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The Incredible Shrinking Antenna

—give your vertical a top hat

You might not believe it if I told you that you can build a vertical antenna for 40 meters that has a 2:1 swr bandwidth of over 1 MHz, is highly efficient, is only 12′ high, and will withstand wind velocities to an extent that it will probably never blow down.

It probably sounds too good to be possible. And yet, it can be done easily using a technique that I have seen very little of at amateur frequencies: oversized capacity hats. The antenna described here was built from the remnants of an old 14AVQ 4-band trap vertical, a few feet of wire, and three ordinary porcelain insulators.

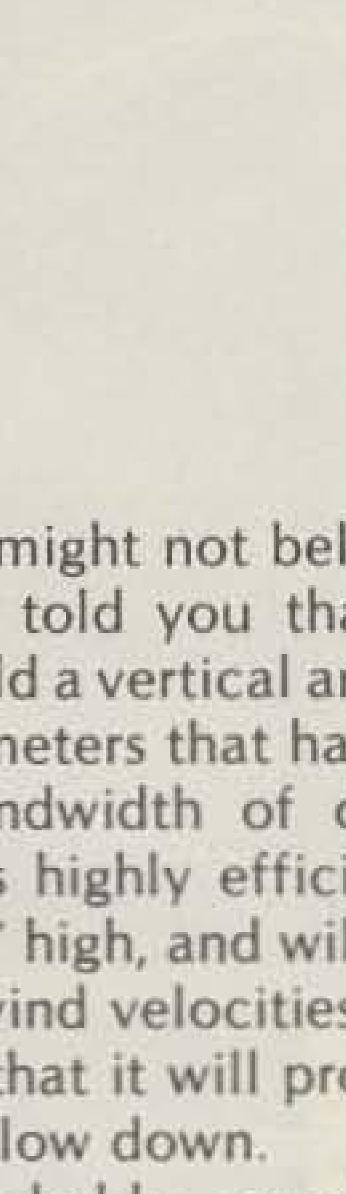

Fig. 1. A Capacity hat of radius r increases effective antenna height by twice its radius, or 2r. That is, the antenna at A and the antenna at B will have about the same resonant frequency if the lower section (thick line) is identical in both cases.

Capacitive Loading

Take a drive around your local ham neighborhood and observe the trap vertical antennas being used. Most of them have a little top hat consisting of three or four prongs about a foot long. What is the purpose of this little thing? Basically, it increases the capacitance of the high-voltage end of the antenna. Capacitive loading brings down the impedance value at the top of a vertical antenna, reducing chances for "corona" effects. It also increases the bandwidth somewhat on the lowest band; not much, but a little is better than nothing. The capacity hat also makes the antenna look much more sophisticated and *increases* the wind loading. (Isn't that great?)

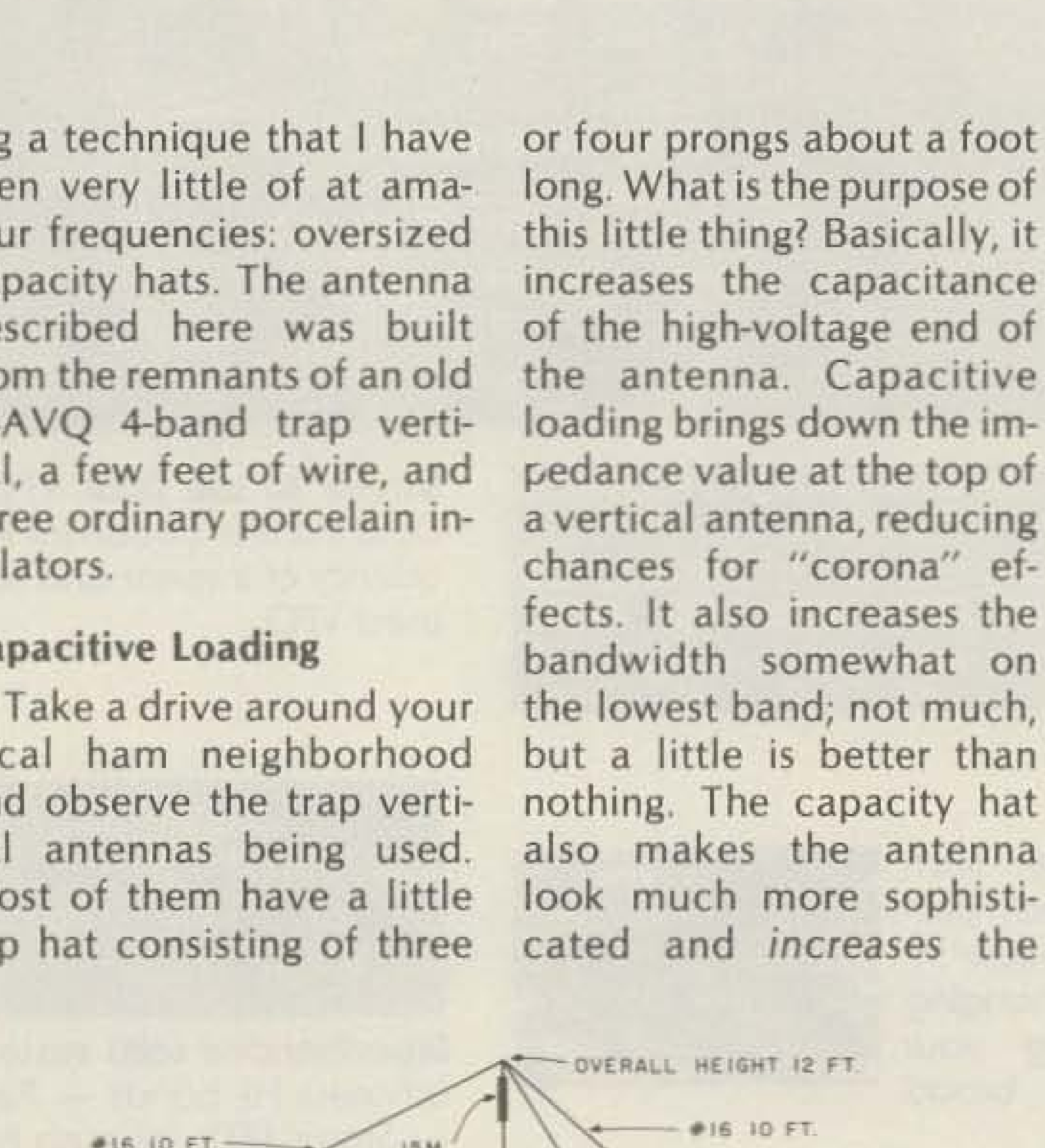

Fig. 2. The basic design of the 12′ 40/15-meter vertical. The trap and base mount are from the original 14AVQ. The capacity hat wires were attached to the top of the trap via an ordinary hose clamp. The fine details of construction are not critical, and the builder may use whatever methods suit his situation.

Actually, capacitive loading is under-utilized on the 40-, 80-, and 160-meter amateur bands. While the radius of the capacity hat on a commercially manufactured trap vertical is about 12″, which translates to an electrical length of 0.008 wavelength on 40 meters or 0.004 wavelength on 80 meters, it is possible to have a capacity hat radius of up to about 0.1 wavelength without producing detrimental effects on antenna efficiency. This is true because most of the radiation from an antenna occurs where the current is highest, and that's near the bottom of a quarter-wave vertical.

In general, a capacity hat of radius r, consisting of three or four elements, increases the effective height of a quarter-wave vertical by about 2r. This is illustrated in Fig. 1. The physical size of 0.1 wavelength is about 12′ at 40 meters, 24′ at 80 meters, and 48′ at 160 meters.

The 40/15-Meter Vertical

Fig. 2 shows the design of the 40- and 15-meter antenna I constructed. Actually, I designed the antenna with only 40 meters in mind, but it turned out that the lengths and inductance values required were close enough to allow the inclusion of 15-meter capability. The entire antenna system is resonant as a quarter-wave vertical on 40, and the 11′ section underneath the 15-meter trap operates as a quarter-wave system on 15.

I installed six radials, each 34′ long, simply by laying them on the grass (after warning the landlord to have me remove them before he cut the lawn!). This is admittedly a marginal system; actually it takes dozens of radials to make a ground-mounted vertical optimum. But, being basically lazy (and frugal), I felt quite content with only six. This proved to be entirely adequate on the air.

Using the formula that the 10′ radius of the capacity hat translates to about 20′ of additional height for the antenna, you can see that the effective height of this vertical is pretty close to a full quarter wave on 40 meters. Actually, the swr bandwidth is astonishing. Fig. 3 shows the swr measurements across the 40-meter band.

Of course, you may say that Fig. 3 doesn't tell us much about the antenna; after all, a dummy load would have a swr curve every bit as flat, and even lower! And, if this antenna were radiating almost nothing but happened to have a ground resistance close to 50 Ohms, you might get a curve similar to that shown in Fig. 3. This is a valid point. So, I checked out the swr on 20 and 80 meters; it should be very high if the antenna is working properly—it is. The broad resonant response of this antenna is, no doubt, attributable to the effects of the gigantic capacity hat.

One note if you happen to have a 4-band trap vertical and are thinking about trying this idea: The radius of the capacity hat may vary a little bit, depending on the ground characteristics in your vicinity and the Q of your 15-meter trap. However, the radius should be between 8′ and 12′ in almost any situation.

On the Air

Then came the ultimate test, the real checkout. There's only one way to see whether an antenna works after all the engineering and swr checking is done. The question was, of course: Will this antenna "get out"?

On the air, the antenna performed as expected for a vertical. Nearby stations (within a radius of about 300 miles) were relatively weak, and stations further away were strong. A lot of DX was heard and worked, especially from Europe in the evening and Japan and New Zealand in the morning. Many of these DX stations were as strong as stateside W2 stations.

I'm not about to make any extraordinary claims for this antenna. In operation, it seemed to outperform the original 14AVQ with respect to DX; it proved essentially the equivalent of a full-size, 33′ structure which I subsequently built and tested. This little antenna certainly is more physically rugged than the full-size job. The latter strained perilously against mere 20-mph winds, while the little 12′ antenna was indifferent to gusts in excess of 40 mph. By indifferent, I mean that it hardly moved. And, of course, during a heavy thunderstorm, I would much rather have a 12′ metal structure in my yard than a 33′ metal structure!

Considerations for 80 and 160

Since 40 meters is my favorite band by far, I did not consider applying this technique to 80 or 160. However, these low bands are even better candidates for the idea than 40 meters.

If you are interested in building an antenna of this kind for 80 or 160 meters, remember that the maximum radius of the capacity hat is 0.1 wavelength, or 24′ on 80 and 48′ on 160. These values are probably best. Why go for anything shorter? As for height, choose the maximum height you feel comfortable with. On 80 meters, 16′ would be a good choice, since the coil or trap would allow resonance on 20 meters also.

In place of the trap, it is recommended that an air-core coil be used, which can be tapped until the proper value of inductance is obtained. The trial-and-error process may take a while, but resonance should be very broad, so the task should not be that difficult. ■

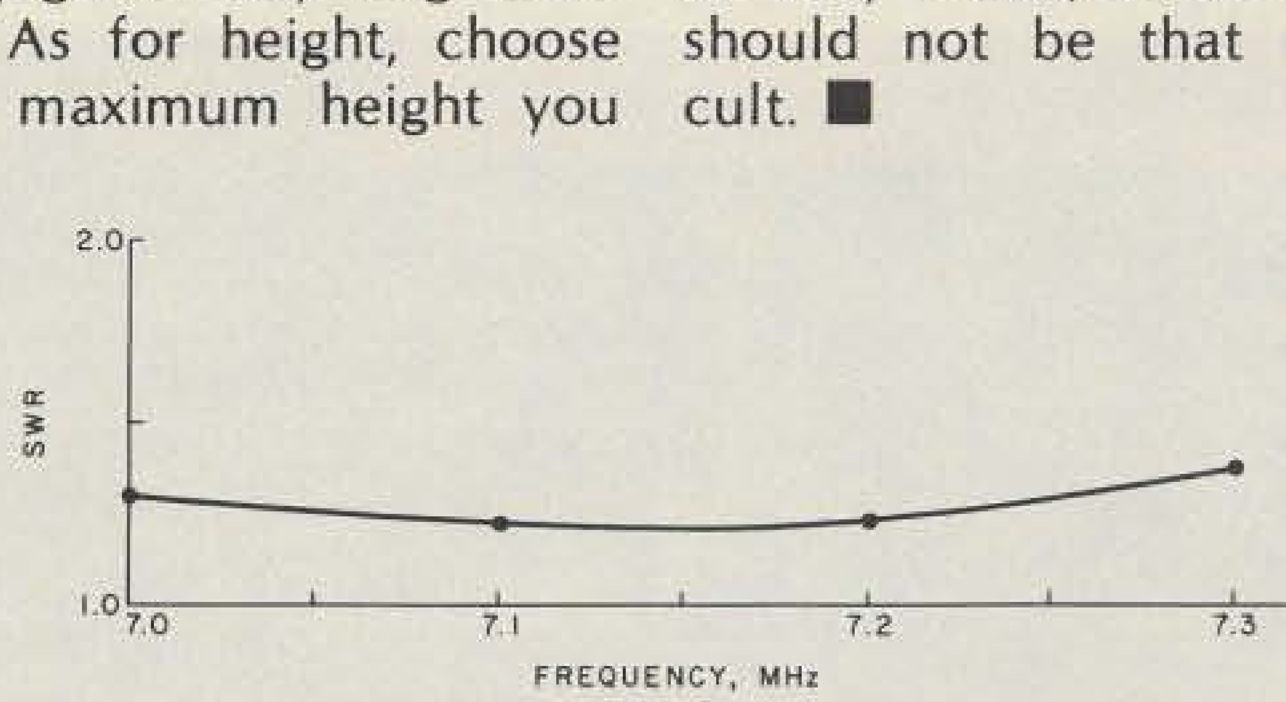

Fig. 3. The swr curve for this antenna is almost flat. The exact value will depend on the number of radials used and the conductivity of the ground. Anything less than 2:1 is generally regarded as acceptable. The important characteristic here is the flatness of the curve, indicating a very low Q attributable to the large size of the capacity hat.