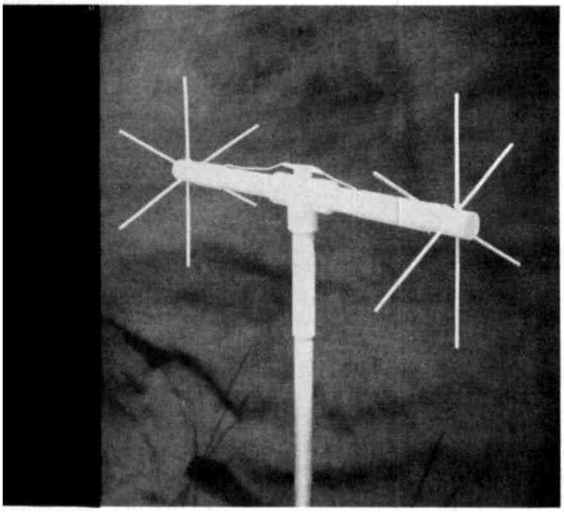


three-band ground plane

A low-cost high-performance omnidirectional antenna for 20, 15 and 10 with low-angle radiation

Fred Brown, W6HPH, Pine Cove, Idyllwild, California

This antenna was inspired by a mobile contact; a solid 20-meter QSO with a Los Angeles station from G3NMR/mobile. This is rather spectacular performance for a mobile in motion down on the street level of London. I was even more impressed when I saw that G3NMR's antenna was only 6 feet long. It was a commercial three-band mobile antenna for 20, 15 and 10 known as the Mark Products HW-3.

Since this antenna worked so well mobile, I thought it would work even better as a home-station antenna, especially if I made it bigger and put it up in the air. The active length of the HW-3 is about 5 feet; by extending this to a quarter wave on ten meters, I thought it should be possible to eliminate the ten-meter loading coil and improve efficiency on 20 and 15 at the same time.

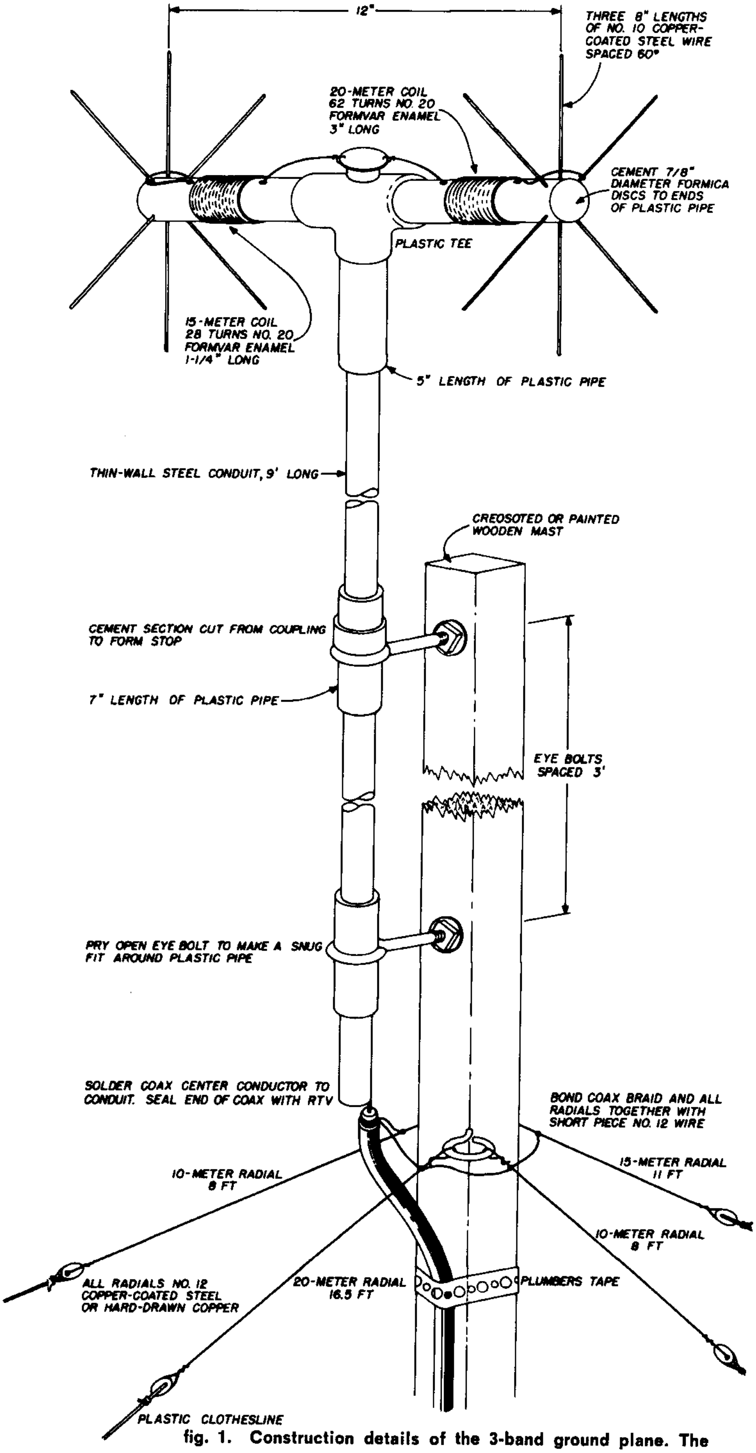


fig. 1. Construction details of the 3-band ground plane. The top tee is bored out so the end of the conduit sticks through; then a copper plate is soldered to the conduit for connecting the loading coils. Coil leads must be soldered to all three spikes.

construction

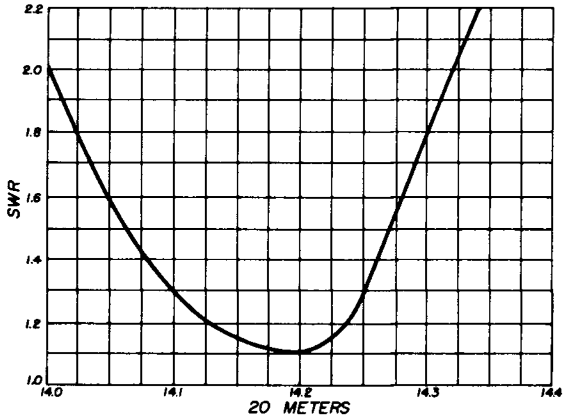
For the monopole, I used ordinary thin-wall steel conduit; it's available in ten-foot lengths from any building supply store. At first I thought the 20- and 15-meter loading coils would act as a slightly capacitive load so the resonant length on ten meters would be somewhat less than 8 feet. After cutting one piece of conduit to 8 feet—then successively shorter lengths—without obtaining any resonance on ten meters, I finally realized that the loading effect is really **inductive!** Therefore, the length should be **more** than a ten-meter quarter wave; a nine-foot length worked out very nicely.

Most of the construction details should be evident from the drawing shown in **fig. 1.** Half-inch plastic water pipe (which is actually 7/8" OD) is a perfect fit over the conduit. You'll need 3 feet of plastic pipe and one tee. The top of the tee is bored out so the conduit sticks through for connections to the loading coils.

The loading coils for 20 and 15 are terminated in capacity hats made from three pieces of number-10 wire forced through the ends of the plastic pipe. This permits loading coils with far less turns than would be the case if they were unterminated and helps reduce coil losses. It also improves the bandwidth since the L-to-C ratio is reduced. The coils would exhibit higher Q if they were larger in diameter, but in the interest of low wind resistance they were wound directly on the plastic pipe.

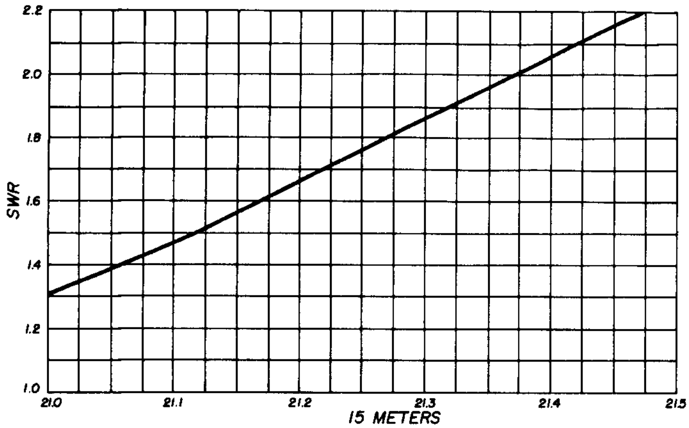
Losses in the twenty-meter coil can also be reduced by using fewer turns and making the capacity hat twice as large (16-inch spikes instead of 8-inch). This will also improve the swr bandwidth on twenty. However, if you make the 15-meter capacity hat larger, it will

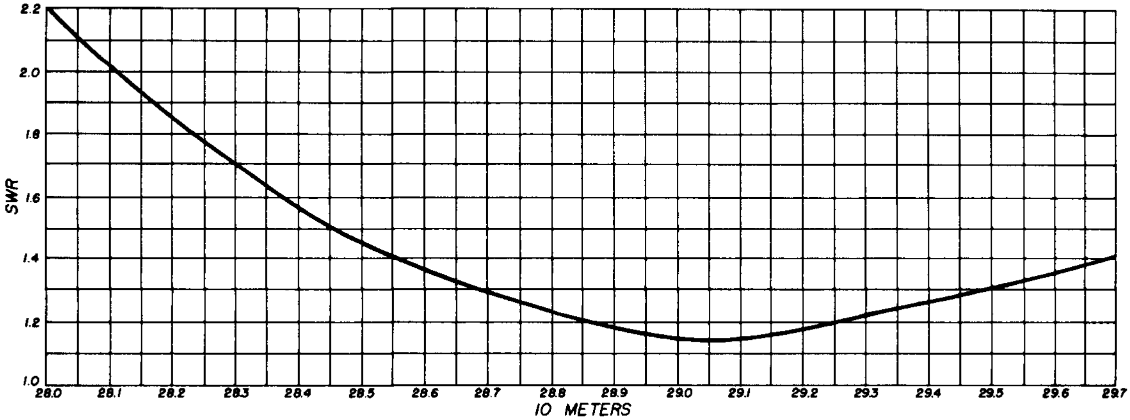
fig. 2. Swr performance of the 3-band ground plane.



turns is quite critical and it's best to start with a few too many turns and remove a half turn at a time until the frequency of minimum swr is near the band center. The inductance can also be trimmed by changing the spacing between turns. There is practically no interaction between 20- and 15-meter resonance.

The resonant frequency will be lowered about 150 kHz when the coils are painted, so it's a good idea to be about that much too high before painting. I used several coats of white spray-can enamel. This holds the turns in place nicely and makes the antenna fairly weather-proof. However, the frequency of





result in too small a coil which will foul up the ten-meter resonance. In the interest of appearance I made both capacity hats the same size.

I used number-21 Formvar insulated magnet wire for the coils because I happened to have this size on hand, but number 20 or number 18 would be better. The number of

minimum swr on twenty meters is still lowered about 100 kHz when the antenna is wet. The conduit is zinc plated but sprayed with clear lacquer as a further rust preventive.

The best way to tune the antenna is with an swr meter. You can make a good counterpoise by spreading four 8- to 10-foot lengths of wire on the ground to make a big X. The monopole can then be suspended over the X with plastic clothesline. This will put the coils only 9 feet off the ground so they can easily be reached with a step ladder. Solder the center conductor of the coax to the base of the monopole and the outer conductor to the junction of the X. Alternatively, you can use a car body or other non-resonant object as the counter-poise.

In its final form, the antenna has four radials which also serve as guy wires, forming a drooping ground plane. Two of the radials are resonant on ten, and these run in opposite directions. One is resonant on 15 and one on 20. I found it important to have at least one radial resonant on each band to prevent rf current from flowing down the outside of the coax. The relative values of rf current in the radials and on the outside of the coax can be checked with the rf current probe described in **ham notebook** on page 76. So long as the current in at least one of the radials is more than four times the current measured on the coax, radiation from the coax will be negligible.

results

The final swr-vs-frequency plots are shown in **fig. 2.** Bandwidth is more than adequate on 10 and 15 meters, but is just barely good enough for covering twenty with an swr below 2.0:1. These measurements were made through 45 feet of RG8/U, but essentially identical results were obtained with a short piece of coax and the antenna mounted over a counterpoise on the ground. The swr curve for 15 meters would indicate that perhaps the 15-meter loading coil has a half turn too many; but 15-meter resonance is so broad I haven't bothered to change it.

This antenna will not equal the performance of a good full-sized rotary beam, but it will give excellent low-radiation-angle omnidirectional coverage on 20, 15 and 10. Field-strength measurements and flattering signal reports received from DX stations around the world indicate the antenna does all that could possibly be expected of it. Total cost of materials, neglecting the mast and coax, was under $4.00. For this price, you'll find it hard to beat.

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