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Antenna Fans: Try the Skeleton Slot

— an improved driven element for VHF/UHF

One of the problems with simple yagi antennas is obtaining wide bandwidth while keeping the swr low over an entire band. Usually, one has to compromise and dimension the antenna for a particular portion of a band.

The main reason that the swr changes across a band is that the lengths and spacings of the elements used in the antenna do not change as the transmitted frequency is changed. These physical arrangements, along with the wavelength change due to frequency alteration, cause changes in the mutual coupling to the driven element, and the feedpoint impedance of the driven element also is changing, and this contributes also to changes in the feedpoint impedance.

One classic approach to solving this problem has been to make the driven element a folded dipole. The inherently wider bandwidth characteristic of the folded dipole element, as compared to a simple dipole, prevents the driven element impedance changing as much as the electrical length of that element changes. However, G2HCG has gone a step further and developed a driven element configuration which not only has broad bandwidth by itself, but when used in a yagi is far less affected by the influence of frequency-dependent electrical length changes of other elements in the yagi. To top it off, the overall gain of the yagi may also be slightly increased by his form of driven element. Although his form of driven element is popular in G-land, it has not yet been used much here. Those amateurs who have simple, multi-element yagis and desire to increase the bandwidth characteristics will find this new form of driven element very applicable.

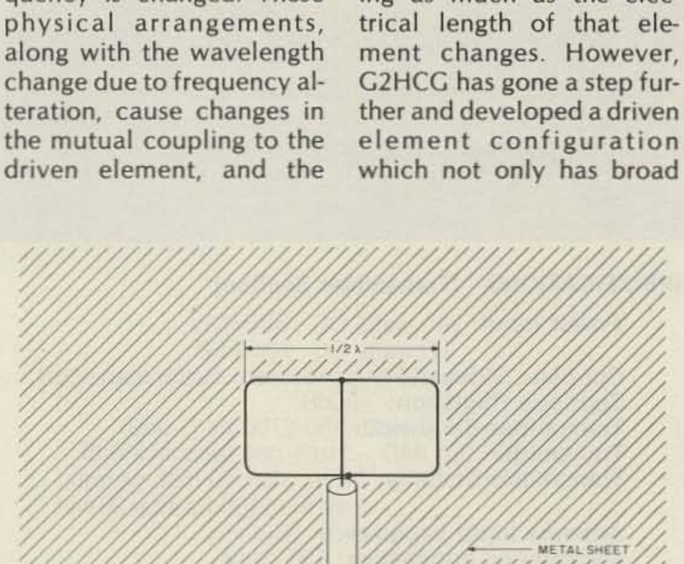

Fig. 1. The true slot antenna doesn't look like an antenna at all. It is a dimensioned slot cut in a large piece of sheet metal.

The skeleton slot-driven element, as it is called, derived from experiments concerning a true slot antenna. A true slot antenna, as shown in Fig. 1, is not what most of us would visualize as being a "real" antenna. It is, as the name indicates, a slot cut out of a sheet of metal. The slot thus formed radiates much like a conventional dipole. If one makes the slot wider, it is similar to making the length-to-diameter ratio of a conventional dipole smaller. In other words, the dipole length remains the same, but the diameter of the elements increases. This will increase the bandwidth. In the case of properly-dimensioned slot antennas, very large bandwidths can be achieved in the UHF range.

The skeleton slot resulted from experiments to determine how small the sheet of metal could be made and still retain the characteristics of a slot antenna. The final result was to demonstrate that a "skeleton" made of tubing, and dimensioned as shown in Fig. 2 (a), acted much like a slot antenna. The antenna of Fig. 2 (a) can be visualized as shown in Fig. 2 (b), i.e., as two ½-λ antennas spaced 5/8 λ where the ends of each ½-λ section are bent.

The final practical form of the antenna is shown in Fig. 2 (c) along with practical dimensioning information for the VHF bands. If the antenna, used as a driven element in a yagi, is constructed of the tubing sizes normally found in VHF beams, the feedpoint impedance is approximately 300 Ohms. So, one can use twinlead as a feedline for low-power installations or use a conventional 4:1 balun at the antenna for a 75-Ohm coaxial cable transmission line.

Further practical experiments with the skeleton slot as a driven

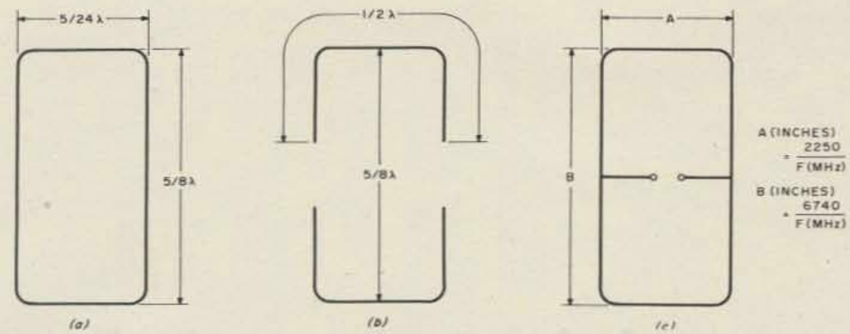

Fig. 2. (a) The original skeleton slot. (b) Showing how it might be visualized as stacked dipoles. (c) Showing practical dimensions.

element showed that it worked best if bent slightly forward, as shown in Fig. 3 (a), at an angle of about 11 degrees from the vertical. Also, when using the skeleton slot as a driven element, the parasitic reflector elements in a yagi should be changed so there are two: each one at the approximate height of each horizontal member of the skeleton slot, as shown in Fig. 3 (b). The reflector and director elements can retain their normal dimensioning. There is some slight increase in forward gain using the skeleton slot as the driven element. This is probably due to the fact that the skeleton slot itself acts as two stacked dipole radiators, and also from the effect of the added reflector elements. The gain increase can be about 2 dB.

It is difficult to say how much the bandwidth of a given VHF antenna will be increased by the use of the skeleton slot as the driven element. Increases in bandwidth of up to twice that using normal dipole elements are possible. Of course, this would be an increase in bandwidth in regard to keeping the swr low. It doesn't mean that the antenna would retain its forward gain characteristics over the entire bandwidth. Nonetheless, the ability to load into this antenna and get some gain at an increased bandwidth may well make the skeleton slot modification worthwhile.

Although the skeleton slot antenna has its main application at VHF frequencies, it also might have some applicability at HF frequencies as a wire antenna. The dimensions might suit some situation where only a small distance is available for the horizontal portion of the antenna on a given band, but height is available. One idea that suggests itself is to try the antenna on a tower using arms extending from the tower to form the horizontal portions of the antenna. Even on 7 MHz, only two approximately 13-foot-long arms would be required. Constructed of wire and used on the HF bands, the feedpoint impedance of the antenna might rise severalfold. This is because the dimensions of the antenna become so much larger than the diameter of the wire that would be used to construct it. Nonetheless, the idea is an interesting one, and such an antenna fed with a resonant transmission line might perform very well.■

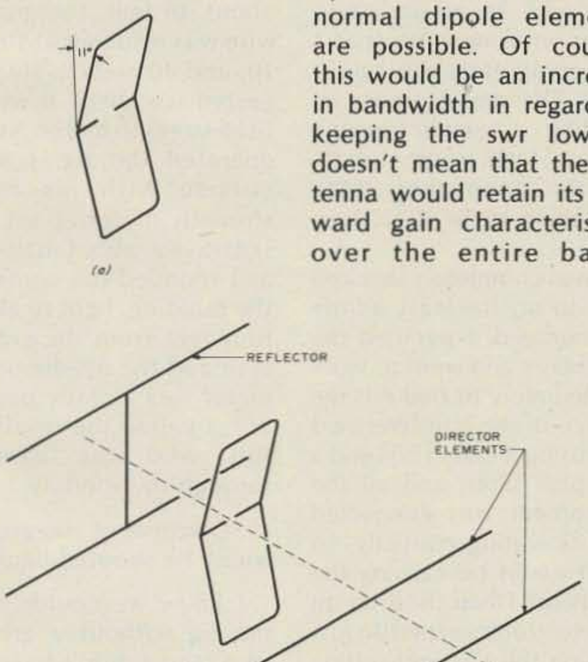

Fig. 3. (a) There is a small forward tilt to the skeleton slot. (b) This is how the skeleton slot would be used in a yagi, with a modified reflector.

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