Transmission-Line Loading for Short Antennas

By Henry S. Keen, W2CTK*

PROBABLY one of the biggest ham problems is that of putting up the best antenna system that the location will permit. Nearly any amateur will admit that a good antenna system is half the battle, yet the time and effort spent on the sky wire is far from being in proportion to the importance of that unit.

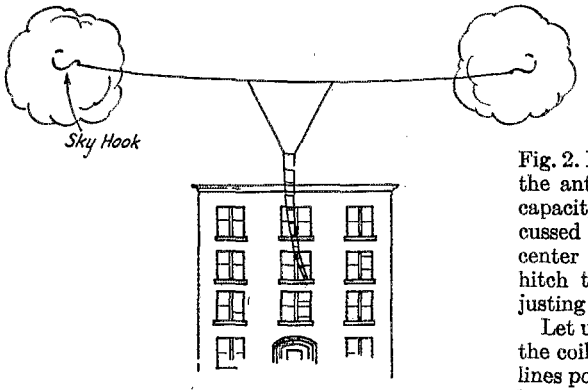

FIG. 1

"... 160-METER FLAT TOP ON A SMALL APARTMENT BUILDING? IT'S QUITE A JOB!"

Most of us—particularly those living in the cities—are cramped for the necessary space in which to hang the antenna, and as a result take a questionable refuge on the higher frequencies. Probably lack of room has kept many a ham from enjoying the relatively open spaces on the lower frequencies, particularly 1.7 mc. There is also the problem of b.c.l. QRM in crowded localities. If we only could remove the radiating portion of the antenna from surrounding objects, this problem would be considerably simplified. But how to get a half wave flat-top for 160-meter 'phone or c.w. on the top of a small apartment house? It's quite a job! (Fig. 1).

The usual device for lowering the fundamental frequency of an antenna is well known. It is our old friend the loading coil, and was very widely used in the old days. It behaves best when inserted at a voltage node. Our 160-meter flat-top can be brought into step by putting the proper value of loading coil in the center, as in Fig. 2. Loading coils can also be put at the ends of the antenna, but here they operate partly as a capacity load at the ends, and will not be discussed now. That leaves the loading coil in the center as the alternative. However, there is a hitch to this proposition, that of making, adjusting and weatherproofing the coil.

Let us consider an equivalent circuit to replace the coil. A pair of closed or shorted transmission lines possesses inductive reactance, providing the length is less than one-quarter wave. Conversely, a pair of open transmission lines less than a

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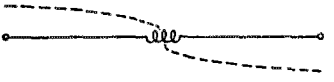

FIG. 2

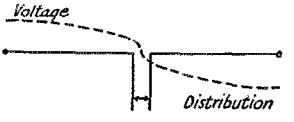

FIG. 4

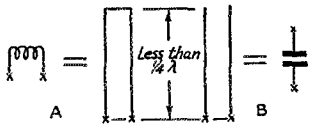

FIG. 3

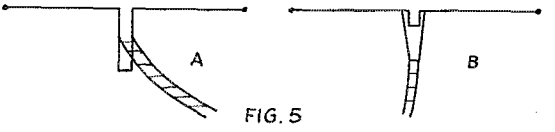

FIG. 5

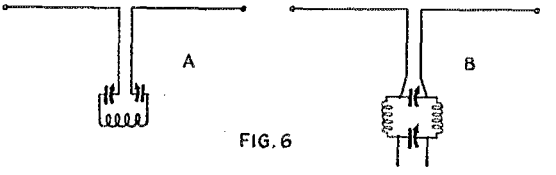

FIG. 6

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tion of so many i.f. stages in close proximity may lead to oscillation troubles, however. Should the additional noise stage be tried and found to oscillate, one of the noise amplifier tuned circuits can be loaded down with resistance (50,000 to 100,000 ohms) to stabilize its operation; while this may result in lowered gain in the noise circuit, there still should be ample voltage available for noise suppression. Unless the cutting-off action as described above is obtained, whatever the arrangement used, full realization of the noise-reducing possibilities of the device cannot be secured.

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quarter wave in length possesses capacitive reactance. This is indicated in Fig. 3. A shorted line one-fourth wave long is equivalent to a parallel resonant circuit. Incidentally the L_2/C ratio of such a "tank" may be changed at will by moving the two voltage points from one end to the other of the quarter-wave line. The open end of the line (capacity) may be considered as paralleled to the shorted end of the line (inductance). Therefore we can replace the loading coil of Fig. 2 by a closed transmission line. For adjustment of the system a sliding bridge is suggested as shown in Fig. 4. Feeders can be attached to the loading line at an appropriate point (5-A) to permit feeding the set-up from a matched-impedance line. If the loading line is only a few feet long, the feeders will have to be attached to appropriate points on the flat top on either side of the center of the loading line, Fig. 5-B.

If the loading line is long enough to be brought into the window of the operating room, two systems of feeding are feasible. The customary pick-up coil can be used with series condensers for fundamental and shunt tuning for harmonic operation, as shown in Fig. 6-A, or a Collins type impedance-matching network may be used to cover all bands, with appropriate coil and condenser changes, as at Fig. 6-B.

Of course the popular Zepp feed system may be used if the operating room is properly located, and the operator prefers it.

If the matched impedance feeders are desired, the loading line should preferably be cut to the exact length for resonance. For operation at the even harmonics the short, or bridge, across the loading line should be removed. The point at which the feeders are attached will be different for each band, but will not be difficult to locate.

Strays

When making plug-in coils on tube bases, if the base is too short for the required winding a piece of an old three-cell flashlight case of the fibre type will just slip over the base, thus extending the available winding length.

—*Ray Howdeshell, Minong, Wis.*