A Portable Inverted V Antenna

A portable antenna that is great for ARRL Field Day, offers directional control and may be useful where fixed antennas are not allowed.

By Joseph R. Littlepage, WE5Y

If necessity is the mother of invention then restrictive covenants must be the mother of desperate measures. I recently moved into a new neighborhood and found that the covenants made it difficult for me to erect or install any type of ham radio antenna structure. If you are faced with a similar situation or simply have need for a portable antenna that you can erect quickly and easily, this may be what you need.

The problem I faced is common to many living in newer subdivisions and is quite restrictive of Amateur Radio operations. I was determined, however, to find a way to get back on the air. My challenge was to develop a portable antenna system that would be easy and quick to erect and enable me to work a reasonable amount of DX without being obvious to the neighbors. In addition, I needed to determine a low enough power level to avoid TVI and other potential interference that could draw attention to my Amateur Radio activity. QRP and a good antenna proved to be the answer!

The Inverted V

I tried end-fed long wires, difficult-to-support dipoles and finally decided to try an inverted V cut for 17 meters. But how could I support it without a sky hook? That's when I hit upon the idea of using a lightweight telescopic pushup pole for a support mast. To serve as the base support for the pushup mast, I purchased a portable antenna tripod. I spread the tripod legs to about 40 inches apart and locked them in place. This combination is my sky hook!

The top of the antenna should bring together the feed line and two wire elements angled at least 90° apart. Each of the wire elements is cut for a $^1/_4$ λ on the desired band. I chose to try the 17 meter band and cut each element for 18.1 MHz using the formula 234/f, with f the frequency in MHz for each quarter wave as shown in Table 1 for compromise CW and phone operation. You may wish to change the design frequency to suit your operational preferences. Final measurement and trimming was accomplished after the finished antenna was erected on site using an MFJ-259B antenna analyzer.

The next step was to devise a spreader assembly to hold the lower ends of the wire elements apart and keep the spread angle near 90° without resorting to ground anchor points. I wanted to be able to rotate the antenna using the "Armstrong" method to maximize its efficiency in selected directions. The solution was to use two 10 foot lightweight telescoping fiberglass fishing poles held end-to-end. A simple support arm assembly made of two 12 inch lengths of $^1/_2$ inch thin-wall PVC pipe joined to a $^3/_4$ inch PVC X connector. This holds the spreaders in a horizontal position and enables them to ride up and down

Table 1

Wire Half-Element Lengths, Portable Inverted V Antenna

Band (Meters)	*Design Frequency (MHz)*	*Length*
20	14.175	16' 6$^1/_8$"
17	18.1	12' 11$^1/_8$"
15	21.175	11' $^5/_8$"
12	24.94	9' 4$^5/_8$"
10	28.4	8' 2$^7/_8$"

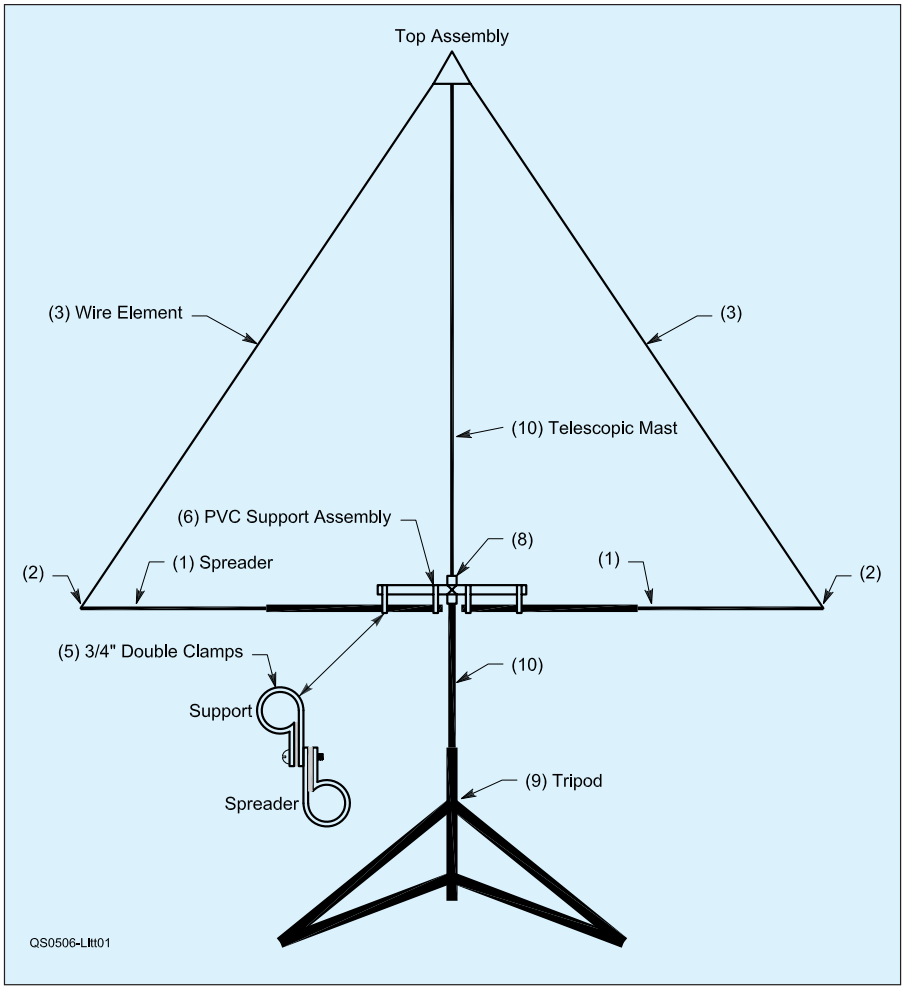

Figure 1—General arrangement of the completed inverted V antenna.

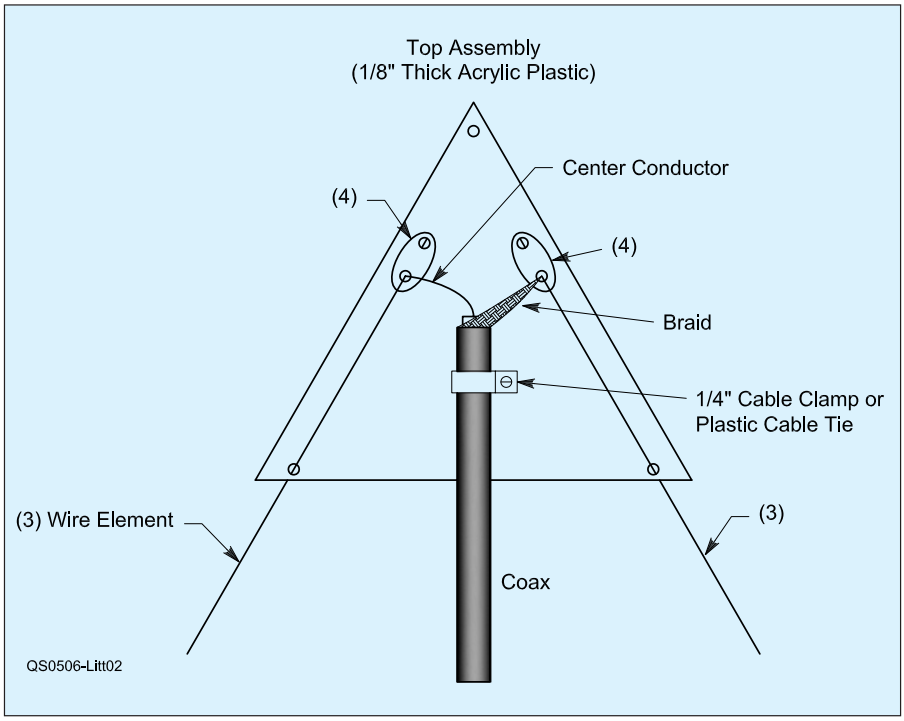

Figure 2—Details of the top assembly.

on the main support mast. The free ends of the wire elements are attached to the eyelets on the outer ends of the two spreader poles that are extended to full length as shown in Figure 1. Table 2 provides the bill of materials and sources for all the antenna's components.

Top Piece Assembly

A top fitting is required to bring the elements and transmission line together and to fix them to the top of the support. I constructed this assembly using a triangular piece of 1/8 inch thick clear acrylic plastic or similar dielectric material. Its dimensions are not critical. Drill holes to accommodate a top hanger, two solder lugs, a nylon cable clamp for holding the coax and a hole in each lower corner to support the antenna wire. Neither the construction method nor the dimensions are critical.

Solder one end of an element wire and the center conductor of the coax to one solder lug and secure that to the top piece. Route the free end of that element half down through the lower hole on its side of the top piece. Solder the other element wire and the coax braid to the other solder lug and secure to the top piece in a like manner. Route that element half's free end through the other lower hole. Secure the coax to the top piece using a small nylon cable clamp as a strain relief. A small cable tie can be used instead if you carefully drill a hole on either side of the coax to route it through. The details are shown in Figures 2 and 3.

Spreader Support Assembly

A 3/4 inch PVC X connector with 3/4 to 1/2 inch bushings pressed into opposite side

Figure 3—Photo of the top assembly.

Table 2

Materials List for Portable Inverted V Antenna

Item	*Quantity*	*Description*	*Source*	*Part Number*	*Unit Price*
1	2	B'n'M Black Widow crappie fishing pole, 3 sections, 10 feet.	Wal-Mart	BW3RR	$ 8.50
2	Package	Black interlock snap swivels, size 5.	Wal-Mart	BISS-5	$ 0.50
3	Roll	Insulated stranded #20 wire, 75 feet.	RadioShack	278-1219	$ 2.99
4	Pack	Crimp-on ring tongues, 24 assorted.	RadioShack	64-3030	$ 1.49
5	Pack	One-hole plastic clamp, 3/4" PP-1575UVB, six in pack.	Home Depot	E449-176	$ 1.49
6	10 feet	Silver line (thin wall) PVC pipe, 1/2"	Home Depot	717141340512	$ 1.80
7	2	PVC bushings, 3/4" × 1/2"	Home Depot	1287162647	$ 0.25
8	1	PVC "X" fitting, 3/4"	Home Depot	1287162483	$ 1.14
9	1	Portable antenna tripod.	MFJ	MFJ-1918	$39.95
10	1	Telescoping antenna mast, 33 feet.	MFJ	MFJ-1910	$79.95

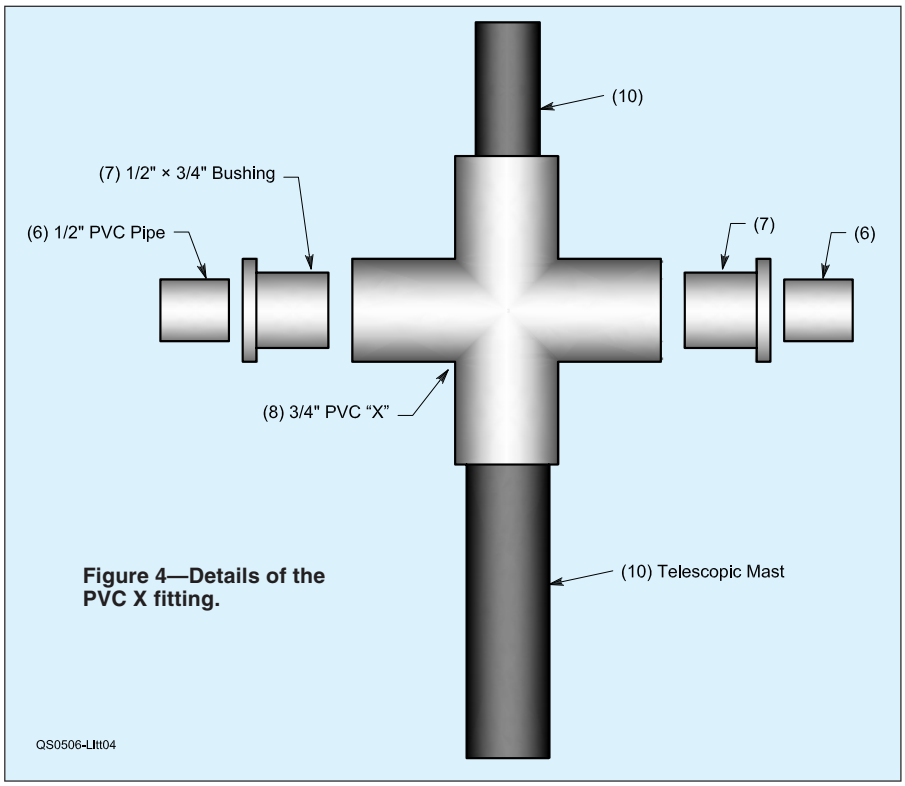

Figure 4—Details of the PVC X fitting.

Figure 5—Photo of the PVC X fitting.

holes is used to hold the two 12 inch long support arms as shown in Figures 4 and 5. The support arms are cut from thin wall 1/2 inch PVC pipe, used in preference to regular schedule 40 pipe to reduce weight. Press the bushings into opposite holes of the X piece until they are firmly seated. Then firmly press a 12 inch support arm into each bushing. Cement all joints using PVC cement. The two remaining holes will allow the spreader assembly to ride up and down the vertical mast. A slight raised lip molded inside these holes should be dressed down flush with the inside surface using a round file. To each support arm install two sets of back-to-back cable clamps. One end of each set is firmly attached around the support arm and the other end of each set around a fishing pole spreader. The outer clamp sets should be placed very near the end of each 12 inch PVC support arm, as detailed in Figure 6.

Stringing the Elements

When the top piece and the spreader support assemblies are completed it is time to string the elements. First, remove the innermost small top mast section with the eyelet from the support mast and set it aside. It will not be used. Place the large bottom end of the vertical mast, with the remaining nested sections inside, into the base supporting tripod. Next, raise the remaining centermost section of the telescopic support mast out about a foot and hold it in place with a spring-type clothespin.

Place the spreader support assembly down over the raised mast section with the spreader poles on the bottom side and against the clothespin. Next, attach the top assembly to the top opening of the small raised mast section with a bent hook fashioned from coat hanger wire run down inside the mast. The ends of the spreader poles can now be fully extended and twist locked in position. The free end of each wire element is then attached to the tip end eyelets on the spreader poles. Small fishing snap swivels can serve as attach hooks for the element ends.

Finally, remove the clothespin as you slowly start to raise the top mast section until it can be twist-locked into the next section below, which will follow it up. All the while the spreader support assembly will be moving down the vertical support mast to a point where the wire elements are straight and the spreader tips bend upward about 6 inches. This will maintain sufficient tension on the elements to prevent them from sagging. At this point, the spreader support assembly X connector should form a snug fit against the vertical mast. Failure to achieve a snug fit can result in the spreader assembly "weather vaneing" in a strong breeze.

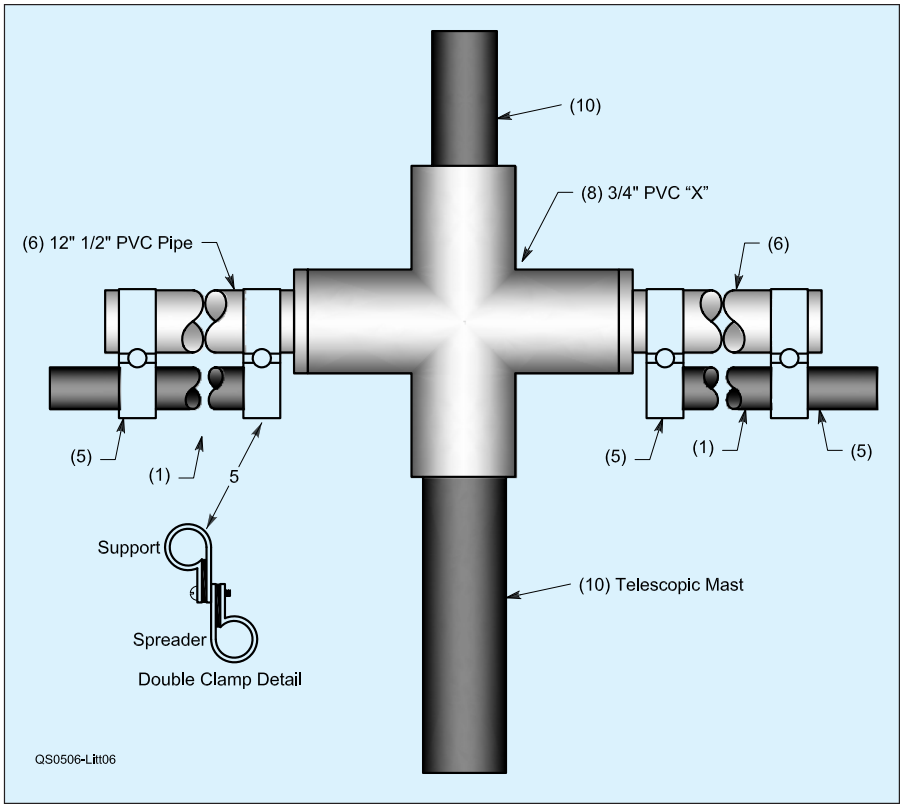

Figure 6—Details of the spreader attachment method.

Figure 7—The completed antenna broken down for storage or travel.

Erecting the Antenna

With everything set up it is simply a matter of raising the remaining vertical support mast sections and twist-locking each one to the section below it. You should take every precaution to prevent the mast sections from loosening and falling back down. This can result in fracturing the lower ends of the sections as they hit the bottom of the support tripod tube. Although the fiberglass sections are strong, they are thin and very brittle and will chip or crack when overstressed. Simply placing a couple of inches of cushioning material inside the bottom end of the tripod tube will prevent damage. The coax cable can be attached to the mast as it goes up. The final height depends on how many sections your support mast has. The pushup pole that I use has 11 sections. I use all but the smallest top section (with the small eyelet tip) since it is too weak to support the antenna assembly without bending over.

Results

My first contacts were on 17 meter SSB running 5 W with an ICOM IC-703 powered by a 33 Ah gel-cell battery. A Connecticut station gave me a Q5 report during our 25 minute QSO. Two days later I worked Costa Rica, Guatemala, Colorado, New Mexico and Wisconsin with the same setup. Two of the QSOs were with pedestrian mobile stations.

The real test came a few weeks later when I worked ON6WA in Belgium and GI3DZE in Ireland using the same setup and power. I have received many good signal reports from the stations I have worked. When not in use, the antenna system can be broken down for storage or transport as shown in Figure 7.

For the 20 meter phone band, you can simply substitute a 1 inch PVC X connector with 1 inch to 1/2 inch bushings and assemble the support arms as described above. This modification allows the entire spreader assembly to ride farther down the vertical support mast and thereby maintain the spreader tension on the longer 20 meter wire elements. As an alternative, you can add a 3 foot 6 inch long drop-down extension wire to the lower end of each 17 meter element and retune the antenna accordingly. Placing a small fishing weight on the free end of each extension wire will help to keep it vertical. For the 10, 12 and 15 meter bands the wire elements will be shorter than the 17 meter wire that I cut. To compensate for this, simply add a length of monofilament fishing line to each element to enable it to reach the spreader ends. This will ensure that the 90° element spread is maintained as well as tension on the wire elements.

Conclusion

The result is a strong, lightweight, rotatable portable antenna system that can be easily constructed of inexpensive and readily available materials. In addition, you can elevate the apex of the V to any convenient height to clear an obstruction such as the edge of a roof or lower it to avoid neighborhood scrutiny. This antenna project has gotten me back on the air and could be the answer to some of your problems. The prospects for ARRL Field Day, emergency operations or backpacking to some remote site are limited only by your imagination.

Joe Littlepage, WE5Y, was first licensed in 1969 as WB5AAI. He upgraded to Advanced Class in 1975 and more recently to Amateur Extra in 2002. He holds a degree in physics and is retired from the USAF. Joe is an active member of the Mississippi Coast Amateur Radio Association (MCARA) and serves as editor of the club newsletter. He enjoys QRP, kit building, homebrewing, building wire antennas and solar power experimentation. Joe can be reached at **jlextra@netzero.net**.