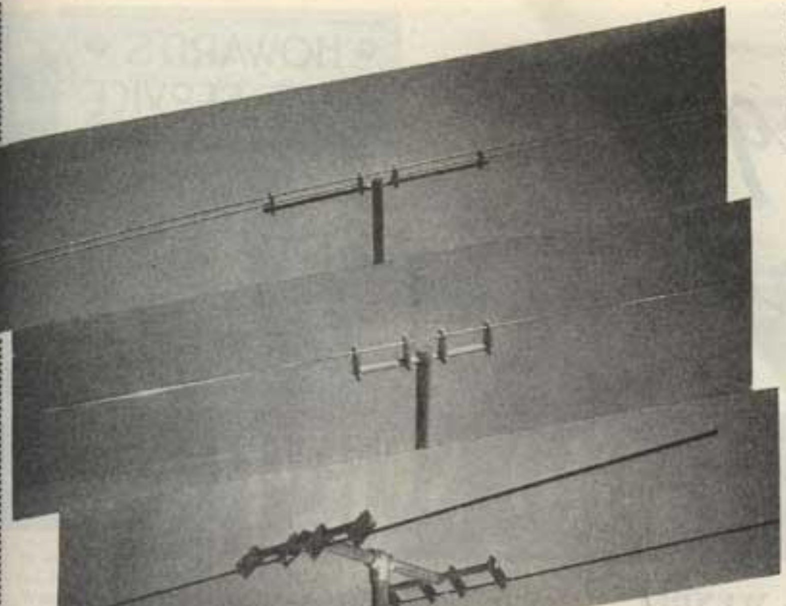

Photographs illustrate some of the more simple television antennas. From top to bottom: bent dipole, dipole, dipole with reflector. The more complicated arrays would include parasitic type reflectors and elaborate directors.

The *Television* Receiver Antenna

By J. J. TEEVAN

Although there are many types of television antennas each has its specific application. Study your installation problem and choose the antenna carefully.

WITH the increase of television sets on the market, servicemen, "hams" and radio engineers are going to be called upon more and more to erect and adjust antennas. Orders and requests will range from the single element dipole to the array complete with parasitic reflector and directors. But whatever the type desired, the basic elements of frequency discrimination, directional properties, and physical construction are still going to determine the merits of the finished job.

An antenna tuned for resonance will insure the frequency discrimination so vital to good video reception. Frequency discrimination will attenuate any unwanted signals that are removed from the resonant frequency of the antenna in question. If the television user desires his receiver to cover the whole range of transmissions in his city or area, the antenna should be made a half-wavelength long at the geometric center of the range. First, determine the allotted range of frequencies of the television stations in the area. The geometric center of this range can then be found easily enough. Assume that the range of a certain city's stations is found to be from 50 mc. to 80 mc. Then:

(1) Range. .50 to 80 mc.

(2) $\sqrt{50 \times 80}$. . $\sqrt{4000}$. . about 63 mc.

Converting this 63 megacycles to wavelength it is found to be about 4.7 meters. Taking into consideration the difference between velocity of propagation in free space as against that in the antenna conductor, (about 10 per-cent) the corresponding wavelength of the antenna will be found to be about 4.2 meters. One-half wavelength would then be 2.1 meters. Converting this 2.1 meters we arrive at an answer of 6 feet 11 inches. The elements of the antenna must therefore be 3 feet 5.5 inches each in length.

If the order comes complete with reflector and director then the antenna element should be made a little less . . . 95% of a half wavelength long at the operating frequency. The reflector should be a half-wavelength long at the operating frequency and the director 92% of a half-wavelength. As for the spacing between the elements place the director 0.1 wavelength in front of the antenna and the reflector 0.15 wavelength to the rear of the antenna.

To achieve physical discrimination, erect the antenna as high as physically possible, and as far removed from any type of electrical wiring as possible. Power leaks, defective neon signs and their ilk will play havoc with good video reception. Metal roofs can really be bothersome as can metal drain pipes but one cannot name all the varying disturbances that may be encountered. Each location will present problems unique to its own setting. Polarization will be determined naturally by that of the antennas at the various transmitters.

Reflections or ghost images on the television picture can be traced in most cases to one of two causes; (1) signals reaching the antenna from indirect paths and (2) faulty transmission line from the antenna to the input of the receiver.

As to the first, such signals reflected by near-by buildings and structures have traveled a greater distance than the main portion of the wave. The ghost image resulting is displaced by a time delay corresponding to this extra transmission distance. The degradation of the picture viewed corresponds to this delay and varies from a loss of fine detail to a distinct double image. To help combat this unwanted phenomenon, rotate the antenna until signals reaching it from any direction removed from that of the station desired are discriminated against. If one signal can be made to predominate sufficiently over the others, an image relatively free from ghosts will result. This applies, however, only to the reception of a signal from one station. But that kind of arrangement is not going to suit anyone who knows that there are five or six transmitting stations in his area. He isn't going to surrender his right to change programs that easily. In that case, a compromise adjustment must be found. Rotate the antenna until all the stations can be picked up with a minimum of reflections. If he desires to spend a little more, rig him up one of the rotating assemblies found in any one of several magazines these days.

An encouraging note for city dwellers has been sounded in this regard by the *Telicon Corporation*. In the system proposed by their engineers separate antennas are erected on a

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na that the signal be restricted to the elements of the antenna only. In other words, the lead-in from the antenna to the receiver must take the form of a transmission line that has no signal pick-up. If in spite of all precautions, some reflections do occur as a result of some signals picked up, damp them out by terminating the line in its surge impedance.

Three types of transmission lines are available for connecting the antenna to the input of the receiver; the parallel wire type, the twisted pair type and the coaxial type. Take your choice as to which you will use. Each has its own merits and staunch supporters. If your selection is the parallel type be sure that a fixed spacing is maintained throughout. In addition, make this spacing small in comparison to the operating wavelength to prevent appreciable radiation and yet not too small lest when the wires swing with respect to each other in a wind the line constants be caused to vary. Spreaders will answer the problem of fixed spacing. In many magazines published these days one will note the advertising of a type of feeder now available on the market which consists of two conductors spaced apart by a plastic ribbon. Different sizes with corresponding impedances can be purchased and it might be mentioned in passing that very favorable reports have been received from users of this type of parallel wire transmission lines.

The twisted pair type has a surge impedance of from 50 to 150 ohms and its high value of attenuation is excellent for suppressing unwanted reflections if, by any chance, a mistake is made in termination. If the transmission line is very long, however, say over 50 feet, difficulties will be encountered in the use of the twisted pair. The high value of attenuation mentioned will then cause a serious loss of the desired signal strength resulting in a weaker image. When such is the case, use the coaxial type with its low attenuation and insensitivity to signal pick-up. The attenuation in the coaxial type is from .01 db. to .05 db. per wavelength as compared to the 1 to 2 db. per wavelength in the twisted pair.

When the simple dipole is used as the antenna, a transmission line having an impedance of the order of from 50 to 150 ohms will render satisfactory performance. The average resonant impedance at the center of such a dipole varies from 72 ohms for a half-wavelength to 125 ohms for three-and-a-quarter-wavelengths. It is true that a mismatch is present in coupling a line of the impedance just stated to the center of a dipole but it will be found by experience that no serious loss of signal will result. However, very few television users are going to get by using the simple dipole as is. Directors and reflectors are going to be wanted and in most cases needed. If your requisition or order calls for such, remember that the impedance of the dipole drops considerably with the addition of each new element. Use matching stubs, concentric line matching sections or a delta matching transformer to compensate. Of the three, the third is about the easiest to install.

At the other end of the transmission line, if the input circuit of the receiver consists of an antenna coupling transformer, as is usually the case in television receivers, the impedance of the primary coil must match the transmission line impedance. Reflections will result if this match is not at least approximate and if the primary coil is not balanced with respect to ground. These reflections can produce ghost images on the screen as the result of waves traveling back to the antenna and then returning to the receiver with a delay in time proportionate to twice the line length. If care has been taken, however, in matching the impedance of the primary coil to that of the transmission line, little or no difficulty of this nature should be encountered. The balance between the primary coil and ground is essential with both the twisted pair and open wire types of transmission lines so that any unwanted signals picked up may cancel out each other. Coaxial transmission lines eliminate this problem altogether inasmuch as such a line is unbalanced in itself. The sheath of the coaxial type being grounded allows such a line to be connected to an unbalanced primary in the input transformer of the receiver.

The foregoing treatment of reflections was written more or less with reception in large cities in mind. However, television users dweling in areas where trees and foliage are plentiful will attest to the fact that with the advent of spring, picture quality drops off markedly. All through the winter reception may have been very good but as soon as the foliage begins to appear on the surrounding trees, the pictures have become weak and in some cases very unstable. There is every reason to believe that foliage does act as an effective barrier for television frequencies. It would appear that this phenomena is caused partly by the physical effect of the presence of the leaves and partly by the moisture content increasing in the trees due to the rising sap. *Bell Laboratories* have reported strong standing wave patterns existing on the edge of wooded areas, especially in the warmer months. Here again, if your friend or client has his home in such surroundings, the problem will have to be met by shifting and orientating the antenna until the best possible reception is obtained.

By way of summary then, we cannot stress too much the importance of a good antenna for the reception of the video signal. The general public has to be sold on this. They must be shown that a little time and money spent on the proper construction and erection of the antenna will pay large dividends on the television screen. Convince them that a lot of money spent for an extra good receiver is money wasted if they are going to be content with a make-shift antenna made from a piece of wire that happened to be lying around the cellar. —30—