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THE "SKELETON SLOT" ANTENNA

BY G. M. BOWEN,* VK5XU

There has been quite a deal of interest in the slot as an antenna since the technical details of the Sutton-Coldfield t.v. station were released in "Wireless World." As the original slot antenna had a very high wind resistance with its solid surround, it was only natural that the Amateurs who could see the makings of a good v.h.f. radiator in it, would set to work to see how much of the surrounding metal could be cut away without seriously affecting its performance.

G2MC, in the August issue of "W.W.," gave the details of a "skeleton" for the 144 Mc. band and in order to have something different to talk about at a lecture, I made up a model in about half-an-hour which provided us all with a night's entertainment. The construction is very simple and the accompanying diagrams should be sufficient guide; the diameters are not critical.

The antenna radiates as a broadside array with a polar diagram like two half wave dipoles spaced half wave apart and fed in phase. The resultant figure of eight pattern is elongated and results in an approximate gain of 4 db over a single dipole.

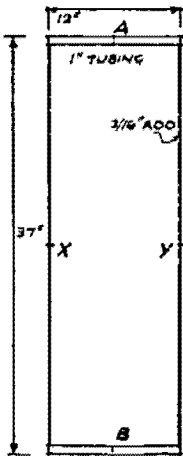


Fig. 1.

Maximum radiation takes place from the two short ends made from large diameter tubing as it is here that maximum current appears and that it does, can be proved by testing for horizontal or vertical polarisation with a simple dipole field strength meter. The dipole gives maximum reading when it is parallel to the two pieces of tubing, so that when they are horizontal the radiated wave is horizontally polarised.

Referring to Fig. 1, X and Y are high voltage, high impedance points, but as yet there is no data as to the exact value for the "skeleton." A and B are points of maximum current and therefore low impedance points which can be earthed if so required.

Since our article on "Skeleton Slots" in February, 1954, issue of "Amateur Radio," we have received further articles by VK5XU and VK2NO describing further experiments and results obtained with them.

To complete the picture we are publishing both articles to give readers additional food for thought and to satisfy the urge to try something new.

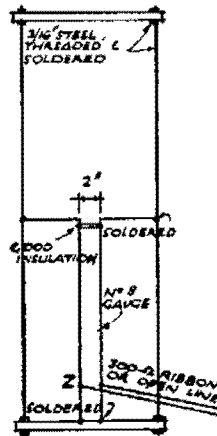


Fig. 2.

A quarter wave open line shown in Fig. 2 can be used as an impedance transformer and any line can be matched into the antenna. I found that 300 ohm ribbon matched in about one-third of the way up from B.

Fig. 3 shows an arrangement of feeding an unbalanced co-axial line into the two high impedance points X and Y. Some fanning out of the open line connections to the co-axial quarter wave

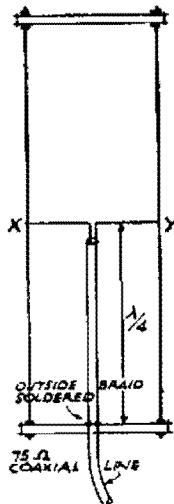


Fig. 3.

may be found necessary as the quarter wavelength of co-axial matching section will only need to be about 60% of 19" according to the velocity factor of the co-axial cable chosen.

Fig. 4 shows the quarter wave open wire stub affixed at right angles to the plane of the antenna. With this construction it is possible to add a reflector at the point where the stub is shorted. Its length will be an electrical half wave which will be approximately 38 inches.

When experimenting with reflectors and directors, I found that the use of reflectors gave the better results; better still, a reflector spaced 0.15 wavelength behind each 12 inch section of the antenna. In this case the reflectors were 5% longer than the length of an ordinary dipole (i.e. about 39 to 40 inches). The closer spacing reduced the radiation resistance and a re-adjustment of the feeder input was necessary to obtain correct matching.

By adjusting the distance between the two reflectors, the depth of the radiated beam can be altered, but as yet I have not made any quantitative tests to ascertain what gain could be expected. This particular aspect should be worth experimenting with, especially if readings can be obtained over some considerable distance.

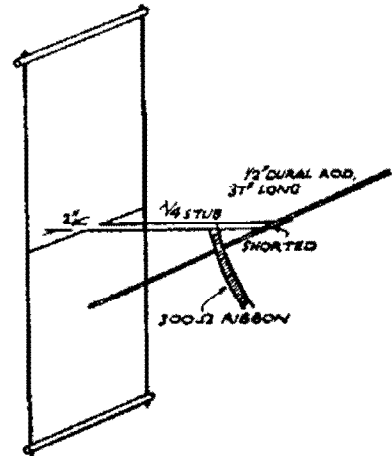


Fig. 4.

The single reflector raises the forward gain another 3 db and increases the front-to-back ratio as is usual; while there is quite a considerable improvement with the two, but how much I cannot yet say.

Fig. 5 should be self explanatory. Points A, B, C and D are at earth potential and therefore can be bonded together with the supporting mast passing through B and D, thus enabling the constructor to make a thoroughly rigid job which can be easily rotated. A third reflector could then be mounted a quarter wave length behind the feed points X and Y. The method for feeding the array, then, would be preferably as in Fig. 4.

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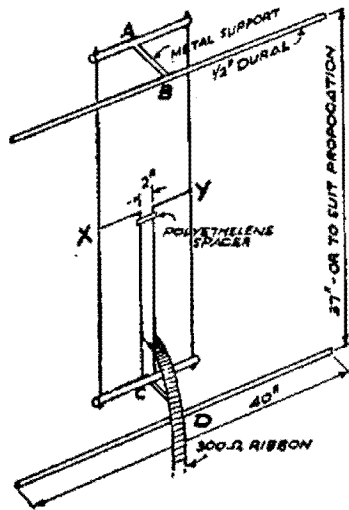


Fig. 5.
Spacing of Reflectors approx. 13 inches.

If a combination of any unlike metals is used in constructing the array, it is wise to give the finished array a fairly heavy coating of aluminium based enamel to stop corrosion of the joints in the damp weather. Make sure, too, that all joints are soldered if steel and brass are used, particularly where the long side pieces enter the larger diameter tubing. This will keep the ohmic losses down.

Having Fun With "Skeleton Slots"

BY DON B. KNOCK,† VK2NO

Although until now practically unheeded by VKs, something new and intriguing has hit the headlines (overseas) in the way of antennae. The "skeltonised" version of the aircraft type "slot" antenna, first appears to have originated in U.K., although passing reference has been made to it in "QST" (U.S.A.).

It remained for G2MC to evolve a practical version for 2 metres, with a full description in August, 1954, "Wireless World." I wish to draw attention also to a very informative article on the subject in "R.S.G.B. Bulletin" for January, 1953, dealing with the stacking, for v.h.f. work, of "Skeleton Slots." (An article on this subject was published in "A.R." of February, 1954, p.2—Ed.)

Co-incidental with a return to Amateur v.h.f. activity after an enforced absence of six years at VK2NO, some QRP 144 Mc. gear was put together, and a start made with a plain dipole. With a transmitter boasting all of 2 watts on the 6J6 p.p. triode p.a., excellent contact was established with most Sydney stations. One or two, however, remained "hard to get" from my coast-wise "edge of beyond" location.

In the search for better signal strength, the dipole grew a reflector,

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became rotatable, and things began to look up. Then I thought of the skeleton slot and got busy.

Two such slots for 144 Mc. were made up, fed in phase, with one above the other, and backed by reflectors. The immediate results border on the fantastic, most of the v.h.f. gang around Sydney being sceptical about the 2 watts producing such a "mighty" signal.

There is no fuss about tuning up this array—for it is broadly resonant. The field strength indicator, a 0-1 Ma. meter with a 1N34 diode and small dipole, shows a high degree of forward gain, several feet in front of the array. Tests made with reliable observers up to 60 miles distant indicate a back-to-front ratio of 7 S points, which is around 30 db, and a very good discrimination off the ends of the array.

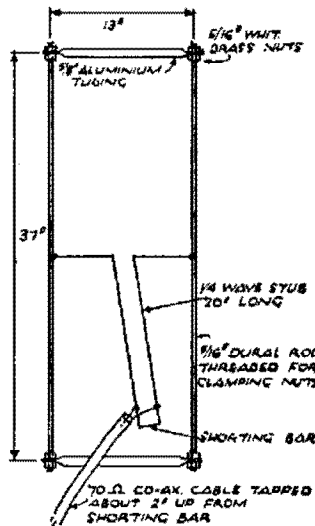


Fig. 6.—Skeleton Slot for 144 Mc.

The sketch (Fig. 6) shows the structure of the skeleton slot for 144 Mc., cut to hit around 144.6 Mc. Two 37 inch lengths of 5/16 inch rod, dural in my case, are threaded at the ends for hex. nuts. Two 14 inch lengths of tubing are flattened at the ends and drilled for 5/16 inch clearance at 13 inch centres. Clamped in position by the nuts, the assembly becomes rigid and virtually self-supporting. The centres of the 14 inch tubes at top and bottom are "cold" for r.f. and therefore no insulation is necessary for mounting on a pole or any structure.

Now comes the really important point about the skeleton as distinct from the metal surround slot—although a physically vertical arrangement, it radiates horizontally polarised waves, a decided advantage with interesting possibilities for lower frequencies. The feed points at the centres of the 37 inch upright rods approximate 600 ohms, so that if desired an open line may be applied, or a quarter wave stub with shorting bar for 70 or 300 ohm line. G2MC found that the stub can be brought down vertically and terminated on the bottom cross tube member. Alternatively, the stub can be arranged hori-

zontally on a strut from the supporting pole, and a 40 inch reflector placed as combined shorting bar and reflector.

Fig. 7 shows how the two skeleton slots are arranged at VK2NO. A length of 1 1/4 x 1 inch timber 10 feet long is used as the foundation, with three struts 20 inches long. Two of the struts are at positions from the centres of the slots, to hold the respective reflectors, and the centre one is for the junction of the feedlines.

From the centres of the 37 inch rods, 34 inch lengths of 16 gauge wire are arranged, being brought together on 2 inch polystyrene spacers to form a uniform feedline. These lines, from each slot, are paralleled and thus the effective impedance is 300 ohms, the feedline from the array being Telcon 300 ohm ribbon.

It will be appreciated that with these two slots phased and paralleled (make sure you don't transpose the lines), no matching stub is necessary. If you wish to use low impedance line, that is simple too. Just make the paralleled lines from the slots 50 inches long each, instead of 34 inches (as for 300 ohms), join on the 70 ohm co-ax or ribbon, and away you go.

The results obtained with this little array are so promising that the writer is harbouring slot ideas for other bands. For instance, a skeleton slot 9 ft. 6in. by 3 ft. 3 in. should be interesting on 6 metres; remember—horizontal radiation with a vertical array! What about one 22 ft. by 7 ft. for 21 Mc., hanging vertically from that unused pole? You can pull it around with two ropes for directivity!

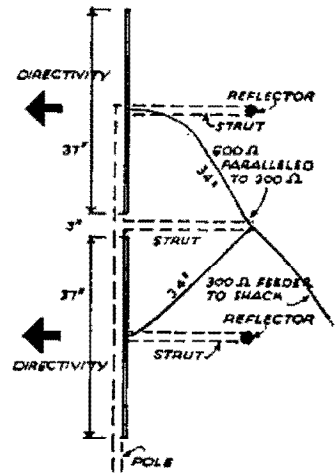


Fig. 7.—Side View.

There are other considerations, too, subject also to trial and result. It may be possible to use a 6 metre skeleton slot inside a 15 metre one, and rotate the two together! When on 6 metres the larger metal rectangle might contribute somewhat to the normal slot "surround." My reason for telling this yarn about the skeleton slot is mainly because of its convenience in erection. It is not claimed that there are any magical qualities, but it most certainly is a fine performer on 2 metres.