A Kite/Balloon-Supported Zepp for 160 Meters

Make your antenna fly high!

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Here's a way to really put out a big signal on 160 meters! Hook your antenna to a balloon for some really spectacular results. I've made a number of changes to improve the efficiency of this antenna since my article "Balloon-Supported Antennas for HF" in the September 1988 issue of *73 Amateur Radio Today*.

Efficiency without radials

Many people say that a good ground system is necessary for antennas to perform efficiently. This is not true with certain types of antennas. An end-fed antenna does require a low-resistance ground if its input (feed) impedance is low. However, when an end-fed wire antenna measures any integral multiple of a half wavelength, the input impedance is extremely high and a low-resistance ground is not nearly as important. Since a low-loss ground generally requires many radials, an antenna is much simpler, cheaper, and easier to install if its feed-point impedance is very high.

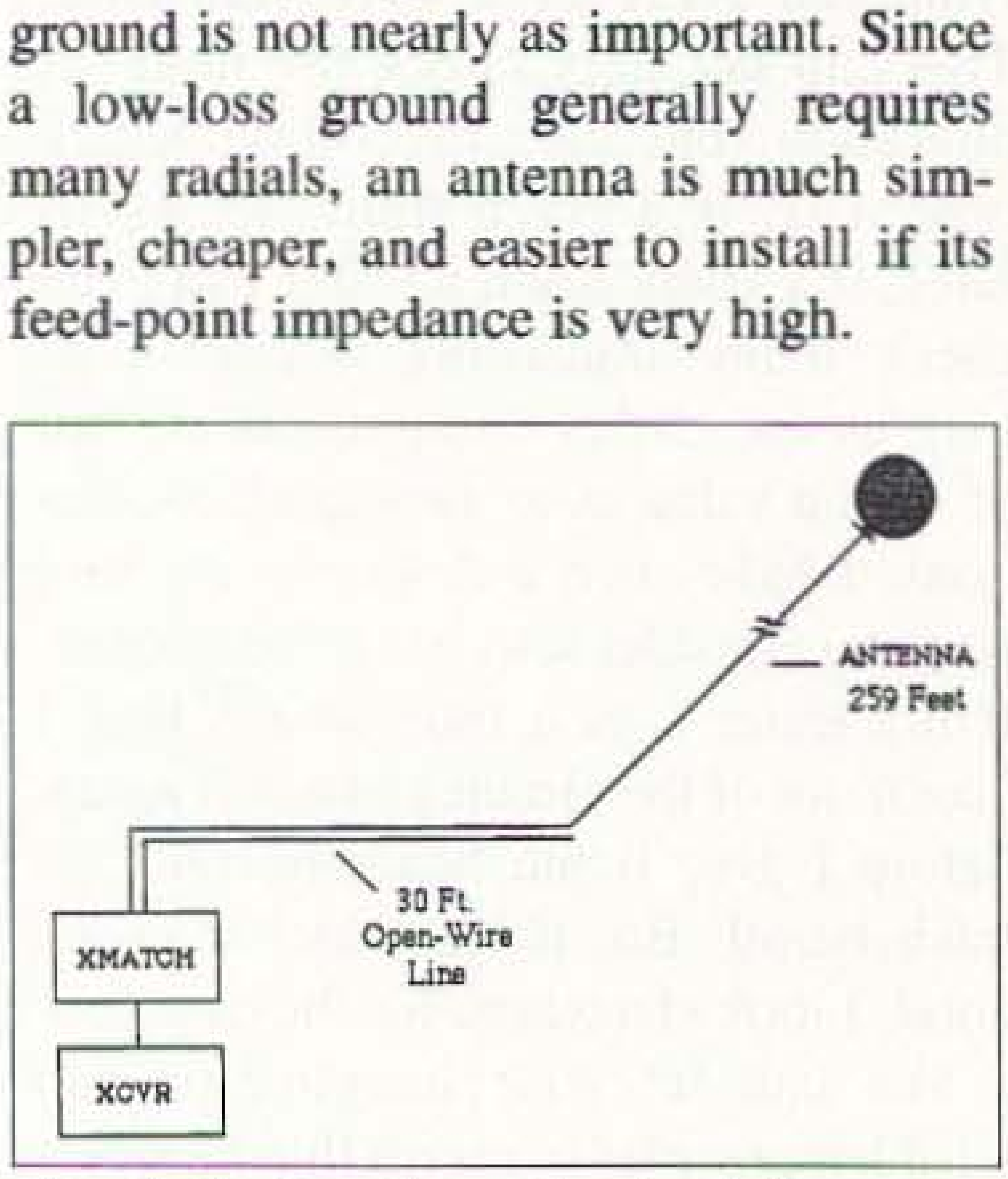

Fig. 1. Basic scheme for the balloon-supported half-wave zepp. The feedline may actually be any length; it was used primarily to get a good match with a transmatch that could not handle the half-wave antenna alone.

I chose a length of 259 feet (78.9 meters) for my end-fed wire antenna. This represents a half wavelength at 1.810 MHz. For a 160 meter contest, I planned to operate mostly between 1.800 and 1.820 MHz with the FT-101EE. Above 1.820 MHz, power must be reduced with this transceiver to keep spurious emissions under control, and 85 watts output is little enough power on this band.

I laid down two radials and employed a water-pipe (cold) ground at the station to provide a fair ground system. Using an antenna with a feed-point impedance on the order of several thousand ohms, the ground loss would be low even if the ground resistance were as much as 100 ohms—and that is a pessimistic estimate for the ground system I used.

Zepp-feed advantages

Unfortunately, my transmatch could not match the extreme impedance of the half-wavelength, end-fed wire antenna to 50 ohms for the FT-101EE. It seems the unit did not have enough inductance to accomplish this, but the transmatch did provide a 1:1 SWR if the antenna were zepp-fed with 30 feet of open-wire transmission line (**Fig. 1**). This may seem strange—that, by introducing reactance into the feed-point impedance, a match could be easier to get than with zero reactance—but apparently the transmatch could tune out reactance enough to allow the somewhat lowered resistive component to be matched to 50 ohms. It worked, and that was all that mattered to me.

With zepp feed, the bandwidth is very narrow and the tuning of the transmatch extremely sharp. I was careful to ensure that the antenna was exactly 259 feet (78.9 meters) long. I measured it with a tape measure bought just for that occasion! If the operating frequency is much different from the exact resonant frequency of the antenna, the feedline will become unbalanced and will radiate. This occurs a little bit even at resonance, but is not significant over the range of 1.800-1.820 MHz.

Zepp feed has several advantages. It can be used not only with a half-wave radiator, but also with a radiator that measures any integral multiple of a half wavelength. Also, it allows you to locate the antenna feed point away from the station. However, the SWR on the parallel-wire feeder is quite high so it is important to use a low-loss open line. Television "twinlead" is generally not good enough.

Balloons for calm or light winds

The main difference between my earlier station and the current station is the position of the antenna. In 1987 it was about 25 feet (8 meters) above the ground; now it consists of a sloping radiator with the near end at ground level and the far end about 180 feet (55 meters) above ground. The wind results in a slope of about 45 degrees with the supports described here.

The balloons I used were either 40 inches (1 meter) or 54 inches (about 1.4 meters) in diameter at maximum inflation. I got them, along with the helium gas, from a local welding supply store. I used rubber stoppers to seal the balloons after inflation. A small screw eye in the stopper provided for the connection of the antenna, using a kite swivel (**Fig. 2**).

The antenna wire is Baygard 6 electric fence wire, which is lightweight and quite strong. The conductors are aluminum so the wire has excellent conductivity and low loss. I backed up this wire with nylon twine in case the wire came loose. You don't want to have the balloon fly away with all or part of the conducting line dangling from it!

For increased stability in light-to-moderate winds, glue a disk to the stopper (**Figs. 3** and **4**). This tends to deflect air downward. I have used disks of about three feet (one meter) in circumference with success to prevent the balloon from "heeling over" and becoming nearly useless in winds of 10-20 miles per hour.

Another stabilizing method is to use a kite in conjunction with the balloon. A dime-store variety eddy bow kite works well for this purpose. The kite is flown with the balloon behind it (**Fig. 5**). It is important to attach the kite securely to the balloon. You may need a heavier bridle on the kite than if it were flown alone. Also, the kite and antenna must be light enough for the balloon to lift them when the wind dies down.

The antenna spool and safety precautions

The antenna wire and tether cord may be wound on an electric cord spool, available in most hardware stores. This spool allows rapid retrieval of the antenna and easy extension. It also provides a way of anchoring the antenna. I use a belt with extra holes punched in it to fasten the spool to a tree or other anchoring post (**Fig. 6**). A small insulator is attached at the end of the antenna to reduce end effects. The feedline is connected with a clip lead, as shown. It is important to fasten the whole assembly securely at all splice points.

There are several safety considerations that must be observed when an antenna of this type is used:

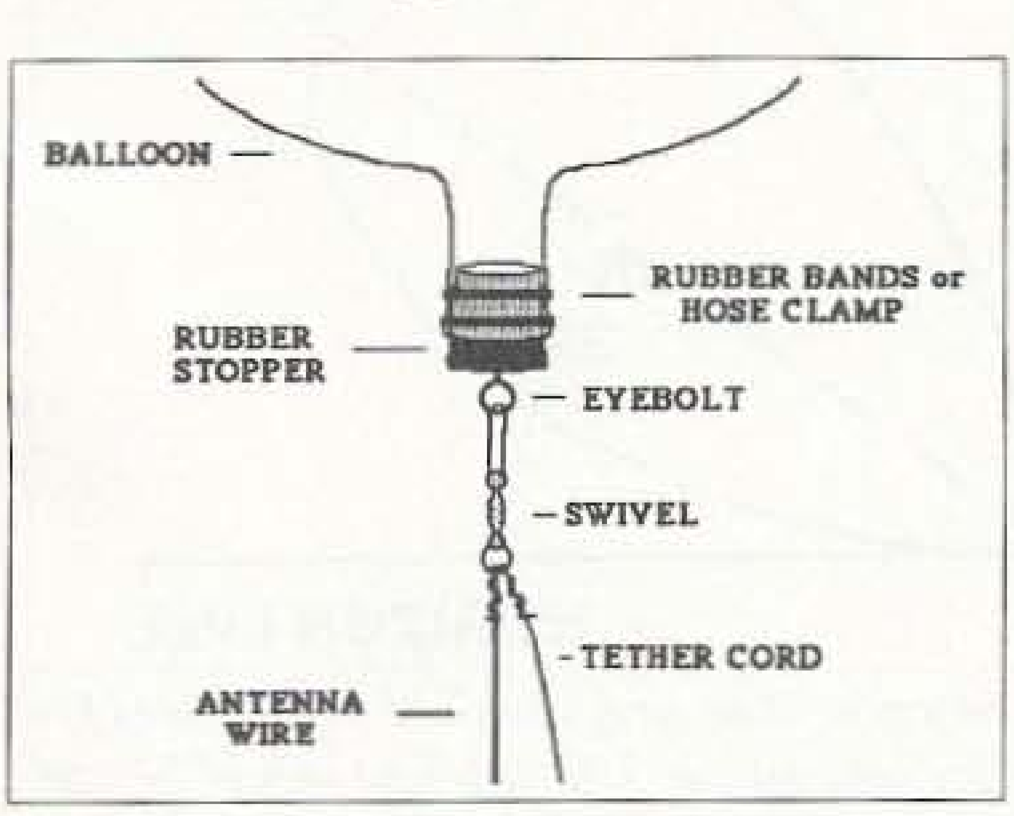

Fig. 2. Base attachment for connecting the balloon to the antenna wire and tether cord.

- The antenna must be shorter than the straight-line distance to the nearest above-ground utility line. The reason for this is obvious if you value your life!

- An atmospheric charge may develop on the wire, even in clear weather, so be careful because you can get a severe shock from the antenna wire when it is fully extended and not connected to the transmatch. A grounded wire may be used to discharge any potential before touching the wire.

- This type of antenna should never be flown during severe weather conditions or near thundershowers.

- It is best not to fly this type of antenna where it may come down on a roadway or other congested area.

- Federal Aviation Administration regulations require that a kite or balloon not present a danger to people, property or other aircraft. Further, balloons greater than 6 feet (about 1.9 meters) in diameter, or kites that weigh more than 5 pounds (2.27 kilograms), require special FAA permission before being used. (These large devices are not normally needed for amateur antennas.)

Larger kites for moderate winds

In winds gusting to more than about 20 miles per hour, balloons do not behave well, so it's better to use a kite. A good choice for this purpose is the winged box kite, or delta-Conyne. These kites are available by mail from Into the Wind, 1408 Pearl Street, Boulder, CO 80302. Other types of kites that work well are the plain delta and the airfoil or Parafoil design.

Some larger kites, especially the delta-Conyne and airfoil, will pull hard, with up to 150 pounds of tension. A strong tether line is a necessity for these kites. Also, larger kites will have sufficient pull to require more sophisticated reel-in devices than the simple cord spool. Generally, a parafoil should be eight square feet or less, and a delta-Conyne should have a wingspan of eight feet or less. This is all that is required for a half-wave or even a full-wave 160 meter antenna.

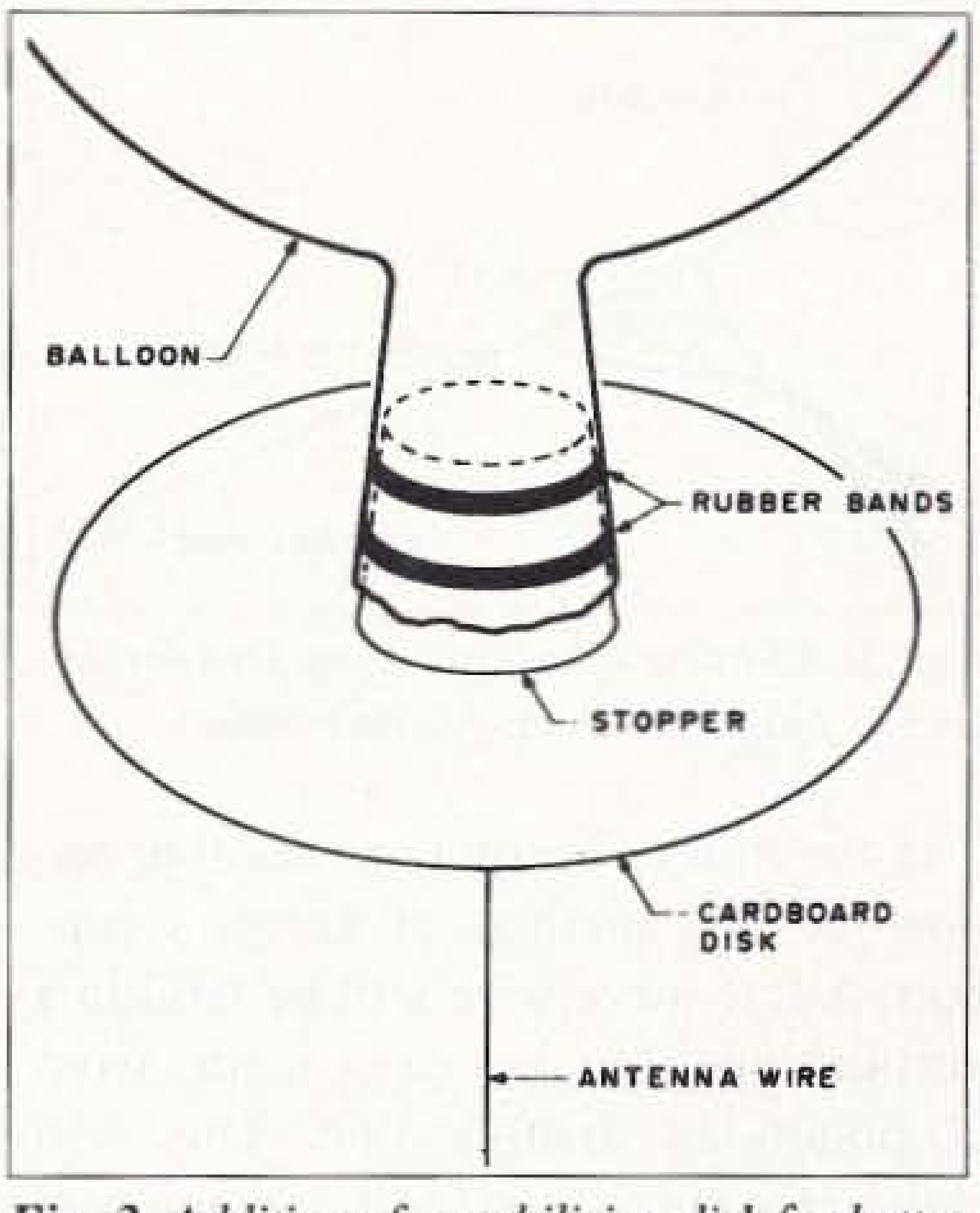

Fig. 3. Addition of a stabilizing disk for better balloon behavior in light-to-moderate winds.

For the future

The antenna at W1GV during a 160 meter contest in 1988 was what I call a "balloon sloper." On the first night of the contest, December 3, the wind was from the southwest. Therefore, the optimum direction for the sloper was toward the southwest, and the worst direction was northeast. On the second night the wind was from the north-northwest, shifting to west. The optimum direction for propagation was therefore north-northwest, and shifted to west later on.

For a domestic contest, such as a 160 meter contest, moderate-to-high angles of radiation are actually more desirable than low angles. From the Minnesota location, a north wind is less desirable than a south wind if a balloon or kite is used to support the antenna.

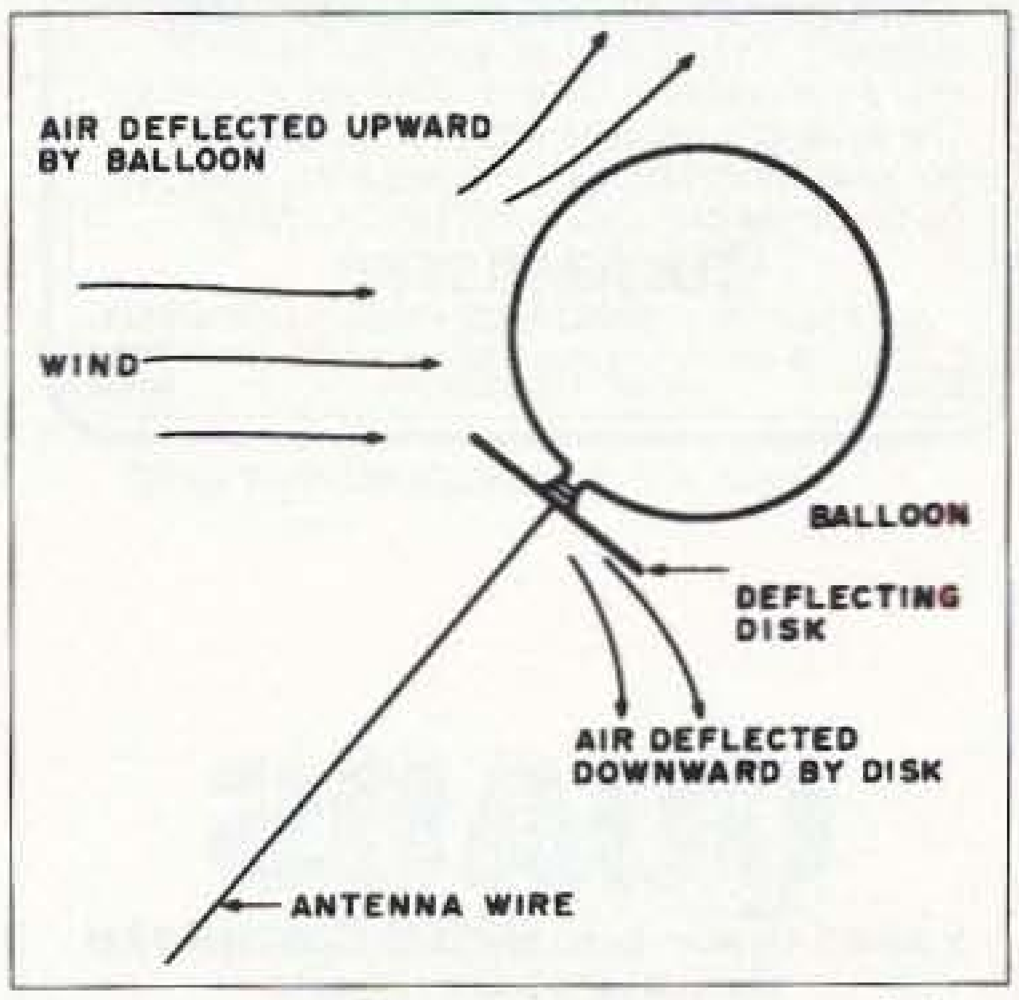

Fig. 4. The cardboard disk serves to stabilize the balloon in winds. The upward force from the disk balances the downward vector caused by air flowing around the balloon itself.

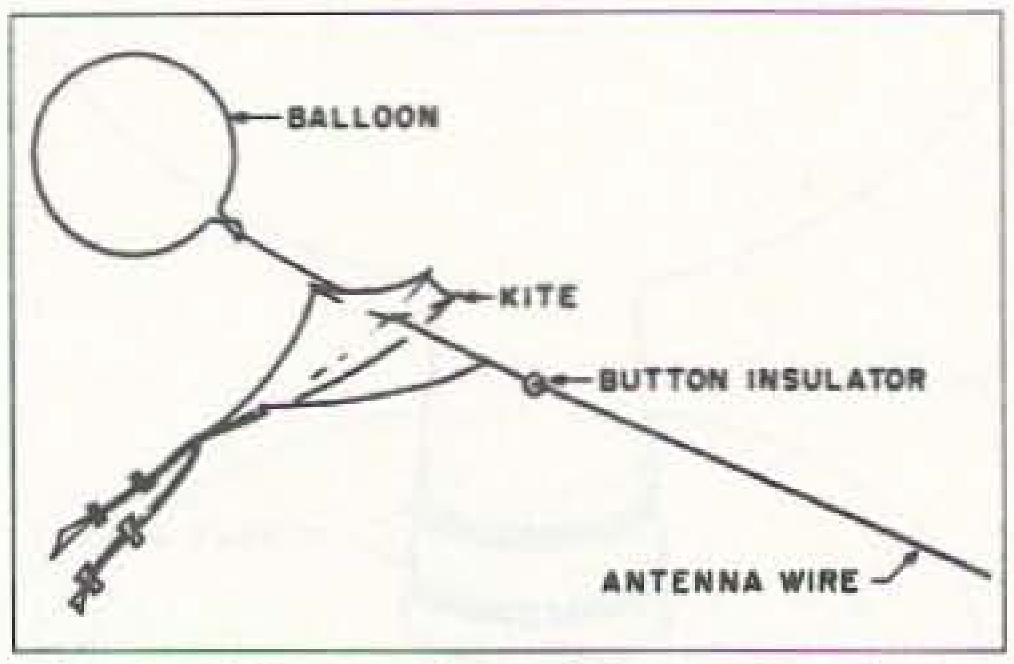

Fig. 5. Addition of a stabilizing kite for improved operation in moderate winds.

In the future, I might use another option for this method of antenna support. A full-wave wire will be held in a vertical position by guys made from 20-pound-test fishing line. This will result in a maximum radiation angle of about 36 degrees with respect to the horizon. The same feed system will be used. The antenna is shown in **Fig. 7A**, and the radiation pattern in **Fig. 7B**.

Other possibilities include flying a second wire near the driven wire to get a parasitic array. The second wire could be lengthened or shortened to render it a director or reflector. This scheme would require that the wind be out of the north or south, ideally, so that the maximum radiation would be toward the east or west.

Of course, Mother Nature has something to say. High winds, thundershowers, ice storms, snow, or heavy rain make it difficult or impossible to fly this type of antenna. 73

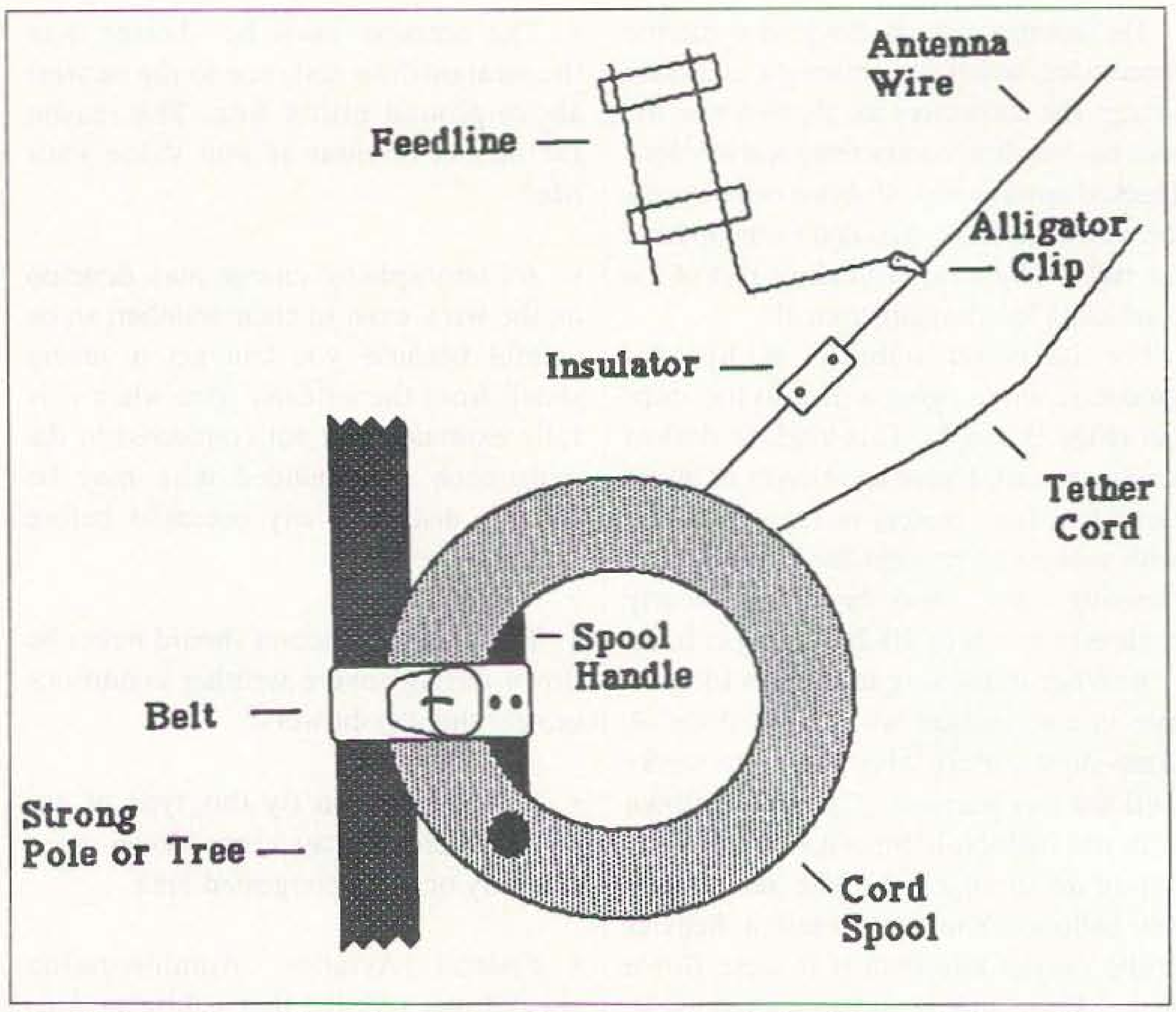

Fig. 6. The cord spool is anchored to a pole or tree using a belt with extra holes to allow it to be strapped tightly. An insulator reduces the end capacitance of the antenna. The feedline is connected with an alligator clip.

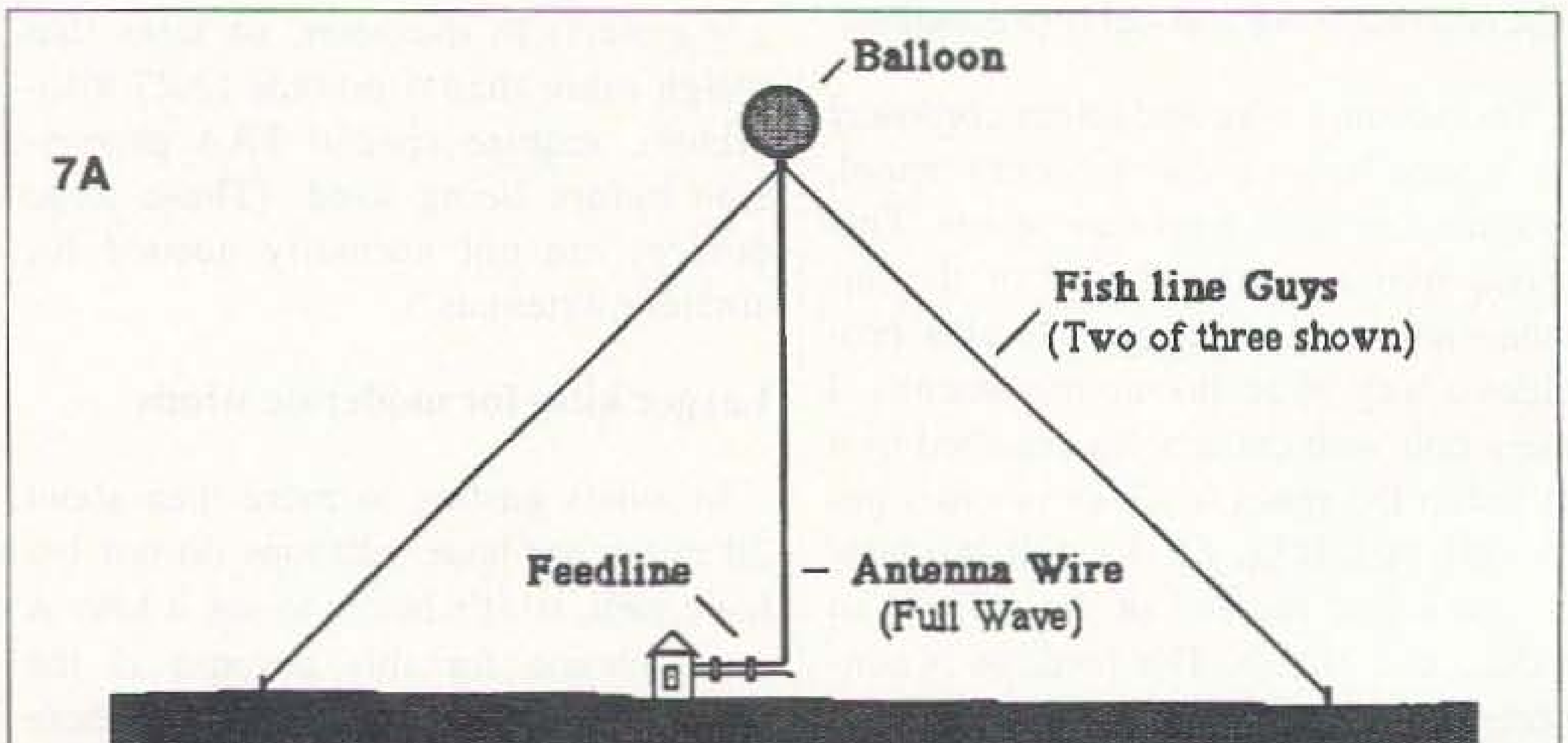

Fig. 7. A) The scheme for a vertical full-wave antenna. The height would be 530 feet for 1.810 MHz. B) The expected vertical-plane radiation pattern. The antenna would be omnidirectional in the horizontal plane and would theoretically provide excellent stateside performance from a central location such as Minnesota.