Want to get high on our lowest band? Build this vertical antenna over a weekend.

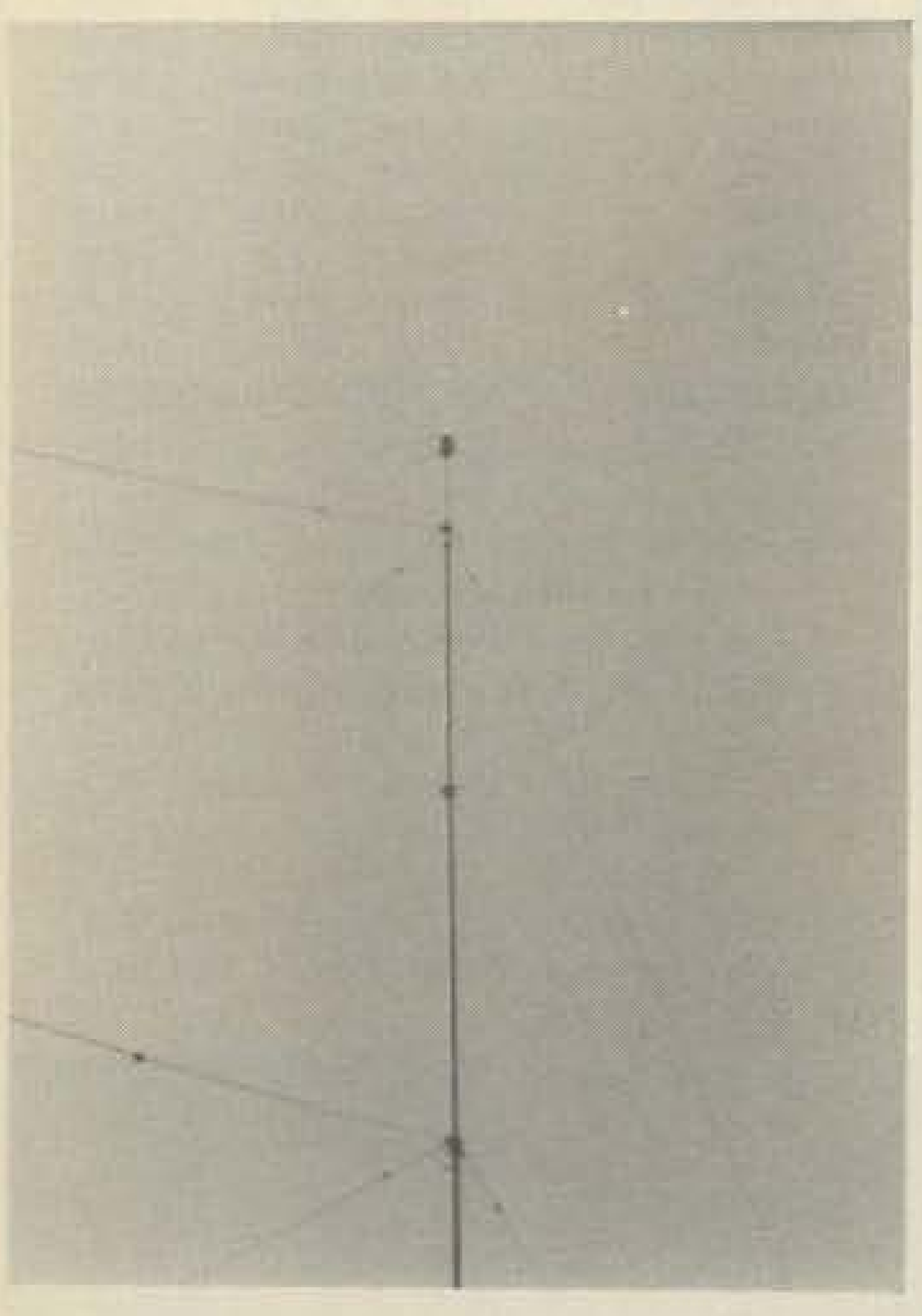
A 160-Meter Vertical Antenna

BY ROBERT G. EVANS*, K6QAY AND A.E. "DOC" NELSON*, K6ZHJ

The top-loaded vertical described in this article has been in use for a number of years in the Southland.

How many times while in QSO have you heard something like this? "Break, break. This is Station XYZ loading up my 40-meter dipole with an XYZ tuner. How do you copy me, old man?" You come back to him with a 5X9 report for he is about 10 miles away, but the rest of the group cannot hear him because he is only putting out a ground wave. He comes back with something like this: "That's funny. I copy all stations. Wonder why they can't hear me." If you are satisfied with this sort of condition, you are wasting your time reading this article. If you are not, read on.

**10509 Collett Ave., Granada Hills CA*



The 160-meter vertical antenna. The capacity hat can be seen near the top.

The height required for a full 1/4 wave vertical on 160 meters and the realization of high radiation resistance are quite impractical for the average amateur on a city lot. 130+ feet high would be out of the question. However, if the lower end of the vertical is grounded and electrically lengthened with a loading coil at its base, it will resonate at the same frequency as a grounded 1/2-wave vertical 260+ feet long. The directional characteristics will be the same as a 1/2-wave dipole in free space. Remember, we said, *resonate* not *radiate*. The shortened vertical will have a loss of 5.5 dB in comparison to the full 1/2-wave at one mile distant.

Now let's take a good look at our ground system. The actual power radiated from the antenna is the difference between the total power and the power dissipated in the ground resistance. Some poorly constructed vertical antennas have been shown to radiate 4% of the available power. The remaining 96% will be lost and dissipated in the loading coil and ground itself.

If, for instance, the ground resistance is equal to the radiation resistance, only one-half the power available at the antenna will be radiated; the other half will be lost in the form of heat in the ground and coil resistance. (*Air Force Antenna Manual* - Vol. 52-19 p.119).

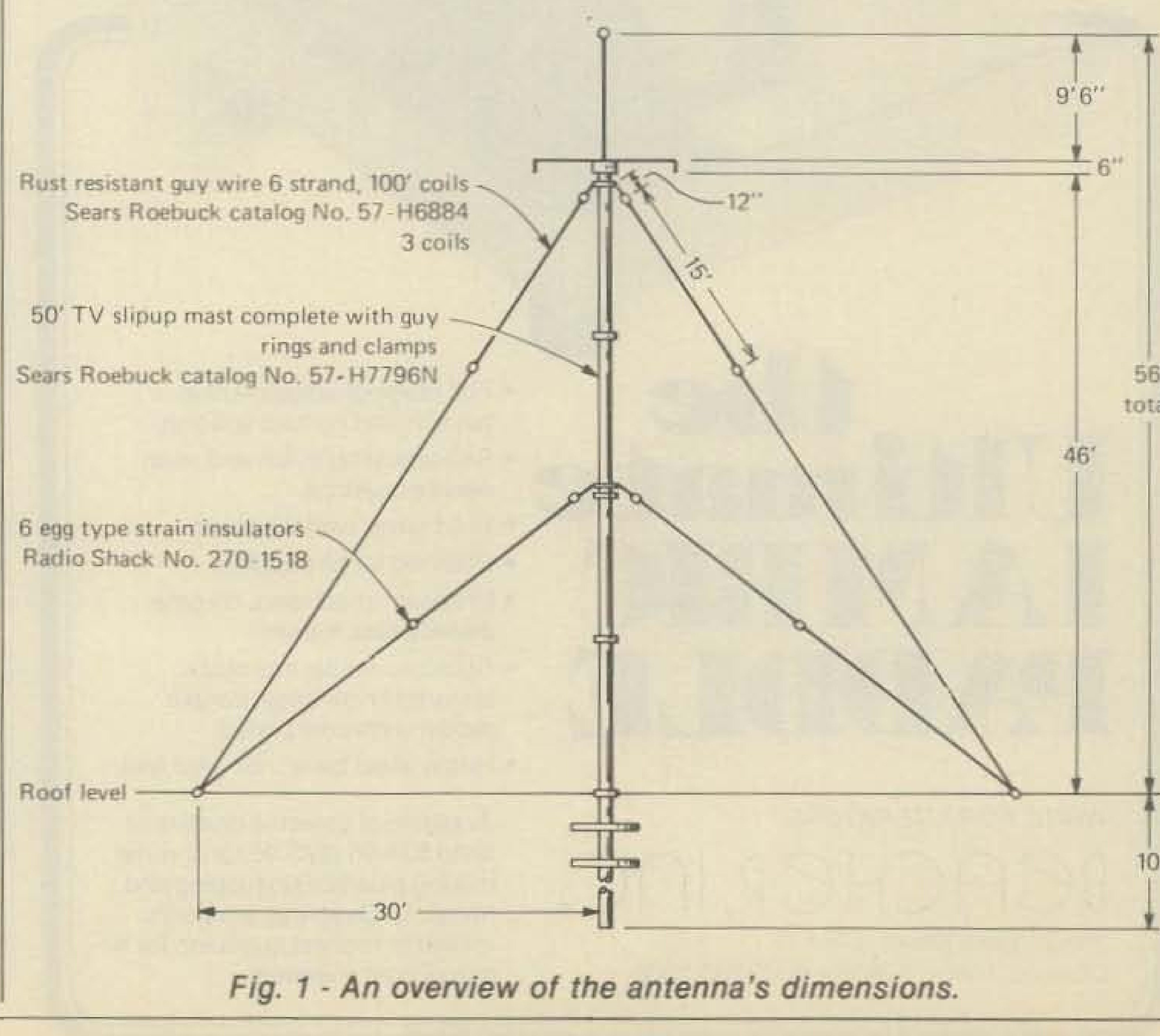


Fig. 1 - An overview of the antenna's dimensions.

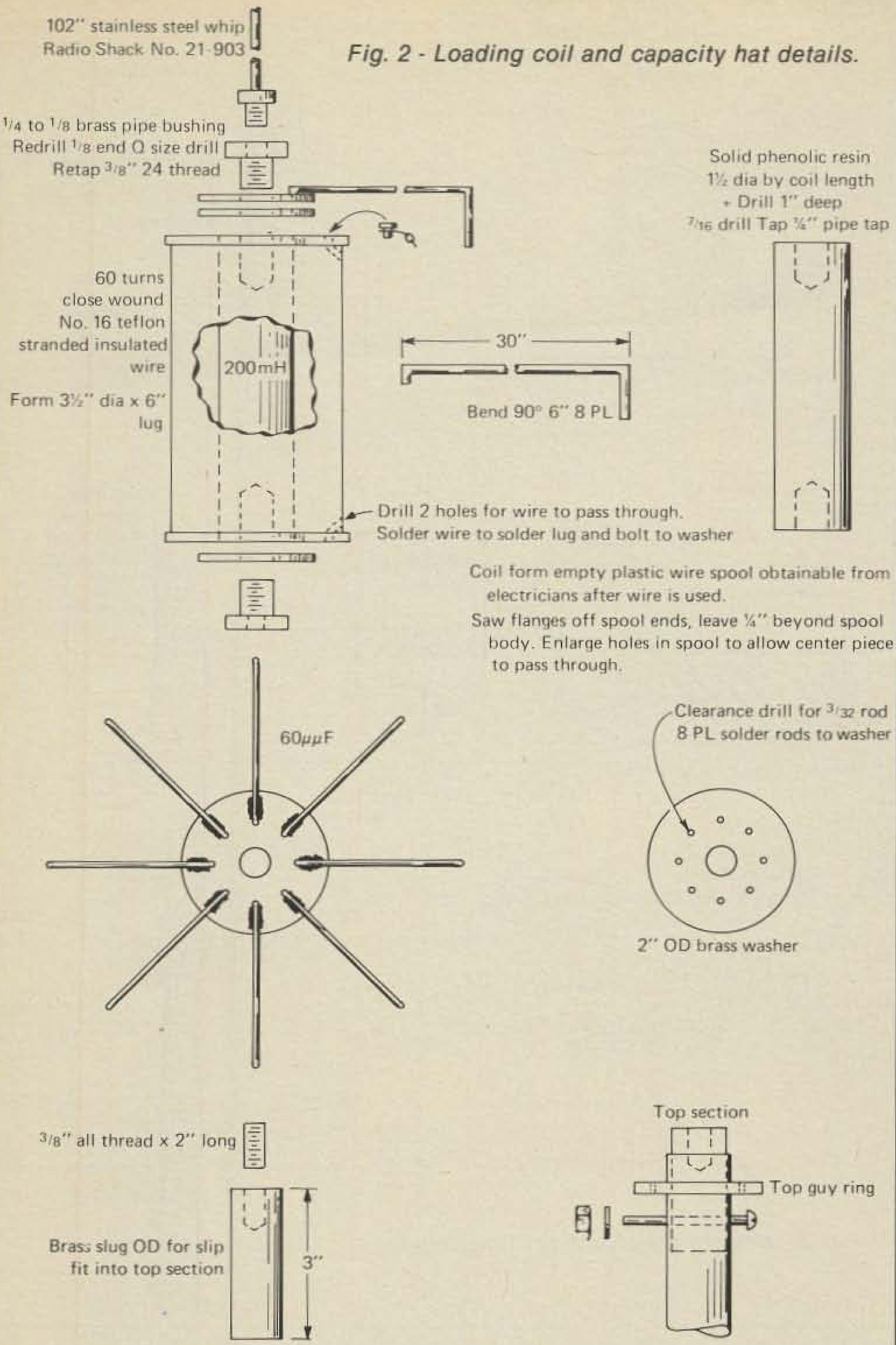


Fig. 2 - Loading coil and capacity hat details.

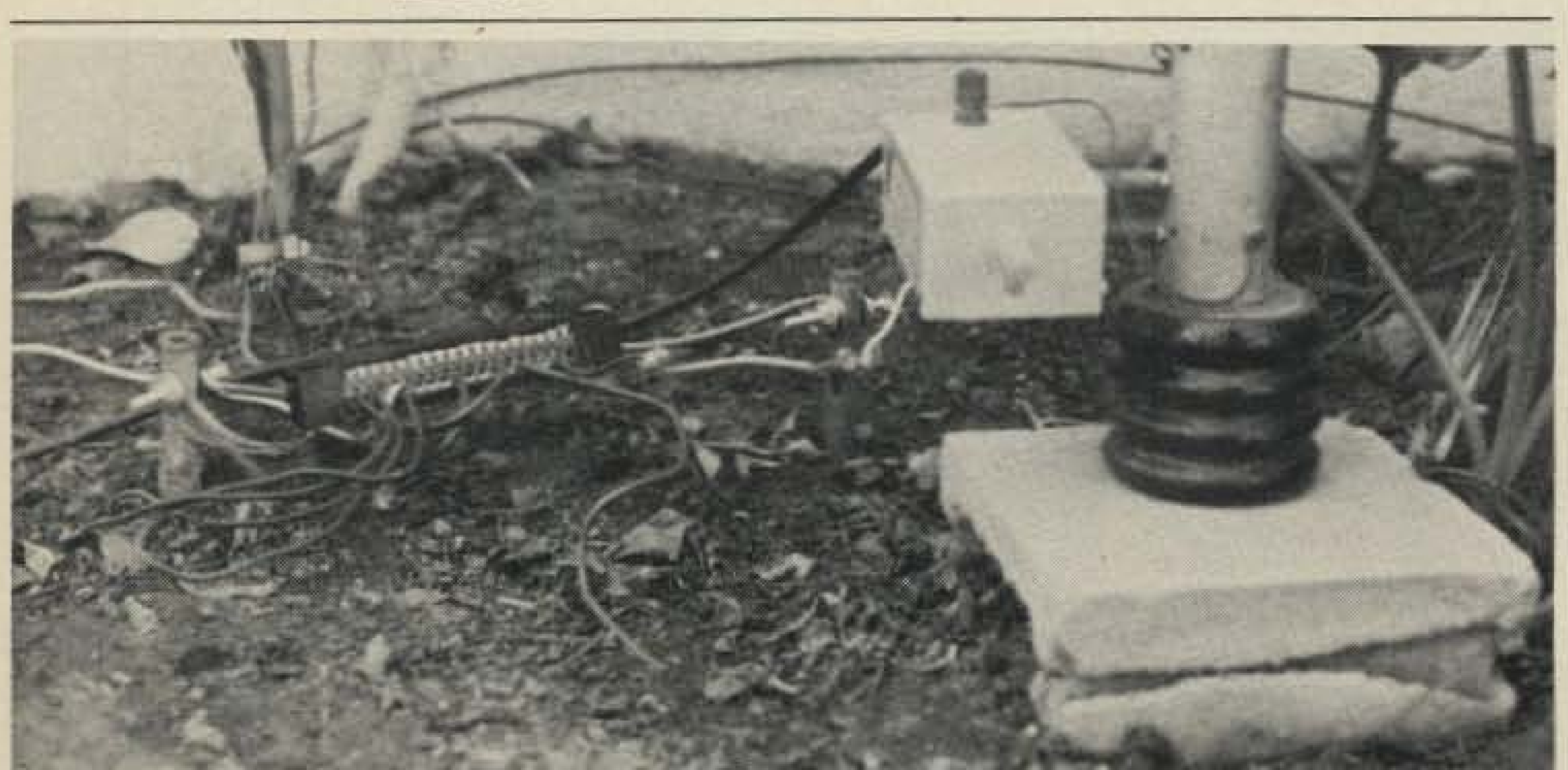


Photo of the antenna's base. See text for explanation.

A fairly efficient ground can be made by driving four copper-clad 8-foot pipes into the ground at the corners of a 10-foot square. The tops of the pipes are bonded together with #14 or larger wire.

You may want to improve this as I did. Drill four (6" diam.) holes with a post-hole digger. Obtain approximately 40 lbs. copper sulphate (bluestone). Mix with an equal amount of pea gravel. Drop the rods into the center of the holes. Shovel in the 50/50 mix. Let the water hose run into these holes very slowly for 24 hours. This will allow the copper sulphate to practically dissolve and seep into the ground around the rods. Approximately 24 hours later you will have 4 grounds, 24" diam., tied together with #14 wire which will be a substantial improvement over the water pipe ground. Next, tie in the water pipes, sprinkler systems, etc. Install whatever number possible of buried radials. These radials need not be in a straight line. Try to have at least 2 radials beyond a 1/4-wave. Do not have the radials more than 6 inches into the ground as the surface moisture may not reach much deeper than this.

After you have improved the ground systems the ratio of radiated power to power loss in the ground connection can only be increased further by increasing the radiation resistance of the antenna. The radiation resistance, as measured at the base of the antenna, may be increased by: (1) increasing the actual length of the antenna to a greater length than 1/4-wave or (2) increasing the electrical length of the antenna by inserting a lumped inductance in series with the antenna or (3) using a horizontal flat top or top hat which causes the antenna current loop to move upward on the vertical thus decreasing the current near the ground or base of the antenna.

Since procedure no. 1 is again out of the question, nos. 2 and 3 will be considered. Install a coil on the top of the mast, a top hat and a whip above the coil. The length of the whip is very critical and could very well put you clear out of the ball park if made much longer or shorter than the callout. Now to proceed a step further. Add enough turns on the coil and enough top hat and whip, thereby adding enough capacitance to the antenna for it to resonate at a frequency much lower than we wish to operate, approximately 1750 kHz. Next, install a variable capacitor in a weather-tight box at the base of the antenna, in series with the feed line and the antenna just above the base insulator. Excite the antenna with a low level signal at the frequency desired to operate and tune the capacitor for a 1 to 1 standing wave ratio.

I chose 1818 which allows me to QSY between 1810 and 1825 without having to retune. Remember, however, that the 1 to 1 standing wave ratio will only be had at the frequency your transmitter was tuned to when you set your variable capacitor. In this installation the variable capacitor is padded with a fixed transmitting capacitor. The combination should be large enough to cause you to use from 75% to 90% of the maximum capacity of the variable for best transfer of energy. (.0004 - fixed; .0003 - variable.) The completed antenna, if you have followed instructions, will grid dip at approximately 1750, + or − 10, and will tune back into the 1800-1900 segment with a standing wave ratio of 1 to 1.

I am using 52 ohm coax with this system and the impedance is a 1 to 1 match. This eliminates the ground loss that would occur with a resonant antenna, not using series tune and not matching the input line.

All complicated math has been left out of this article. Instead, a complete list of instructions and parts callout, including snapshots and diagrams, have been including to enable you to build a complete 160 meter vertical antenna, with little difficulty. A photo and drawing are also included for an alternate base and wall mount as the insulators I am using may not be readily available to you. A grounding switch is used in case of electrical storms. Please include this as it may save your entire station. The antenna mentioned in this article has worked very well within a radius of 100 miles at high noon; into the midwest in the early evening hours; and to the east coast in the late evening hours with approximately 70 to 90 watts to the antenna. It has withstood 70 miles per hour gusts of wind with the only movement being in the stainless steel whip. You have just gained back a portion of the 5.5 dB loss, for the antenna in this article is within 2 dB of the 1/2-wave dipole at approximately 60 feet high.

The antenna at this location is attached to the side of the garage. The bottom 10 foot section tops out at roof level, standing on the roof. One man can telescope it up without any difficulty. The first section should be installed with a level as it must be plumb in both directions. The TV mast will be self-supporting if no wind is blowing. The guy lines may be attached, left loose until the mast is fully extended. Start with the top section. Pull it out of the nest of tubes until it is slightly above the pin hole. Insert the pin and secure the L bolt in the locking collar. Continue with the rest

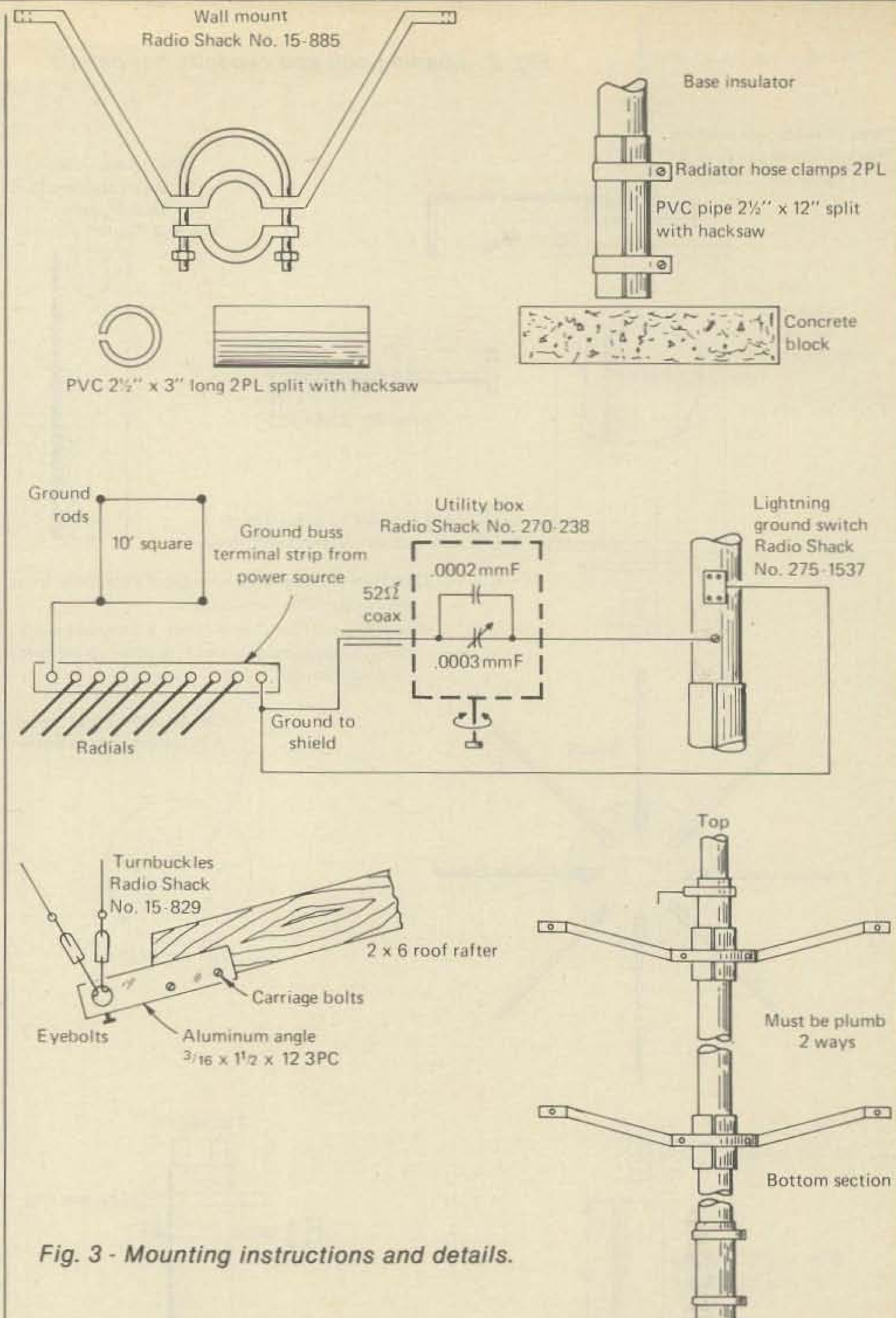
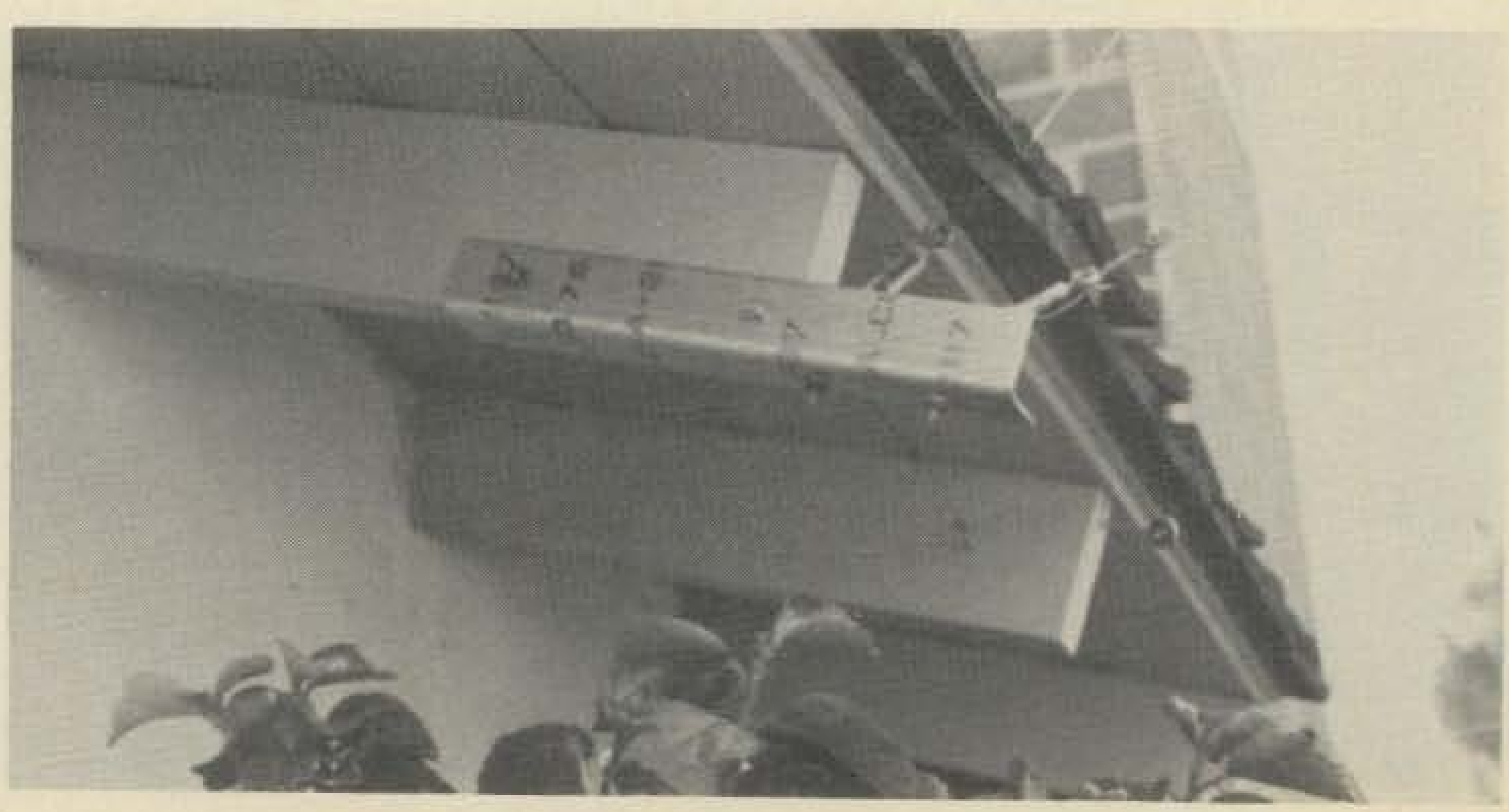


Fig. 3 - Mounting instructions and details.



This photo shows how the guy wires are mounted under the eave of the house.

of the sections until you have it fully extended.

CAUTION: As this is an all metal mast, *watch for overhead electrical wires.* **You could be electrocuted** if the mast were to fall across the lines. As this antenna is top-loaded above the coil the first guy wire insulator should not be more than 12" away from the mast as you do not want to introduce any more distributed capacitance below the coil than is necessary. This antenna has been duplicated by several other amateurs in the San Fernando Valley. All who have stayed away from base loading have had comparable reports. No antenna is without faults and this one is no exception. It has a tremendous ground wave so it may cause some interference problems to HiFi installations, also telephone and TV. This is not the fault of the antenna installation and may all be taken care of by following the instructions in the *Radio Amateurs Handbook*, 1978 Edition, pages 492-505.

Listen for us any evening, 1818 -1820, between 6 p.m. and 8 p.m. PST.

Editor's Note

This might be a good time to get one of these up. Remember the *CQ* 160 WW DX Contest is coming up in January.

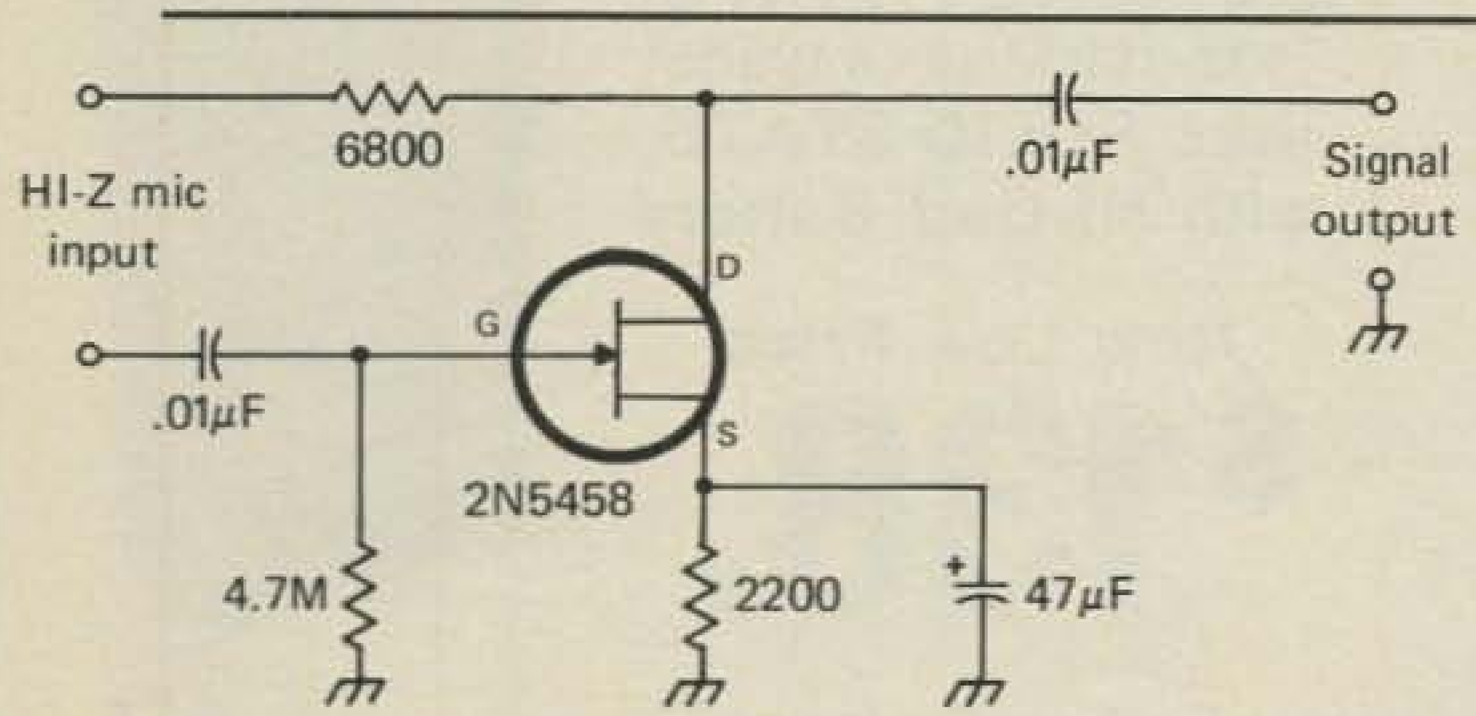
Material Callout

	Quantity	Description
☐	1	Base insulator PVC pipe
☐	2	Radiator hose clamps
☐	2	PVC pipe 1st section wall mount insulation
☐	4	5/16 X 2 1/2 lag bolts to secure wall brackets
☐	12	Strain type insulators
☐	300 ft.	Guy wire
☐	1	102" stainless steel whip - w3/8" - 24 THD stud
☐	1	Top loading coil form
☐	65 ft.	#16 Teflon TM insulated wire stranded
☐	2	Solder lugs
☐	2	6-32 bolts, nuts and lock washers
☐	8	PC 3/32 X 3' brass welding rod
☐	3	2" OD brass washers - w3/8" center hole
☐	2	1/4" to 1/8" brass pipe reducer bushings
☐	1	3/8" 24THD all THD stud X 1 1/2" long
☐	2	3/8" lock washers
☐	1	Brass slug to fit inside of top section of mast
☐	1	10-32 bolt X 2" long with nut and lock washer to secure slug into top section
☐	1	50' TV slipup mast
☐	3	PC aluminum angle
☐	6	1/4" X 3" carriage bolts, nuts, flat and lock washers
☐	3	1/4" eye bolts with 2 nuts and lock washers each
☐	6	Turn buckles
☐	1	.0002 Fixed mica trans capacitor
☐	1	.0003 variable - can be receiving spacing
☐	1	Utility box to house capacitor with mounting hardware
☐	1	Phenolic resin or teflon 1 1/2" diam. X length of coil to extend flush through coil form
☐	1	Knife grounding switch
☐	1	Concrete block

CRANIUM QUERIES

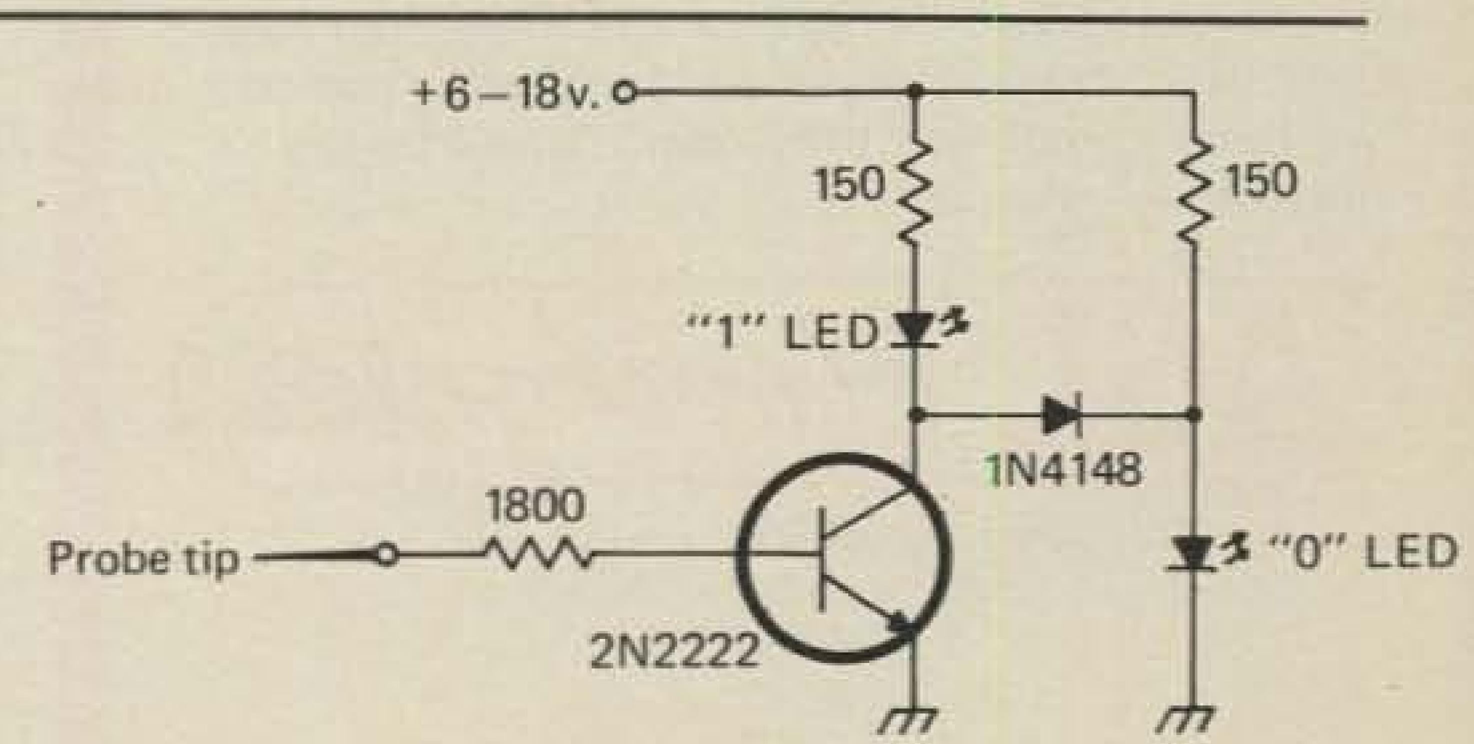
" FIND THE ERROR"

BY MARTIN BRADLEY WEINSTEIN, WB8LBV
130 Coe Avenue, Apt. 73
East Haven, CT 06512



Here's What Was Wrong.

There's not much signal available at the source, but there's plenty at the drain. So a little physical QSY of the output cap provides an ample preamp.



What's Wrong?

The idea behind this Logic Probe is pretty straightforward: a "Hi" logic level turns on the 2N2222, which turns on the "1" LED: a "Lo" turns off the "1" and turns on the "0". They just stay on and change brightness. Whahoppened?

(Solution next month)