Antenna Workshop

Having Fun With A Slinky!

John Heys G3BDQ has been playing with a popular children's toy to create an antenna that can crawl downstairs!

I'm sure that you have all seen the well known children's toy that can 'walk' downstairs, known usually by the generic name of Slinky. The toy is essentially a helix or coiled spring, usually made from metal or plastic (but we cannot use that form as an antenna for obvious reasons). But before embarking on descriptions of successful h.f. antennas that I've made from these Slinkies, a short description of their vital statistics may be in order.

An Antenna that can crawl downstairs!

The basic model, available in most toy shops is manufactured by **James Industries Inc. of Hollidaysburg, Pennsylvania, USA.** When looking for one it pays to look around in a variety of shops as the prices charged can vary quite a bit. My local stationer-newsagents, with a small toy department upstairs, charged a pound less than a leading toy shop!

Slinky Helix

The Slinky helix is made from a silver-grey metal that although it's magnetic never seems to rust, even after a long exposure to the great wet British outdoors. The metal itself may be easily soldered for connections. When at rest, the 230gm coil of metal fits easily into its small-almost cubic-card-box.

Made with an oblong cross-section (0.5mm thick and 2.5mm wide) the Slinky has 87 complete turns with an overall diameter of 69.5mm with a complete length of about 19m. The comparatively large surface area of the metal shape gives it the capability of being a good r.f. conductor. The length of one complete turn is some 218mm.

When building helically wound elements for antennas, a well known characteristic is that the length of wire needed for each element has to almost twice as long as the freespace wavelength. I've found that, on any band, the overall length needs to be some 69% (conveniently 70%) longer and that changing the stretched out length of the Slinky makes negligible change to the resonant frequency of the antenna.

My experiments with Slinky coils have all been made indoors, which makes it easy to adjust for resonance without enduring the rigours of our climate. For checking resonance and bandwidth, I use my trusty Autek RF-1 antenna analyser, which makes things quite easy.

Dip Oscillator

If you do not have access to an antenna analyser, then a dip oscillator and the station s.w.r. meter can be used, as a substitute. I began by pulling the Slinky out to some 3.35m and strung it up above head height along the upstairs landing. The antenna analyser soon showed that it had a resonant frequency of 6.8MHz and when fed against the station earth had a feed-point impedance of 40Ω.

I didn't trim the helix to resonance, I just connected it directly to the a.t.u. On the receiver, some signals in the 7MHz band were as strong as if I had used an external antenna, although other signals were some 6-18dB down. With just 60W of output power, I had many c.w. and voice contacts with European stations.

Encouraged with the results on 7MHz I turned to the 21MHz band, for which I decided to make a half-wave dipole. For this band a normal wire dipole would be some 6.75m long...however, the Slinky version was only 2m long!

The constructional details of this design are shown in **Fig. 1**. Initially I made each side 31 helical turns, but analysis with the

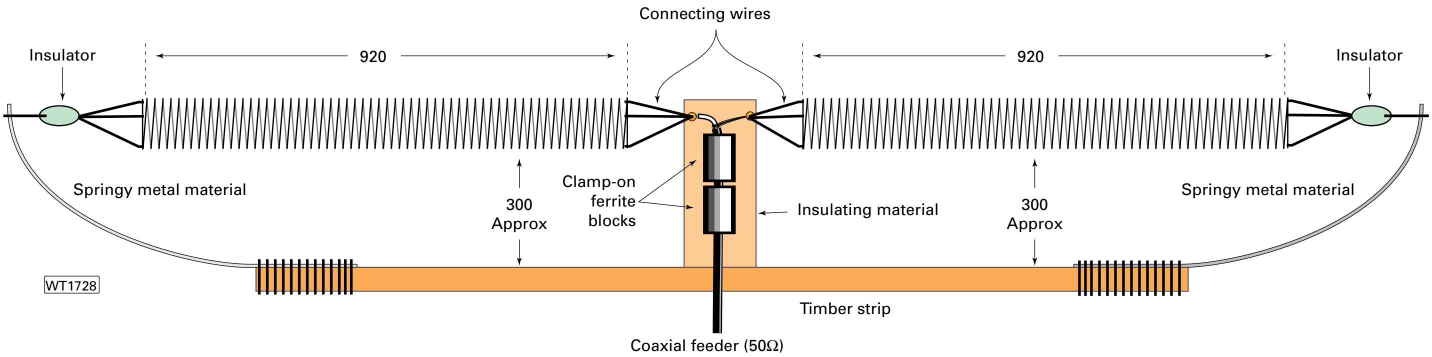


Fig. 1: Shortened dipoles for h.f. bands follow this general design. (See text for more details for band design principles).

Autek showed that the resonant frequency was too low. By shorting out a few turns, the correct length was soon discovered.

The unwanted turns on each side were held together with thin bare wire, which was soldered together. and I was pleasantly surprised to find the 70% rule held on this band too. The feed-point impedance turned out to be 45Ω and the midpoint so, I could use an eight metre length of 50Ω coaxial cable to the transceiver. A pair of clamp-on ferrite blocks at the feed-point formed an effective current balun.

Good Bandwidth

In use the antenna had a good bandwidth with a range of 150kHz in the centre of the 21MHz band where the s.w.r. was 1.4:1 or below. This tiny dipole gave an incoming signal reports of S6-S9+ with European stations and a few DX stations were also worked.

Oddly, some signals were stronger on the Slinky than on a well placed outside tri-band dipole, others being some four S-points down. I had no problems finding c.w. stations to work and the voice contacts expressed surprise at the make-up and location of the antenna!

Should the overall length of the extended Slinky be over four metres long I can recommend that a length of heavy duty monofilament line is used as a support. If so, run the monofilament along inside the coil, tie both ends down and extend the antenna along it.

Indian Rope Trick

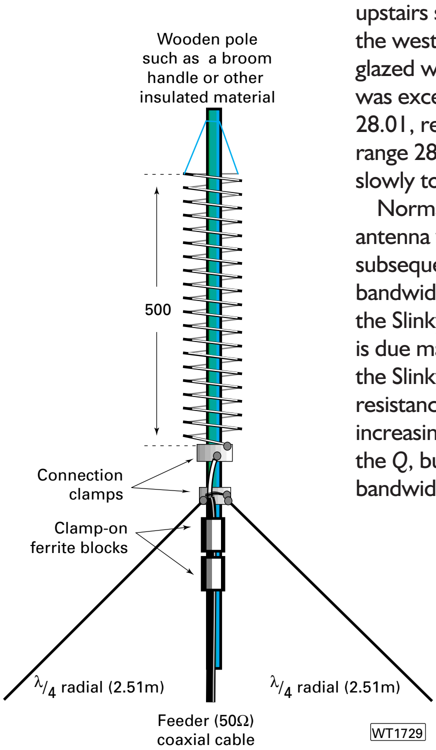
Now to try something like the Indian Rope trick, by creating a vertical Slinky antenna for the 28MHz band. A vertical λ/4 for this band is normally about 5m high, so the Slinky was calculated being 70% longer, which turned out to be 20 helix turns.

I checked the Slinky for resonance above a λ/4 ground plane, and at 20 turns it was rather long, needing one less turn to bring it to resonance at 28.45MHz. I then added a second radial, the overall layout is shown in **Fig. 2** and the photograph of **Fig. 3**. The vertical support I used was a short length of glass fibre (g.r.p.) tubing.

The Slinky was extended to cover just half a metre, the same length as a λ/4 vertical for the 144MHz band. The feed-point impedance however, depends on the layout of the two ground radials. I also found that, with the two in line 180° apart and angled down 45° there was no loss of sensitivity in any one direction and the feed-point impedance was close to 50Ω.

The mounting pole for my 28MHz vertical was a broomstick arranged on the spare room adjacent to the upstairs shack, 'looking' out to the west through a big double glazed window. The s.w.r. curve was excellent. being 1.5:1 at 28.01, reducing to 'flat' over the range 28.3-28.65MHz, rising slowly to 2:1 at 29MHz.

Normally an inductively loaded antenna would have a high *Q* and subsequently a narrow bandwidth, but not the case with the Slinky! This wider bandwidth, is due mainly to the resistance of the Slinky helix material. The resistance has the effect of increasing the losses so, reducing the *Q*, but which gives a wider bandwidth.



■ Fig. 2: A vertical for the 28MHz band, just the same length as a λ/4 for the 144MHz band.

DX Potential

The DX potential of the Slinky vertical antenna was surprising as many stations were worked with only 60W of r.f. In round terms signals reports were from 1-2 S-points down on the signal from the outdoor tri-band dipole, but during the 2001 ARRL SSB Contest many American stations were worked first call.

Later contact with USA stations were interesting, when I got some 'real' reports which ranged from S4 to S7 rather than the somewhat rubber-stamp S9 contest report. Moving the antenna to my stairway landing area, with its eastwards looking window this allowed many solid contacts with European stations, often with S9 or S9+ signal reports.

Devising an indoor antenna for the 3.5MHz band is not easy! A quarter wave on this band is 19m long, needing a Slinky helix length of over 32m if the 70% rule holds. So, to start, I soldered two Slinkies together to produce a double length helix of some 38m.

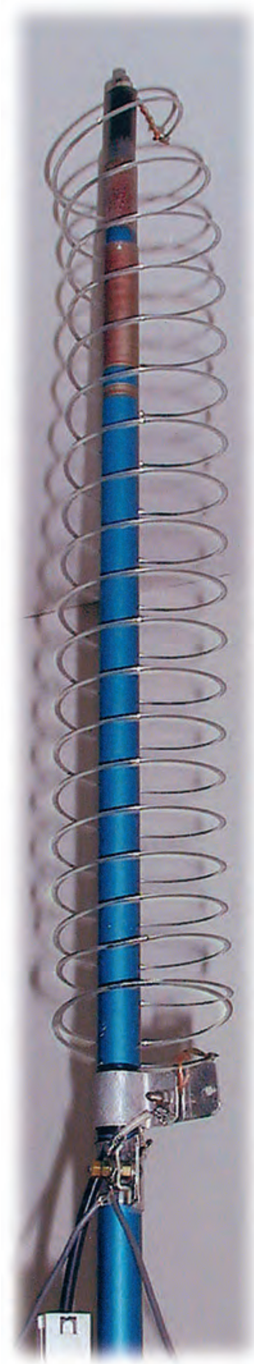
With a strong monofilament through the middle, I pulled the Slinkies out to cover some six metres, and tied a support line in the middle to counteract sag. The whole thing was slung along the landing and into the spare room.

Antenna Analyser

On using the antenna analyser, I found that this double length was resonant a way under the 3.5MHz band. By using an a.t.u. and tuning against the station earth, I achieved a usable s.w.r. on the s.s.b. section of the 3.5MHz band and was soon operating, receiving S8 and S9+ signal reports.

By shorting out 10 turns, I was able to operate without an a.t.u. with an s.w.r. of 1.3: at 3.65MHz. Again only the station earth line was used without additional radials.

But what else can you do with Slinkies? Well to answer that question, although I've not actually tried it myself, there are enthusiasts that have made up Beverage type receiving antennas using several Slinkies soldered together. As a Beverage antenna has to be at least two wavelengths long, creating such a length, even for the lower bands should be quite simple.



■ Fig. 3: Compare this photograph with the illustration of Fig. 2.

A plot of land smaller than a football pitch would accommodate at some 27 to 30 Slinkies in line. They would need only to be just over head height so, a series of support poles around two metres long would be needed to hold the antenna up.

Slinkies could also be used as ground plane wires where space is very limited. What about other designs using Slinkies in place of elements? What about a really 'baby' quad for one of the h.f. bands? The possibilities are almost endless! **PW**