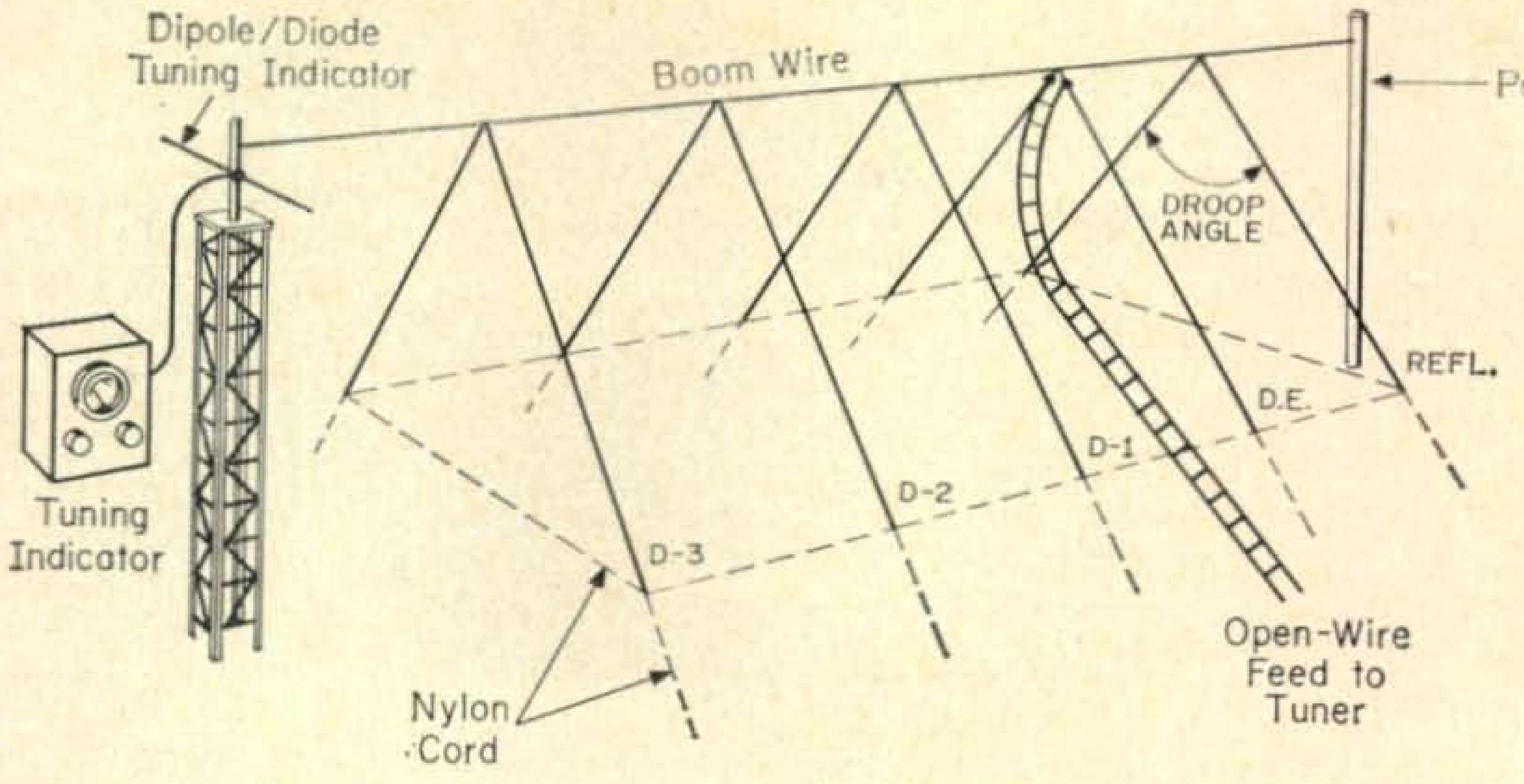

Fig. 1—Top view of the inverted vee fixed yagi antenna showing five elements. The dotted lines indicate nylon string used to maintain spacing and droop angle. Length and spacing formulas are given in the text.

THE INVERTED VEE YAGI

BY MERLE B. PARTEN,* W6ULS

THE popularity of the so called inverted vee antenna, and a desire to try a fixed Yagi for 7 mc long-path to Europe, led the writer into some experiments using this type of construction for a beam.

The limiting factors in constructing this type of array would be, first, two trees or poles, or TV type masts lined up in the proper direction to support the "boom-wire." Second, enough space between them to allow 0.15 wavelength spacing for 2 elements, plus 0.2 wavelength for each added director. This amounts to 20 feet for a 7 mc two element antenna, plus 27 feet for each director.

A 40 foot span would support a 2 element job for 80, or 47 feet would give you 3 elements on 40, or 74 feet between the supports would allow 4 elements on 40. In my case I was able to squeeze 6 elements into the 150 foot span between supports.

The third factor is the width. A generous half-wave should be available if you are to keep the ends far enough above the ground to prevent the kids from drawing two foot arcs. (?)

If the space requirements fall within what you have available, read on. But to prevent you from turning to the last paragraph to check results, they will be presented first.

Performance

The 6 element 7 mc array tested was 35 feet lower at its highest point (due to down-hill terrain) than the 2 element Hy-Gain Duo-band, which was up 75 feet. Coax switching was done with a relay, giving instantaneous comparisons. On days when conditions were poor, and a signal would be fading in and out of the noise on the high 2 element rotary, facing the same direction, it was solid copy on the "monster." The difference was not fantastic, but resulted in QSO's that otherwise would have been a failure. The added gain was just enough to take some of the QSB out of the signal, which is what we are after, during adverse conditions.

Feedline

If you are still interested, you might ask how do you get up to the center of the antenna to match it. No problem. You feed it with open-wire line, through a matching network. The coax from the rig or antenna relay is coupled to a parallel-tuned tank, and the feeders are tapped down to the point of minimum s.w.r., or best match. The light-weight open-wire line minimizes sag in the "boom-wire." Granted that standing waves on this line will result in a poorer front-to-back or side ratio, but the forward gain is still there.

The old story about putting up the beam by formula, then carefully tuning it, and finding that you wasted your time because the formula was close enough in the first place, does not apply in this type of antenna. The formulas I give should be used as a *starting* point only. Since a beam must be raised almost a half-wave before it stops being affected by ground capacity, and since this type of beam will probably not reach this height, tuning will be necessary if optimum gain is to be achieved. However, tuning is easily accomplished at one end of each element and will be described later.

Just to remind you of what you already know, if you take a half-wavelength of wire and support it horizontally, it will be resonant at a given frequency. If you maintain the same height at the center, but lower both ends until they are together, then it is no longer resonant at the original frequency, but is more nearly a quarter-wave, or twice the frequency. Consequently the in-

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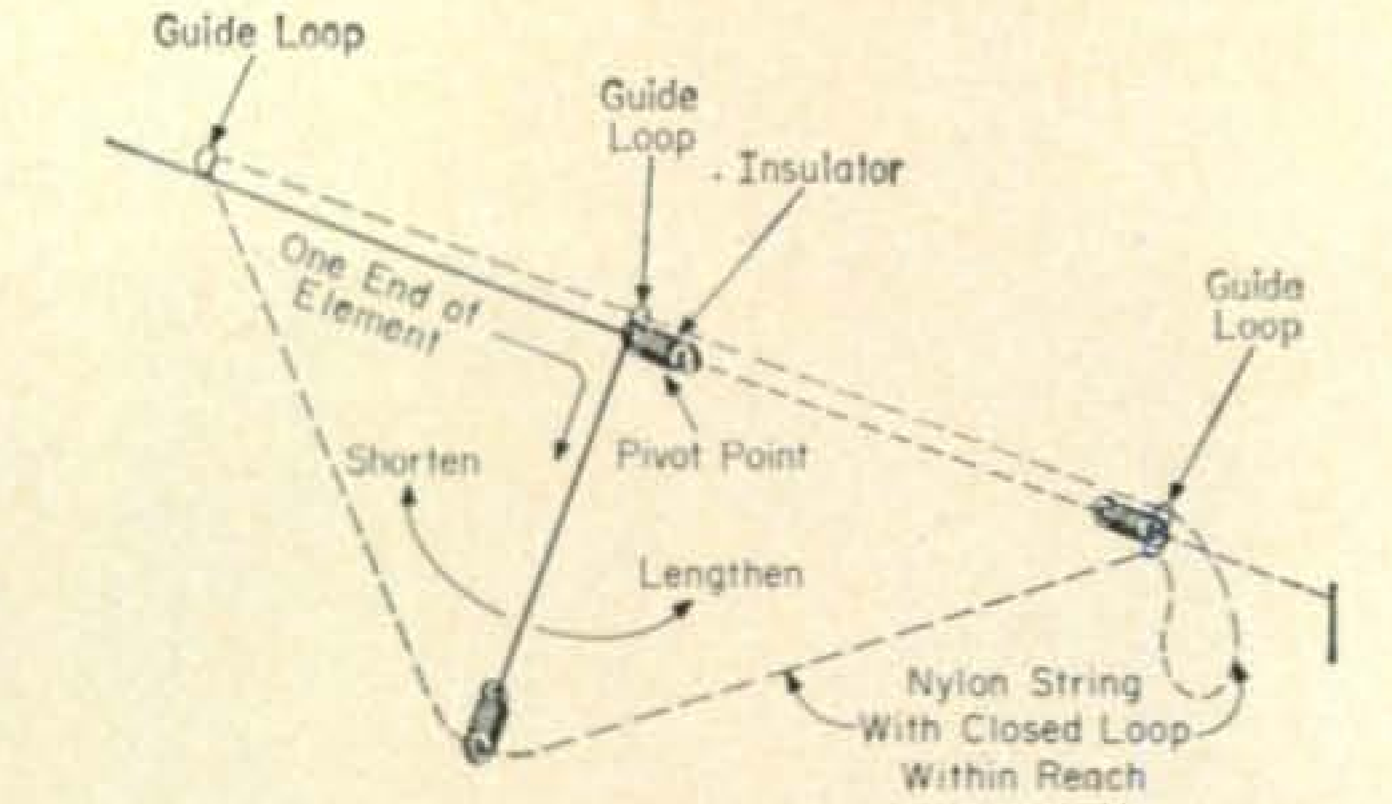

Fig. 2—Tuning is accomplished at one end of the element using this nylon loop adjustment system.

verted-vee type of construction, with drooping ends, requires a wire to be longer than the straight, horizontal half-wave. For this reason, as well as the height-above-ground, no set formula can be given, since no two installations will have the same angle of droop at the center. The formulas given were derived *after* tuning the "monster," which had a 90 degree "droop-angle," and was installed over uneven terrain.

Nylon twine was used to maintain the spacing between element ends and the droop-angle. This angle, whatever it is, should be maintained. Bench experiments in the 700 mc region indicated that the most gain was achieved when the elements were horizontal, but if the angle of droop was the same on all elements, it still had gain. Please, no fan-mail from the antenna eggheads. Try getting gain with a horizontal driven element and vertical elements. Maybe the spiral "non-polarized" arrays work. I don't know.

Construction

Figure 1 shows the layout of the inverted vee yagi. The element spacing may be determined as follows:

Reflector to driven element	$S=140/f_{mc}$
Driven element to director #1	$S=189/f_{mc}$
Director #1 to director #2 etc.	$S=189/f_{mc}$

Element lengths may be calculated as follows:

Reflector	$L=550/f_{mc}$
Driven element	$L=510/f_{mc}$
Director #1	$L=497/f_{mc}$
Director #2	$L=483/f_{mc}$
Director #3	$L=475/f_{mc}$

The element lengths are based on a droop angle of 90° with the ends about 20 feet above the ground.

Element Tuning

If the droop angle is less than 90°, add wire to the calculated length (or *vice-versa*) if you hope to hit resonance. The arrangement for adjusting the length for tuning is shown in fig. 2. Make a pivot point about 3 feet from the end of the element so that this 3 feet may be added or cancelled by pulling the strings.

Tuning the array was accomplished by mounting a small dipole-diode indicator on the support at the directional end, with a pair of wires long enough to connect to a microammeter that could be viewed as each element was tuned. Later the

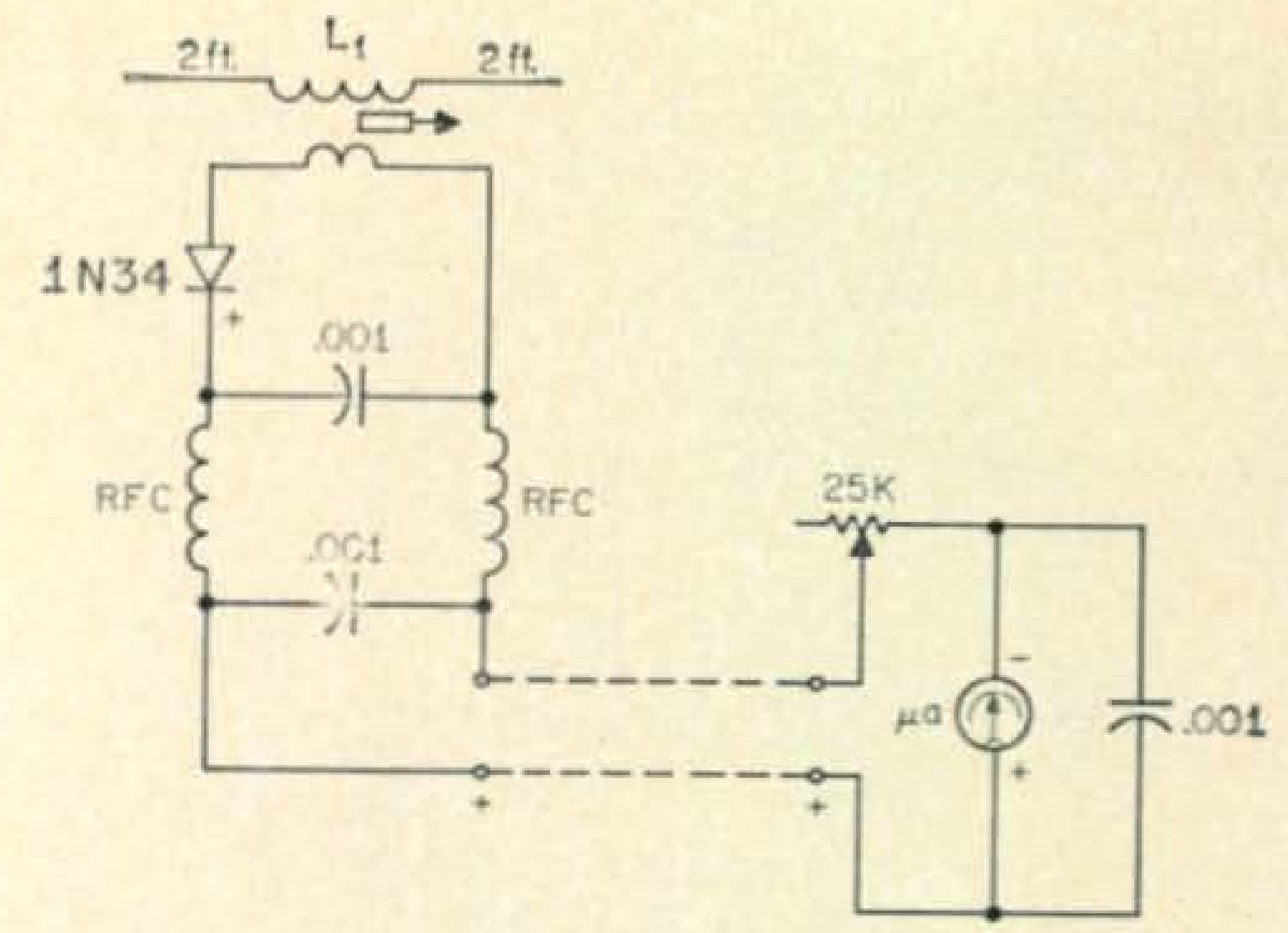

Fig. 3—Dipole tuning indicator. Coil L_1 is a slug tuned form with sufficient turns to resonate in the band the antenna is cut for. The secondary feeding the detector circuit consists of a two turn link.

meter was extended to the shack as a constant field strength indicator. The circuit is shown in fig. 3.

Using the tuning indicator, adjust the 3 foot length to peaks. If the maximum field strength is within the added three foot length but does not tune through the peak, add wire to the other end of the element until a peak is obtained.

The driven element does not require this procedure as its length will be compensated for in the open wire line and tuner.

Variations

Many variations of antennas constructed in this manner are possible. If that tree is in the right spot, and is 0.15 to 0.3 wavelengths away from your present inverted vee, hang a reflector behind it, and get more zoom in one direction. The tilted wires make it slightly directional off the ends, and the pattern is broad.

With conditions on the up-swing, I plan to try 10 or 12 elements, fixed on the long path to Europe, either in the manner described here, or by insulating the two ends at the "boom-wire" and using a string of parasitic half waves in phase.

How many elements can you add before the beam width becomes so sharp that your QSO's are limited to the north side of that distant town? ■