No. 34: The Turnstile Antenna on 10

L. B. Cebik, W4RNL

Net control stations often ask for an omni-directional horizontally polarized antenna. One of the simplest antennas to meet this need is the turnstile. The basic outline appears in **Fig. 1**.

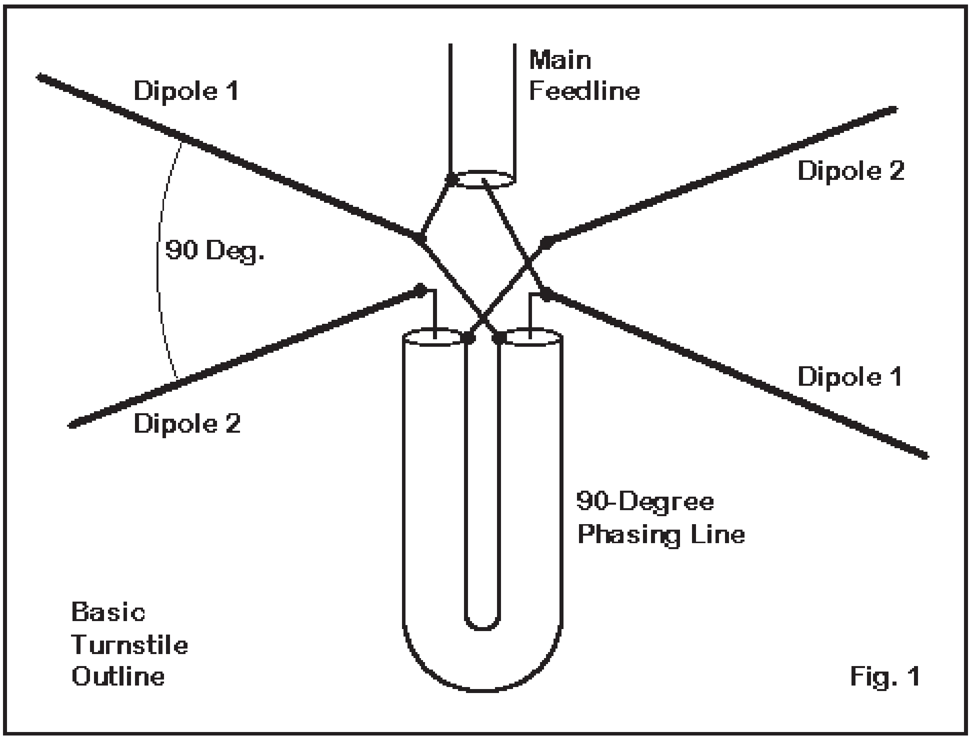

Fig. 1

Essentially, the turnstile consists of two dipoles at 90 degree angles to each other. One dipole is connected to the main feedline, in this case a 50-Ohm line (since the two dipoles together will give a 36-Ohm feedpoint impedance). Between the feedpoint of Dipole 1 and Dipole 2, we run a 90-degree or 1/4 wavelength section of 72-Ohm coax to effect the required phase shift between the two dipoles. It is this phase shift that gives the turnstile its nearly omni-directional pattern.

For 1/2" to 5/8" tubing--or a combination of the two--the dipoles can each be 16.5' long--8' 3" on each side of center. This size will make them resonant at about 28.5 MHz. The dipoles must not touch each other. You can accomplish this by mounting them on opposite sides of a square plywood board or by keeping the feedpoint separations large enough so that nothing touches.

Connect the main feedline across one dipole. Then connect the phasing line from the feedline connection points to the other dipole connection points. If you use a balun, connect it only to the main feedline. Let the phasing line droop. You can tape it together for control. But it is best to keep it spaced from any metal antenna mast you use to support the antenna.

The phasing line length will depend on the velocity factor of the line you use. 72-Ohm coax comes with either solid or foam insulation. The solid insulation usually gives the line a 0.66 velocity factor, while foam lines have a velocity factor of about 0.78.

Use the velocity factor as a multiplier on the basic 1/4 wavelength to determine the physical length of the line. 1/4 wavelength is about 8.63' at 28.5 MHz. A 0.66 VF line will be about 5.69' long, while a 0.78 VF line will be about 6.73' long. As with any antenna, be sure to weatherproof all connections to prevent rain from entering the coax line.

Since the turnstile impedance is about 36 Ohms, a 50-Ohm feedline will show an SWR of between 1.3:1 and 1.4:1. Do not try to tune the antenna for a 1:1 SWR, since that will require shortening the elements below individual dipole resonance. The resultant pattern will no longer be omni-directional. On the other hand, once you have built the antenna close to the dimensions suggested here for both the elements and the phase line, it will be very broad-banded, covering all of 10-meters.

What kind of performance can we expect from a turnstile. **Fig. 2** gives us an answer.

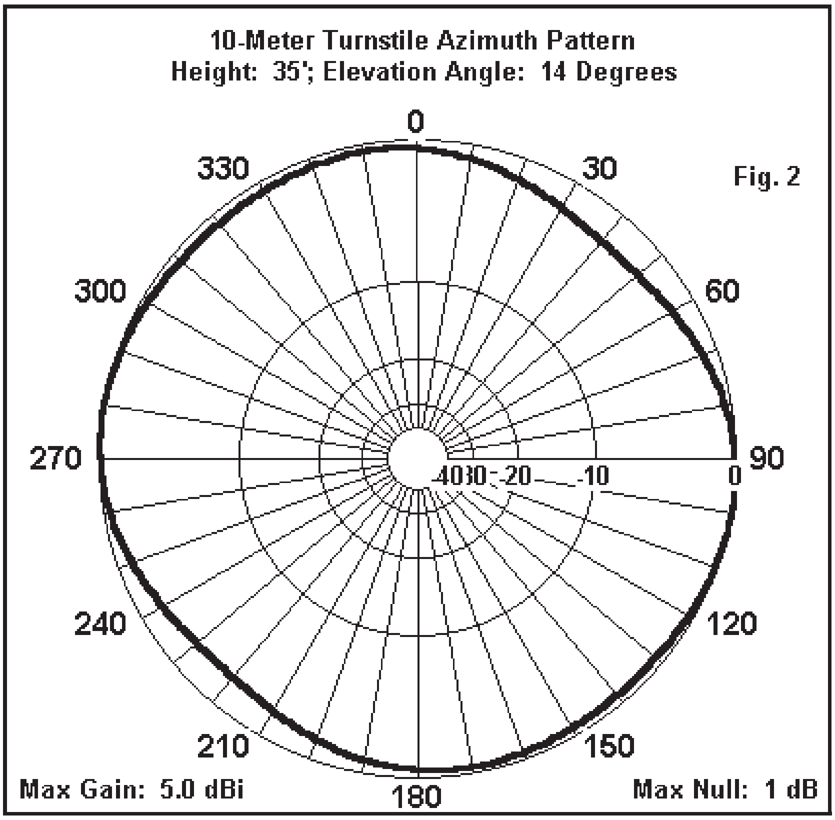

Fig. 2

The pattern is a blunted circle with only a 1 dB decrease from maximum gain along two of the flattened edges. This is as close to a perfect circle as you will come with a horizontally polarized antenna of this efficiency. The maximum gain is about 5 dBi when the antenna is 1 wavelength (about 35') above ground. At this height, the antenna has 2 elevation lobes, one at 14 degrees for long hauls and the other at 48 degrees for short skip and e-layer reflections. The local point-to-point abilities of this antenna are quite good.

As always with horizontal antennas, the higher, the better--up to about 1.75 wavelengths or so--especially for local contacts. The turnstile gain is lower than the maximum gain of a dipole along, but remember that a single dipole has only two main lobes working at one time. The turnstile has 4 overlapping lobes. Since the power for any operation is constant, it must distribute itself over more territory--and hence will not be quite as strong as when we can limit its coverage to two lobes. (The uni- directional beam gets its gain from concentrating almost all of the power in one lobe.)

The turnstile can be a useful antenna for net control stations. It may also be useful for folks who want a dipole, but do not wish to turn it with every new incoming signal. You can orient the antenna along any axis, so you have some options in fitting it into the space you have.

However, the turnstile has limitations. For its area, gain is not high. In the same footprint, you can create a small 3-element beam with much higher gain and directivity. Also beware of the temptation of folding the ends around to reduce the space required by the crossed dipoles. The omni-directional pattern will become a bi-directional, weak set of dipole lobes. Finally, the turnstile is a monoband antenna, due to the requirement for the 90-degree phasing line. If you want a turnstile for another band, you will have to design the entire antenna--both dipoles and the phasing line--for the new design frequency.

So the turnstile is a special-purpose antenna. If it has the pattern you need, use it. If you need a different pattern, then try one of the other antennas in this series.