How To Construct A Low-Cost Elevation Rotation System

There is more than one way to get there from here. W6POK shows us how to fabricate a simple elevation system for satellite work.

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Operating on the various high and low earth orbit satellites has been a pleasurable pursuit of mine over the years, albeit a rather casual one. Satellite operation has always been secondary to my primary interest in VHF/UHF terrestrial communications and DXing on the HF bands. Consequently, I have not gotten into computerized tracking programs and the like, nor have I cared to invest a great deal of money or effort in dedicated satellite operating facilities.

For Mode B operations on Oscars 10 and 13, my antenna system has consisted of either linear or circularly polarized Yagis mounted on a 4 to 5 foot crossboom, in turn mounted to a vertical support mast or single tower section. One of the old Alliance U-100 or U-110 rotors served to provide elevation rotation of the array. Current construction articles in the *ARRL Handbook* and *Antenna Handbook* still recommend these old rotors for elevation control. Unfortunately, they no longer are manufactured, and it has reached the point where it is difficult to find one in good condition on the used market.

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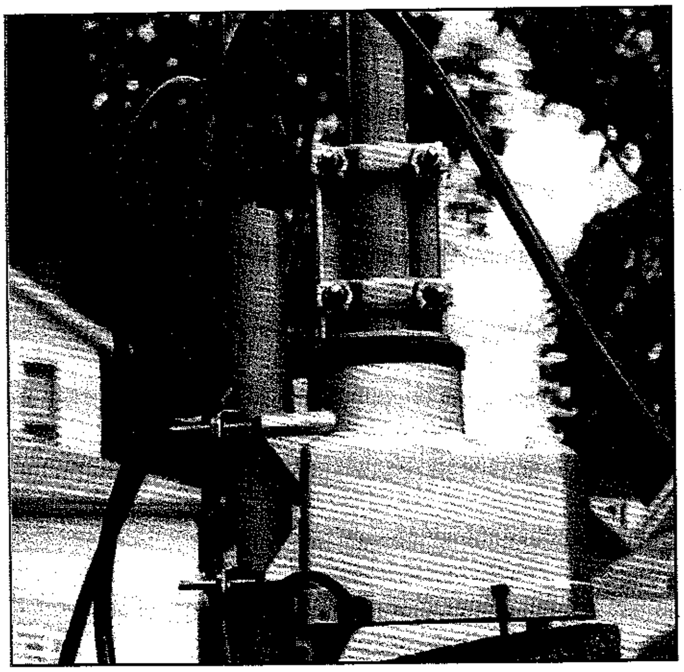
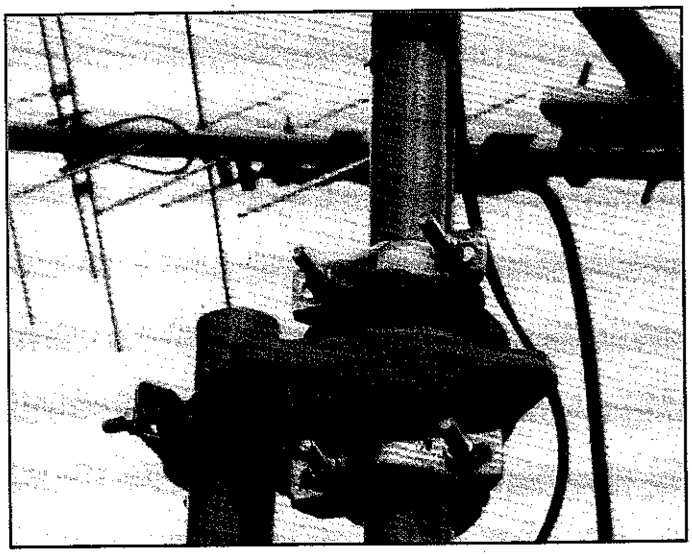
The advantage of these rotors, besides cost, was their design. A 1 1/4 inch mast section could pass through the rotor center, thus making it ideal for elevation rotation when mounted on its side. Several manufacturers currently are offering some excellent rotors for azimuth and elevation control of satellite antenna arrays. However, they are expensive. If you don't require automated tracking and can't locate one of the old Alliance rotors, there is another low-cost alternative.

While on a long-term assignment in Turkey, I was using the "armstrong" method for rotation of my satellite antennas. Due to weight restrictions and power differences, I had left my rotors at home. This method of rotation was a bit tiresome, especially on rainy days. Setting out to find an alternative, I was surprised to find that a 220 VAC, 50 Hz version of the Phillips U-105 rotor was available at one of the larger TV dealers in Ankara. This was the same rotor (shown in the photo) that I had been using as an azimuth rotor at my stateside station for several years. The U-105 is available here from both amateur radio suppliers and some TV shops. With a little effort these rotors can be made to function efficiently as elevation rotors.

The key to using the U-105 for elevation is to be able to distribute the load and eliminate lateral torqueing of the rotor's mast clamp and drive train. In the Amateur Electronic Supply catalog, the U-105 is listed at $69.95. In the same section of the catalog there is listed a companion model TB-105 support bearing for use with the U-105, at a cost of $18.25. One of these bearings can be seen in the picture being used in conjunction with the U-105 functioning as an azimuth rotor. You will need two of these support (thrust) bearings to convert the U-105 into an elevation rotor.

The rotor case is constructed of cast metal with a sheet-metal hinged floor plate for access to the motor connections. The control cable passes through a grommetted slot on the side, near the bottom of the case. Because the rotor will be lying on its side, we need to be concerned about water entry into the unit. If the rotor is mounted with the control-cable entry port downward, we still can get water under the rain cover on the mast clamp or around the floor plate. The easiest solution is to clamp a sheet of rubber around the body of the assembly or





▲This is a close-up view of the Phillips TB-105 support bearing. You will need two of these for this project.

◄This is what the basic Phillips U-105 antenna rotator looks like.

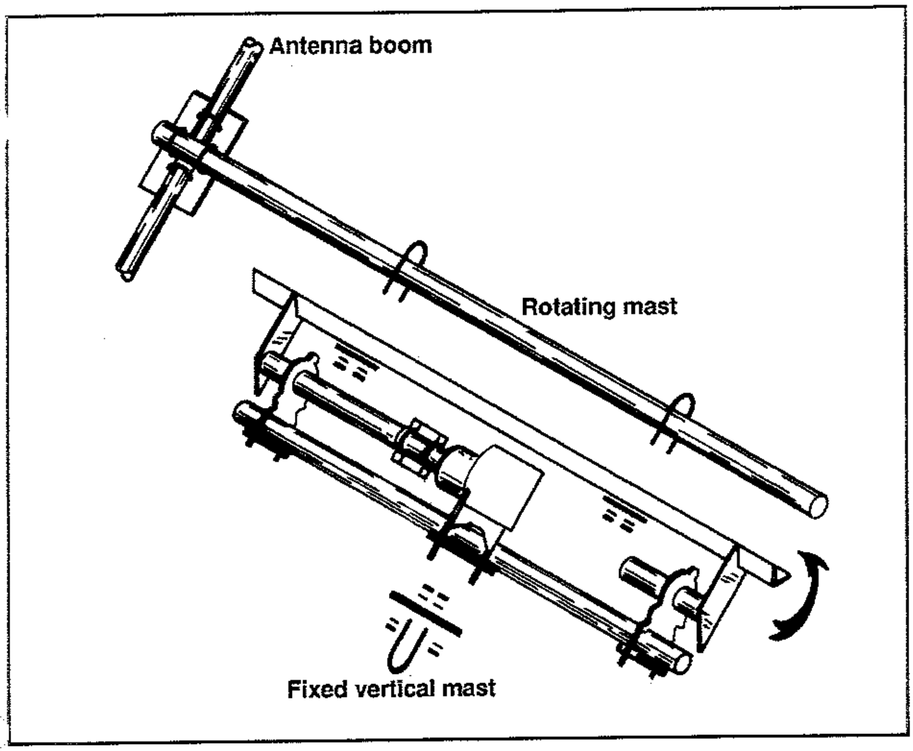


Fig. 1– Shown here is the basic overall mechanical view of the elevation system. (See the text for construction details.)

make a cover from a flexible plastic refrigerator food-storage container.

The rotor is supplied with two mast clamps and four sections of threaded bolt stock, which thread into holes at the back of the rotor housing. With the rotor mounted horizontally to a section of 1 1/4 inch diameter steel mast, a full 1 inch of bolt stock extends beyond the clamps, a length more than sufficient to mount a 1/8 inch aluminum plate, through which two additional U bolts and clamps will be required for attachment to the vertical support mast. I used a sheet that was 7" × 9" and had previously been used on another project. With the rotor horizontal, the spacing of the four bolts is 3.5 inches on center horizontally and 2.25 inches on center vertically. The bolt stock measures 1/4 inch in diameter. Size of the additional U bolts and the spacing will depend on the diameter of the mast to which the final assembly will be mounted.

From fig. 1 you can see that the rotor is centered on a 28 inch long section of steel mast. There is some latitude as to actual length required, but I chose to keep the support bearings a little farther from the rotor housing and give myself some latitude with regard to positioning of the bearing clamps. The support bearings and the mast clamp on the rotor will accept mast sizes of 1 1/8 inch to 2 inch diameter. Depending on the size of your array, you may wish to use larger material than shown.

I used two sections of 1 1/4 inch diameter mast material for the part of the bracket that passes through the support bearing on one end and the support bearing and rotor mast clamp on the other end. Again, you have some latitude with regard to the length of these sections. I used a length of 6 1/2 inches for the former and 10 1/2 inches for the latter. A local machine shop then welded a 6 inch length of flat 3/16 inch by 1 1/2 inch steel plate to one end of each of the mast sections. At the other end of these plates a V notch was cut to accommodate welding to a 30 inch length of I inch steel angle iron. The actual antenna support boom can then either be clamped or bolted to the angle iron. This offers flexibility in your choice of boom materials. Most of the fiberglass boom material offered by suppliers is 1 1/2 inches in diameter, too large to pass through the older Alliance antenna rotors. If you are using fiberglass rod, it is suggested that you use screw-type hose clamps for securing the boom to the angle iron, thus maintaining the structural integrity of the boom material.

It is important that the antenna array and cross-boom mounting structure be balanced to minimize stress on the gear train of the rotor. The procedure I used was to first go through the rotor control calibration procedure in the instruction manual. The control was then placed at the west position on the compass rose. When the motor ceased rotation, I then positioned the cross-boom mount so that it was directly below the rotor and then tightened the mast clamps. The cross boom to which the two Yagi arrays are mounted was then positioned with the hose clamps tightened to the point where the boom could still be rotated with light finger pressure. The antennas were positioned on the cross boom to achieve static balance at all elevation angles. The boom clamps were then tightened with the antenna array in a horizontal position.

Elevation of the array is accomplished by rotation of the control between the west position (0 degrees) and the north position (90 degrees). Minimum stress on the gear train is exhibited when the antennas are in a horizontal position, which is where I usually placed them when not in use. However, rotation due to wind forces up to 40 miles per hour in strength was never experienced in either elevation or azimuth, regardless of position.

The U-105 is indeed a light-duty rotor, but it is fully capable of functioning as either an azimuth or elevation rotor for VHF/UHF arrays with boom lengths on the order of 10 feet. The rotor has been functioning successfully as an azimuth rotor since l992. If you have been unable to find an old Alliance rotator, why not give this alternative a try?