A LOW LOSS CUBICAL QUAD

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An effective technique to increase both transmitted and received signal strengths of the cubical quad antenna system.

NUMEROUS publications attest to the fact that the cubical quad Antenna is a highly efficient device and a definite competitor of the yagi. Excluding the addition of elements, little can be done to improve the performance of the basic two element quad. Other factors contributing to the quad's overall performance are antenna height, proper matching, and low loss transmission line, the latter being the weak link when coaxial cable is used, as is generally the case. Depending on the type of cable used, its length and age, a loss of several db may be experienced. One practical consideration to substantially reduce this loss is to use open wire transmission line, which coincidentally lends itself nicely to cubical quad design.

By referring to fig. 1A, it will be noted that the conventional folded dipole antenna exhibits a 300 ohm impedance. When expanded into a single wave length loop, the impedance is reduced to 150 ohms. Adding a reflector behind this loop forms the conventional cubical quad array with an impedance of approximately 75 ohms.

In fig. 1B, it will be noted that a double folded dipole exhibits an impedance of 1200 ohms. Expanding this double folded dipole into a loop with a total wire length of two wave lengths will reduce the impedance to 600 ohms. Adding a reflector behind this double loop reduces the driven element impedance to an approximate 300 ohms which may then be directly fed with low loss 300 ohm transmission line.

Construction

The double loop driven element is relatively simple to construct. The only difference between it and a conventional single wire loop is that 300 ohm open wire transmission line [1] is used in place of the single wire.

At the feed point, care should be taken to connect the open wire line to form the double loop as shown in fig. 1B. The two remaining open wires are fed directly by 300 ohm open wire transmission line. Insulation will be required on the open wire line where it circumvents the rotator to prevent the line from shorting.

Using open wire line for the double loop, as well as the transmission line, prevents the double loop wires from becoming entangled or shorting. The use of TV ribbon type wire should be avoided unless the antenna is used in an extremely dry area. The characteristics of ribbon line change drastically in damp weather.

[1] Allied Radio, 1968 Catalog #270, page 383 #11B1473.

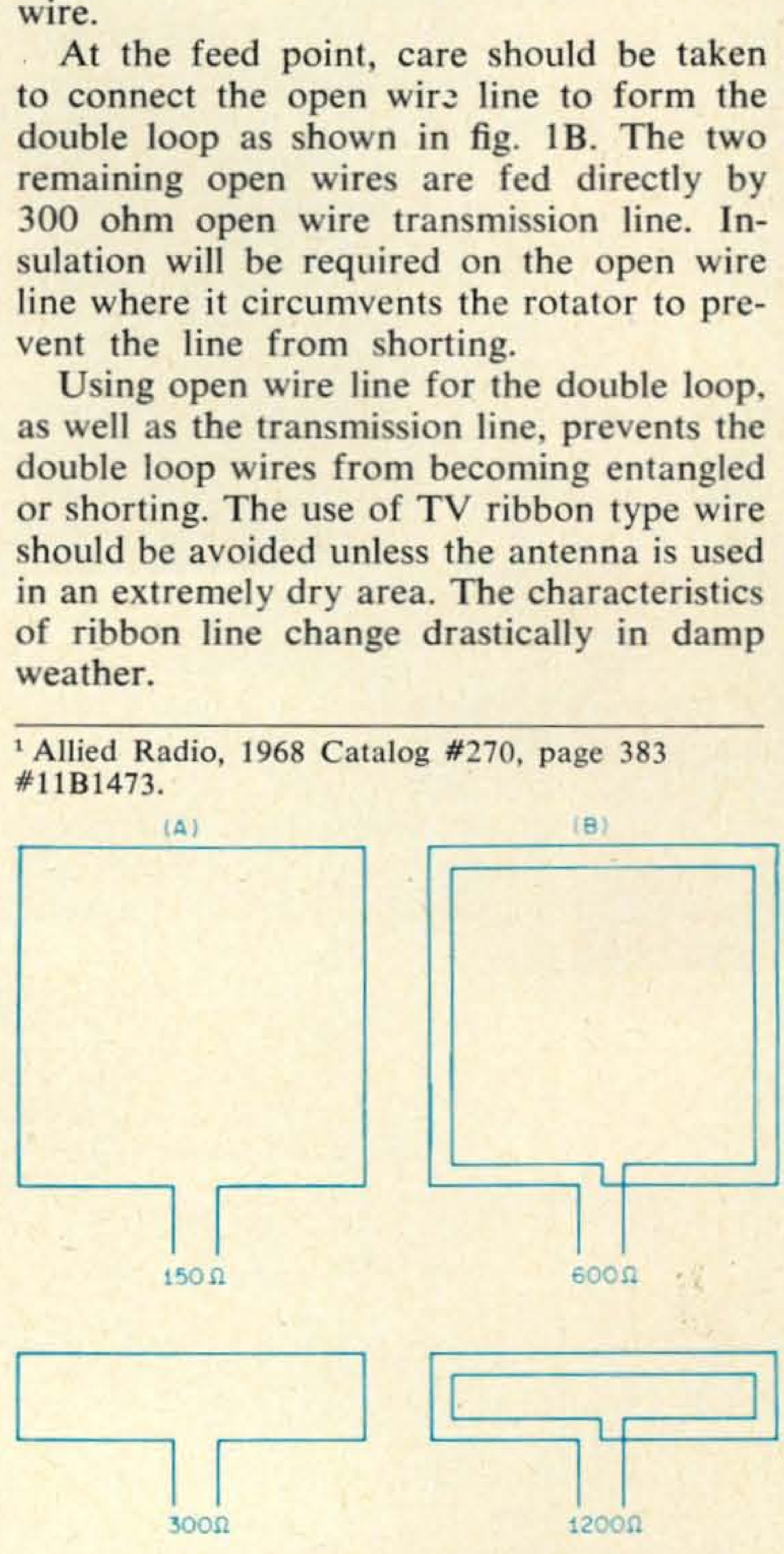

Fig. 1 (A)—The impedance of the half wavelength folded dipole and the expanded full wavelength antenna. (B) The double half and full wavelength dipoles have double the impedance values.

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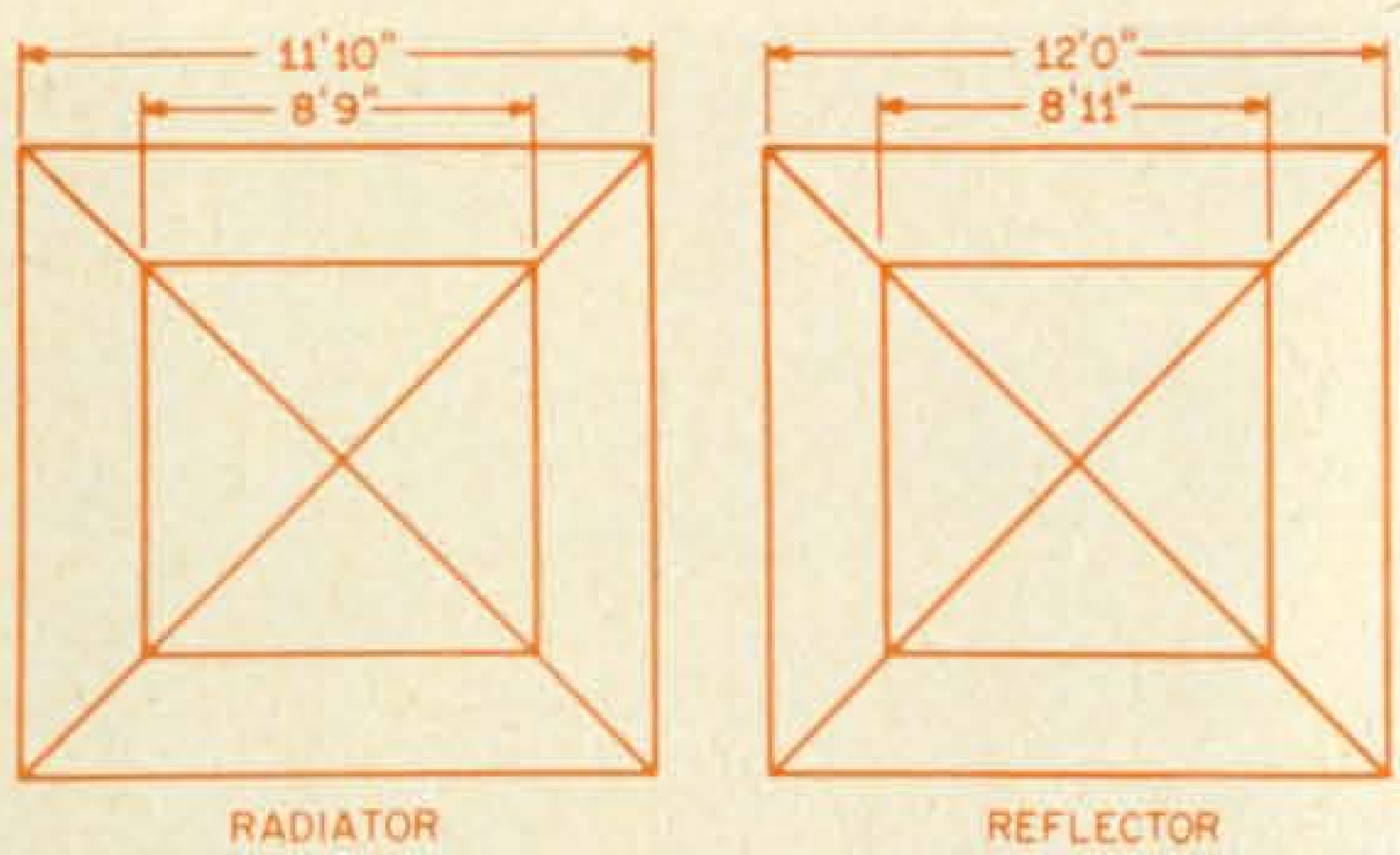

Fig. 2—Dimensions of the driven element and reflector of the author's 10 to 15 meter quad. The boom length is 5'6".

Standard quad dimensions may be used throughout. For imformation purposes, fig. 2 reflects the dimensions used in construction of the author's 10 and 15 meter antenna. It will be noted that the reflector is slightly larger than normal. It should also be noted that no tuning stub is used. Extensive tests were conducted, maximizing on gain while at the same time expanding the reflector dimensions, until the tuning stub was eliminated. Comparisons between a reflector using stub tuning and the expanded reflector without a stub, demonstrated a slight additional gain.

Antenna Coupler

Matching the 300 ohm balanced line to the transmitter will require an antenna coupler, unless the transmitter has provisions for link coupling. Building an antenna coupler is a relatively simple task. The only special tool required is a grid dip meter for checking resonance. The authors coupler,

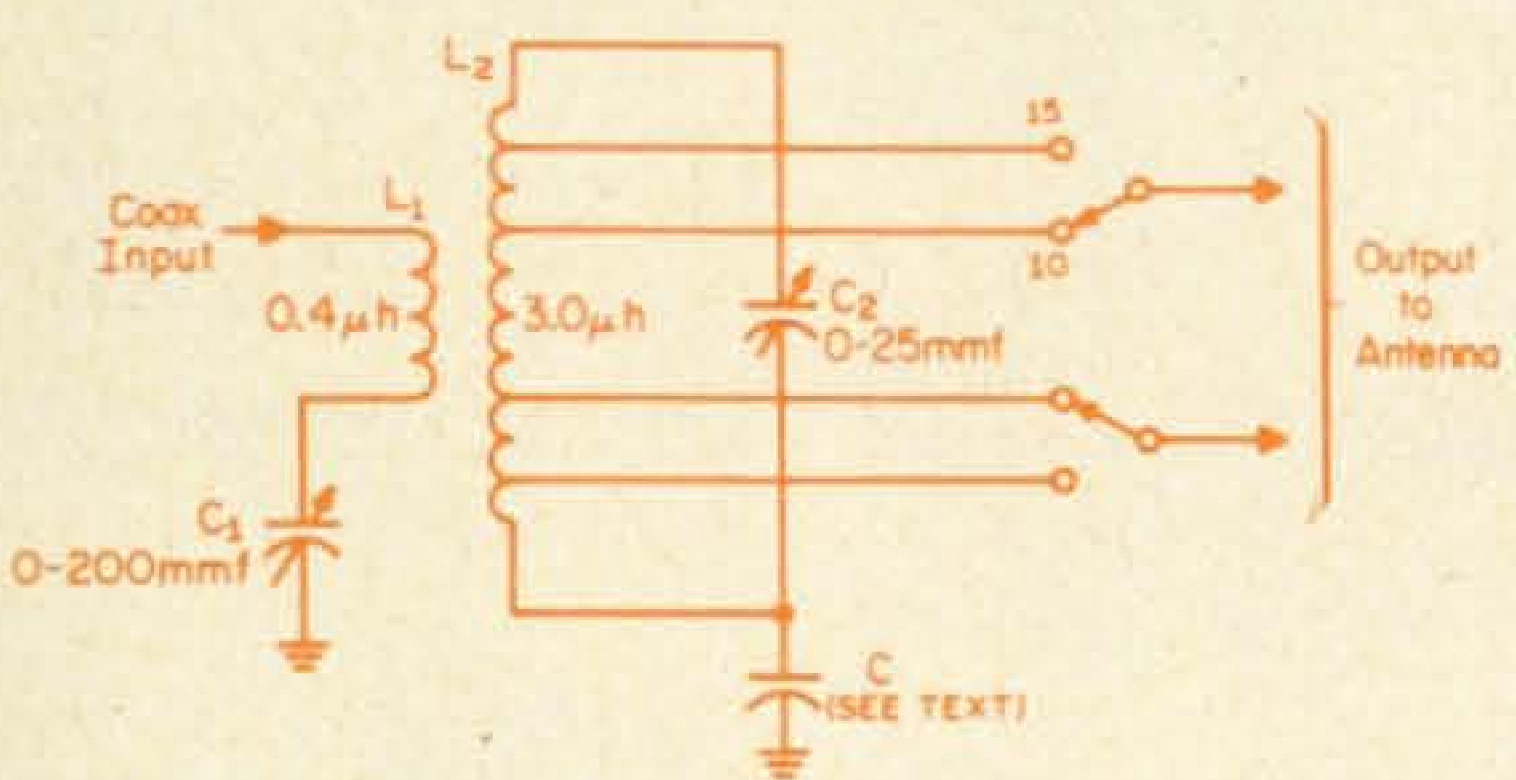

Fig. 3—Circuit of a tuner used to match an unbalanced 52 ohm output to balanced 300 ohm open wire feedline. Inductor L_2, 3 microhenries, may be made from a 10 turn length of Air Dux 1604 and L_1 is two turns of the same stock. This coil can be fabricated from a 14 turn length of the coil stock with L_1 cut from the center as shown above. The tap locations are determined experimentally as noted in the text.

designed for 10 and 15 meters, is shown schematically in fig. 3. The critical components, from the stand-point of value, are capacitors C_1 and C_2. The inductors L_1 and L_2 need only be that value of inductance required to resonate at the desired frequency, the 10 and 15 meter bands in this case. For ease in matching, L_2 should be as large as practicable and will be if it resonates within the given value of C_2.

In the conventional antenna couplers, a split capacitor is generally used to maintain the same ratio of capacitance to ground for both stator and rotor. Unless this capacitive balance is maintained, a balanced output will not be achieved. In the coupler described, a split capacitor is not used; however, the unbalance of capacitance is corrected by capacitor C.

Capacitor C is standard RG-58 coaxial cable which exhibits 28.5 mmf per foot. The shield is connected to ground, and the center conductor to the rotor of C_2. The coax is then trimmed until a balanced output condition is observed. Surprisingly, accurate results of a balanced condition may be achieved by holding a NE-51 neon bulb to each output line and noting the relative brilliance.

Reference should be made to the handbooks for additional information on the construction of antenna couplers.

Operation

The transmitter should be coupled, as shown in fig. 4, to the antenna, Capacitor C_2 of fig. 3 should be adjusted alternately with C_1 for the lowest SWR reading. At the same time, the taps of L_2, should be adjusted on the coil until an SWR of 1:1 is measured at the desired operating frequency.

Signal reports with this antenna have been in excess of those anticipated. The previous system, using coaxial cable (RG-58/U) and Gamma Match, obviously had greater losses than supposed. On 10 and 15 meters with 100 watts input, and the antenna at 30 feet, signal reports of S9 plus are the general rule. ■

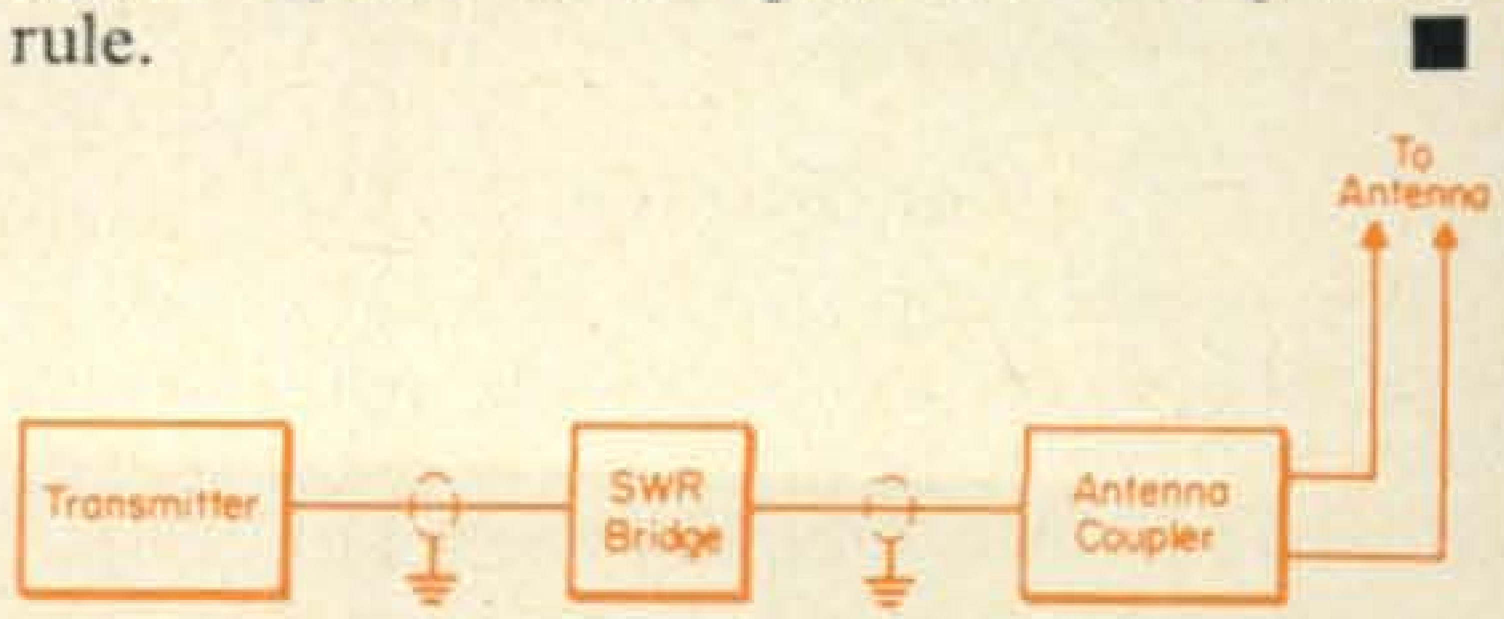

Fig. 4—Tuning set up described in the text.