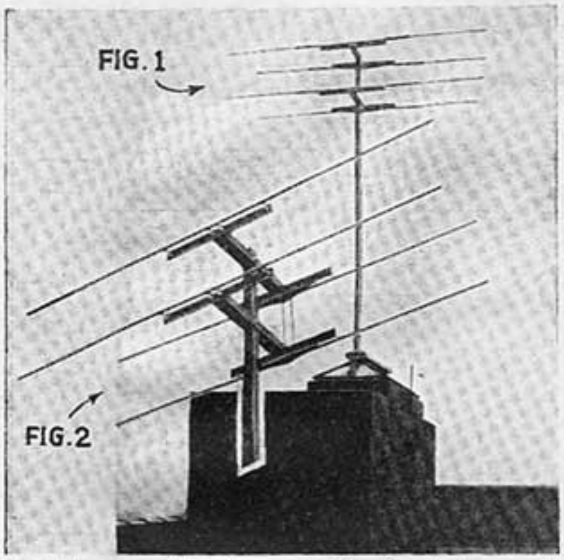


Fig. 1 shows erected antenna assembly; Fig. 2, close-up of double doublet with reflectors.

Constructing an Efficient Television Antenna

Charles R. Leutz
Author of "Super-Heterodyne Receivers," "Modern Radio Reception" and "Short Waves"

Efficient antenna, relatively inexpensive and simple to build, can be used for all ultra-short wave work as well as for television reception. A double doublet with reflectors, it increases signal pick-up and reduces interference.

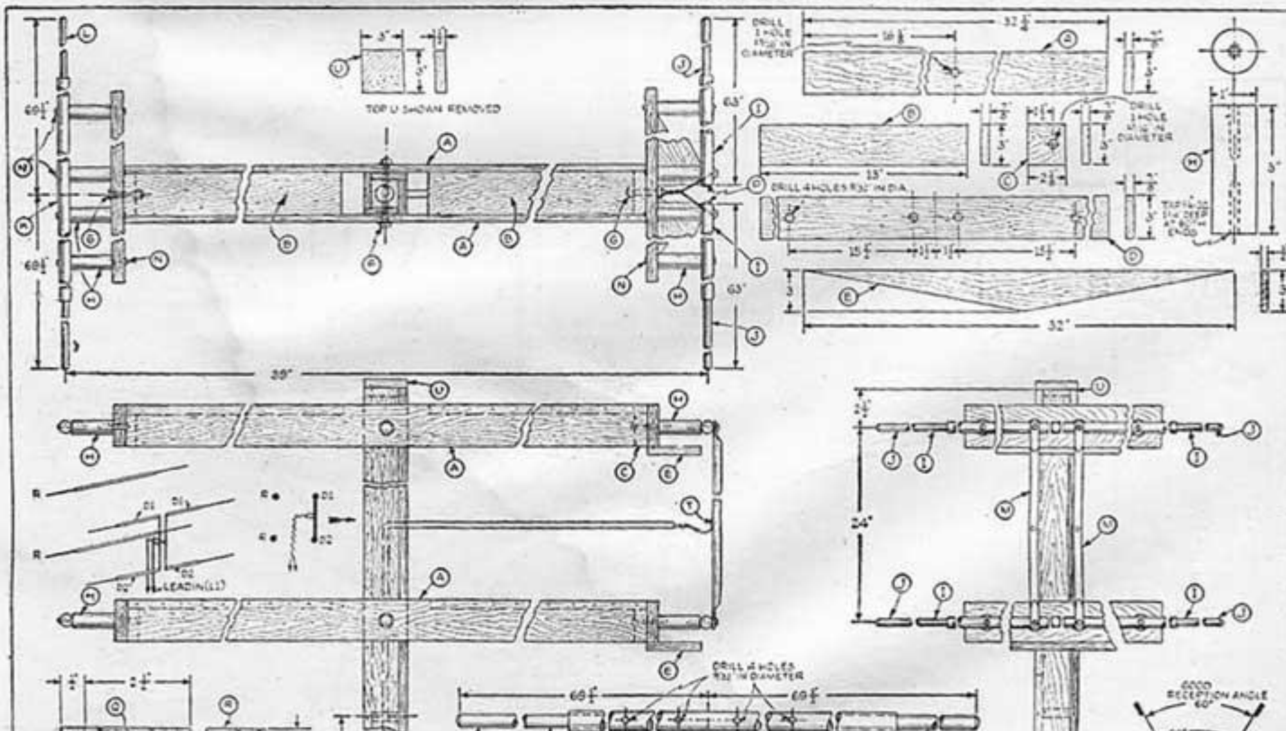
● IN commercial radio engineering practice, both in the case of transmitters and receivers, the antenna system costs on an average, at least 15% of the entire installation. In comparison, it is not unusual to find television receivers costing from about two hundred dollars to several times that amount, being operated with a simple inefficient makeshift di-pole and of course giving generally unsatisfactory results.

There are many advantages in having an efficient television antenna and a properly designed unit will not only improve reception in the desired directions but will also exclude interference. The feature of eliminating interference from over as wide an angle as possible is very important, not only as a possible means to exclude automobile ignition and similar disturbances, but also to prevent the reception of undesired interfering "ghost" signals from other distant television transmitters. As television activities expand and the number of transmitters is increased, the problem of "ghost" signals may become very severe and more attention will have to be given to the matter of directional antennae, possibly both for transmission and reception. These "ghost" signals have already been received in the United States from a European television transmitter.[1]

Only recently an attempt was made to

(*Continued on page 35*)

Construction details of the efficient, noise reduction antenna.



Constructing An Efficient Television Antenna

(*Continued from page* 10)

operate two television transmitters simultaneously on the same bands, one in Philadelphia and one in New York, a distance of about 80 miles. Theoretically each station has a range of about 30 miles and no interference should result. However in practice, "ghost" signals from the Philadelphia transmitter caused interference with reception at New York of the New York transmitter. Now the two stations divide operating time.

The problems associated with television antennae and the requirements for a satisfactory installation have been well covered in the past.[2] The essentials may be summarized as follows:

1. Maximum antenna elevation conveniently attained.
2. Antenna location removed as far as possible from sources of automobile or similar interference.
3. Antenna supporting structure to be free from any large metallic members which may cause absorption or reflection.
4. A well designed and constructed di-pole and reflector erected to give maximum reception in the desired direction and to eliminate interference in all other directions. Or, a double di-pole and reflector to extend the pick-up angle of good reception or to increase the signal to noise ratio.
5. Di-pole and reflector elements to be readily adjustable to permit experiments and compensation for differences in wave polarization or direction of arrival other than originally calculated or anticipated.
6. An efficient transmission line or cable between the antenna and the receiver input.

This article is intended principally to give the constructional details of an antenna to meet the above requirements. The system is designed primarily to efficiently cover the present television picture and sound bands of from 44 to 90 megacycles. The double di-pole and reflector is also suitable to use with short wave or all-wave receivers having a doublet input circuit.

The di-pole and reflector elements are made of half hard aluminum pipe and tubing, combining light weight, rigidity and low wind resistance. Iron or steel elements can be used, but to get equivalent rigidity, the sizes must be substantially larger causing an appreciable increase in weight, wind resistance and surfaces to collect ice.

The 24′ supporting mast and cross arms are constructed of Fir plywood, combining light weight, rigidity and low wind resistance at a low cost.

The required stand-off insulators are machined from a Polystyrene base ultra high frequency insulating material. This material is easily sawn, drilled and tapped by hand tools; it is very strong and not at all brittle. Fortunately this material is practically free of moisture absorption and shows very low loss at ultra high frequencies; the result is unusually efficient and durable outdoor stand-off insulation.

Fig. 1 is a view of the erected assembly and Fig. 2 gives a close up of the element assembly. An accompanying drawing covers the entire assembly and details of the individual parts, also a complete bill of material.

In both the photographs and the drawing, the two di-poles and reflectors are shown parallel to each other, this arrangement providing a good reception angle in the desired direction of about 60°; the area of zero or near-zero pickup extends approximately 180° as shown in the drawing. By having the di-poles off parallel, as required, the good reception angle can be increased and with a corresponding diminished near-zero pickup area.

Construction of Mast

The 24′ mast is self supporting if fastened at the base and at a point about six feet up from the base, for example to the side of a building or roof shed as shown in Fig. 1. Guy wires should be avoided. In absence of a suitable support, a wooden stub tower, about 6′ high and with a 6′ square base can be made and fastened to the roof.

The mast assembly starts by gluing and nailing one of the 4′ uprights (R) to one of the 10′ uprights (S) and inserting spacers (Q) at the start and every 6″, on centers. These spacers (Q) are also glued and nailed into place, avoiding driving nails into the center hole of the spacers which is reserved for the transmission cable.

With the spacers in place, another 4′ upright (R) is glued and nailed into place, opposite to the first 4′ section. At this point, the transmission line, or a wire leader, is threaded through the spacer holes and this procedure followed so the transmission cable will be in place when the nailing is completed. The idea of starting with two 4′ and two 8′ sections is to have the horizontal joints staggered.

The same assembly procedure is followed, now using up the remaining eight 10′ uprights. The remaining two 4′ uprights fill in at the top of the mast. In reaching the last section, the holes for the two cross arm bolts (F), 13/16″ diameter, should be drilled and also an outlet hole for the transmission cable where it leads to the di-pole buses (M).

The strength and rigidity of the mast depends wholly on a first class gluing job. The glue used must be waterproof, preferably a marine glue, applied strictly to the manufacturer's instructions, not too thin and not too thick or lumpy. One inexperienced in gluing wood should first experiment with scrap pieces of wood until the results are right. The uprights are nailed to each other with 1½″ wire brads and the spacers are nailed into place with 1″ wire brads. Plywood can be nailed fairly close to edges without danger of splitting. The top of the mast (U) is not fastened into place until the very last.

Cross Arms

The two cross arms are of identical construction, each consisting of two sides (A), two tops (B) and two ends (C), all glued and nailed together. A 13/16″ hole is required at each end for the bolts (G).

The supports (D) for the di-poles and reflectors are identical. For the reflector end, this support (D) is reinforced by the one piece aluminum pipe piece (K). At the di-pole end, the aluminum pipe (I) is in two pieces and requires the supplementary supporting braces (E), as shown.

Insulators

The stand-off insulating material may be secured in one piece or cut to size. In any event the stand-offs (H) should be cut accurately to size, each 3″ long from 1″ diameter round rod, and tapped ¼″—20 for 1¼″ deep at both ends. While this material can be easily worked with an ordinary hack saw, hand drill and machine tap, the operations must not be at too great a speed or heat generated will gum the tools.

Di-Poles

The four di-pole sections (I) are cut from ½″ IPSX aluminum pipe which comes

.840" outside diameter, .622" inside diameter and .109" wall. The four di-pole tips (J) are cut from ⅝" outside diameter aluminum tubing having a .065" wall.

After the sections (I) are drilled as called for in the drawing, one end of each is reamed ⅝" for about 6" deep or more to receive the ⅝" tips (J) in a tight drive fit. After driving the tips into place, they are sawn off at the ends for the exact dimensions specified in the drawing. In machining aluminum, sawing, drilling and tapping, kerosene is the proper lubricant. A plug (O) is inserted in each tip; plugs (P) are inserted in (I).

Reflectors

The reflectors are assembled essentially the same as the di-poles, first drilling out the sections (K) as shown in the drawing and adding the four tips (L) and the plugs (O).

Final Assembly

The stand-off insulators (H) can now be fastened into place on the supports (D) and (DE), and the di-poles and reflectors fastened into place, using the bolts and washers (N).

The cross arms are then slipped over the top of the mast and fastened into place with the bolts (F), taking care not to damage the transmission cable during this operation.

The supports, together with the di-poles and reflectors are now ready to assemble on the cross arm ends, using the bolts (G).

The two buses (M) are placed into position, (M) and (I) being held to the insulator with the same bolt. The transmission line is connected to the buses by the screws (T).

The top of the mast (U) can now be placed into position.

The aluminum elements, bolt heads, transmission line connections and caps are all painted with a good weatherproof insulating varnish.

The entire assembly is so light, it can be erected by two men, one holding the base and the other "walking" the mast up similar to raising a long ladder. However, there is danger if the mast becomes unbalanced during this operation and it is well to have an extra man or two available until the base is fastened.

Where there is any question about the exact direction of arrival of the desired signals, or if the desired waves arrive other than horizontally polarized, experiments can be conducted with the assembly mounted on a short stub mast, only a few feet high, above the roof. The bolts (F) and (G) must be well tightened in the final assembly.

References.

1. "Transatlantic Television?", De Witt R. Goddard. SHORT WAVE & TELEVISION, February, 1938.
2. "What About That Television Antenna". An interview with O. B. Hanson, RADIO & TELEVISION, May, 1939.

"Practical Television by RCA," booklet published by RCA Manufacturing Company, Camden, N. J.

Bill of Material

Item	*Quantity*	*Name Description*
A	4	Cross Arm Sides 5 Ply Fir Plywood 32⅛" x 3" x ⅞"
B	4	Cross Arm Tops 5 Ply Fir Plywood 13" x 3" x ⅞"
C	4	Cross Arm Ends 5 Ply Fir Plywood 2⅛" x 3" x ⅞"
D	4	Supports 5 Ply Fir Plywood 36" x 3" x ⅞"
E	2	Braces 5 Ply Fir Plywood 32" x 3" x ½" (To Pattern)
F	2	Steel Bolts 6" long x ⅜" diam., with nuts and washers.
G	4	Steel Bolts 3" long x ⅜" diam., with nuts and washers.
H	16	Stand-offs 1" diameter (round) x 3" long, Amphenol 912B
I	4	Di-Pole Section 3S Half Hard Alcoa ½" IPSX Aluminum Pipe 30" long.
J	4	Di-Pole Tips 2S Half Hard Alcoa Aluminum Tube ⅝" O.D. x .655" wall x 39" long.
K	2	Reflector Section 3S Half Hard Alcoa ½" IPSX Aluminum Pipe 61" long.
L	4	Reflector Tips 2S Half Hard Alcoa Aluminum Tube ⅝" O.D. x .655" wall x 45" long.
M	2	Bus Connectors 2S Half Hard Alcoa Aluminum Tube ⅝" O.D. x .655" wall x 24¼" long.
N	32	Steel Bolts 2" long x ¼"—20, with washers and lock washers.
O	8	Plug Buttons, for ½" hole, Cinch #50652
P	4	Plug Buttons, for ⅝" hole, Cinch #50809
Q	49	Spacers, 2" x 2" x ⅞", 5 Ply Fir Plywood (To Pattern)
R	4	Uprights, 4' x 2½" x ½", 5 Ply Fir Plywood
S	10	Uprights, 8' x 2½" x ½", 5 Ply Fir Plywood
T	2	Rh. Hd. Brass Screws, #10-32 x ½" long
U	1	Mast Top, 3" x 3" x ½", 5 Ply Fir Plywood

1 Pint Weatherproof Insulating Varnish—for metal

1 pound 1½" Brads

½ pound 1" Brads

¼ pound Waterproof Glue

1 Quart Weatherproof Black Paint

Transmission line or cable as required.

Note: Fir plywood can be secured plain or weatherproof. When ordinary plywood is used, it must be protected from the weather thoroughly by a coat of paint followed by a coat of marine varnish. When weatherproof plywood is used, the exterior surfaces should still be protected by at least one coat of Outdoor paint, or varnish.