COUPLER OR MATCHING-CIRCUIT CONSTRUCTION

The design of matching or "antenna coupler" circuits has been covered in the preceding section, and the adjustment procedure also has been outlined. When circuits of this type are used for transferring power from the transmitter to a parallel-conductor transmission line, a principal point requiring attention is that of maintaining good balance to ground. If the coupler circuit is appreciably unbalanced the currents in the two wires of the transmission line will also be unbalanced, resulting in radiation from the line.

In most cases the matching circuit will be built on a metal chassis, following common practice in the construction of transmitting units. The chassis, because of its relatively large area, will tend to establish a "ground"— even though not actually grounded — particularly if it is assembled with other units of the transmitter in a rack or cabinet. The components used in the coupler, therefore, should be placed so that they are electrically symmetrical with respect to the chassis and to each other if a parallel-conductor transmission line is to be used.

In general, the construction of a coupler circuit for parallel lines should physically resemble the tank layouts used with push-pull amplifiers. In parallel-tuned circuits a split-stator capacitor should be used. The capacitor frame should be insulated from the chassis because, depending on line length and other factors, harmonic reduction and line balance may be improved in some cases by grounding and in others by not grounding. It is therefore advisable to adopt construction that permits either. Provision also should be made for grounding the center of the coil, for the same reason. The coil in a parallel-tuned circuit should be mounted so that its hot ends are symmetrically placed with respect to the chassis and other components. This equalizes stray capacitances and helps maintain good balance.

When the coupler is of the type that can be shifted to series or parallel tuning as required, two separate single-ended capacitors will be satisfactory. As described earlier, they should be connected so that both frames go to corresponding parts of the circuit — i.e., either to the coil or to the line — for series tuning, and when used in parallel for parallel tuning should be connected frame-to-stator.

A coupler designed and adjusted so that the connecting link acts as a matched transmission line may be placed in any convenient location. Some amateurs prefer to install the coupler at the point where the main transmission line enters the station. This helps maintain a tidy station layout when an air-insulated parallel-conductor transmission line is used. With solid-dielectric lines, which lend themselves well to neat installation indoors, it is probably more desirable to install the coupler where it can be reached easily for adjustment and band-changing.

MATCHING TO "RANDOM" ANTENNAS

In many cases it is impractical or impossible to install a conventional antenna complete with transmission line. Under these conditions, the only solution may be to string a wire to an existing support or between two supports and run one end to the transmitter. Such a "random" antenna will not couple conveniently to the low-impedance output of most transmitters unless its length happens to be an odd multiple of a quarter wavelength. In cases where a random antenna must be used, the antenna-coupler circuit of Fig. 13-14 provides a simple solution. Although specific values are given for C_1, C_2 and L_1, they are not critical. C_1 and C_2 should be at least 150 pf. The spacing of C_1 and C_2 should be 0.025 inch for transmitter inputs of 100 watts or less. L_1 may be a convenient length of any of the two- to three-inch diameter air inductors, or it can be a homemade coil on a ceramic form. It should be tapped every two or three turns. The tuner may be built in an open "breadboard" style, or it

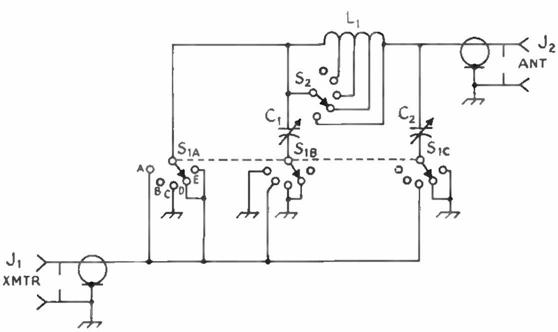

Fig. 13-14—Circuit diagram of an antenna coupler for "random" antennas. All contacts of S_2 are not shown.

C_1, C_2—150 pf. See text for spacing.
J_1, J_2—Coaxial receptacles (SO-239).
L_1—20 turns No. 12 bare, 2½ inch diam., 6 t.p.i. (B&W 3905-1). Tapped every other turn.
S_1—Three-pole 5-position ceramic rotary switch.
S_2—Single-pole 11-position ceramic rotary switch.

can be enclosed in a metal cabinet or chassis. If it is built breadboard, it may be more convenient to use a small clip instead of S_2 to vary the inductance of L_1. An elaborate version can be made with a built-in Monimatch and output indicator.

The several configurations that can be obtained from the coupler are shown in Fig. 13-15. The letters correspond to those on the switch S_1.

When first using this tuner with an antenna, try various positions of C_1, C_2, S_1 and S_2 in order to find the point at which maximum output

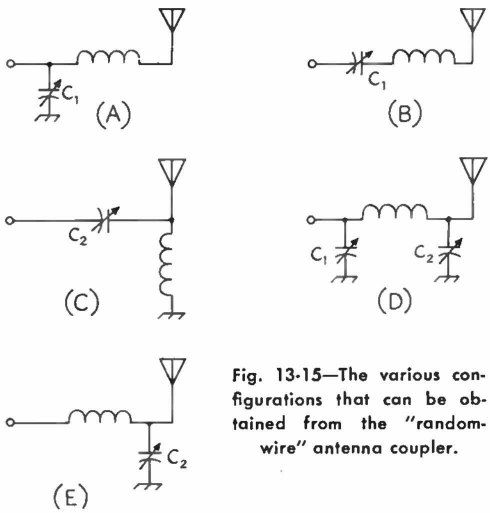

Fig. 13-15—The various configurations that can be obtained from the "random-wire" antenna coupler.

is obtained (maintaining a constant transmitter input). When the correct settings have been found for each frequency band, and these settings have been noted for future reference, it is an easy matter to hop from band to band. With certain settings and configurations it will be possible to dissipate a large part of the transmitter output in the tuner itself, and for this reason an output indicator is highly desirable, at least for the initial tune-up. Either an r.f. ammeter in the output lead or an r.f. voltmeter from it to chassis will be satisfactory. Under some conditions a neon bulb will serve as an r.f. voltmeter.

If TVI is a problem, the low-pass filter should be installed in the line between coupler and transmitter.

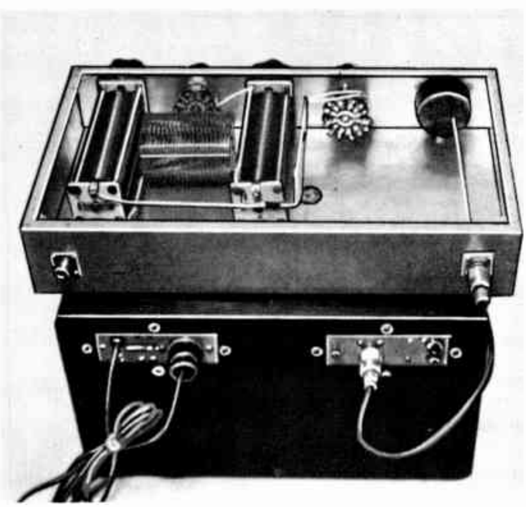

Fig. 13-16—An example of how the antenna coupler can be built. In this case the components are installed in a 10 × 17 × 3-inch aluminum chassis that serves as the support for the transmitter. An r.f. ammeter (right) is used as an output indicator. (W4UWA/DL4, *QST*, November, 1958).

A WIDE-RANGE COUPLER FOR BALANCED TRANSMISSION LINES

Matching networks or "Transmatches" for unbalanced (coaxial) lines are normally satisfied by the circuits shown in Fig. 13-13. The limitations of coaxial line with high standing-wave ratios automatically put a limit on the power ratings of the components in the network.

It is different with open-wire (balanced) line. They can operate with much higher standing-wave ratios than coaxial lines can, for the same loss or without failure. As a result, couplers designed for use with open-wire lines may be called upon to withstand higher voltages and currents at any given power level than would a coupler used with coaxial line. For this reason, couplers designed to be used with open-wire lines often seem to require components out of proportion to the power being handled. However, the antenna system with the open-wire line and the "large" coupler may be an efficient system on three or four amateur bands, while the "convenient" system may be a compromise with efficiency on two or three bands.

A wire antenna, fed at the center with open-wire line, is the most efficient multiband antenna devised to date. A transmission-line coupler of the type to be described is required, because the transmission line is "tuned" (it always has a high s.w.r.). The coupler permits the antenna system to present a proper load to the transmitter, with maximum overall efficiency. Regardless of the s.w.r. on the open-wire line, the coupler transforms the load to a non-reactive 50 ohms. A built-in "Monimatch" s.w.r. indicator shows when the correct tuning has been obtained.

Since low-impedance loads require series tuning, and high-impedance loads require parallel tuning, provision is included for both types of circuits. Tapped coils tend to be lossy at the higher frequencies and suitable switches are expensive, so the coupler uses plug-in coils for efficiency and clip leads for simplicity.

The choice of series or parallel tuning is obtained by using a split-stator capacitor (C_3 in Fig. 13-18) and an inductor, L_2, that may or may not be split in the center. When the inductor is not opened, the transmission line is connected across the entire coil, to provide parallel tuning. Series tuning is obtained by opening the coil and connecting the transmission line to the break. The several combinations are shown in Fig. 13-18.

A good idea of the construction can be obtained from Figs. 13-17 and 13-19. All construction is straightforward and conventional, with the possible exception of the Monimatch. The jack bar for the inductors (Millen 41305) is mounted above a hole through which the coaxial line (inner conductor) from P_1 passes, as well as the return back to the stator of C_1 and, on the 80-meter unit, the jumper to the stator of C_2. C_1 is supported by a small aluminum bracket, to bring its shaft to the same height as that of C_3. A Millen 39106 shaft coupling is