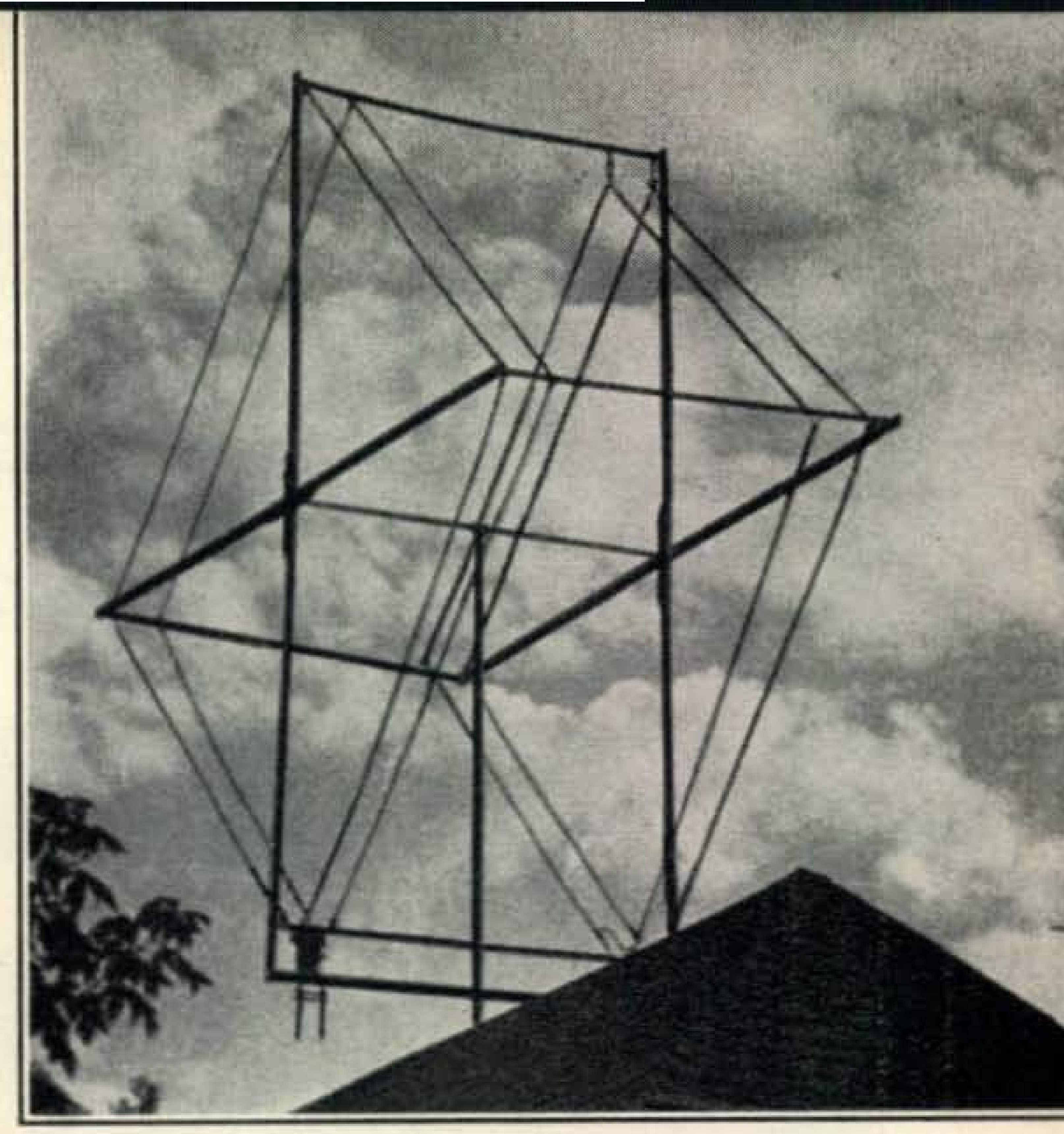
W8RLT's cubical quad viewed close up. The stub is visible, the feed line obscured by the roof peak.



CUBICAL QUAD-

Topic Number One!

THE CQ STAFF

AN INCREASING TENDENCY during this past fall was not to discuss the relative merits of antennas in general, but the merits of one antenna in particular—the "cubical quad." It seems quite possible that never in the history of amateur radio has one development run the gauntlet from sheer derision to wild acclaim in a span of a few months. The whole story of the cubical quad remains to be told in its entirety. Many versions of the story, and the antenna itself, are rampant. Just how much like the original design they are, is still unknown—and will be revealed only when the person who developed this antenna can release all the facts.

In the meantime, from the midst of this confusion, certain points about the quad are in agreement, although many installations often vary in small details. The Editors of *CQ* are naturally in the position that they may compare the many installations and from them extract sufficient data to form a fairly solid background of the mechanical design and construction. This is the extent of this article. In lieu of an "official" release by the developer, we have compiled many notes and from these have selected what appears to us to be the most universally accepted version of the cubical quad antenna.

The Radiator—or Quad

The basic principle of the quad radiating section is to take four half waves and fold them about a vertical square frame that is one-quarter wave on a side, the configuration being fed at the bottom. In doing so, the wire length will go around twice and hence must be spaced with a cross-over made at the bottom so that the feed may be attached to the two free ends. The spacing between wire "wrap around" generally will not exceed 9 inches.

The physical configuration of the quad radiator shows us that the radiated pattern must be one of horizontal polarization. The quad radiator may be

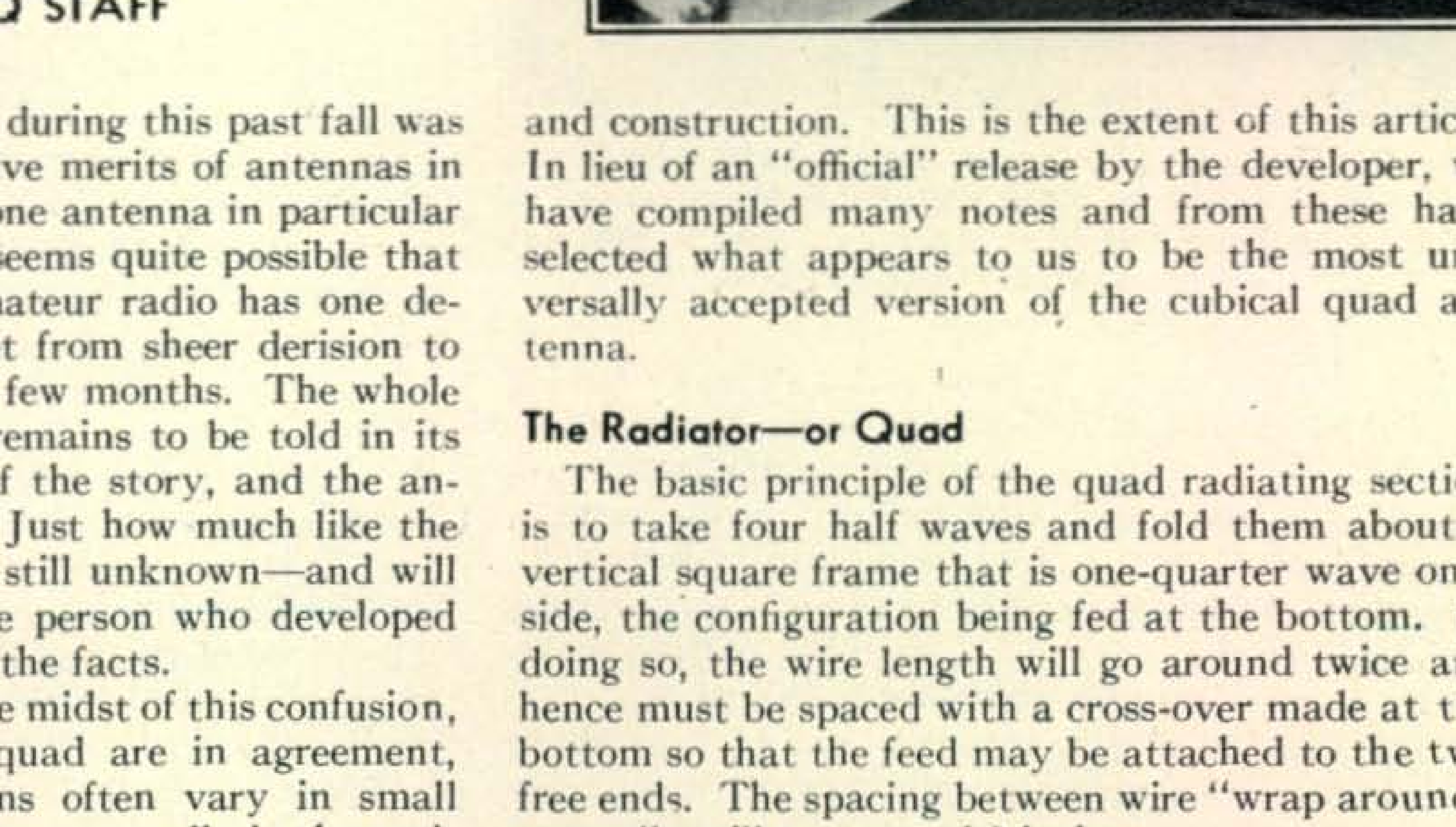


Fig. 1. Recommended dimensions for cubical quad on 28.6 mc. Wire size is not important. Spacing between the parallel wires in the same loop should not exceed 9 inches, and close spacing is preferable.

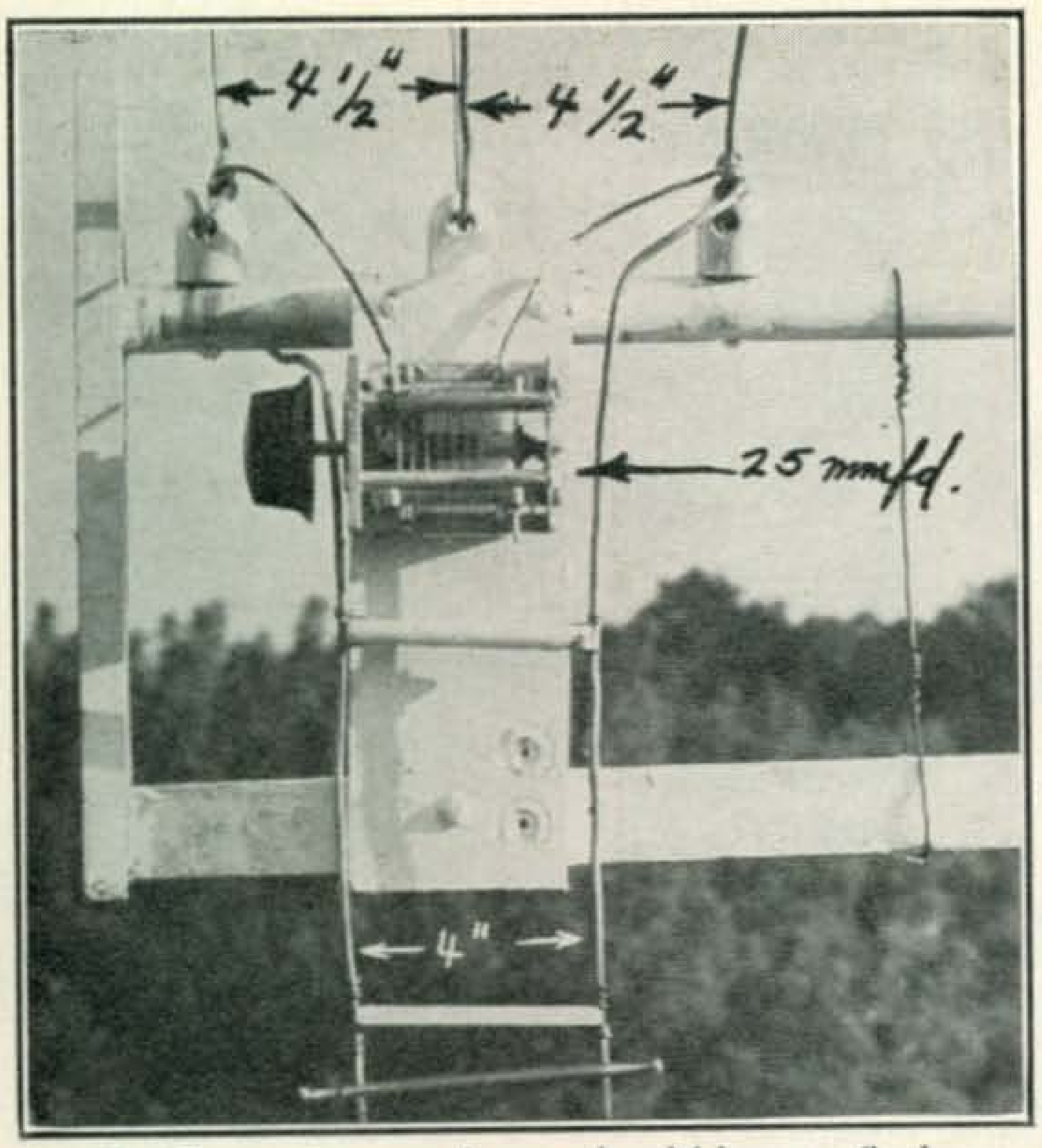


Fig. 2. The tuning condenser should have a flash-over voltage no less than 3000 volts for medium power. It is best to protect it from moisture. This is the stub on the bottom W8RLT's quad.

analyzed as a sort of in-phase stacked array having less than the usual half-wave spacing between elements. As might be expected from stacked arrays there is an increase in the radiated power concentrated at the lower angles of radiation, although the less-than-optimum spacing employed only results in a gain of the order of 1-2 db. The pattern maximizes perpendicular to the plane of the quad.

The spacing of the wrapped-around wire about the frame is a (probably unimportant) matter apparently open to some variation. The greater number of installations inspected by the Editors were spaced according to the wire size and center-to-center spacing of a 600-ohm transmission line when the quad was used with a reflector, the "cubical quad."

The Reflector

The addition of a single reflector transforms the quad into what is now popularly referred to as the *cubical quad*. In general, the optimum reflector spacing appears to 0.15 wavelength from the radiator. It has been experimentally determined that the reflector should be 1.03 times the length of the radiator on a side. The complete dimensions for a 28.6-mc cubical quad are shown in *Fig. 1.*

It will be noted that the reflector is identical (except for the slight increase in length) to the radiator also consisting of four half-waves in series. The reflector is terminated in a shorted stub and a small air-spaced variable condenser. The optimum length for the stub is 22 inches, being tuned by a variable condenser having a maximum capacity of about 40 to 50 $\mu\mu f$. A suggested method of mounting the stub, as used by W8RLT, is shown in *Fig. 2.*

The use of a variable condenser at the termination of the reflector permits an easy as well as an accurate adjustment of the front-to-back ratio or forward gain. Beforehand, however, the loading of the radiator should be properly adjusted. Experiments show that cutting and trimming the feed line to the quad is very important. Rather than thinking of the feed line in terms of SWR, the line is cut until it presents the least reactance (the greatest loading) at the transmitter final tank coil. Actually, the line is trimmed to resonate with the antenna link or pick-up coil. Equal results may generally be obtained by inserting a tuning condenser in series with link and feed line. Of course, the conventional stub and flat feed line arrangement can be used. After this has been established the cubical quad is tuned for maximum forward gain or greater front-to-back ratio. To do the latter, a field strength indicating device is necessary. It is set up about 50 to 75 feet in front of the radiator. While another operator *slowly* tunes the variable condenser on the reflector the meter is carefully watched for a sharp pronounced peak. This adjustment may be quite critical.

The theory of operation of the cubical quad has not been too well determined. On the basis of a stacked array of this small spacing the forward gain with a reflector should not exceed 5.5 db over the conventional dipole. However, the claimed gain of this array is 11 db, or that equivalent to a lazy-H with reflectors. The many users have noted comparable gains and as far as can be determined most reports show gains equal to this, or slightly higher. It is felt that the change in the mutual impedance produced by the reflecting quad is such that the stacking gain optimizes at the shorter vertical spacing. It is also noteworthy that the cubical quad has an excellent front-to-side and front-to-back ratio. The proof of the pudding is the eating—the theory may be cloudy but the antenna really performs exceptionally well.

There can be little doubt that the quad is an extremely interesting antenna development. Mechanically speaking, it is somewhat easier and more stable to erect than parasitic beams. Electrically, it is little affected by moisture as it has no extreme voltage points on the elements and it is easy to tune. The array has been successfully operated in the proximity of large metal objects and can be tuned and adjusted on the ground with little deviation experienced when erected. The quad principle is applicable to other types of arrays (those having more than one parasitic element) and may offer further possibilities in high gain highly directional antennas.

If you want to know more about the cubical quad—right now—than this brief story tells, put up a quad! If you do, the Editors of CQ would like a postcard about the results you obtained. If you're rockbound to wait until the full story is published, watch future issues of CQ. Developer Clarence Moore, W9LZX, is preparing the entire story for us. In the meantime, keep us posted on your quad results —we'll pass them on to the gang.