the receiver by the transmitter.

One of the simplest approaches is the circuit shown in Fig. 8-15. The 6C4 cathode follower couples the incoming signal on the line to the receiver input with only a slight reduction in gain. When the transmitter is "on," the grid of the 6C4 is driven positive and the rectified current biases the 6C4 so that it can pass very little power on to the receiver. The factors that limit the r.f voltage the circuit can handle are the voltage break-down rating of the 47-$\mu\mu$f. capacitor and the voltage that may be safely applied between the grid and cathode of the tube.

To avoid stray pick-up on the lead between the cathode and the antenna terminal of the receiver, this lead should be kept as short as possible. The entire unit should be shielded and mounted on the receiver near the antenna terminals. In wiring the tube socket, input and output circuit components and wiring should be separated to reduce feed-through by stray coupling.

The switch should be connected to the transmitter by as short a length of coaxial cable as possible, particularly if the higher-frequency bands (21 and 28 Mc.) are commonly used. If this rule is not observed, there may be conditions where a loss of received signal will be noticed, caused by resonant conditions in the cable and the transmitter output circuit.

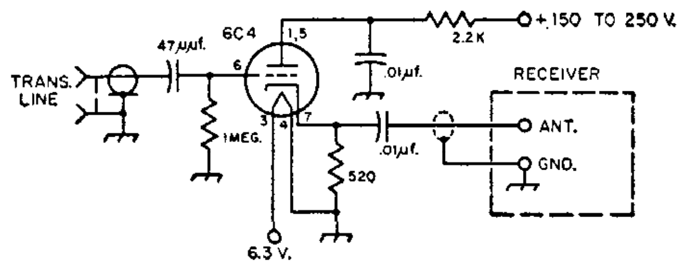

Fig. 8-15—Schematic diagram of cathode-follower t.r. switch. Resistors are ½-watt. The unit should be assembled in a small chassis or shield can and mounted on or very close to the receiver antenna terminals. The transmitter transmission line can be connected at the coaxial jack with an M-358 Tee adapter.

The heater and plate power can be "borrowed" from the receiver in most cases.

SELF-CONTAINED ALL-BAND ELECTRONIC T.R. SWITCH

The t.r. switch shown in Fig. 8-16 differs in several ways from the preceding example. It contains its own power supply and consequently can be used with any transmitter/receiver combination without "borrowing" power. It will add gain and front-end selectivity to the receiver. A commercial switch-coil-capacitor combination is shown in the unit, although the constructor could build his own if desired.

Referring to the circuit diagram in Fig. 8-17, one triode of a 12AU7 is used as an amplifier stage, followed by the other triode as a cathode-follower stage to couple between the tuned circuit and the receiver. As in the simpler switch, the triodes are biased during transmission periods by rectified grid current, and insufficient power is passed along to the receiver to injure its input circuit.

The t.r. switch is intended to mount behind the transmitter near its output terminal, so that the connecting cable is short. The lead from the t.r. switch to the receiver can be any reasonable length. Components are mounted on the sides and walls of the chassis, although a small bracket will be needed to support the tube socket and another is required to hold the far end of the coil L_1. The single coil bracket, aided by panel bushings for

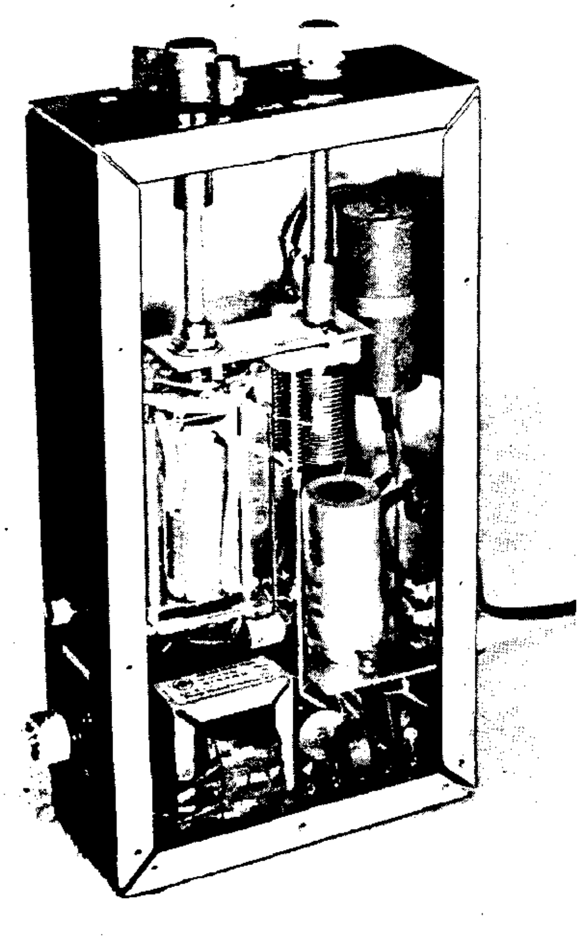

Fig. 8-16—The electronic t.r. switch is built in a 5 × 9 × 2½-inch chassis; the bottom plate has been removed to show the placement of parts. Although two receiver outlets are shown on the near face (a phono jack and a coaxial receptacle), only one is required, depending upon one's choice of cable termination.

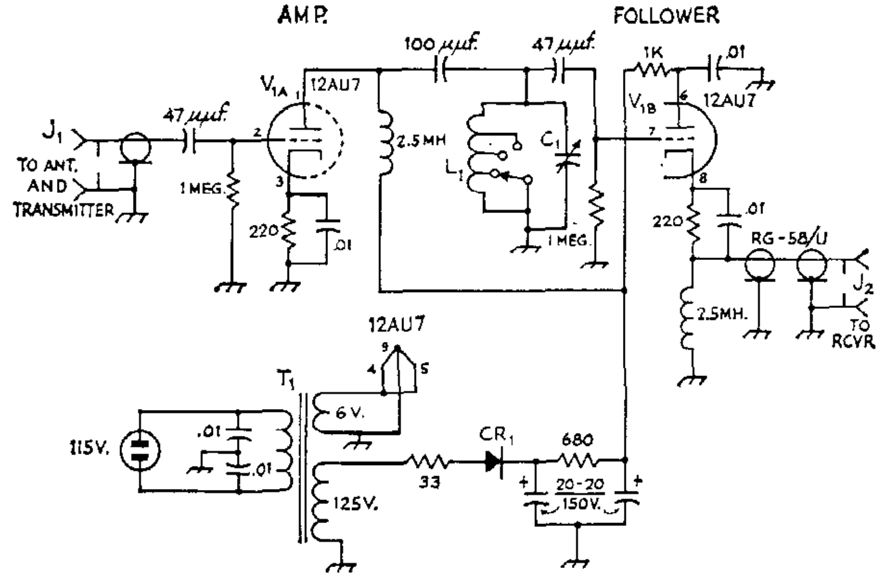

Fig. 8-17—Circuit diagram of the electronic t.r. switch. Unless otherwise specified, resistances are in ohms, resistors are ½ watt, capacitances are in μf.

C_1—140-μμf. variable (part of Harrington GP-20 tuner).

CR_1—200-ma. 360-p.i.v. silicon rectifier (Sarkes Tarzian K-200).

J_1—Coaxial receptacle and tee fitting (SO-239 and M-358).

J_3—Coaxial receptacle or phono jack.

L_1—52 turns No. 24 on ¾-inch diam. form, 28 t.p.i. Tapped at 5½, 8½, 13 and 24 turns from grounded end. (Part of Harrington GP-20 tuner).

T_1—125-v. 15-ma., 6-v. 0.6-amp. transformer (Stancor PS-8415) (GP-20 tuner available from Harrington Electronics, Box 189, Topsfield, Mass.).

the switch and capacitor C_1 shafts, is sufficient support for the coil-and-capacitor assembly. In wiring the switch, a length of RG-58/U should be used between the cathode-follower load (resistor and r.f. choke) and the output jack J_2, to minimize "feedthrough" around the tube. A pair of 0.01 μf. capacitors across the a.c. line where it enters the chassis helps to hold down the r.f. that might otherwise ride in on the a.c. line.

In operation, it is only necessary to switch the unit to the band in use and peak capacitor C_1 for maximum signal or background noise. A significant increase in signal or background noise should be observed on any band within the range of the coil/capacitor combination.

A simple t.r. switch that has been used successfully for fast break-in operation with a 100-watt transmitter was described by W8EUJ in *QST* (September, 1958). The circuit, shown in Fig. 8-18, uses a dual triode. A grounded-grid input stage (switched by grid rectification) *R-C* coupled to a cathode-follower output stage, provides a broad-band low-impedance t.r. switch suitable for use with coaxial cable. The unit has some gain but, if needed, more gain can be had by increasing the plate load resistance of the first stage to 6800 ohms or more.

The switch can be built as a separate unit with its own booster-type transformer, selenium rectifier and other components built on a 3½ × 5-inch aluminum sheet chassis and housed in a 4 × 4 × 5-inch sheet metal can. A phono jack in the transmitter end of the low-pass filter will provide a convenient point for connection to the r.f. line.

TVI and T.R. Switches

The preceding t.r. switches generate harmonics when their grid circuits are driven positive, and these harmonics can cause TVI if steps are not taken to prevent it. Either switch should be well-shielded and used in the antenna transmission line between transmitter and low-pass filter.

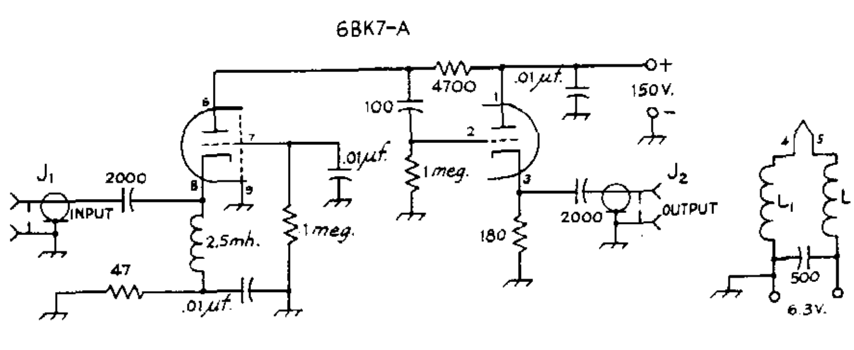

Fig. 8-18—Circuit diagram of W8EUJ's t.r. switch. Unless otherwise indicated, capacitances are in μμf. Resistances are in ohms, resistors are ½ watt. L_1 and L_2 are each wound with 30 turns No. 24 wire to a diameter of 3/16 inch.