homebrew antenna mount

Hand tools and standard hardware are all you need for this project

A number of years ago I visited a ham friend who proudly showed me his new tribander. Sitting atop a rotatable mast secured to a ground-mounted fixture, the antenna could also be lowered so that one could work on it comfortably.

We lived in an apartment then, and the only antennas I could install were dipoles for 80 and 40 meters and a vertical for 20, 15, and 10. Later, when we finally bought a home, I found that despite a large back yard, power and telephone lines — as well as trees we'd planted — put an end to my plans for an antenna farm.

Though finding antennas for 80 and 40 meters was no great chore, finding room for a tower or mast was. It was then I realized I already had a platform for working on my antenna — namely, the gently sloping garage roof. I decided I might be able to put up something similar to the arrangement my friend had shown me years before.

My plan was to use a push-up mast, supported somehow at the bottom, and drive it, with the antenna on top, from ground level. I did some shopping for parts and spent some time at the work bench; using hand tools only (with the exception of an electric drill), the result was a mast which has been in use now for a dozen years or more, with no problems (**Photo 1**).

initial considerations

One of the first things to realize is that your antenna isn't going to rotate at 5000 rpm. It turns *very* slowly (my rotor takes a full minute to turn 360 degrees), and hence puts little strain on the bearing you'll use. Aside from the inevitable accumulation of dirt, which is easily removed with a stiff brush and some paint thinner, I've had no problems with the bearing at all.

The second thing to realize is that when you have everything done, extending the push-up mast with the antenna on top of it isn't easy unless you've made some advance preparations. Suppose you've acquired such a mast; it will probably have three or four sections, depending on the height you've chosen. Mine has four, and the outside diameter of the lowest section is 2-1/4 inches. The lifting problem isn't one of weight, but of having some way of knowing when you're reaching the point at which you should stop lifting and secure the section with the clamp provided, and maybe even drill to pass a 1/4-inch bolt through the two sections if you're a bit timid.

mast inspection

Lay the mast out on the ground, fully extended, and examine the point at which the smallest section emerges from the one below it.

Although the smaller section of my mast won't separate from the larger one, there's an illusion at work: when you're lifting the smallest section, with the antenna mounted on it, you become absolutely convinced that at some point the whole thing will pull out, leaving you on the roof with 10 feet of mast and an antenna in your hands and nothing else to hold them. To avoid this, use paint or some other marker to warn you when you're just a few inches from the clamp-off point. Do this with all of the sections. At this point, let me add a caution: whenever you're extending or collapsing the mast, wear heavy gloves! (I use a pair of leather gardening gloves.) The mast sections have a nasty habit of pinching your flesh between them. *Wear those gloves!*

mounting the mast

Decide where you'll mount the mast. For aesthetic reasons, an exterior garage wall is a good choice; you may prefer to attach hardware through to the exposed studs rather than to a finished interior or exterior wall of your house.

You'll also have to decide how far off the ground the lower end of the mast will be supported. This will

Howard A. Bowman, W6QIR, 5872 West 77th Place, Los Angeles, California 90045

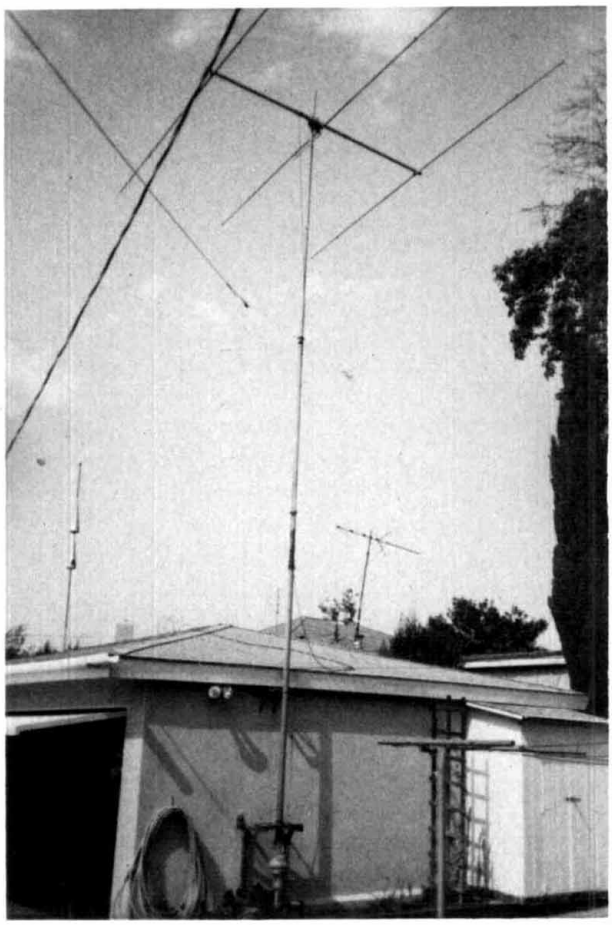

Photo 1. Complete installation.

depend on the length of your rotor, which will hang below the "shelf" you'll build (see **photo 2**), and should clear the earth by a few inches. At this point, do one other thing as well: measure the inside diameter of the lowest section of your mast.

Before you head out to the plumbing supply shop, try to visualize what your array of mast, rotor, and connecting pieces of pipe will look like overall. A short length of pipe should fit snugly inside the lower end of the mast. (Though it doesn't have to be an exact fit, it should be fairly close.) It should be 5 or 6 inches long and threaded on both ends; you'll find it at your local plumbing supply house, described as a "nipple." You'll also need two lengths of pipe — one to run from the support you'll build to the upper clamp of your rotor, and the other to run from the lower clamp of the rotor to about a foot below the surface of the earth. One end of the upper piece must be threaded. Aside from this, it's probably simpler to get one long piece and cut it in half yourself.

You'll also need a reducing fitting. At its larger end, it should accept the threads on the nipple, and at its smaller end it should accept the threads on the longer piece of pipe. Caution: pipe sizes are guaranteed to confuse everyone in the world except plumbers. Pay no attention to the designated pipe sizes; use a tape or a scale and measure everything for yourself. Try the mating pieces to be sure they do what they're supposed to do. That way you won't encounter unwelcome surprises.

The next step takes place in your own workshop. Screw the nipple tightly into the reducing fitting, securing it by drilling and tapping for a machine screw of some convenient size. (The screw won't bear any load, but will keep the two parts from coming apart.) Then slide the nipple into the lowest section of the mast until the lower edge of the mast section rests on the reducing fitting.

At this point I drilled and tapped for 1/4 inch x 20 machine screws and used hex-head screws about 1/2 inch long. This was overkill, but, to some extent, the number of screws you use will depend on the snugness of the fit between the lowest mast section and the pipe inside it. The idea is to square things up as well as you can. If you need four screws 90 degrees apart, use them.

You'll need a bearing with an inside diameter large enough to accept the smaller end of the reducing fitting. The tapered shoulder of the fitting will ride on the inner race of the bearing. I've used two bearings — one a standard ball bearing and the other a tapered roller bearing. Either does fine. The inside diameter of each is 1-5/8 inches, and the outside diameter is just a bit over 3 inches. It's important that the slanted portion of the reducing fitting fit inside the bearing, so take careful measurements or take the fitting with you when you shop for the bearing at an establishment that stocks new and used machinery. In a pinch, you may find one at an automobile junkyard.

mast and rotor support

Having come this far, you've done all but the drudgery of making some kind of a support for the mast and rotor. Mine is made of ordinary 1-1/4 inch angle iron, which you can find at any iron fabricating shop or even at some large hardware stores. If you get it at a hardware store, it will most likely be sold in 6-foot lengths; you'll need three of them. If you get it from a shop, be careful. Be sure of your measurements, since the cutter may distort the metal where the cuts are made, making part of it unusable for your purpose.

In planning your shelf, be sure to consider its height above ground and its depth. The shelf must be high enough so that your rotor can hang below it with a few inches clearance above ground. Its depth depends upon the distance your mast will be positioned from the wall. In my case, eaves extend 7 inches from the wall, meaning that my shelf had to be about 15 inches deep to allow the mast to clear the eaves and still

provide adequate support. If you have no eaves to contend with, you may be able to make the shelf only 8 or 10 inches deep. (Keep in mind that this dimension will have some effect on the amount of angle iron you'll need.)

triangular supports

The next step is to make two right-angled triangles out of angle iron. They should be made so that they're mirror images of each other; that is, each should have the open sides of the angle iron pieces facing the other. One leg of the triangle will extend outward from the wall, another will fit vertically against the wall, and the third will complete the triangle by extending from some point near the outer edge of the horizontal piece to some point toward the lower end of the vertical piece.

Start by drilling both the vertical and horizontal pieces where they overlap and bolt them together. I used 1/4-inch bolts on mine. Use a square to make certain that the angles form a 90-degree angle. Measure carefully for the third leg, cut it to size, and, once again, drill for bolts. Do the same with the other three pieces of angle iron, making sure that the open sides of the triangles face each other.

Now, try to mount these triangles — at least temporarily — to the wall to which they'll be bolted. Once you've decided how far your shelf is to be above ground, locate a point on a stud adjacent to where you want to mount the antenna. (That point should be 2 or 3 inches below the intended level of the shelf.) Drill a small hole through from the inside, keeping it as close to the center of the stud as you can. Now move to the stud on the other side of the intended location and drill a similar hole. These holes should go all the way through the studs and the outside covering of the wall.

Locate one of the triangles over the small hole, have someone hold it there, go back inside with your drill, and, using the hole through the stud as a pilot, drill into the metal of the triangle at least far enough to make a mark. Now both holes can be enlarged to accept a 5/16-inch diameter bolt. You can also drill another hole in the triangle vertical leg toward its lower end. Align things carefully so that the leg is vertical, then drill through the wall and the stud for a second bolt.

Studs are sometimes not exactly vertical, so this hole may be a bit off center. Don't worry. If the triangle is vertical and your bolt has a good bite on the wood of the stud, you'll be all right. Use a washer under the head of the bolt, and a fender washer (one that is larger in diameter), a lock washer, and a nut on the inside.

Locating the second triangle is a bit tricky because you want its top and the top of the first triangle to be as level as possible. The easiest way to do this is to have someone hold the second triangle against the wall so that one edge of the vertical leg is beside the hole you've drilled through the wall, and so that a spirit level across from the first triangle to the second shows that both are at the same height. Carefully mark the angle iron beside the point at which you've drilled, then drill the angle iron for the bolt. Locate the position of the second bolt just as you did for the other triangle.

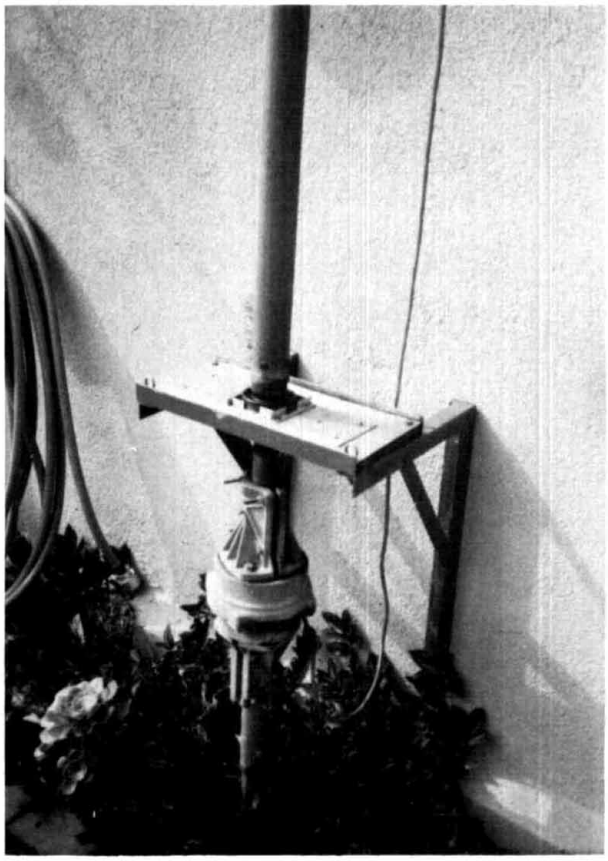

Photo 2. Lower support: the shelf.

joining the triangles

At this point you have two triangles bolted to the outside wall of your garage. The next step is to join them, using two pieces of the same angle iron. One piece should join the outer ends of the triangles, and the other will be several inches closer to the wall, depending on just where the mast will come. It should be midway between these two crosspieces. Having located both pieces, and drilled them and the upper leg of the triangle to accept 1/4-inch bolts, secure them in place.

shelf assembly

You'll note that these two cross-pieces and the triangle legs to which they are bolted form a rectangle. Find a piece of wood about 3/4 or 1 inch thick and

Photo 3. Lower support viewed from different angle.

cut it to lie inside this rectangle. Then find a piece of aluminum about 1/8 inch thick to go on top of it. (I used marine plywood for the wood, but a solid piece would do just as well.) This assembly — the pieces of aluminum and wood — will form the actual shelf. Drill them for mounting with 1/4-inch bolts, but don't assemble them yet. With the two pieces clamped or bolted together, mark the center by drawing cross lines from the corners. This is where the bearing will rest. You'll need to drill a hole through both pieces that's large enough to clear the inner race of the bearing, and any ham who has had to make a hole for a meter can cope with this. One precaution: make a small pilot hole through both pieces first. You may find that a large socket-hole punch will do for the aluminum, and an expansion bit for the wood.

bearing placement

Once you've made this hole, you can mount everything but the bearing. Center the bearing over the hole and mark around the circumference of the bearing with a pencil. You'll need to devise something to make a "fence" around the bearing to hold it in place. I used some 1/2 x 1/2-inch aluminum angle stock I happened to have. Almost anything will do, so use your imagination. You can use small machine screws to fasten this fence to the shelf; there's little strain on it. When it's complete, the bearing should drop neatly into the hole.

When the bearing is in place, lean over and sight down through it to the earth beneath and mark the spot with a chip of wood or some other marker. You may want to drop a plumb bob down to mark this spot; it's where the lower pipe on your rotor will enter the earth.

Your next job is to dig a square hole about a foot deep with this point at the center. You can also prepare the length of pipe by drilling holes through it at a point which will be well below the surface of the earth. Run some long bolts through it, leaving them so they extend a couple of inches on either side of the pipe. Two or three of these should do nicely.

What will happen, you ask, when you get the mast, the various pieces of pipe, the bearing, the rotor, and everything else set up on the shelf? Answer: *it will all fall over*. To prevent this, you'll need an upper support, located directly above the shelf and as high on the wall as you can get it. Perhaps "support" is the wrong word, since it doesn't bear any load. All it does is hold the mast in a vertical position and allow it to rotate within a loose collar.

wall-to-mast structure

Install a piece of the angle iron horizontally on the wall, bolted between the same pair of studs as the shelf. Then put the mast up temporarily and make sure it's in a vertical position (use a spirit level). You'll probably need a helper to make sure the mast stays in this position while you measure the distance from the wall to the nearest edge of the mast.

Now, using the leftover pieces of angle iron, you'll need to assemble a rectangular structure as deep as the distance from the wall to the mast. It needn't be as wide as the distance between the studs; mine is only 8 inches wide. It must be wide enough, however, to accept either a band bent to go around the mast, or perhaps a large U-bolt. It should be braced corner-to-corner so that it retains its shape, and further braced by two supports running from the rectangle down to a point on the wall. These last two supports may be pieces of the 1-inch strap iron, suitably bent in your vise, and bolted to the wall. These bolts needn't go through the studs, but remember to put those large fender washers on the inside.

erecting the mast

Now put the mast up on the fittings you've made. Clamp the rotor to the pipe extending below the bearing. Clamp the other piece of pipe to the lower part of the rotor. Mix up some cement and pour it into the hole below the rotor. Go inside, wash your hands, and find yourself a good book that will take you a couple of days to read while the cement cures.

guying

When the curing process is complete, you may want to shovel some dirt back over the top of the cement block. You'll then be ready to install the antenna on the topmost section of the mast. At this point, you'll probably recall that your mast was supplied with a set of guy rings — one to fit atop each of the larger sections. In large part, whether you'll use any at all

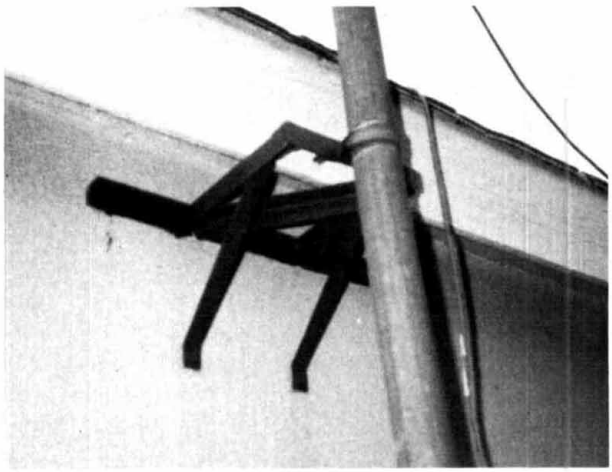

Photo 4. Upper support.

will depend on how high your mast is, how much support you can give it at the bottom, and whether experience has told you if you're likely to have a wind problem.

Consider the matter of support at the bottom. My lower installation is on a planter, but yours may be at ground level. Although I had eaves to contend with, you may have none. If your installation allows positioning your lower shelf close to the ground and your upper support near the top of the wall, you may have 7 feet or so between the bearing and upper support. (I have 4.) If there are no eaves to force you to extend your structures away from the wall, they'll be more rigid; you may be able to avoid guys entirely.

In my case I thought it best to have a set of guys at the bottom of the topmost section of the mast. Hams traditionally have followed the practice of using three guys spaced 120 degrees apart. However, the guy rings supplied, for reasons known only to the manufacturer, have four holes spaced 90 degrees apart, and a fifth hole midway between two of the others. It appears not to matter. Just use what you can, and don't tighten the guy wires as if they were violin strings. Remember, the mast is going to rotate inside that guy ring, so leave a bit of slack in the wires.

installing the antenna

At last you're ready to install the antenna atop the mast. I certainly wouldn't advocate installing a monster with a 30-foot boom, but I used to have a tribander on the mast, and all went well. My present antenna is a 10-meter monobander. Just raise that upper section to about eye level, mount the antenna on it when you get it clamped off, and do whatever final work is necessary while standing in reasonable safety and comfort on your roof.

Once the antenna is mounted, you'll have the task of extending the mast. Let me repeat my warning —

wear heavy gloves! As you push the mast up, you'll find that by pushing the section to one side a bit, it will bind enough so that you'll have a momentary respite and will be able to change the position of your hands.

Remember those marks you made on the mast sections for later reference? Now they'll prove their value. When you get the top section fully extended, clamp it off securely. If you're using the guy ring at this position, be sure to attach the wires to it before you raise it out of reach. If you have doubts about the efficacy of your clamp, you may even want to drill through the overlap between the two mast sections and secure them with a 1/4-inch bolt, flat washers, and a lock washer.

The higher you raise the mast, the less secure it will seem. *Don't worry*. Even though what you're lifting does indeed get heavier (because there's an extra section of mast each time, and the lower sections are larger and therefore heavier than the upper ones), you'll find that the load is well within your capacity. Of course, if you want to be doubly sure, ask a friend to hold the mast while you take a breather, search around for the pliers or wrench you've dropped, or just stand back and admire what you've wrought.

final precautions

One last thought: if you live in an area where the climate is less benign than it is here in Southern California, you may want to consider some sort of protection for the bearing assembly *before* you mount the mast to the nipple. The protective device will likely need to be attached, in some fashion, to the lowest section of the mast. Some sort of clamp or machine screws, with holes suitably drilled and tapped, can be used to secure it to the mast.

ham radio