An Indoor or Window-Mounted Vertical Dipole

A floor-to-ceiling antenna for 10-20m.

by Robert H. Johns W3JIP

With a spring-loaded center insulator and rubber tips at the ends, this antenna is held by friction against the floor and ceiling, and is self-supporting. Its parts are less than three feet long and the coils fold up, so it stores nicely. You can also mount it temporarily on a window frame or railing and operate it outdoors.

When set up in a room with an 8-foot ceiling, the antenna is a full half wave on 10 meters, with end capacity hats making up for the lack of vertical length. On lower frequency bands, part of the large split loading coil shown in Photo B is connected into the antenna with an alligator clip. This coil resonates the antenna from 12 to 20m.

Construction Details

Only one loading coil? Yes. This means that the antenna is fed off-center. Even though the coaxial connector is in the middle of the vertical section, the element with the coil in it is electrically longer. The feed point impedance is also higher as a result of the off-center feed. This is convenient, since the impedance of a loaded antenna is often too low for a good match to 50 ohm coax. The two effects nicely balance here, giving this short antenna a low SWR on all bands so that no tuner is needed. Off-center feed is a useful trick for short-loaded antennas.

Since the coils for an indoor antenna are not exposed to the weather like an outdoor antenna, or to the wind load like a mobile whip, it's possible to get much greater Q and efficiency by making the coils big. This is a chance to reclaim some of the losses inherent in indoor operation!

The coils in the photos are approximately 8" in diameter, made from #8 aluminum wire. If you are wondering how in the world you might wind such monsters, have no concern. You can purchase the wire already wound to the proper diameter. Aluminum ground wire (Radio Shack #15-035) comes in 40-foot lengths, and coiled to this diameter. Building the coil requires preparing the PVC insulating ribs and cutting off the proper number of turns of aluminum wire, and then bolting the ribs around the turns of the coils.

This same wire is also used for the capacity hat rods at the ends of the antenna. All of the parts of the antenna are either hardware store or Radio Shack items.

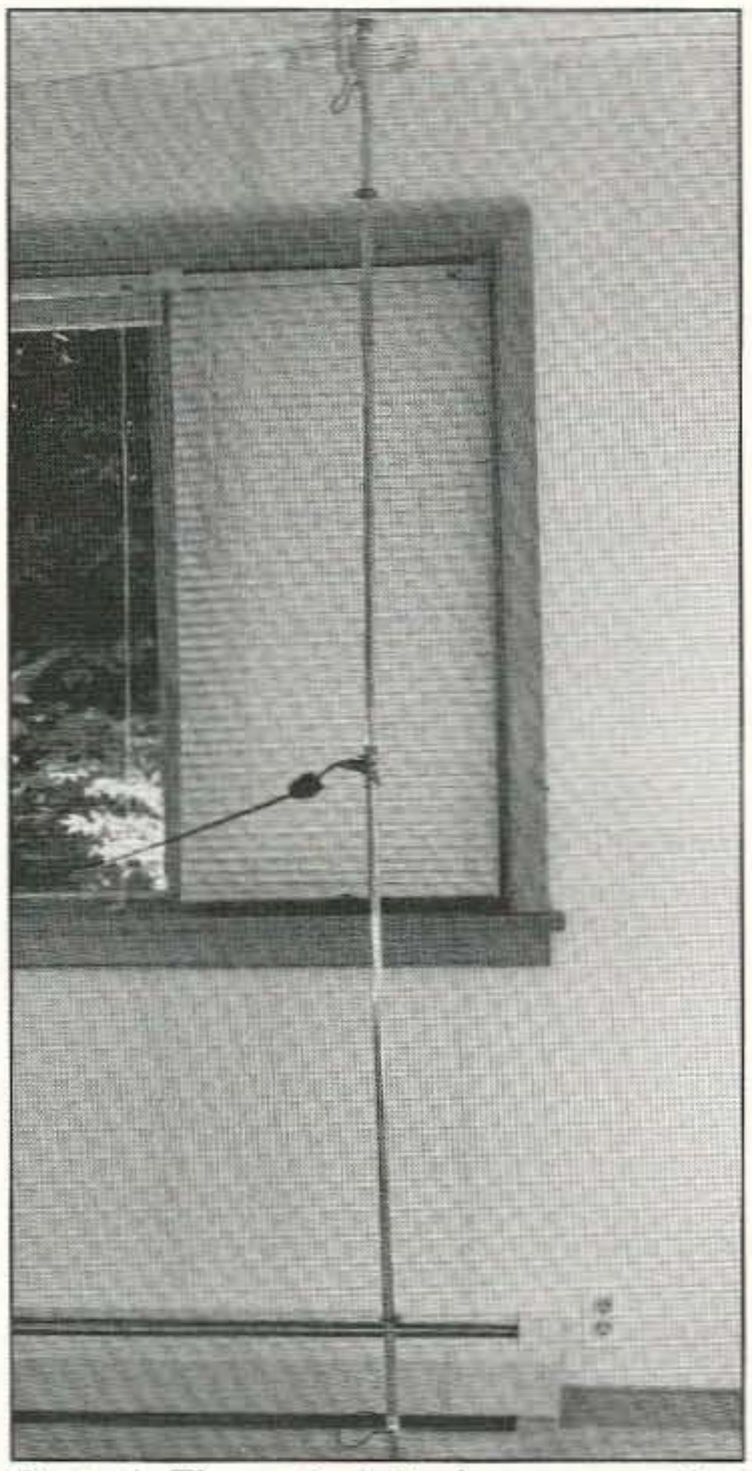

Photo A. The vertical dipole presses against the floor and ceiling to stay in position.

The folding feature comes about because there are only two ribs or supports for the turns, on opposite sides of the coil. They allow the coil wire to twist relative to the plastic ribs when the coil is flattened, as shown in Photo C. However, there is still enough grip on the wire to support the turns in a horizontal position out from the antenna when the coil is opened out again.

The outer end of the aluminum coil is connected to the antenna element via a short length of flexible wire to a ring terminal on its mounting bolt. This short wire connects to the coil by another ring terminal which is bolted to the end of the coil.

The capacity hat rods are three feet long and are attached to the antenna by inserting them into holes (#30 drill) 1/4" apart, through the end of the aluminum tubing element, as shown in Photo B and Figure 1. The rods are held in place by a 5/16" nut that slides over the two rods and then is threaded onto them to tighten them, as shown in Photo B.

Use two lengths of tubing that telescope to make each element adjustable in length. The antenna will fit against ceilings about 7.5 to 12 feet high. The larger center segments are 3/4" in diameter with a 0.048" wall, three feet long. This size of aluminum tubing is available from hardware departments. The thinner end segments are 5/8" in diameter, also three feet long. Some hardware stores carry this size, but not many. An alternate source is aluminum clothesline poles, from hardware or home building supply stores. These are 5/8" in diameter with a thinner tubing wall, about 0.030". The antenna in the photos uses this material.

One end of each 3/4" segment is slotted and tightened around a 5/8" segment by a hose clamp.

A 3.5" length of the 5/8" aluminum tubing at the tip of each element is separated from the rest of the element. This insulates the capacity hats from the elements. The insulator is a 1/2" CPVC (not PVC) pipe coupling, which is a tapered snug fit around the 5/8" tubing. Gently hammer the two tubes into the coupling and secure them with #8 x 1/2"-long sheet metal screws, as shown in Figure 1. A clip lead about 12" long is attached to the inner element tubing by a 6-32 x 1" bolt and nut. This alligator clip is the adjustable connection to the loading coil, or to the C-hat when no coil is in the antenna.

The center insulator is a 5/8" hardwood dowel, 8" long (see Figure 1 and Photo D). The SO-239 coax connector is mounted by means of 1"-long 6-32 steel bolts. Drill out two of the holes in the connector with a 9/64" bit to provide clearance for the bolts, then solder a 4"-long wire to the center terminal of the SO-239. This will pass through a hole in the dowel and connect to one of the elements by a 6-32 bolt securing the 3/4" aluminum tube to the center insulator, as shown in Photo D.

The heavy spring (C-263, Century Spring

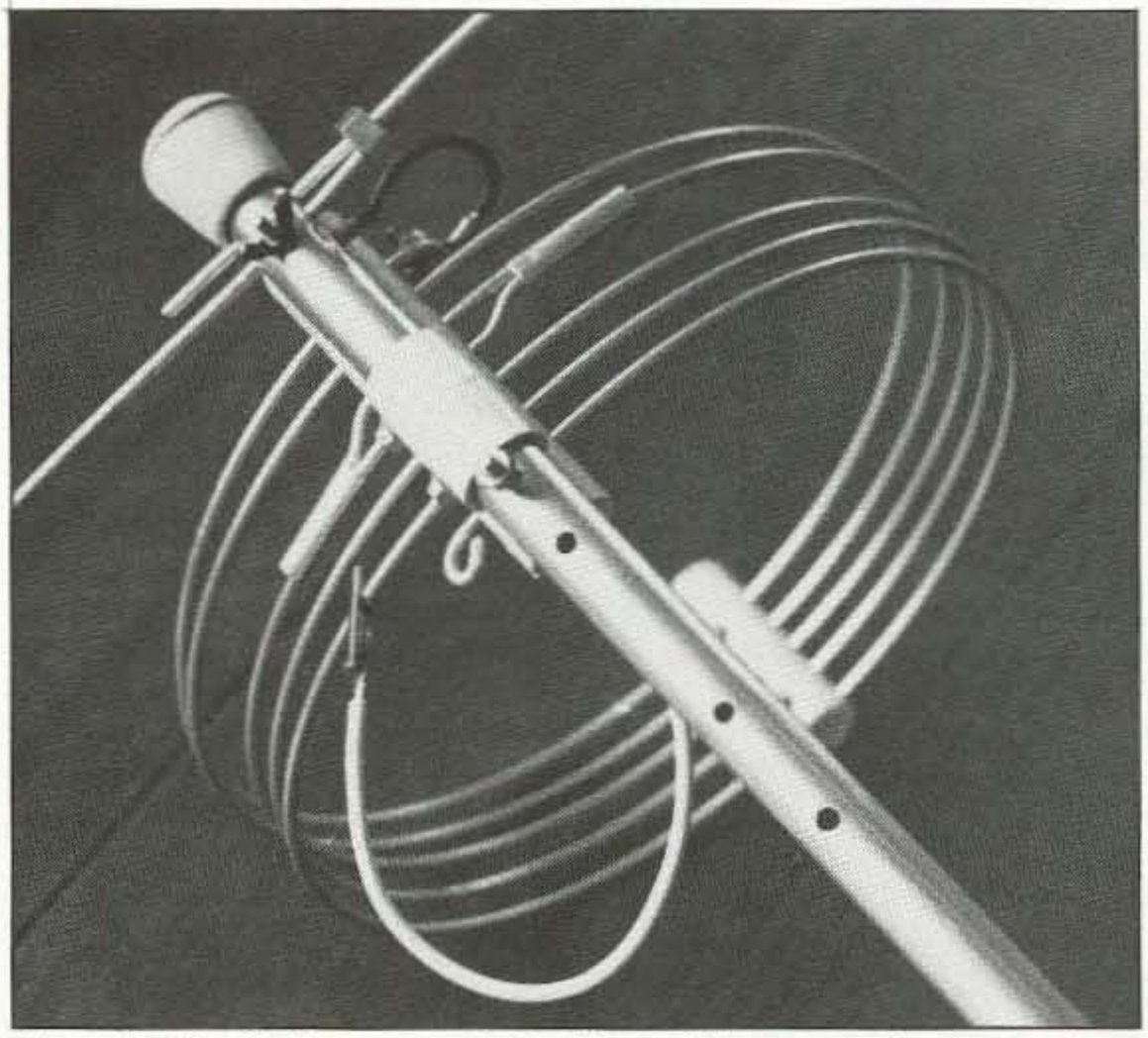

Photo B. The 8" diameter split loading coil has spaced turns so that a clip lead can tap into any point in the coil. The capacity hat rods are each 3 feet long. They are held in place by the large nut around them located near the tip of the element.

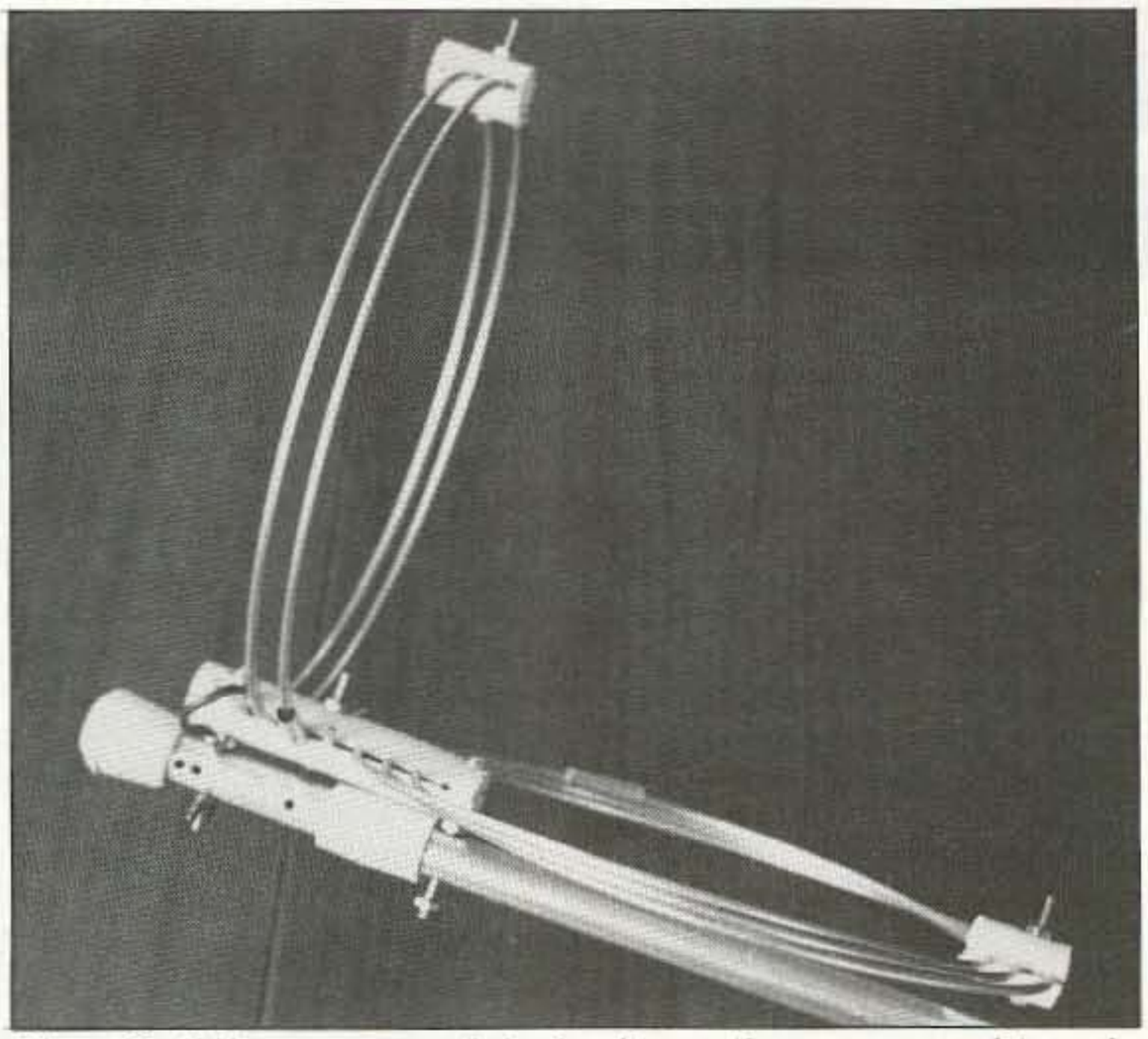

Photo C. Only two turns of the loading coil are connected into the antenna. Three turns are disconnected by sliding away the sleeves that are visible in Figure 2, and the three turns are folded down beside the element. Both coils fold for easy storage.

Corp., in a hardware store spring assortment) is a loose fit around the 5/8" dowel. This spring needs to be stretched so that the turns are spaced apart, as shown in Figure 1-b, and cut with a file or grinding wheel. It is threaded around one of the bolts that supports the coax connector so that it stays in place on the center insulator. With this compression spring in place, electrical contact to the second element of the antenna is made when the tubing is pressed against the spring.

All of the coil supports are made from 1/2" PVC Schedule 40 pipe. The turns of the aluminum coil are held in place by slots in the ribs made by drilling holes (9/64") on 3/8" centers into the pipe, and then sawing the pipe lengthwise through these holes. When the two halves of the pipe are bolted together again, with one turn of the coil in each slot, the coil turns are spaced properly and gripped by the rib. Figure 1 shows side views of coil ribs and the 6-32 x 2" bolts used to mount the coils to the antenna. You also need to drill 9/64" holes for these bolts in both the ribs and the aluminum tubing they mount to.

The 5-turn coil for 12-20m is made in two separate pieces that can be spliced together. The 2-turn coil is used for 12 and 15 meters with the 3-turn coil disconnected and folded down, as shown in Photo C. For 17 and 20 meters, the 3-turn coil is pulled up beside the 2-turn coil and they are spliced together by aluminum sleeves made from 1/4" o.d., 7/32" i.d. tubing, available from hobby stores. These two splices are visible in Photo B, which also shows the ends of the coils bent to bring them next to the adjacent coil.

To assemble a coil, bolt two rib halves together loosely at one end. Slide the aluminum sleeves onto the coils, and then put the aluminum wire between the half-ribs, with one turn in each slot. Hand-tighten the nut to keep the coil turns in the slots and add the remaining bolts to clamp the rib together. Use wing nuts to attach the coils to the elements. Connect the free eyelet of the solder lug at the top (as shown in Figure 1-a) to the outside end of the 2-turn aluminum coil. Bend the #8 wire into a tight loop that will allow a 6-32 x 1/2"-long brass screw to pass through. A #6 brass or stainless steel finishing washer will take a good bite into the aluminum wire and also wrap around it. Bolt the eyelet, the end of the aluminum wire, and the finishing washer together.

Operation

To set the antenna up between floor and ceiling, the length of the vertical section is adjusted with the hose clamps on the telescoping sections. The antenna is made about 1/2" to 3/4" too long, so that it tilts when held against the floor and ceiling. Then push down on the top section to compress the spring and bring it to a vertical position. The

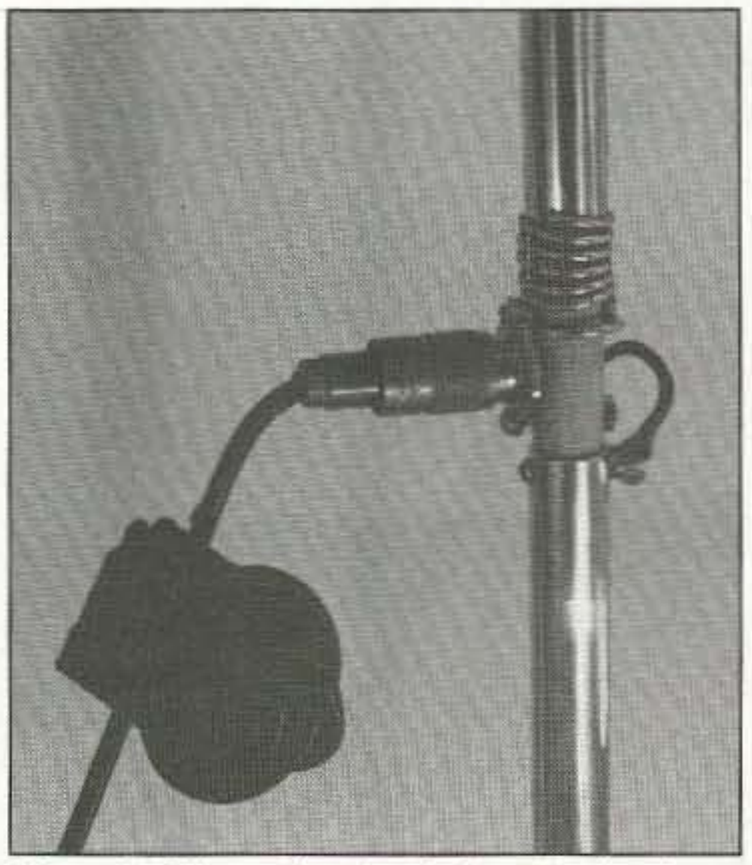

Photo D. The spring-loaded center insulator. Use a current balun (RF choke) at each end of the coaxial cable. The one shown has 5 turns of RG-58 coax wound on ferrite cores (Radio Shack 273-104).

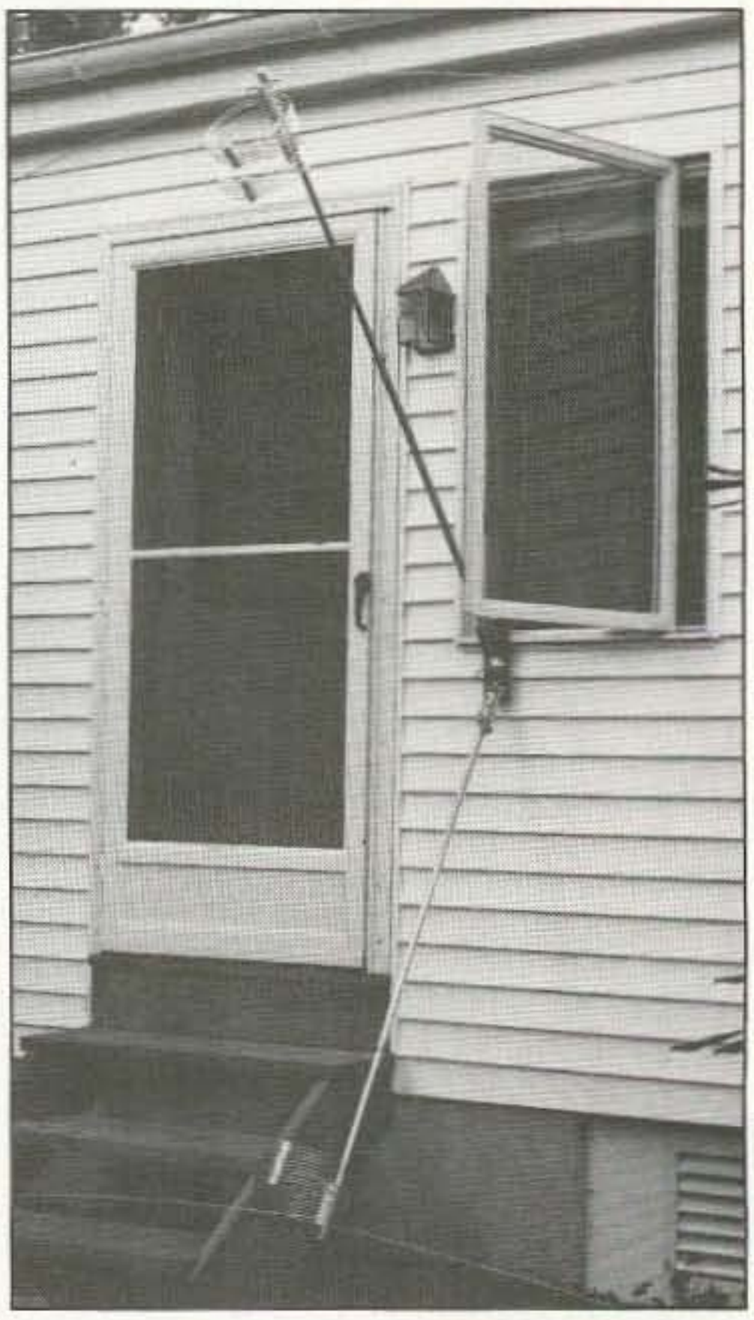

Photo E. The indoor vertical dipole can be window-mounted for better performance. A first-floor window was used for the photo, but the antenna should be as high and clear as possible. Extra coils with 5 turns (top) and 10 turns (bottom) may be added to the antenna, as shown here, for operation on 30 and 40 meters.

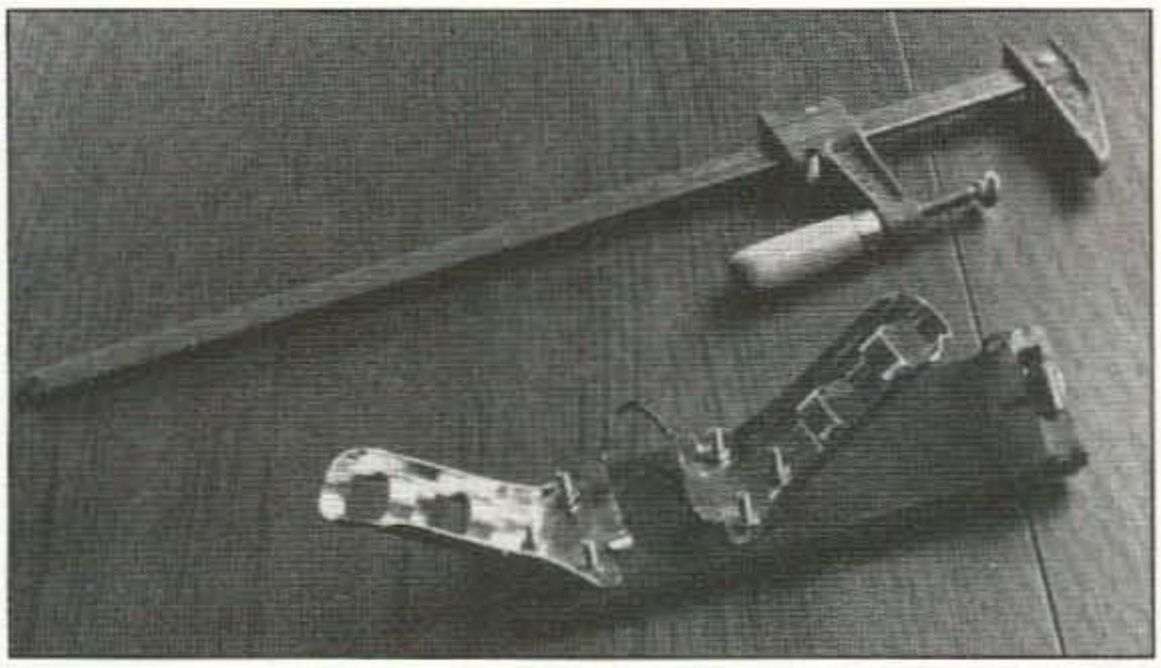

Photo F. The mounting hardware consists of 3/4" flagpole brackets on a board, and an 18" C-clamp that attaches to the board with a large hose clamp.

5/8" rubber furniture tips (not plastic) will hold it securely and not mark the floor or ceiling. Frequency changes are easier to make if the end with the coil is placed near the floor.

Table 1 gives the approximate number of turns to use for each band. These will vary, depending on how much metal in the building is close to the antenna, and on the height of the ceiling. The small increase in the number of turns from 15 to 17m is because the 3-turn coil must be connected and placed next to the 2-turn coil. This adds inductance from the mutual coupling.

When trying out the antenna for the first time or setting up in a new location, check the SWR across a band. This will tell you if an adjustment is needed. If the SWR is lowest at the low edge of a band, the antenna is too low in frequency. Remove some coil from the antenna by moving the tap (clip lead). If the SWR is best at the high end, add more coil. You are aiming to have minimum SWR where you operate in a band.

On 10 meters where no coil is used, the clip lead must connect the element to the outer tip in order to have the C-hats in the antenna. If the 10 meter frequency is too low, raise it by pushing in the C-hat rods so that they overlap and don't extend out as far.

An important part of this antenna system is a good RF choke, or current balun, to isolate the antenna from feedline currents. Especially with off-center feed, the coax will become part of the antenna if you connect it directly to the antenna without a choke. This will be seen as SWR and resonant frequencies that change with cable location, RF feedback (shocks from the radio knobs and squeals from its speaker), and inconsistent results. Use a ferrite-bead coax-shield choke (as reviewed by John Belrose in "Transforming the Balun," *QST*, June 1991, pp. 30-33) or an RF choke formed by winding the coax on ferrite cores as in Photo D.

Outdoor Operation

There are many options for portable operation of this antenna. If you bolt the removable element to the center insulator so that it contacts the spring, you can use the antenna as a horizontal dipole or hang it from a tree as a vertical dipole. You can also put the dipole outside for better efficiency, mounted on a windowsill or railing, as shown in photos E and G.

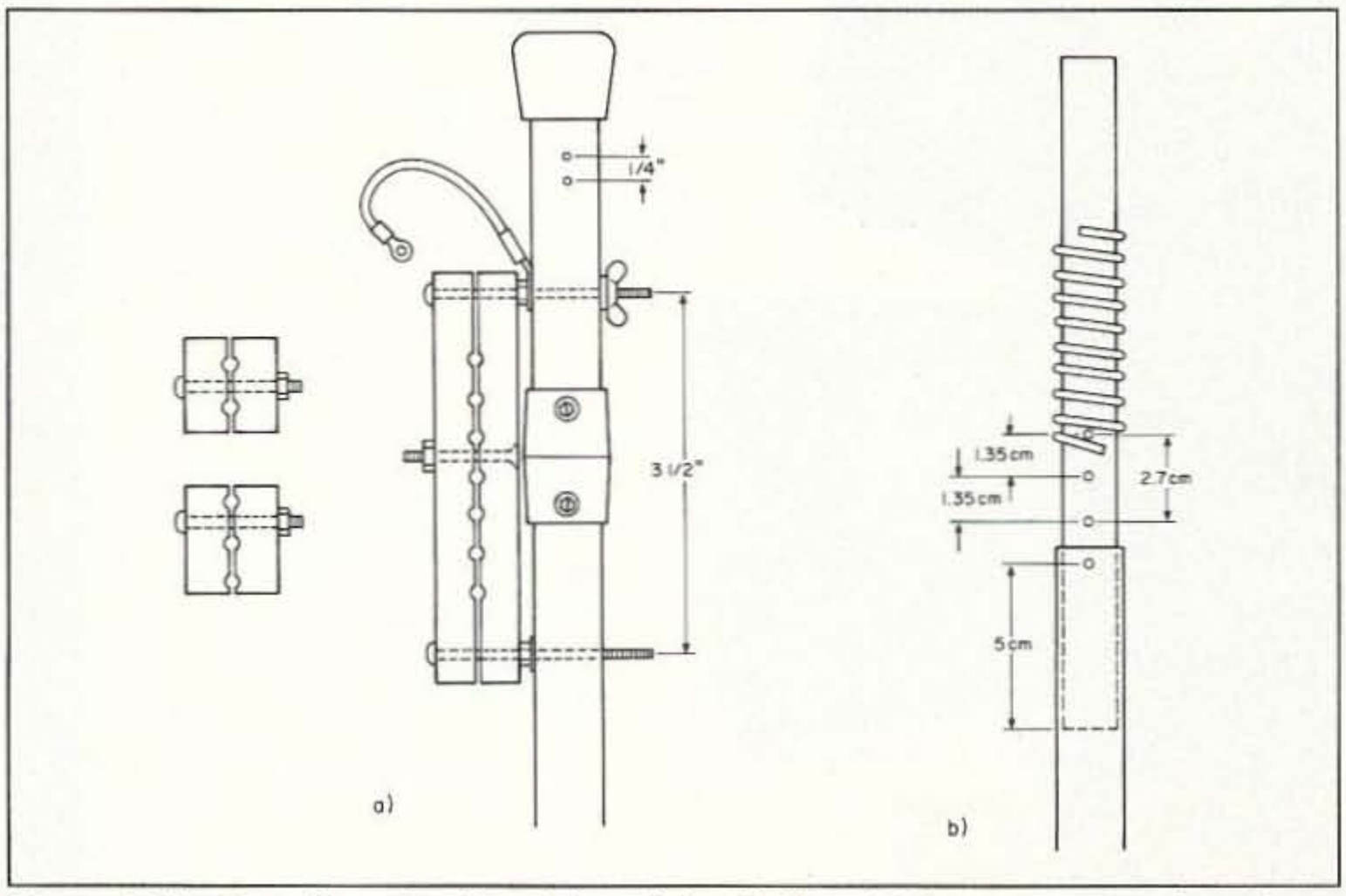

Figure 1. Sketch a) shows the ribs of the coil for 12 through 20 meters, mounted on the antenna. The slots that grip the turns of the coil are made by drilling 9/64" holes in the plastic pipe and then sawing the pipe in two, through the holes. All the bolts are 6-32, preferably brass. The longer ones are 2" and the shorter ones 1". The holes for the bolts are also 9/64". Sketch b) shows the holes to be drilled in the center insulator. These are for mounting the SO-239 connector and for bolting one element to the center insulator.

Photo G. A closer view of the window mount in operation. Notice that the indoor dipole's coax connector and center insulator are used here also. The compression spring fits into the mounting bracket and is the electrical connector to one element of the dipole.

The two elements, held in a 3/4" flagpole bracket switch, are mounted on a base and clamped to a window or railing with a large carpenter's clamp (see Photos F and G). These are all hardware items. The base can be wood (1" x 3" x 12") or a rigid plastic such as PVC or Plexiglas (1/2" x 3" x 12"). With your flagpole brackets as guides, drill the mounting holes shown in Figure 2, and countersink them so that flathead mounting bolts (3/16" x 1") won't scratch the window frame. The 1/4"-wide, 1"-long slot in the mounting base is for the spine of the long clamp. When the spine is in the slot and a large hose clamp is tightened around the clamp head and the board, they are held securely together.

There are four 3/16" holes for each bracket, even though a bracket mounts with only three. The extra one lets you mount the bracket at right angles to the way they are shown in the photos. This can be used for a horizontal mounting of the elements (first floor apartment) or to clamp the mounting base to the side of the window frame. The antenna can also be clamped to a post or a small tree, as well as a railing. The carpenter clamp and flagpole brackets make a very versatile

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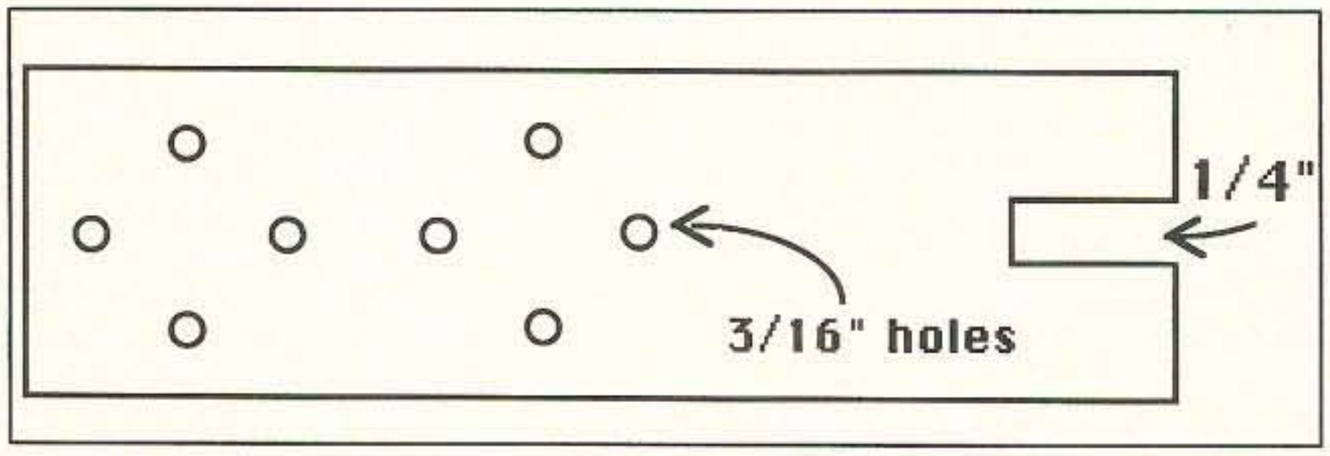

Figure 2. Approximate locations of the bracket mounting holes and the slot for the C-clamp in the mounting board.

mount. However, the type of clamp shown in the photos will rust if it is left outdoors.

The element with the center insulator, coax connector, and spring attached to it should be inserted into the bracket pointing upwards, not as shown in Photo G. The spring will fit into the bracket more securely if you open up the outer end of the bracket a bit wider so that the spring fits inside it. This can be done by flattening the side of the bracket in a vise, as shown in Figure 3.

The two mounting brackets must be connected together. Use a short wire with ring terminals that fit over the mounting bolts for the brackets.

Safety

Never operate the antenna so that anyone could come in contact with it. Shocks and RF burns are a real possibility with an indoor antenna. Also give attention to hazards of electromagnetic radiation from this antenna, and place it as far as possible from you, your family, and your neighbors. *[Ed. Note: Use the minimum power that is necessary for communications when operating the antenna indoors.]*

When considering possible outdoor locations, never place the antenna where it could possibly fall on someone. Since it is likely that you will eventually drop part of the antenna, attach a safety cord to each element before putting it out the window to mount it, and tie the other end to a heavy piece of furniture.

A patent application is pending on these coils, but amateurs are welcome to build this antenna for their own use. Coil ribs and antennas are available from Urban Antennas, Inc., P.O. Box 662, Bryn Athyn PA 19009; (215) 947-0235. 73

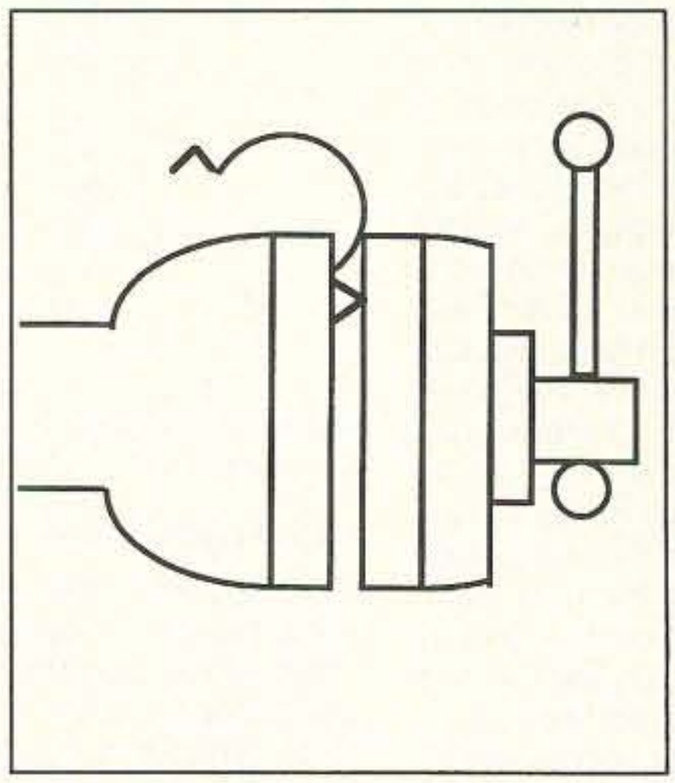

Figure 3. Using a vise to flatten the edges of a flagpole bracket to make the end half-ring a little larger so that the spring will fit in.

Table I

Loading Coil Dimensions

Band	Turns for 8' antenna length
12m	1.0
15m	2.0
17m	2.3
20m	4.0