Radio FUNdamentals

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THINGS TO LEARN, PROJECTS TO BUILD, AND GEAR TO USE

Controlled Feeder Radiation

Feeding a balanced antenna with an unbalanced coax line will, as every schoolboy knows, result in a certain amount of feeder radiation. That is, RF current flows on the outer braid of the coax because it divides between one leg of the antenna and the coax (fig. 1). There is nothing to prevent it from doing this. The outer braid current radiates, and the coax thus becomes part of the antenna instead of merely being a conduit to the antenna for radio energy.

Outer braid current can also be induced in the coax if the line is out of the plane of the antenna—that is, not perpendicular to the antenna (fig. 2). Few amateurs can bring their coax directly down from the feedpoint because of location of the shack, trees, or other obstructions. As a result, braid current is created by the field coupling between coax and antenna.

What are the effects of braid current? First, it confuses SWR measurements. SWR readings will vary from normal depending upon coax placement and the length of the line. That's the reason why some amateurs think that changing line length "tunes" the antenna. It doesn't, but trimming the coax gives a warm, fuzzy feeling to some operators who have a fetish for low SWR readings.

Second, braid current upsets the radiation pattern and may change feedpoint resistance of the antenna. A Yagi beam, for example, might show very poor front-to-back or front-to-side ratio due to coax line radiation which "fills in" the otherwise excellent beam pattern. Many amateurs diddle with element length to improve front-to-back ratio when coax radiation and/or signal pickup are the real cause of the problem. Odd-ball input impedance values may be caused by an unknown amount of braid current. The operator can compensate for this with the antenna matching system (gamma match, hairpin match, etc.), but the problem isn't solved. It is merely obscured.

Finally, including the coax line as part of the antenna system can bring about interference pickup of a perplexing kind. The use of a computer in the home station has in some instances brought about a serious rise in receiver background noise. Coax pickup is a common cause of this problem. Automobile ignition noise is another source of QRM that is frequently enhanced by coax pickup.

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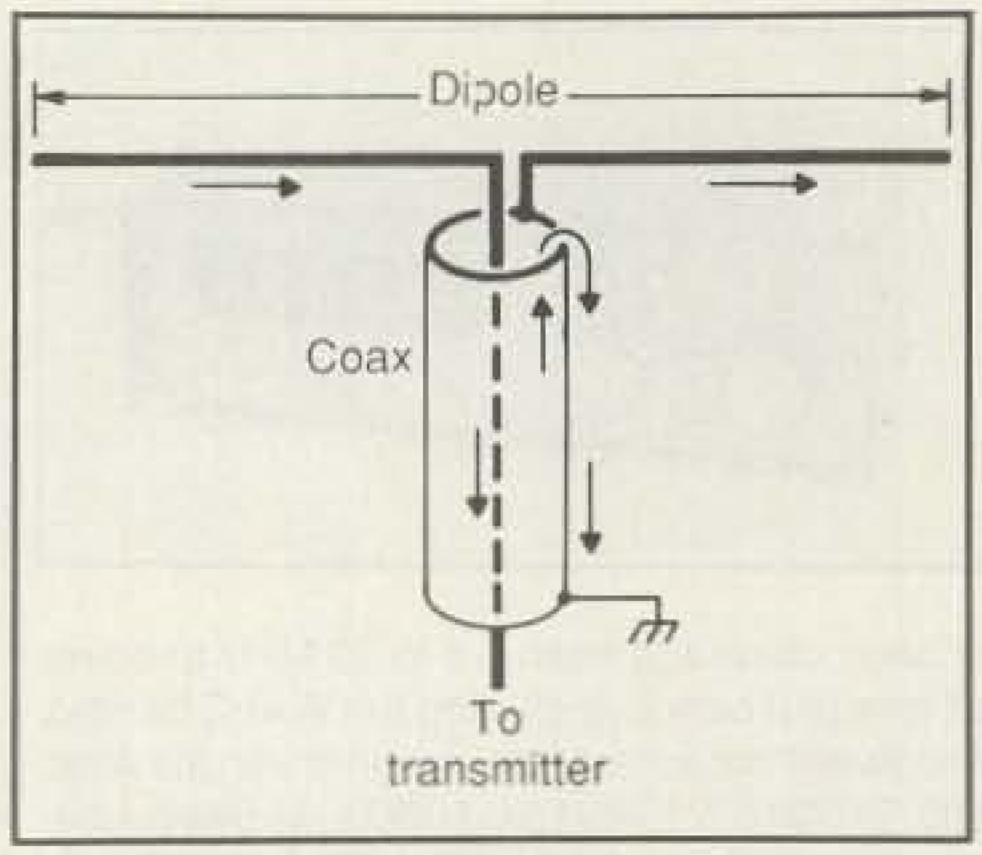

Fig. 1– Current flowing on inner braid of coax divides between one leg of antenna and outer braid of coax.

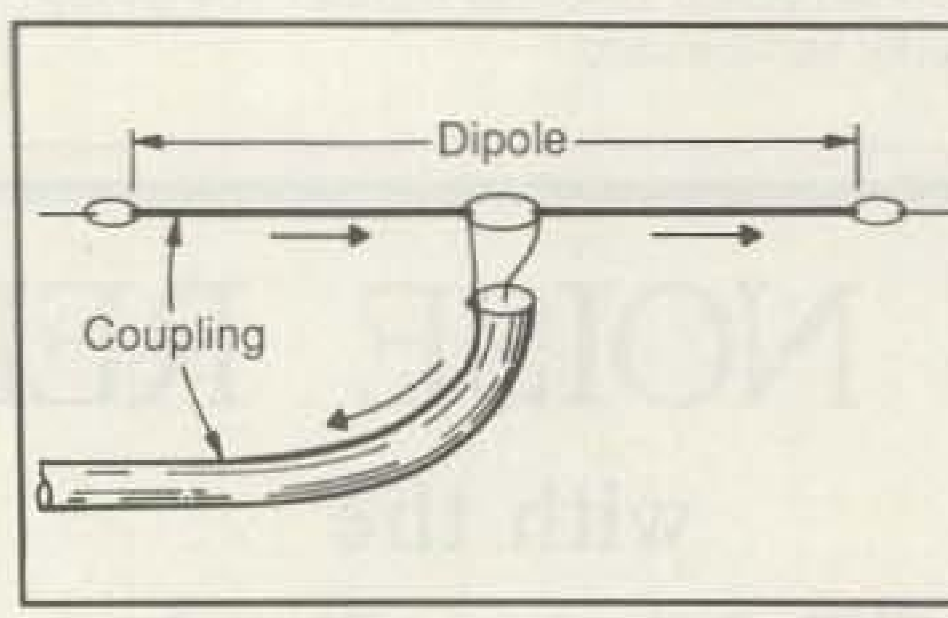

Fig. 2– Outer braid current can also be induced in coax if line does not come away at right angles to axis of antenna.

All of these problems can be avoided by placing a current-type line isolator at the antenna feedpoint to choke off directly coupled current, and by bringing the coax line down vertically to ground level in the plane of the antenna to lessen induced current.

Controlled Feeder Radiation

After this dissertation about the evils of coax shield current, why am I discussing the benefit of controlled feeder radiation? Can the nuisance of coax radiation be turned into a virtue? Some amateurs think so. A few years ago B. Sykes, G2HCG, suggested using feeder radiation to manipulate the radiation pattern of a dipole to fit his operating needs.[1,2] His dipole was fed with a balun and coax line and provided the classic figure-8 pattern. He couldn't move his dipole, yet he wanted to contact stations off the end of it. To accomplish this he turned the nuisance into a virtue by allowing a quarter-wave section of the feedline to deliberately radiate (fig. 3). This was accomplished by placing a ferrite line isolator down the coax from the feedpoint, permitting a section of the coax to simulate a top-fed quarter-wave vertical antenna having an omnidirectional radiation pattern.

At the time of his experiment G2HCG was living in southern France and wished to communicate back to the UK on 7 MHz. An omnidirectional pattern, created by controlled feeder radiation, proved to be very effective over this path. Two days of deliberate operation without the coax radiator resulted in many comments of reduced signal strength in the UK.

Other amateurs, principally in Europe, have tried the idea with success. At least one US manufacturer features wire antennas with controlled feeder radiation[3] and interest in this novel idea is growing.

It is instructive to examine controlled feeder radiation with an antenna analysis program. I used the K6STI MN4.5 version[4] to see what, if anything, feeder radiation contributes to a dipole antenna pattern. A dipole cut to 14.2 MHz, 40 feet above ground, was chosen as the guinea pig, and the data was input to the antenna program.

With no feeder radiation, the dipole exhibited the classic figure-8 pattern, with maximum radiation at right angles to the wire. Radiation off the end of the antenna was absent.

A vertical radiator about a quarter-wave long was added to the dipole in the manner shown in fig. 3. The length of the vertical section was varied to see what the results would be.

If the vertical section was very short (an eighth-wave, for example) it accomplished little. As the length was increased, vertical radiation increased and the nulls of the figure-8 pattern started to fill in. When the vertical section was about a quarter-wave

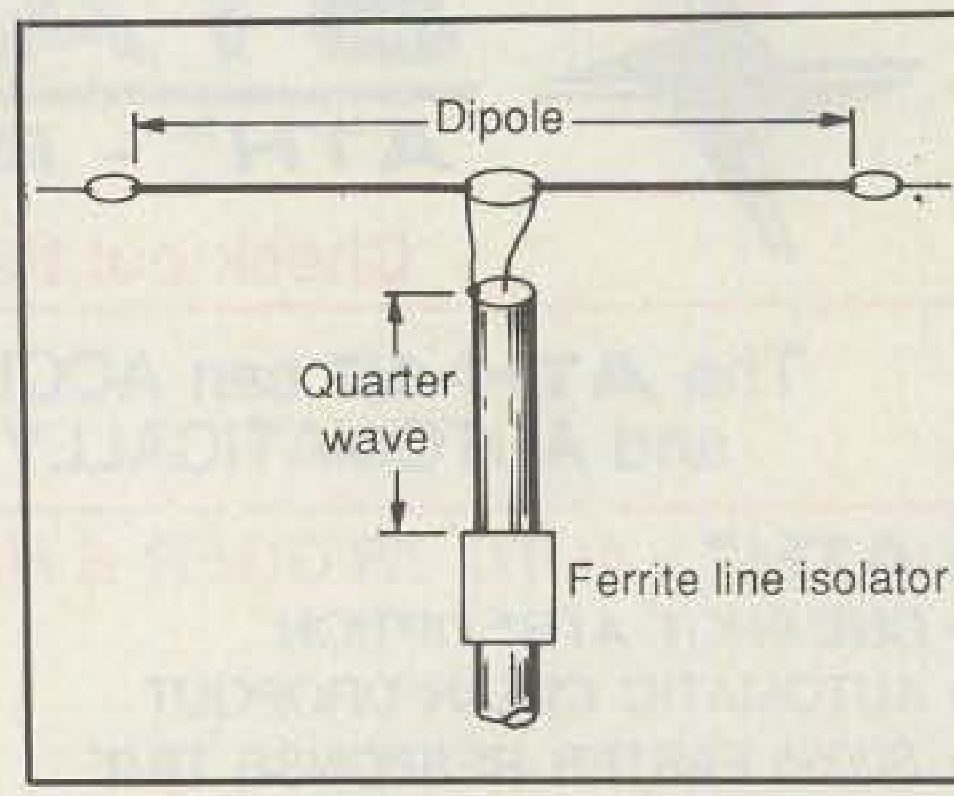

Fig. 3– Quarter-wave section of coax is allowed to radiate by placement of line isolator as shown.

long, the combined radiation pattern was nearly omnidirectional (fig. 4). And, when the vertical section was longer than a quarter-wave, the pattern started to revert back to the figure-8 dipole plot.

I noted that as the vertical section was increased in length, the feedpoint impedance of the antenna and the resonant frequency changed. When a nice, nearly circular pattern was obtained, antenna length was slightly longer than normal. The length of the radiating section of coax was very close to a quarter wavelength. Dimensions for the 20 meter band are shown in fig. 5.

The Line Isolator

The key to controlled feeder radiation is the line isolator, which provides a very high impedance to outer shield current, effectively choking it off from the rest of the feedline. Choice of the isolator is critical. G2HCG used 10 turns of coax wound on a ferrite core. He states that the choke operates at high impedance and relatively low flux in the core, which allows high-permeability materials to be used without fear of core saturation.

He used British URM-76 coax (.195" OD), which, I assume, is equivalent to RG-58C/U. His core is 1⅝ inch outside diameter (fig. 6). A relative permeability of at least 50 at the lowest operating frequency is suggested.

While I have not tried out this concept, I would suggest that winding RG-58 size coax on such a small diameter core is a dicey proposition. Bending the coax on such a small radius is not a good idea. I think a 2½" outside diameter core is a better approach. The Amidon FT-240-43 (43 material with a mu of 850) would be my core choice.

It should be noted that the RF on the outside of the coax at the choke point can be quite high, as the end impedance of this section of the antenna can be several thousand ohms. The RF voltage drop across the choke is therefore high. Operation of the antenna in the proper manner depends

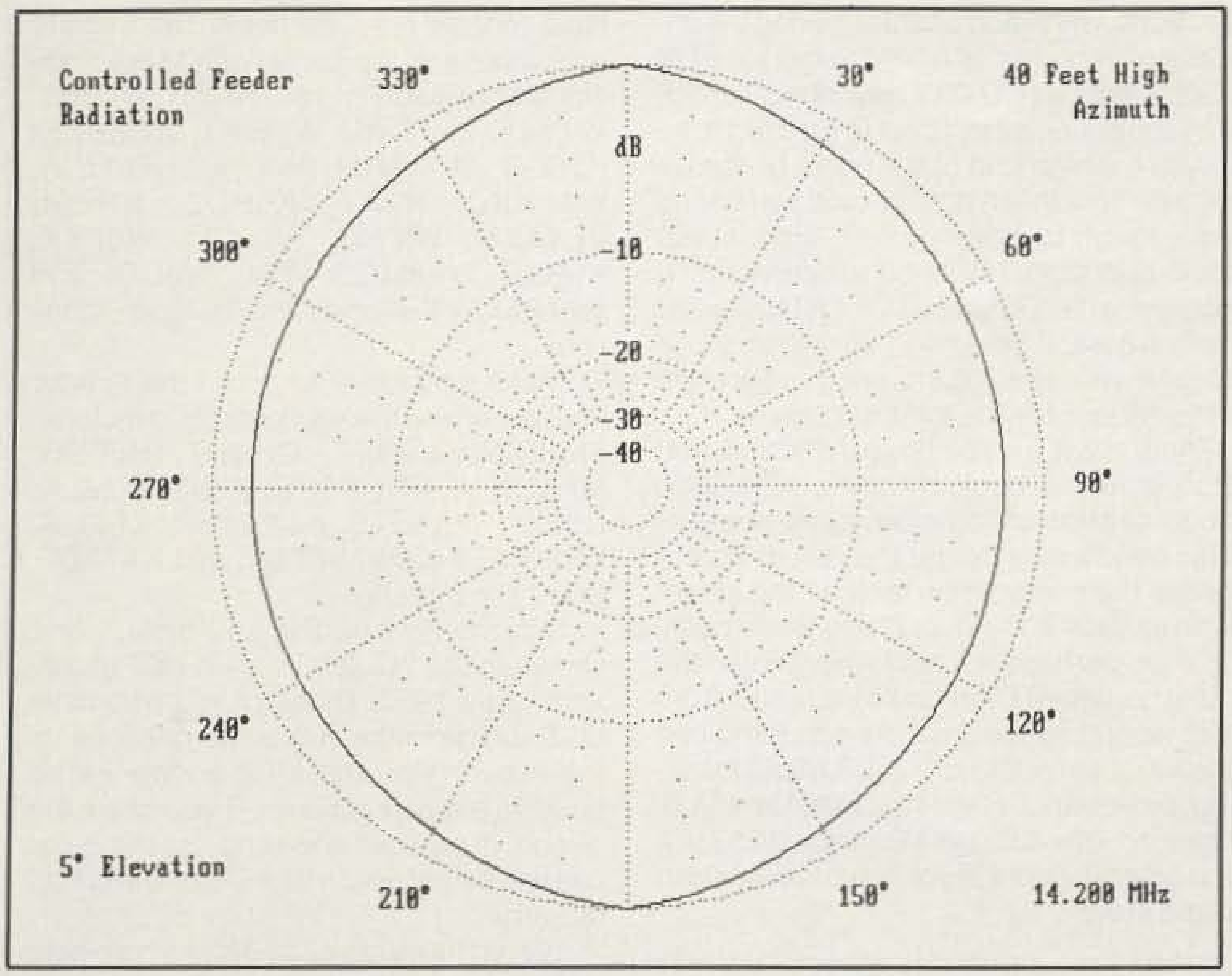

Fig. 4– Nearly omnidirectional pattern of dipole with controlled feeder radiation.

upon the isolation provided by this choke.

One candidate for the job might be the Radioworks[5] type 4K-LI isolator. From the illustration in the catalog this device looks like a ferrite rod assembly, as the length of the case is about five times the diameter. In any event, the choice of isolator will undoubtedly influence the length of the vertical section.

I would be pleased to hear from experimenters who try this simple antenna. Let me know your operating results.

Shop Talk

Ever try to cut RG-8 size coax with wire cutters? The result is usually a messy cable end that has to be trimmed before you can begin to put a coax plug on it. A better and neater way to cut coax is with a hedge shear sold in most hardware stores and garden shops. The shear has a notch in the blade for cutting small tree branches. It cuts coax cleanly with a single snap of the blade. Try it! You'll like it.

In reply to several queries, NEVER use bathtub calk or other everyday household sealant to seal coax plugs or antenna hardware. As it dries it exudes nitric acid that will quickly corrode the metal surface of the plug or coax. A nonacid sealant such as Dow Corning 3145 RTV Adhesive Sealant will do the job without causing this problem.

In addition to using the sealant, I fill my PL-259 plugs with Dow Corning Vacuum

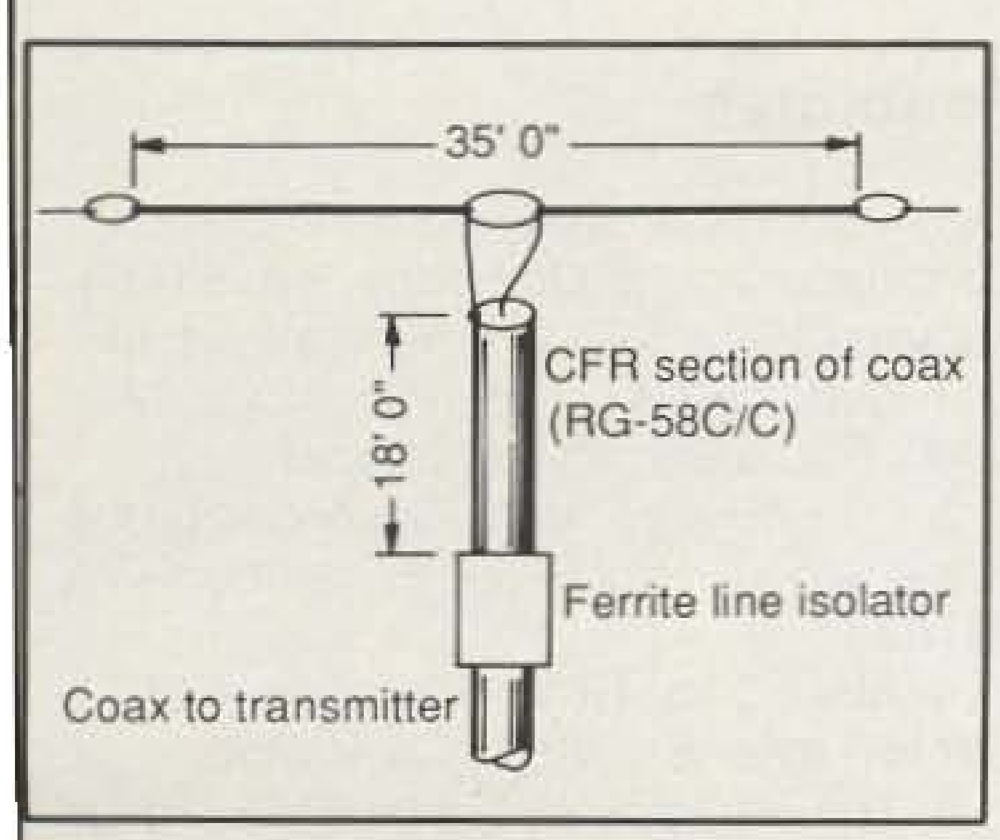

Fig. 5– Dimensions for CFR dipole. Height above ground is 40 feet. Feedpoint impedance is about 40 ohms.

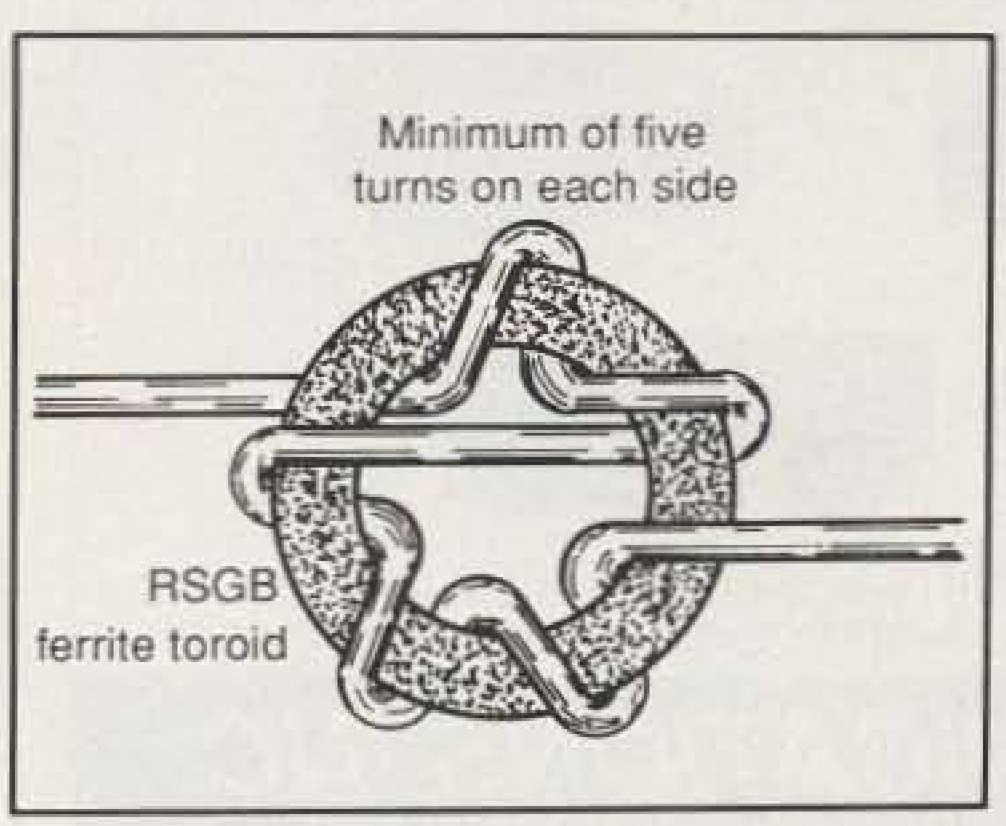

Fig. 6– The G2HCG isolator uses 10 turns of coax on toroid core for 14 MHz dipole. (See text for details.)

Grease. This fills all interstices and helps to keep moisture out after the connection is made. Wipe excess grease off the outside of the plug after you have made your connection, as it is slippery stuff and you can't use Coax-Seal® tape on the plug. It won't stick to the grease.

CQ Book Review

Hello, DXers out there! Many of you enjoy the robust sport of contesting. This high-tech sport is a hotly-fought free-for-all and shows up almost every month, in one form or another, on the principal DX bands.

To the beginner, contesting is a bewildering world of numbers, multipliers, countries, and zones all conducted in a "hot" environment. Confused? Not to worry. Bob Halprin, K1XA, helps you take the plunge into one of amateur radio's most exciting, intense, and challenging experiences.

Ham Radio Contesting, by K1XA, is a how-to-do-it book that guides you through typical contests. Pre-contest preparation is covered, along with matters such as operating procedures, goals, timing, and the exotic art of predicting band openings.

The book is conveniently divided into sections, with each chapter having a summary of contents. Is it best to call loud DX stations or call CQ DX? How do you crack a difficult pile-up? Is it best to tune from the low to the high end of the band, or the reverse? How much time should you spend on a tough-to-work station? How about multi-operators? Multi-band operation? If you get a QSO number of "ATN," what does it mean? Oh, boy! Your pulse starts to race while reading this book and you are "hyped up" for the next contest!

Actually, it's something of a shame that Bob wrote this book. He reveals the operating secrets of top scoring contesters. This makes it easier for the rest of us, but raises the competition for the "top guns" who already know everything in the book.

Well, perhaps not everything. Even the most hardened DXer could learn a lot from this work. I suggest before you jump into the next contest, read *Ham Radio Contesting*, by Robert J. Halprin, K1XA, Tiare Publications, Box 493, Lake Geneva, WI 53147. It is also available at your favorite amateur radio store.

The "Dead Band" Quiz

First, thanks to the following readers who have sent me personal notes. I appreciate your input and I'm sorry I can't reply individually to each of you: KN8B, W4RNL, W4YVY, KL7CMN, W3WPY, WD6BUK, KJ6GR, W9WHM, W1PXL, PY1LJA, WA KKC, K9AY, K5BDZ, KH6GI, VE4AKM, W2YYI, W5QJM, W6PYK, K9BXG, WA8MCQ, W8JI, W8UOF and W8ARM, W2FZ, and W8YFB. Again, thank you!

Those who knew all about the *Scarlet Pimpernel* and the voltmeter quiz include: SM5GW, W2DFZ, OH2DT, N2EBG, N7VZB, VE7IIT, K1RD, KI6IS, W3ZLK, N2EID, WA4DTE, ex-K2UKT, KF9HG, W4HYY, N4OFV, VE7BS, and KA1ADF. Good show, gang!

This month's quiz is an "oldie," first shown in the "Quist Quiz" in *QST* magazine, June 1957. Those of you who save *QST* and have the July issue can look up the answer. For others, the answer will be given in a future column. If you know the circuit, draw it out and send it to me. Your call will be entered in the Dead Band Hall of Fame.

"Given three lamps and four single-pole switches, wire the lamps and switches so that switch 1 turns on lamp 1, switch 2 turns on lamp 2, switch 3 turns on lamp 3, and switch 4 turns on all lamps, regardless of the position of switches 1, 2, and 3. Don't clutter up the circuit with relays, diodes, or other stuff. All you need are the relays, the switches, the lamps, some wire, and a voltage source."

In a future column I'll print the names of the successful circuit engineers who send their solution to me.

The January Quiz about the Decca recording of Clyde McCoy (1933) was an ode to a Murphy folding bed. No doubt the orchestra members slept on a lot of them during their one-night stands! The other side of the platter was the famous "Sugar Blues," used as a theme song for many months by Martin Block's "Make Believe Ballroom" on WNEW, Newark, New Jersey. Martin was a ham, by the way. I think his call was W2MHB, but that was before my time.

Footnotes

1. Sykes, "Controlled Feeder Radiation," *Communications Quarterly*, pp. 51–54, Summer 1992. CQ Communications, Inc.

2. *Ibid. Radio Communications*, May 1990. Radio Society of Great Britain.

3. "Carolina Windom" antennas by the Radio Works, Box 6159, Portsmouth, VA 23703.

4. MN4.5 by Brian Beezley, K6STI, 507½ Taylor St., Vista, CA 92084.

5. The Radio Works, Box 6159, Portsmouth, VA 23703.

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