Radio FUNdamentals

BY BILL ORR, W6SAI

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

Ideas From The Twilight Zone

I find that a lot of ideas and schemes designed for other people and other communication services are often of great interest to radio amateurs—if they only had knowledge about these innovations. Here are some interesting techniques gleaned from magazines and other sources dealing with communication innovations that may be of interest to the readers of this column.

Noise-Free Compatible AM Radio

"Summertime, and the static is heavy." Maybe that's not the way the song goes, but it is certainly true, especially in the midwest with its plethora of summer thunderstorms. An idea was launched a few years ago for noise-free AM, which might have definite advantages for amateur use on, say, 160 meters which is almost wiped out by summer static. The concept is shown in fig. 1.

The transmitter delivers a 90% amplitude modulated signal, which in addition has FM superimposed on the carrier with plus or minus 3 kHz deviation. The "static-free" receiver is a conventional AM superhet having an intermediate frequency of 428 kHz. The IF signal is passed through a "times 25" multiplier to produce a resultant signal at 10.7 MHz (the standard FM IF channel). This signal is converted to audio in a conventional FM detector/audio circuit. The signal may also be received in the normal fashion on a regular AM radio.

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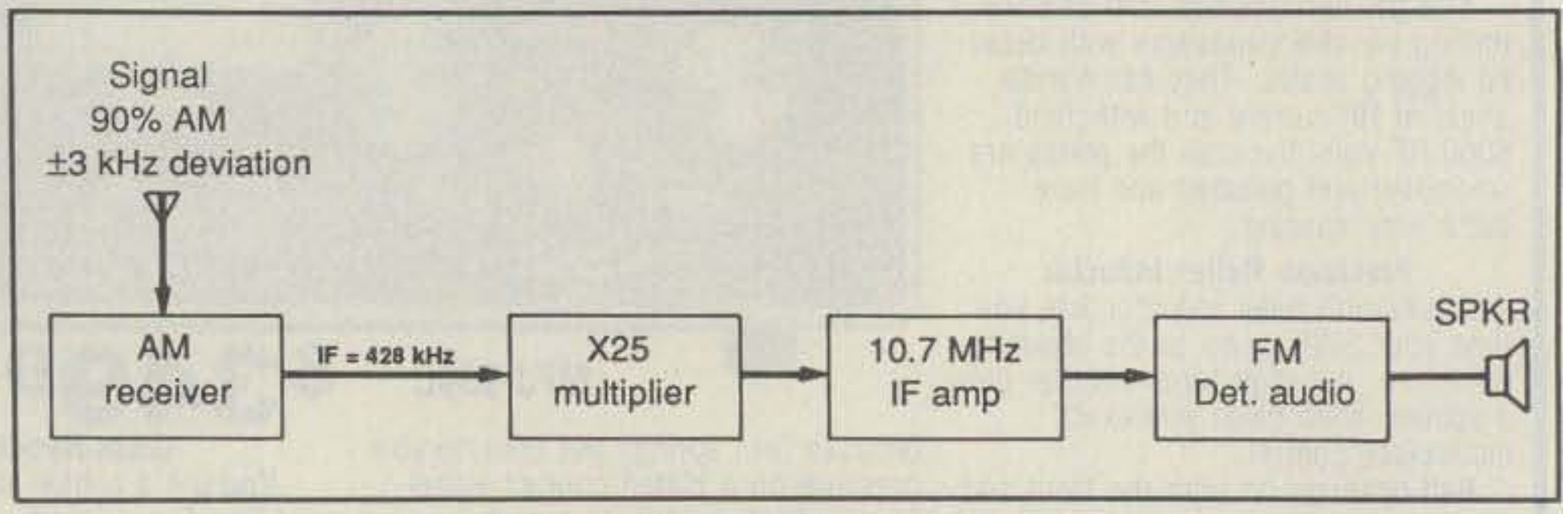

Fig. 1– "Noise-free" compatible AM receiver.

A second scheme is shown in fig. 2. The transmitter delivers an AM signal which is 90% amplitude modulated, also having FM added to it with plus or minus 1 kHz deviation. The IF channel is 455 kHz. A "times 75" multiplier produces a 34.125 MHz signal which is mixed with a local oscillator (23.425 MHz) to provide the conventional 10.7 MHz FM IF channel. The IF amplifier and FM detector are conventional.

An interesting concept! It would be fun to move the system up to the 160 meter band and give it a try. An old DX-100 or Viking II could easily be modified to FM the oscillator. The receiver would have to be built of various modules. Maybe I'll try this idea this summer. (Sorry I can't give more details about the source of this material. Part of my file was lost a month or so ago, so apologies to the inventor of the idea and the publication in which I saw it!)

A Broadband HF Antenna

This antenna was described in the March 1992 issue of *RF Design* magazine. It was designed at the U.S. Army Communication and Electronics Command, Ft. Monmouth, New Jersey apparently in 1985. It is a vertically polarized, terminated log-periodic-type array designed for quick erection in the field (fig. 3). It is designed to cover the range of 2.0 to 30 MHz.

Other field-expedient antennas investigated by the Army were the dipole, the terminated dipole, the terminated sloping vee, and the long-wire beverage. All of them had problems such as size, frequency sensitivity, or poor angle of radiation. The solution to the problem was a zig-zag antenna that had similar impedance and radiation characteristics as a log periodic array. This array is quite small for the frequency span it covers, and the small size limits the gain to about that of a dipole.

The primary objective was to design a broadband, directional, low-angle skywave radiator that is extremely small, easy to erect in a minimum of time, and inexpensive.

The final design was a zig-zag wire whose sections are of a predetermined increasing height. The far end of the wire is

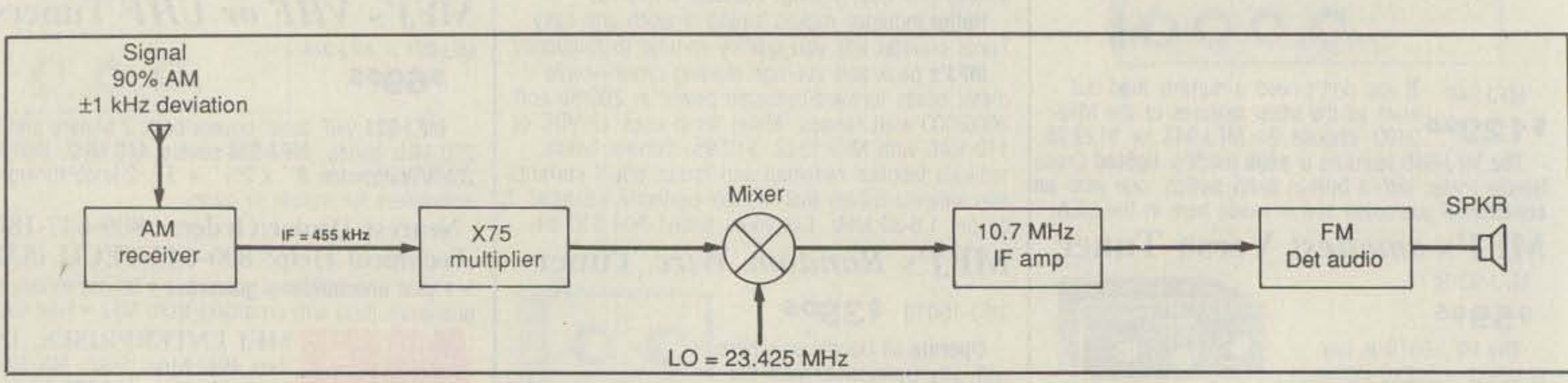

Fig. 2– Advanced "Noise-free" receiver.

terminated to ground. A ground counterpoise wire is utilized to balance the system. Power is coupled to the shortest zig-zag section by a nine-to-one broadband balun.

The angle of elevation above the horizon averages about 30 degrees regardless of operating frequency within the antenna operating range. Performance plots for 2, 10, and 30 MHz are shown in figs. 4, 5, and 6.

I hope to have some physical dimensions and construction data for this interesting antenna in my next column. Stay tuned.

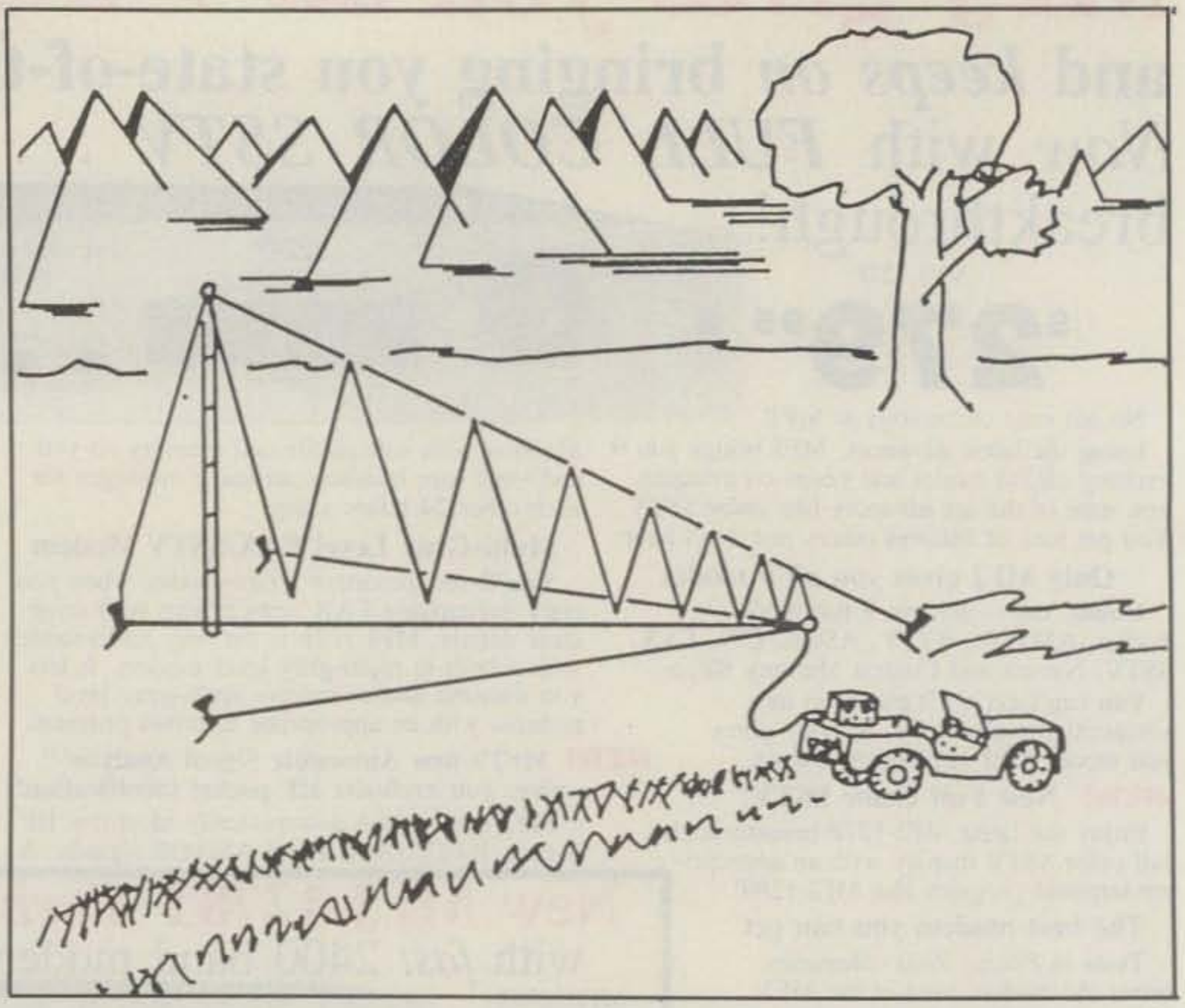

Fig. 3– "Zig-zag" version of log periodic antenna covers 2 to 30 MHz. (Drawing courtesy RF Design *magazine.)*

FM Intermodulation Effects

The December 1991 issue of *Broadcast Engineering* discusses a problem which could possibly show up when two or more VHF or UHF amateur repeaters are operating in the same area.

"Imagine you are driving down the highway and the signal from your FM station disappears as if you were entering a tunnel—only there is no tunnel." That's how the article describes the effects of FM intermodulation. This complicated phenomena occurs when two stations' signals interact inside the listener's receiver.

This interference was noticed in 1988 when WKLX-FM (Rochester, NY) moved its

location about 6 miles. It was now co-located with WRMM-FM. Soon WCMF-FM (also in Rochester) began receiving complaints of interference from an unknown cause. An investigation showed that the carriers of WRMM (101.3 MHz) and WKLX (98.9 MHz) formed a two-frequency, third-order intermodulation product at 96.5 MHz—(98.9 × 2) − 101.3 = 96.5. This was the channel of WCMF-FM.

This was a legal and technical issue only of interest to amateurs in that certain frequency combinations of co-located repeaters can cause mysterious intermodulation products which can interfere with nearby amateur channels or (heaven forbid!) nearby commercial channels adjacent to an amateur band. A good thing to keep in mind if problems arise with your repeater.

The KN6J Radial System for 160 Meters

Any 160 meter band enthusiast who has clashed with Bob, KN6J, over some rare DX knows what a potent antenna system he has. The top-loaded vertical wire is nothing unusual in itself, but his radial system is unique. Together, the assembly makes a superb system that really gets results (fig. 7). The vertical has sufficient top-loading so that when it is series-resonated to 1.85 MHz, the input impedance is close to 50 ohms.

Because of space limitations, Bob had to use radials much shorter than a quarter wavelength. He solved this problem by making his radials out of old coax cable, fashioning each one into a quarter-wave resonant line, making the velocity factor of the line work for him. For ordinary cable, the factor is 0.66, so a radial for 1.85 MHz turns out to be only about 88 feet long—a lot shorter than the usual length of 136 feet!

Bob left the far end of each radial unshorted and taped to protect it from the weather. The shields at the center point of the radials are connected to a ground rod. The radials are run helter-skelter about the ground. A very simple and effective installation that really works!

In the Workshop

PL-259 style coax plugs, connectors, and splices exposed to weather have an evil affinity for water. Moisture seeps into the plug and from there enters the line, drawn along irresistibly by capillary action. The connection quickly corrodes as does the shield of the line. Soon the operator notices a high SWR on his feedline and wonders what in the world is going on.

A simple solution to the problem is to fill the plug, or coax joint, with a compound that prevents moisture penetration by occupation. The filling material should be waterproof, should not oxidize, and should be compatible with the cable dielectric. A big order? Well, such a substance is in use for cable TV, cellular phone circuits, and satellite feed systems. It has the unglamorous name of STUF (Silicon-teflon-unionizing filler). It comes in a tube like toothpaste. You fill the coax plug or joint with STUF and tighten it until excess STUF seeps out. The remaining STUF is forced into the voids in the connection. It is for use in cable sys-

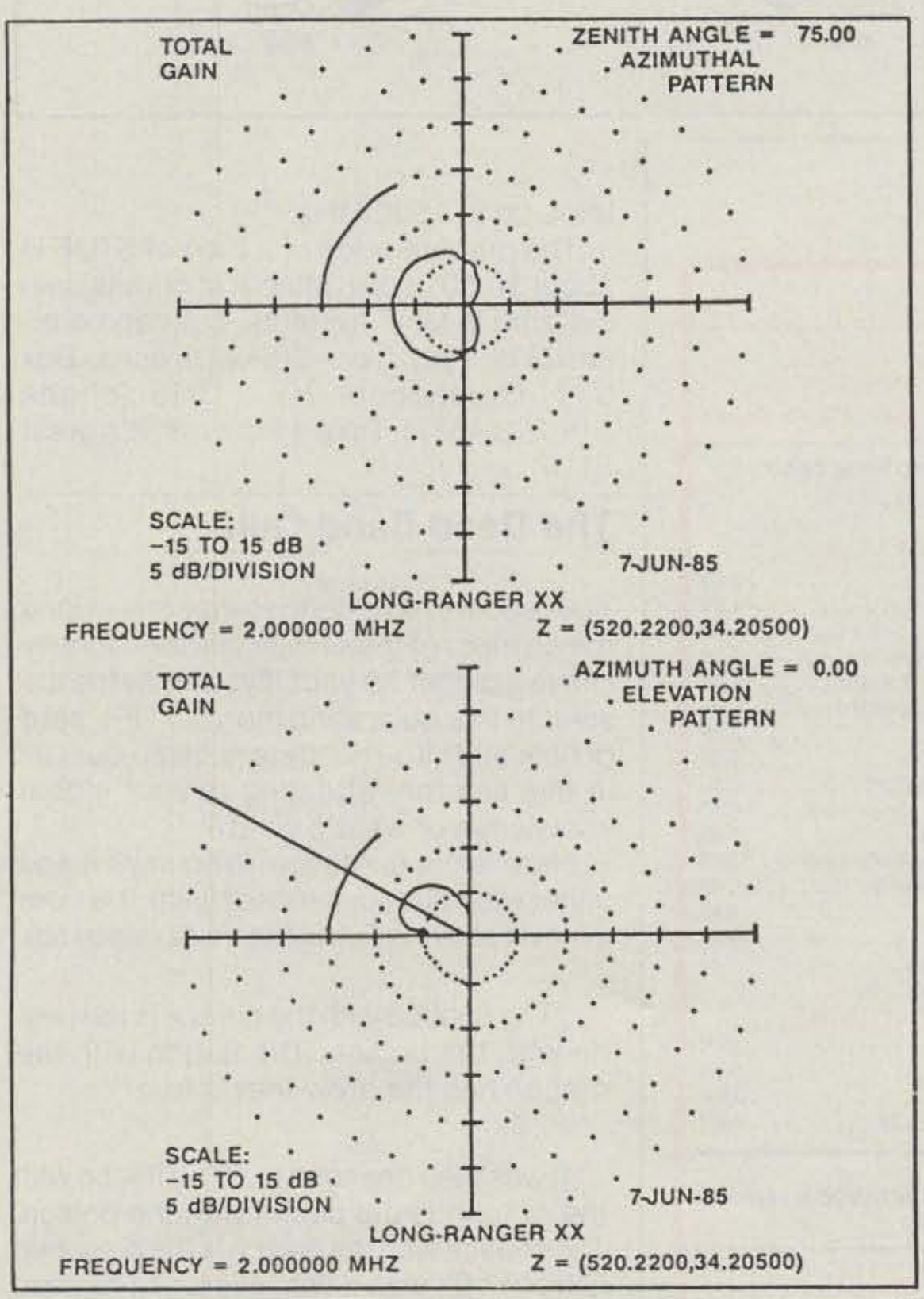

Fig. 4– Azimuth and elevation plots of zig-zag antenna. Take-off angle at 2.0 MHz is 30 degrees. (Drawing courtesy RF Design *magazine.)*

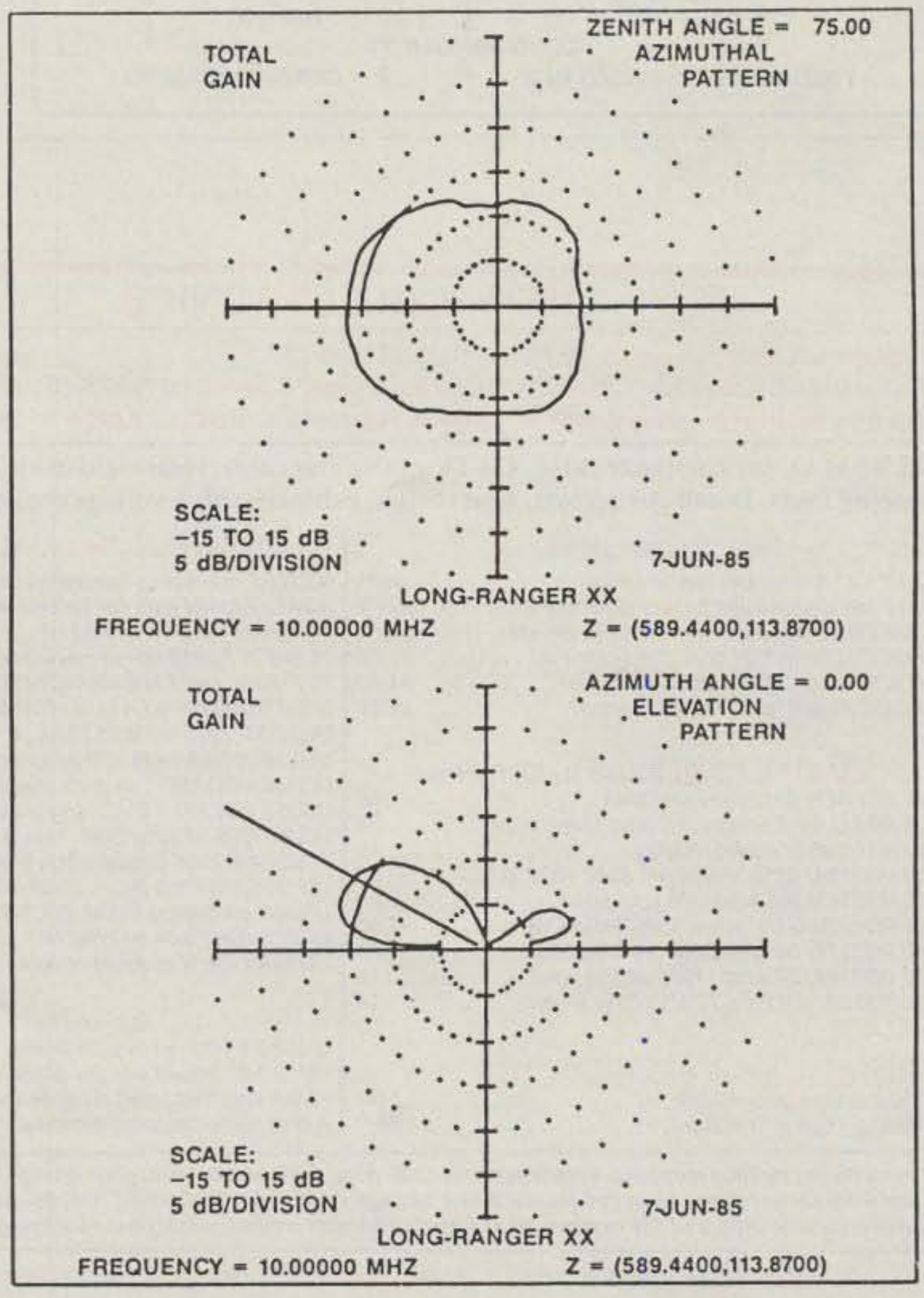

Fig. 5– Front-to-back ratio of zig-zag antenna is about 7 dB.

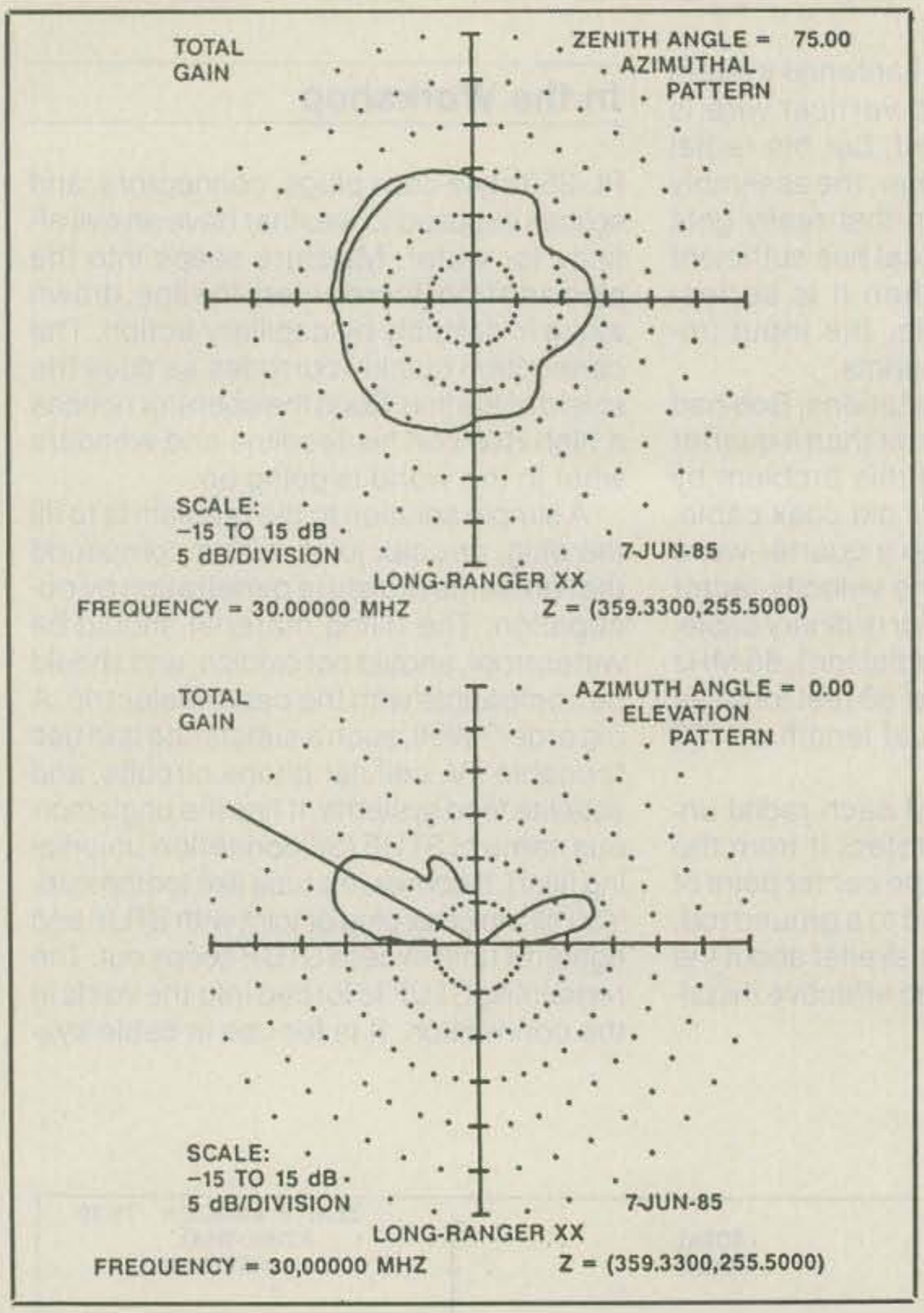

Fig. 6– The pattern remains substantially the same from 20 to 30 MHz.

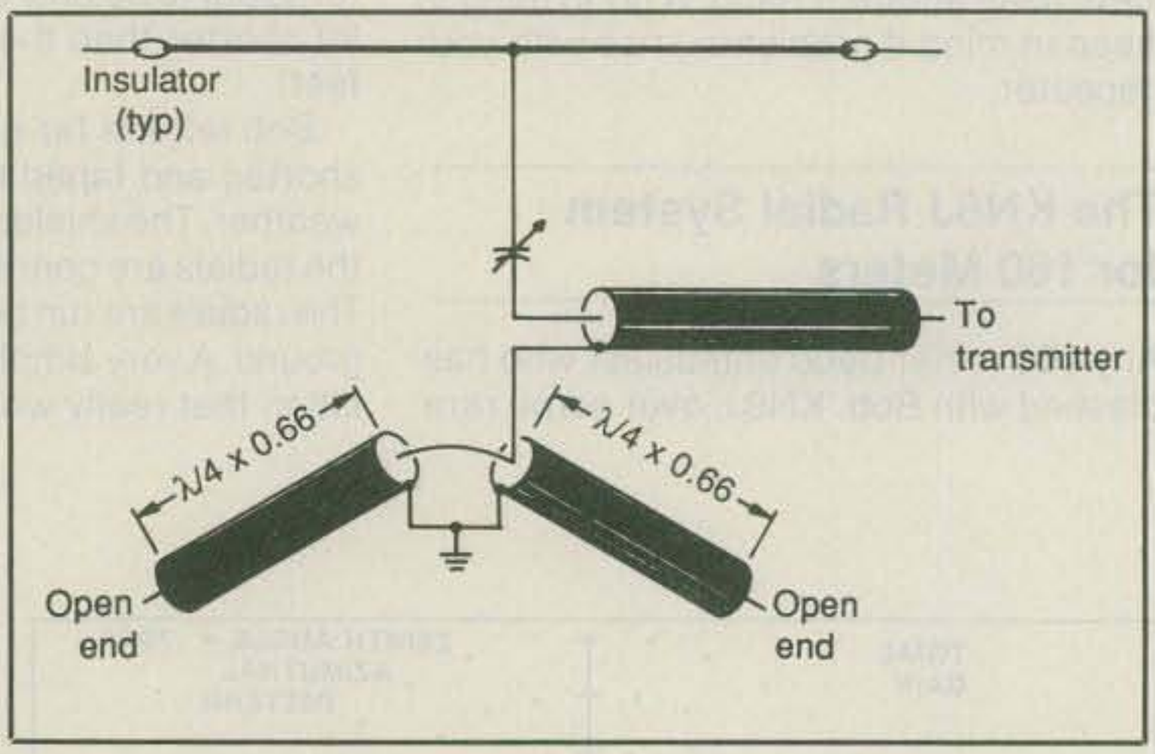

Fig. 7– One-sixty meter T-antenna of NR6J uses coaxial radials to conserve ground space.

tems up to 1500 MHz.

The present price of a tube of STUF is about $4.50. It is available at outlets specializing in UHF systems, but can be ordered directly from Cross Devices, Box 574, Cutchogue, NY 11935 (phone 516-298-4517). Take it from me, it's great STUF!

The Dead Band Quiz

You readers have consistently one-upped me on most of these little quizzes. Finally I have a dinger for you! If you know the answer to this quiz, send me your QSL card or note and I'll be happy to publish your call in this column, attesting to your global knowledge of what's what!

Here is the quotation. Who says it and under what circumstances? (Hint: It is from a movie starring Sylvia Fine's ex-husband).

"The chalice with the palace is the pestle with the poison. The flagon with the dragon has the brew that is true!"

It was then changed to, "The flagon with the dragon is the pestel with the poison. The chalice with the palace is the brew that is true!" Or was it the reverse? The hero of the movie was very confused.

73, Bill, W6SAI