Multiband Antenna for High Frequencies (Continued)

voidably radiated from the feeders, which radiation may or may not be useful for transmission. The multiband system just described should receive preference over the Zeppelin arrangement even if the transmitter is close to one end of the antenna, because the additional loss introduced by running the transmission line horizontally to a point under the center of the antenna, then vertically to the antenna itself will be entirely negligible, and probably will be considerably less than the loss in Zeppelin feeders. The multiband antenna is readily supported from suitable stand-off insulators and can be carried around corners by making bends having a minimum radius of about 10 inches. It is entirely feasible to double back the line in trombone fashion, if desired, to obtain a length which will obviate the use of an impedance matching network.

The directional properties of the multiband antenna vary as the frequency is changed. The directivity is not ordinarily considered in amateur installations where transmission is carried on in random directions. There are a large number of possible combinations giving different degrees of directivity and a review of this subject with special reference to multiband operation will be attempted in a second article.

TABLE I

MODEL	A	B	C	D	E	F	G
Antenna Length—Feet	136	136	275.5	250	67	67	103
Feeder Length—Feet	66	115	99	122	65	98	82.5
Frequency Range M.C.	3.7–4.0 7.0–7.3 14.0–14.4	3.7–4.0 14.0–14.4	1.7–2.0 3.7–4.0 7.0–7.3 14.0–14.4	1.7–2.0 3.7–4.0	7.0–7.3 14.0–14.4 28.0–29.0	7.0–7.3 14.0–14.4 28.0–29.0	3.7–4.0 7.0–7.3 14.0–14.4
Nominal Input Impedance	1200Ω All Bands	75Ω All Bands	1200Ω 160-80-20 m, 75Ω 40 m	1200Ω All Bands	75Ω 40 m 1200Ω 20 m 10 m	1200Ω All Bands	1200Ω All Bands

Section II

Transmission Line Loss Calculation and Measurement

It has been the purpose of this project to study the various types of radio frequency transmission lines that might be used as connecting links between a radio transmitter and the radiating system proper. In this connection it is desirable to study the losses occurring in the line when terminated in its characteristic impedance —and in some cases when terminated in a different value. This latter is the condition of operation of a section of line used as a transformer matching section between two impedances, or as a resonant feeder. It is also necessary to check the calculated characteristic impedance by experimental means and to determine experimentally the velocity of propagation of the electromagnetic waves along the line. The velocity of propagation is necessary to determine accurately the phase shift in sections of line used in directional radiation systems.

There are essentially three types of lines which are used extensively in the transmission of radio frequency power. They are, namely, two wire balanced line, coaxial transmission line and twisted pair. The two wire line may be essentially of two types. It may be constructed of solid wire with nominal spacing and having a characteristic impedance some place in the region of 600 ohms. This type of line is normally used as a properly terminated transmission line. The two wire line may, however, be made of copper or aluminum tubing of ¼ or ½ inch diameter and relatively close spacing. The characteristic impedance of this type of line may be in the region of 150 to 300 ohms. This type of line is very suitable for use as matching sections in which it is desired to get high efficiency in the presence of standing waves. The coaxial or concentric transmission line has a characteristic impedance in the region of 70 to 125 ohms and is inherently an unbalanced transmission line of quite low loss. It is usually used to transmit power from the transmitter to an unbalanced load—such as feeding an antenna against ground. It is very popular with broadcasters due to its high efficiency and to the fact that it may be run on or under the ground without further insulation or increased loss, thus giving neat appearance as well as a factor of safety where high power is involved. A concentric line may also be used to transmit power to a half-wave doublet antenna. It is well adapted for this purpose since the impedance of a half-wave doublet in free