# The Flagpole Deluxe

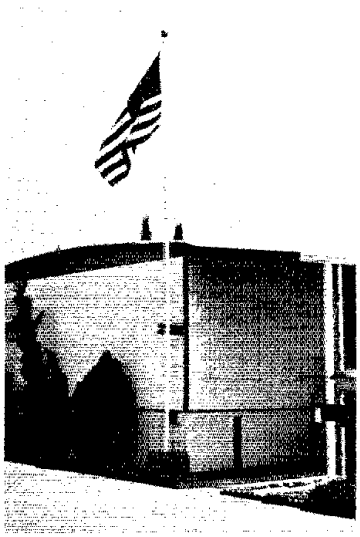
## If you've got to hide your antenna, make this flagpole do double duty as an efficient four-band vertical.

By Fred J. Schnell,* W6OZF

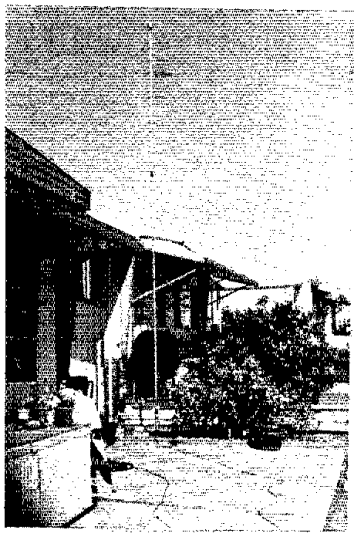
When I moved into a mobile home park some eight years ago I was faced with an antenna problem. The manager of the park told me I could put up an antenna at night, but would have to take it down during the day and also "stay out" of the TV system. The TV problem did not bother me, but putting up an antenna at night and taking it down every day had no appeal. I first mounted a Swantenna mobile antenna on a 42-inch, chain-link fence and got along very well for several years. But I was always dreaming of something different, something with automatic band switching.

I decided to concentrate my efforts toward building a flagpole antenna, with no bulges like the trap verticals. It had to cover 40 through 10 meters and be able to fly a 4 × 6-foot flag. I had room for neither radials nor a large copper screen, so only a ground rod could be used — a compromise. Faced with these constraints, I proceeded with the design of my flagpole.

When finished the antenna is an aluminum tubing vertical with slim, home-built traps, covered by standard PVC pipe, and topped with a toilet-tank ball. The PVC pipe has nothing to do with the antenna itself; it is the flagpole. The base is small and simple, thus easily concealed by brickwork, rocks or flowers.



Would you believe this flagpole is really a four-band antenna, covering 40 through 10 meters? Sturdy enough to fly the flag in a stiff breeze, this trap vertical presents a good match to 50-ohm coaxial line.



The test site for the development of the antenna was the "backyard." Upon completion the antenna was moved to its permanent location and "camouflage" was added to conceal the base, shown at left.

### Problem Solving

A suitable ground system and skinny traps were two areas requiring some head scratching. I settled on a 10-foot (3.05 m) length of copper water pipe for the ground rod. Installation of this pipe was accomplished by soldering a hose fitting on one end of the pipe, connecting a garden hose to it, and turning the water on full force. You'll have to stand on a step ladder to do this but the method works beautifully. I have another ground rod under the mobile home, and the ground system consists of the two ground rods and also the "skin" of the home.

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After much experimenting I finally settled on putting the capacitors inside the trap forms; I selected capacitors which would keep the total height of the vertical under 19 feet. It topped out at 17 feet, 9-3/4 inches (5.43 m). The capacitors used are the Centralab 850S series doorknob transmitting type. I had used them before when I built a five-band dipole which has been described in *The ARRL Antenna Book*. The first traps were made of formica tubing reinforced with Lexan rod, but I recommend fiberglass rod for the added strength and lighter weight.

### Learn to Be a Pack Rat

If you start from scratch, you will have to visit several stores in order to obtain all the materials. Try stores like Sears, Ward's and Penney's for miscellaneous items, then hardware, metal, building and lumber companies. The aluminum tubing is 6061-T6 or equivalent, 0.058-inch wall thickness. The T- and U-bar stock is construction aluminum pieces and is available from most metal supply companies.

Auto supply and discount stores are excellent sources for U bolts and clamps. The 1-1/4-inch conduit may be purchased from an electrician, but since you will only need 2 feet of this he will probably give you that much from his scrap heap. Assemble all the materials before you start since nothing is more exasperating than beginning a project and then not being able to readily get all the parts. Table 1 is a complete list of the necessary parts.

### Getting Started — Preliminary Construction

Fig. 1 shows details of the base mounting assembly. Drill and countersink a hole to accommodate a no. 8-32 × 9/16 flat-head screw. Drill and tap the insulator block and mount it inside the U channel. Drill eight 3/8-in. (10 mm) holes in the T bar as shown; the 2-in. U bolts will straddle the U channel. Assemble the U and T

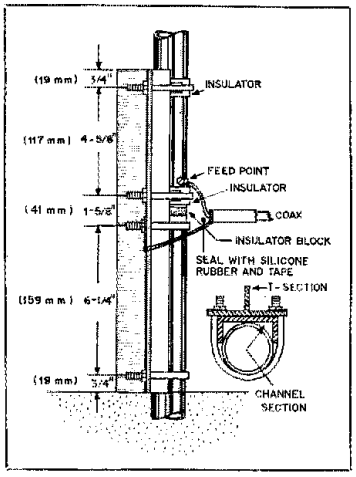



Fig. 1 — U- and T-bar stock details for the base assembly.

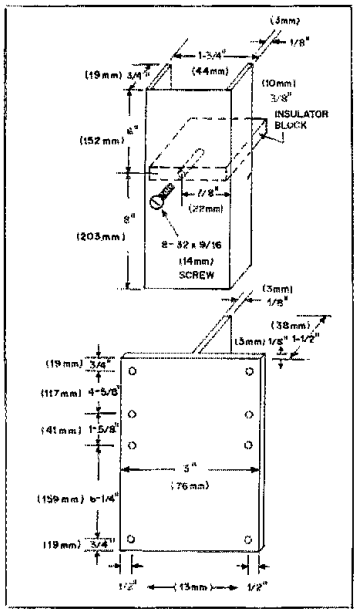



Fig. 2 — Construction details of the T bar and U channel for the base mounting assembly.

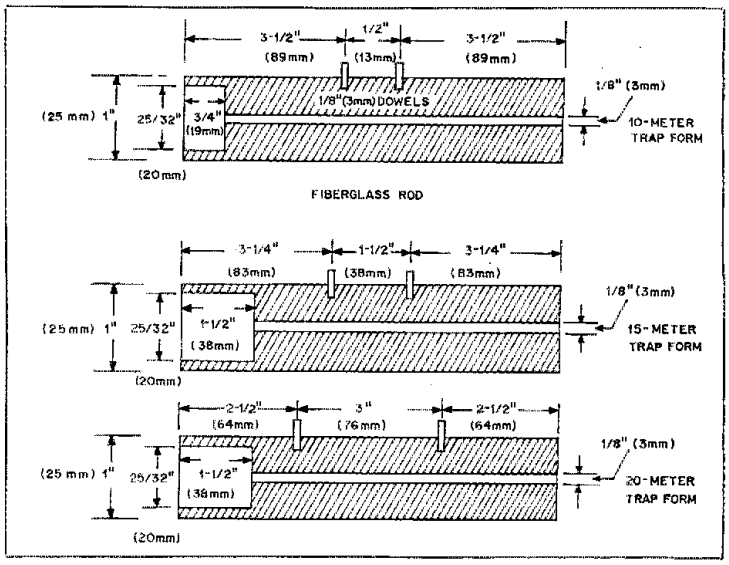



Fig. 3 — Cross-sectional views of the three traps.

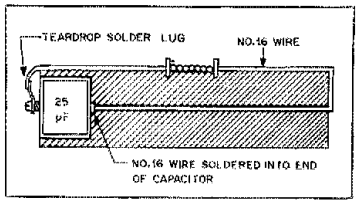



Fig. 4 — 10-meter trap winding detail.

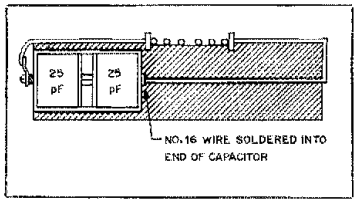



Fig. 5 — 15- and 20-meter trap winding details.

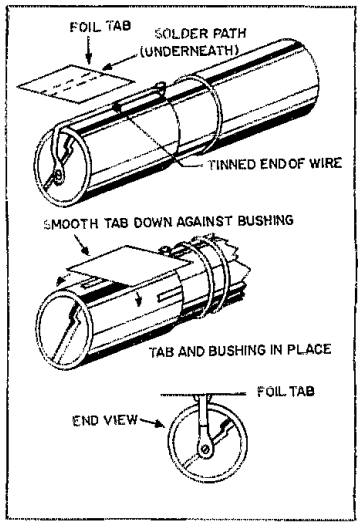



Fig. 6 — Further details of trap construction, showing the foil tab and bushings.

bars per Fig. 2, leaving the U bolts loose.

Fit the insulator sleeves on the 36-in. length of 1-1/8-in., 0.125-in. wall tubing (Fig. 2). These insulators should fit snugly and the U bolts which clamp them to the base assembly will hold them tight. Drill and tap the tubing for a no. 10 screw, 1/4 in. (6 mm) above the top insulator; this will be the feed point.

### Preliminary Construction — Traps

Refer to Fig. 3. Cut one 7-1/2-in. (191-mm) and two 8-in. (203-mm) lengths of 1-in. fiberglass rod, and through all three pieces drill a 1/8-in. (3-mm) hole lengthwise. In one end of the 7-1/2 in. rod, drill a 3/4-in. (19-mm) hole 3/4 in. deep. In the other two pieces, drill a hole in one end 1-1/2 in. (38 mm) deep. I used masonry drill bits for these holes.

In the 7-1/2-in. rod, drill two 1/8-in. holes (3/16 in. deep) for pegs, as indicated in Fig. 3. Insert 1/8-in. pegs in these holes. These pegs will be used to hold the windings in place.

Referring to Fig. 4, wind the 10-meter trap. Begin by soldering one end of a suitable length of no. 16 wire (Formvar or Thermaleze) to one end of a 25-pF capacitor. Push the wire through the rod from the large hole end and push the capacitor all the way in, then pull the wire snugly over the end of the rod to the nearest peg and wind five turns, close spaced. Coming off the next peg, dress the wire to the capacitor and solder to it by means of a no. 6 solder lug. This completes assembly of the 10-meter trap.

Following the same procedure, wind the

15- and 20-meter traps. Note that these traps are space wound and that the last turn is spaced a little more than the others; Figs. 4 and 5 illustrate. The 15-meter trap has 13 turns spaced to a length of 1-3/8 in. (35 mm) and the 20-meter trap has 23 turns spaced to a length of 2-3/8 in. (60 mm), with the last turn of each spaced slightly more than the rest. This aids in later tuning of the traps.

Referring to Fig. 5, scrape the enamel off both ends of each winding from the pegs to the ends of the fiberglass rods, and carefully tin each one with a hot soldering iron. Cut six foil tabs, each 3/4 × 1-1/2 in. (19 × 38 mm) and run a solder-path lengthwise along each tab, on one side only. Now solder these tabs onto the previously tinned wires (Fig. 5).

Cut six lengths of the 1-1/8-in. tubing, each six in. (152 mm) long. In one end only of two of the tubes cut a slot 3-1/2 in. (89 mm) long, using two hacksaw blades together in the hacksaw (Fig. 7). This will make a slot about 1/8 in. wide. On the other four tubes, make this slot 3 in. (76 mm) long. Remove one hacksaw blade and cut three more slots in the same end as the wide slot, spacing them 90 degrees apart. Clean and deburr all cuts. These slots permit tight compression when the hose clamps are applied.

Carefully push these bushings (the slotted tubes) into place on the trap forms, up against the pegs; the longest slotted bushings go onto the 10-meter trap. Then gently press the foil tabs down against the tubing. The bushings must be in place for the following operation (Fig. 8).

The traps should be grid dipped and adjusted for resonance at the following frequencies: 28.0 MHz, 20.5 MHz and 14.0 MHz. Do not couple too tightly to the traps as the grid dipper can be "pulled," resulting in erroneous readings. Adjust the traps by carefully spreading or compressing the last turn on each trap.

### Construction of Adjustable Sections

Refer to Fig. 9 and cut the 12-foot (3.66-m) length of 1-1/4-in. tubing into four lengths, as follows: 5 ft, 6 in. (1.68 m); 1 ft, 9 in. (0.53 m);* 2 ft, 10-1/2 in. (0.88 m);* 1 ft, 10-1/2 in. (0.57 m). The starred (*) items may be cut in half and a bushing inserted to permit adjustment of the 15- and 20-meter bands (Fig. 8). If you choose this method, four more hose clamps will be required.

The tubes just cut are all slotted and deburred on both ends, inside and out. If this deburring is not done the aluminum may sieze or gall and it then becomes difficult (if not impossible) to separate or adjust. A stainless-steel hose clamp is placed over each slotted end of each tube.

Cut and deburr a 6-foot (1.8 m) length of the 1-1/8-inch tubing and insert the 1-inch piece of round aluminum rod, which should be drilled and tapped for 1/4-20 thread all the way through. Secure this in the end of the tubing by drilling two no. 36 holes and tapping for 6-32 screws.

### Putting It Together

Fig. 9 provides an overall picture of assembly of the vertical. Nothing is critical except that care must be exercised when attaching the traps to the 1-1/4-inch tubing sections. Start by spreading *one* of the slots in the tubing ends to expand the diameter slightly. The foil on each trap must be started smoothly between the trap bushing and the tubing sections. This is made easier by carefully pushing the foil tightly against the bushing before sliding the bushing onto the trap itself.

Start by sliding the 21-inch, 15-meter tubing section onto the capacitor end of the 10-meter trap, up against the peg, and tighten the hose clamp securely. In the same manner, clamp the 34-1/2-inch, 20-meter section onto the capacitor end of the 20-meter trap. Tighten all clamps securely, then slide the 15- and 20-meter sections onto the bottoms of their respective traps. See Fig. 9. Next, clamp the 6-foot length of 1-1/4-inch tubing to the bottom of the 10-meter trap, the 36-inch

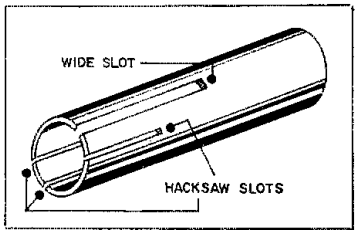
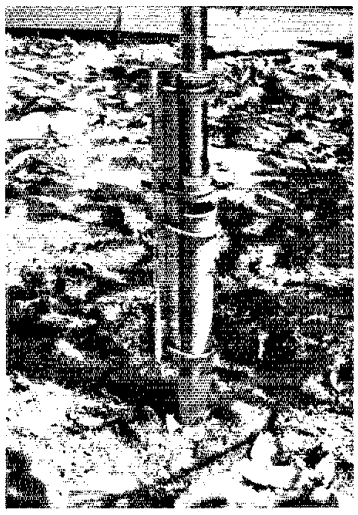



Fig. 7 — Method of slotting the tubing for use as bushings.



Complete base-mounting assembly in place.

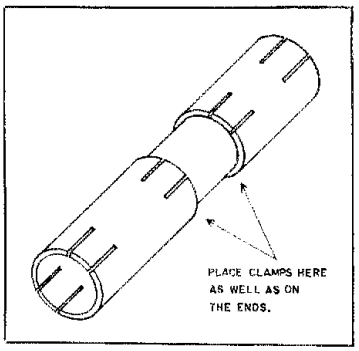



Fig. 8 — Bushings mounted in place on the 20-meter trap.

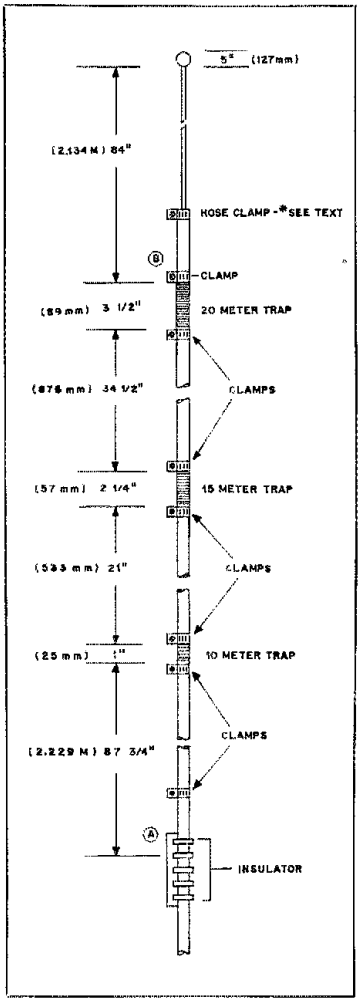



Fig. 9 — The complete Flagpole Deluxe vertical.

**Table 1**

1 — Insulator block, 1 × 1-1/2 × 3/8" (25 × 38 × 10 mm) (formica, Plexiglas, plastic, etc.).
1 — Length aluminum tubing, 1-1/4 × 0.058 × 144" (3.66 m) 6061-T5.
1 — Length alumimum tubing 1-1/8 × 0.058 × 144" (3.66 m) 6061-T5.
1 — Length aluminum tubing 1-1/8 × 0.125 × 36" (914 mm) 6061-T5.
1 — Piece of aluminum rod 1 × 1" (round).
1 — Fiberglass round rod 1 × 24" (25 × 305 mm).
4 — 2" U bolts.
5 — 25-pF Centralab transmitting capacitors, 850S series.
1 — Piece of construction aluminum channel stock, 3/4 × 1-3/4 × 14" (19 × 44 × 356 mm), 1/8" wall thickness.
1 — Piece of construction aluminum T-bar stock, 3 × 1-1/2 × 14" (76 × 38 × 356 mm), 1/8" wall thickness.
8 — 1-1/4" hose clamps.
1 — 2-foot length (0.61 m) 1-1/4" EMT conduit.
1 — 3-foot length (0.91 m) 1-1/4" EMT conduit.
1 — 12-foot length (3.66 m) of 2" PVC schedule 40 water pipe.
1 — 2"- to- 2"PVC coupling.
1 — 1-1/2" PVC cap.
1 — 12-foot length (3.66 m) of 1-1/2" PVC schedule 40 water pipe.
1 — PVC reducer, 2" to 1-1/2".
1 — Tank ball or Eagle 5".
1 — 10-foot length (3 m) copper water pipe (for ground, if required).
1 — Piece of copper or brass foil, 0.005 × 1 × 12" (0.13 × 25 × 305 mm); this may be salvaged from an old transformer or shim stock, or may be purchased from auto supply or metal suppliers.
2 — Insulating sleeves made from plastic tubing 1-1/8" inside diameter, 1/2" wall thickness. These can be made from two PVC 1-1/4-to-3/4"bushings. These are obtainable wherever PVC pipe is sold. The bushings will have to be reamed very slightly to have a press fit over the 1-1/8 × 0.125" aluminum tubing. Either file or turn the flange off on a lathe.

length of 1-1/8-inch tubing into the last tubing just installed and adjust the total length to 87-3/4 inches (2.23 m) from the 10-meter trap to the end of the tubing.

Install the ball on the end of the 6-foot length of 1-1/8-inch tubing, which has the aluminum plug in it, using a 2-inch length of 1/4-20 threaded stock. This can be cut from a 1/4-20 bolt. Install this section of tubing into the end of the tubing on the 20-meter trap and adjust to the dimension shown in Fig. 9. Recheck all clamps for tightness at this time.

### Testing and Adjustment

If your situation is like the author's, you will be forced to test and tune the antenna somewhere other than its eventual "camouflaged" location. Do your tuning in the final position if it is at all possible, since the effects of surrounding objects can undo an entire afternoon's work. Set the 3-foot length of 1-1/4-inch EMT conduit in concrete next to your ground rod, leaving 7-3/4 inch (197 mm) above the concrete. Mount the antenna assembly on this conduit (Fig. 1), and connect a ground strap from the ground rod to the base assembly.

Once everything is in place and tightened, grid dip to determine the resonant frequencies of the vertical on each band. When making adjustments, remember that any change made on one band affects all *lower* frequency bands. Adjust the 10-meter section first, and measure the SWR by attaching the coax and applying very low power to the antenna through an appropriate SWR indicator. Continue with the other bands; very little trimming or adding should be required. If adding length is necessary, the alternate method described earlier of cutting a section of tubing in half and adding a sleeve is recommended.

After the 40-meter section is adjusted, remove the hose clamp and secure the tubing with four no. 6 sheet-metal screws. This is necessary because the 1-1/2-inch PVC pipe will not clear the hose clamp. After all adjustments have been made, SWR should not exceed 2:1 at any band edge.

### Camouflaging

The time has come to turn the vertical into a flagpole, or vice versa. Lay the entire antenna (including the base mounting assembly) flat on the ground, with the 2-inch PVC alongside it. Carefully measure the distance from the top of the base assembly (Point A, Fig. 9) to the top of the 20-meter trap (Point B) and cut the PVC to length. Install the 2-inch to 1-1/2-inch reducer assembly with PVC cement. Next measure the distance from the ridge inside the reducer to the top of the tubing of the 40-meter section; make sure you have the end of the 2-inch PVC even with the top of the base assembly. Cut the 1-1/2-inch PVC to length and cement it into the reducer.

Drill a hole in the PVC cap to clear the 1/4-20 stud in the end of the 40-meter section. Remove the base assembly and slide the antenna through the PVC pipe until the stud comes out the top; slip the cap onto the stud and screw the top ball on tight. Then slide the antenna back until the cap slides all the way on in place on the end of the 1-1/2-inch PVC. Do *not* cement the cap in place. One word of caution — make certain all clamps are tight before sliding the antenna back and forth in the PVC, to prevent any change in dimensions. The end of the 2-inch PVC should now be even with the base mounting assembly when the antenna is reattached.

This completes construction of the Flagpole Deluxe. The author uses a small pulley and rope for flying a flag from his vertical, and comments from neighbors indicate full approval of the obviously handsome flagpole. Results radio-wise have been rewarding, and it is not even necessary to stop operating when it rains! Finally, the author gratefully acknowledges the assistance of George Rice, W6OGR, in the preparation of this article.

## Strays

### *QST* congratulates . . .

☐ the South Eastern Massachusetts Amateur Radio Association, W1AEC/WR1ADR, for being awarded the "Outstanding Service Award" by the National Foundation for the March of Dimes. The amateurs provided communications support during walk-a-thons in New Bedford and Westport.

☐ Benjamin Frank Borsody, K4EC, whose biography appears in the latest editions of *Who's Who in America* and *Who's Who in the World*. He has also been admitted as a senior member in the Florida Engineering Society, a component of the National Society of Professional Engineers.

### A PROSPECTIVE HAM NAMED JASON

☐ One prospective amateur in Arkansas is a bit more determined than most others. But then again he has to be. Jason White, a seven-year-old from Texarkana, AR, was born with a rare disease that prevents him from digesting food. He has been critically ill many times but has always managed to struggle back. Still, he requires treatment at the Texas Children's Hospital in Houston.

Among those helping to offset the staggering medical debts is the southern section of the Country Cousins Net. Also, they gave him a receiver so he can listen to hams, a pastime he enjoys a great deal. Besides continuing to give of themselves as a group project, they are asking other amateurs to make contributions to the Jason White Trust Fund, P. O. Box 1998, c/o The Commercial National Bank, Texarkana, AR 75502, Attention: Mr. Mike Sanders. — *W4YWP*