An Inexpensive Feeder System for Your Beam Antenna

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It was quite a blow to the nervous system to go into the radio store the other day and discover the price of brand-new RG-8/U coaxial cable.

"That will be eighteen dollars for one hundred and fifty feet of cable," said the salesman, twirling his moustache and blowing a speck of dust from his diamond stick-pin.

"EIGHTEEN DOLLARS," I screamed and staggered back from the counter. "What about all the surplus coaxial cable you had for two cents a foot? Sell me some of that!"

"I'm sorry, Sir," replied the salesman, "The surplus cable has been sold out for some months now. Would you prefer some new, low-loss RG-119/U cable at four dollars and thirty-four cents a foot?"

I felt dizzy. A Sterba curtain fell before my eyes and I blindly felt my way to the door of the store. Certainly there must be a cheaper means of conducting my precious rf from the rig to the antenna!

"Naw—just remembered important appointment," I mumbled. "Be back later—maybe."

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Pocket book troubles? Well, here's an inexpensive antenna feed system that is kind to thin purses. Like myself, many hams have found out that the process of buying or building a rotary beam, buying or building a tower, and getting everything in ship-shape condition takes a good-sized chunk of money. The heyday of inexpensive surplus material is waning, the flood of inexpensive coaxial line—the life blood of the rotary beam feeder system—has dried up, following the nineteen dollar BC-221 and sixty cent 304-TL into Limbo.

Then too, many an amateur has had hard luck with some of the more aged species of surplus coaxial line. Subject to faulty storage and occasional dunkings in sea water a lot of surplus coaxial cable was found to be useless, having questionable impedance and high dielectric losses.

This interesting feed system applies to the simple three element beam which is designed for single band operation (usually 6, 10, 15, or 20 meters). The radiation resistance of the driven element of such a beam falls within the range of eighteen to twenty ohms in the majority of cases. This impedance is measured at the center of the split dipole. The writer has "shinned" up more towers and poles, measuring more three element beams than he cares to admit, and every single one fell within this range of radiation resistance, or extremely close to it. Folded dipole elements, Gamma matches, and other matching devices affixed to the driven element of the array are another kettle of fish, as the saying goes. Their purpose is to transform the radiation resistance of the driven element to some higher value, generally in the 50, 70, or 300-ohm region, suitable for matching to the transmission line. We'll pass by these devices right now, as we are only concerned with beam antennas having a split driven element.

The problem at hand, therefore, is to match this balanced impedance of eighteen to twenty ohms to a distant transmitter having a coaxial output system designed for use with 50-70-ohm coaxial lines. This arrangement is the usual configuration of most commercially built amateur transmitters. (*Nobody* builds their transmitters anymore! — *Ed.*). The expensive way to solve this little problem is to place a *Gamma Match* or an *Omega Match* at the antenna and to employ 52- or 75-ohm coaxial transmission line for the feeder system. (*Editor's Note*: Read all about it in the *Beam Antenna Handbook*, by the author. Available at most radio stores, or on order from the Radio Bookshop!)

The following design comprises a simple feed system that has worked well in a number of cases where coaxial line was either unobtainable or judged to be too expensive. The virtues of the system are that it is inexpensive, efficient, and easy to construct. Low cost "TV-type" 300-ohm balanced line is employed for the major portion of the transmission line, together with balancing and impedance matching devices at each end of the line. The "TV-line" costs from two cents to six cents a foot, depending upon the make and style used, and the transmission loss of this line is about one-half that of the usual 52-ohm coaxial cable. The system is to be used with pi-network type transmitters having an output impedance range of 50-70-ohms.

Here's How It Works!

At first thought it might seem odd to use

300-ohm "TV-line" to serve as a feedline between a low impedance antenna and a transmitter having a low impedance output circuit! The explanation lies in the sketch of fig. 1. This is a drawing of the complete matching system, from antenna to transmitter.

Starting at the antenna end of the system, the pieces can be put together like a crossword puzzle. The impedance at the center of the split radiator of a simple three element parasitic beam antenna falls in the region of eighteen to twenty ohms. For this discussion, let us assume a nominal value of nineteen ohms at points A-B. A matching transformer (Q-section) is attached at this point. This transformer is made of an electrical quarter-wavelength section of 75 ohm "TV-type" balanced line. The Q-section has the unique property of transforming impedances, the ratio of transformation being a function of the antenna impedance at points A-B, and the surge impedance (75-ohms) of the Q-section, as shown in formula 1, fig. 2. In this particular case, the nineteen ohm impedance at points A-B is transformed by the Q-section to an impedance of approximately 295-ohms at the "bottom" end of the section (points C-D). This value is an almost perfect impedance match to a balanced 300-ohm line, which may take the form of a random length of "TV-type 300-ohm ribbon." For a few cents a foot this inexpensive and efficient transmission line can be run from the antenna position to the location of your transmitter.

The last requirement is to transform the (approximately) 300-ohm balanced impedance at the "bottom" end of the "TV-type" transmission line (points E-F) to an unbalanced impedance of 50-75-ohms which can be accepted by the great majority of amateur transmitters.

Balance to Unbalance in One Step

At points E-F two operations must be performed in order to solve this problem. The line impedance of 300 ohms must be transformed to the proper value, and the balanced line must be converted to an unbalanced (coaxial) state. It would be well to pause for a second and investigate the terms *"balanced"* and *"unbalanced"* as applied to transmission systems.

A *balanced line* consists of two parallel conductors which are separated a fixed distance by some low loss material. When the *rf* currents in each wire of the line are of equal magnitude and opposite phase the field around the line is small, and a very minimum of power escapes from the line in the form of radiation. On the other hand, the electrical field surrounding a line having unequal or improperly phased currents will be large. The field of the line may interact with that of the antenna, distorting the pattern of the antenna. In any event, the radiated field of the

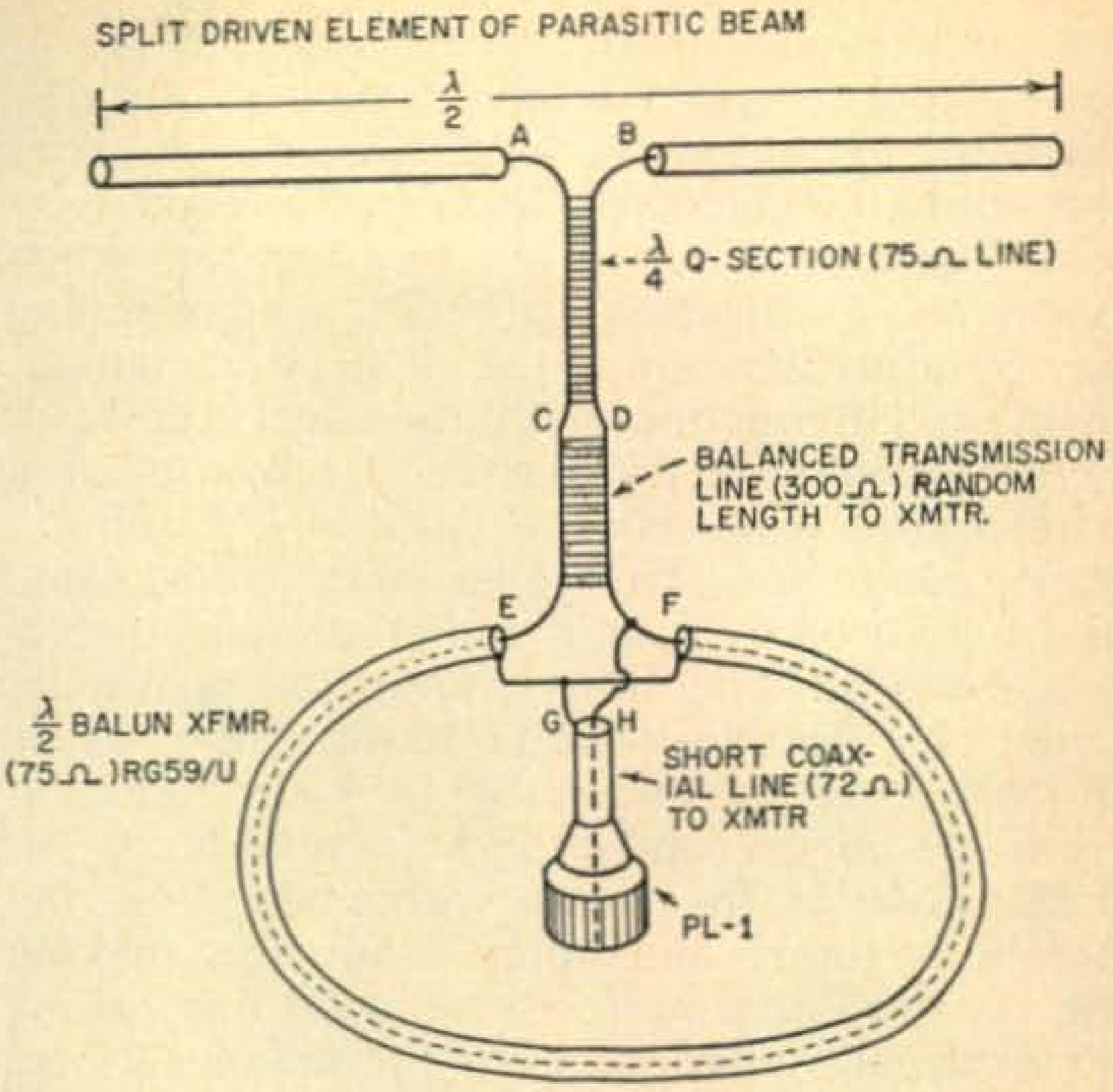

Fig. 1—Inexpensive feed system for 3-element rotary beam makes use of 300-ohm transmission line, used in conjunction with Q-section (at antenna) and ½-wave Balun transformer (at transmitter). Heavy-duty transmitting-type line and RG-11/U coax should be employed for transmitters of more than 250 watts.

75-OHM Q-SECTION (λ/4)

$$\text{LENGTH (FEET)} = \frac{246 \times V}{f\,(mc)}$$

V= 0.68 for Amphenol #14-080 line

V= 0.71 for Amphenol #14-023 line

f= resonant frequency of antenna in *mc*

HALF-WAVE COAXIAL BALUN FOR RG-59/u or RG-11/u

$$\text{LENGTH (FEET)} = \frac{324.6}{f\,(mc)}$$

f= resonant frequency of antenna in *mc*

Fig. 2—The length of the Q-section and Balun may be computed from these formulas. The resonant frequency (f) may be taken as 14.15 mc for 20 meters, 21.2 mc for 15 meters, 28.7 mc for 10 meters, and 50.1 mc for 6 meters. If desired, both the Q-section and Balun may be grid-dipped to the frequency (f). One end of the Q-section is shorted with a small, l-turn loop coupled to the grid-dip oscillator. The section is trimmed at the opposite end until the gdo indicates resonance at the proper frequency. Same method is followed for Balun, except far end of Balun is shorted out when measurements are made.