ham radio TECHNIQUES

Bill Orr W6SAI

ham radio techniques

In the northern areas, winter is almost over and signs of spring are in the air. It's a good time to think about antenna systems. A lot of interesting antenna concepts have just been waiting for some good weather to set in! Here are some interesting projects for you to consider . . . .

inexpensive base station antenna for 2 meters

I think Fred Dietrich, NM6J, has come up with a winning 144-MHz antenna that has decent gain and a low SWR, and costs very little to construct. Shown in **fig. 1**, this vertical, omnidirectional array is only about 6 feet tall. The antenna structure is made of a length of 3/4-inch Schedule 40 (thick wall) PVC water pipe. The overall pipe length is long enough so that the antenna can be supported by clamps at the base end. For this particular installation, an 8-foot length of PVC was selected. The top of the pipe is closed with a PVC cap cemented in place using the liquid sealer that applies to such material.

The radiating portion of the antenna is a No. 12 copper wire 51.75 inches long. Enough extra wire is added to this length to allow it to be attached to the cap with PVC cement and to form a solder connection to the coax line at the base of the antenna.

Two phasing sleeves are used. They're made of galvanized hardware cloth folded around the PVC pipe and wrapped with wire to hold them in place. Each sleeve is 17.25 inches long. The retaining wires are soldered to the hardware cloth at several points around the circumference.*

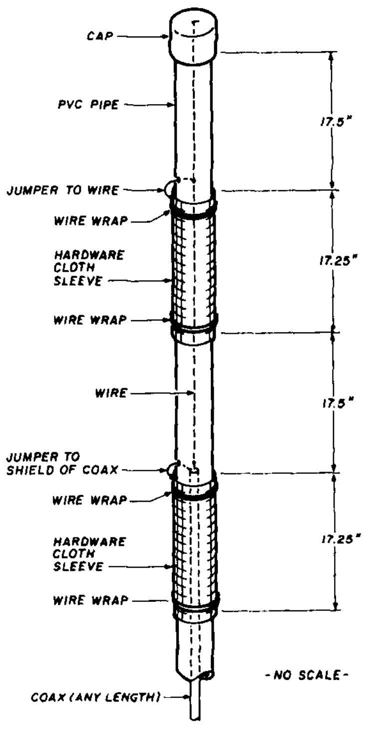

fig. 1. Two-meter PVC base station antenna.

A short jumper wire joins the top of the upper screen to the antenna wire running inside the PVC tubing. It is suggested that this wire be soldered to the antenna wire and then fished out through a small hole drilled in the PVC wall. If this and the following step are done before the top PVC cap is fastened in place, the assembly will proceed smoothly.

A second phasing sleeve is affixed to the structure below the first, as shown in **fig. 1**. This sleeve is connected to the outer shield of the coax line by means of a short length of wire inserted through a second hole after the antenna wire has been passed within the PVC pipe. After assembly, the holes are filled with cement to make the assembly waterproof.

The antenna is mounted in a vertical position and the coax line is brought down directly below the antenna. A VSWR plot representative of the antenna's performance is shown in **fig. 2**.

a "rubber duckie" for 160 meters

The ham who lives on a small, treeless lot faces a real problem when contemplating 160-meter operation. One solution to this problem is a vertical antenna. But a quarter-wave vertical antenna on "top band" is over 130 feet high. Joe Moraski, KY3F, has a solution to the problem. He recommends a helix antenna operating in the normal mode — that is, a coil with a small diameter compared to the operating wavelength. Maximum radiation is *normal* to the axis, hence the name. This is the same mode of operation as that of the 2-meter "rubber duckie" antennas used on handhelds.

*Though more expensive copper-based hardware cloth would maintain its electrical properties longer. — Ed.

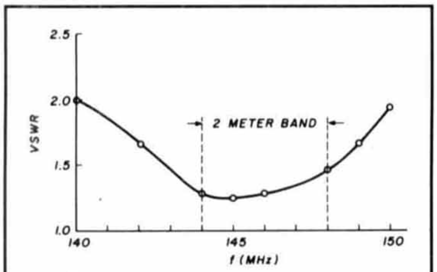

fig. 2. Measured performance of PVC antenna on 2 meters.

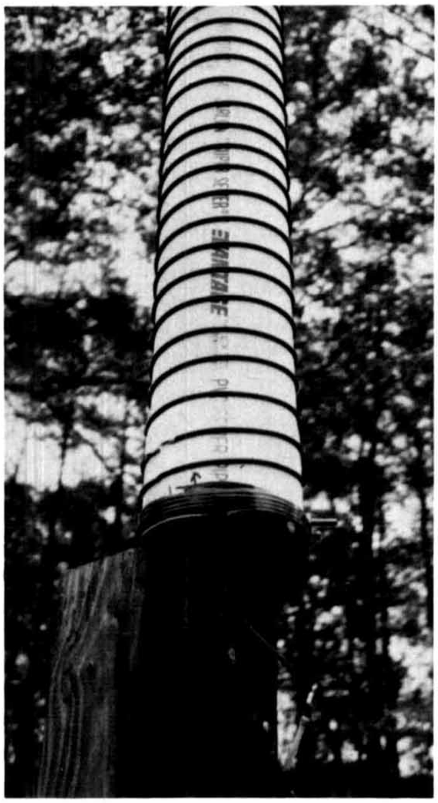

Photo 1. Base assembly of the KY3F vertical antenna for 160 meters. Final frequency adjustment is made by varying number of turns at the bottom of the helix.

There are no hard and fast rules about the length or diameter of the helix. The rule of thumb is that about a half-wavelength of wire is used to make the helix.

Antenna size is a matter of tradeoffs. The shorter and thinner the helix, the narrower the bandwidth. The longer and thicker it is, the harder it is to build and keep up in the air! A shorter helix is less efficient — consequently, the longer the better.

Since the helix bandwidth is narrow, a top hat is added to reduce antenna Q and add capacitance at the high voltage point. The resulting reduction in circuit Q causes the feedpoint impedance at the antenna base to vary less rapidly with frequency change than the unloaded antenna. This means that the antenna can be used over a larger portion of the band than would otherwise be possible.

By experiment Joe found that a 20-foot antenna was a good operating compromise. Accordingly, he used two 12-foot sections of 4-inch diameter PVC water pipe cemented together to make a 24-foot mast. He wound No. 18 insulated hookup wire on it at ten turns-per-inch spacing. This helix, in combination with a screen wire capacitance hat on top, resonated in the 160-meter band when operated against a ground rod and quarter-wave counterpoise wire run around the backyard. Four 30-foot radials were added. A sketch of the antenna is shown in **fig. 3**.

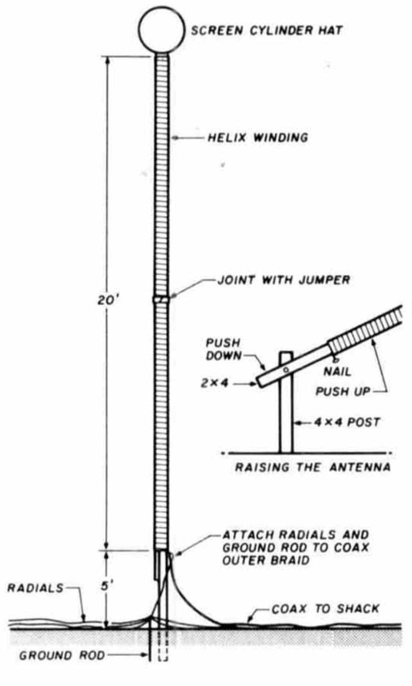

fig. 3. KY3F's 160-meter "Rubber Duckie."

The construction is simple if done in the proper sequence. The first step is to drill holes for the end tie bolts that terminate the winding. The holes are 10 feet apart. Galvanized bolts are used, with washers on each side of the PVC pipe. With a tape measure and felt-tip pen, make small marks at 1-inch intervals between the bolts.

Next, fasten an eye-lug to one end of a 140-foot length of No. 18 insulated wire. Fasten the lug to one bolt and wind the coil on the PVC pipe, using the pen marks as a guide — one turn per mark. Use tape to hold the coil in place as you progress along the form.

Wind the wire as tightly as you can and when you reach the second terminating bolt, cut the wire and place an eye-lug on the end that will fit over the bolt.

With the winding properly spaced, run a bead of RTV along the length of

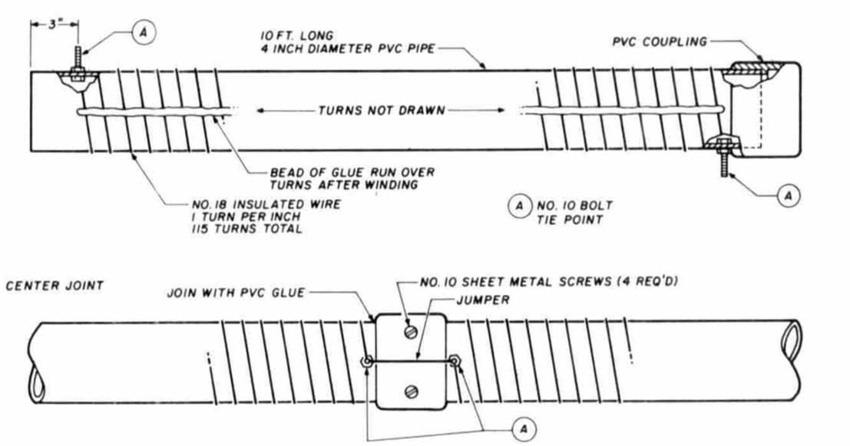

fig. 4. Mechanical details of the coil sections.

pipe over the coil turns to lock them in place.

You have now completed half the antenna. Now, wind a second similar coil on the second section of PVC pipe, making sure that both coils are wound in the same direction (left- or right-hand turns, but be sure they're both the same).

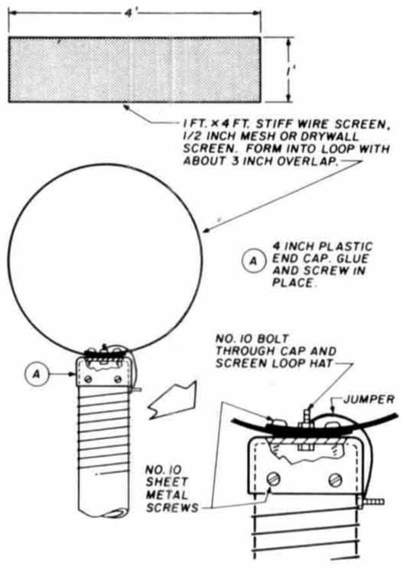

fig. 5. Top Hat assembly.

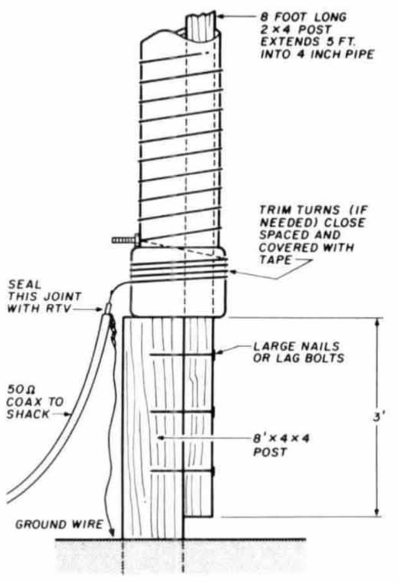

fig. 6. Mounting arrangement of antenna to post.

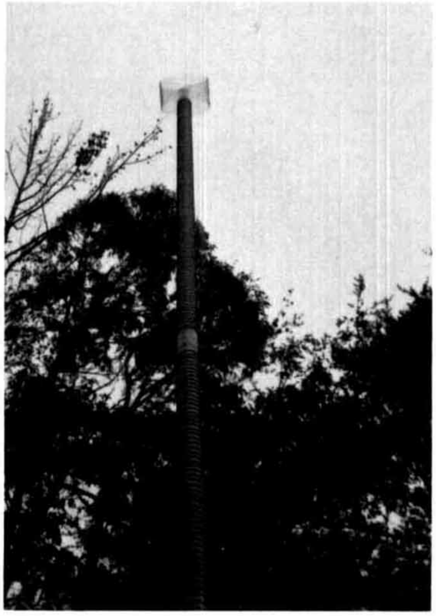

Photo 2. View of winding and capacitance hat on KY3F helix antenna.

The two pipe sections are now joined with a plastic pipe splice section and PVC cement. Align them quickly and let the joint dry (**fig. 4**). Some PVC pipes have a built-in coupling joint — nice if you can locate one. For added strength, run four No. 10 self-tapping sheet metal screws through the joints where the PVC pipes and splice section overlap. Finally, connect a wire jumper between the two coils to form one 20-foot coil.

The next step is to make the "top hat." A section of 1/2-inch mesh chicken wire or drywall screen can be used. Wrap it into a cylinder about 1 foot in diameter and 4 feet long. Solder the overlapping wires. Drill the cap piece of the antenna for a No. 10 bolt, which is bolted through the overlap portion of the top hat. Use large washers on each side of the screen to enhance stability. Then run four No. 18 sheet metal screws through the screen and cap to keep the screen from turning or buffeting in the wind (see **fig. 5**).

The final step is to attach the top hat to the top of the helix with a jumper wire. Glue the top hat in place and pass four sheet metal screws through the hat to hold it securely to the PVC pipe.

Photo 3. Joe, KY3F, standing beside his 160-meter "Rubber Duckie."

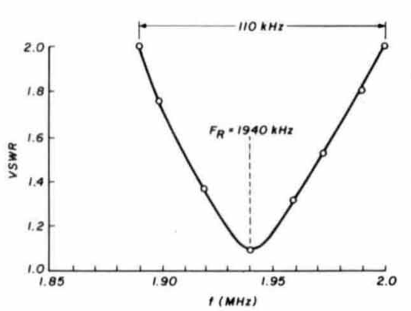

fig. 7. "Rubber Duckie" for 160 meters has 2:1 bandwidth SWR over 110 kHz. Antenna was adjusted for 1940 Hz.

Dig a 3-foot hole for the mounting post. Wrap the portion of the post that will be beneath the surface of the ground with heavy kitchen-type aluminum foil. A double wrapping held in place with plastic tape will protect the post from ground water. After the sides and bottom of the post have been wrapped, place the antenna in the hole and drive a ground rod into a corner of the hole, as far down as possible. Fill the hole with concrete, using a level to make sure the post is vertical.

To make the pivot joint, insert a section of 2x4 lumber within the PVC tubing. Fasten this extension to the 4x4 ground post with one lag bolt, used as a pivot. (See **fig. 6** for details.) Bolt the 2x4 and 4x4 together, with the 2x4 in a vertical position. Then raise the antenna to a vertical position and drop it down over the 2x4 section. When the antenna is in the final position, it will sit atop the 4x4 post with the 2x4 section acting as a positioning guide. Various views of the installation are shown in the accompanying photographs.

When completed, the radials and outer shield of the coax line are connected together and the inner conductor is connected to the helix by a short length of wire. The open end of the coax is taped and covered with RTV to keep water out.

As shown, the antenna is resonant at the top end of the 160-meter band. Four close-spaced turns were added at the bottom of the antenna to bring the resonant frequency down to 1.94 MHz. By picking the part of the band you wish to use most and adjusting the extra turns at the antenna base, you can resonate the antenna at any spot in the band you wish. SWR plots of Joe's antenna are shown in **fig. 7**.

Joe says the helix seems stable without any guy ropes, but recommends that ropes be added if the antenna is in an exposed, windy location. Light nylon guys would do the job.

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