



This article is provided by FMES for your interest thanks to the kindness of the original publishers. FMES makes no representations or warranties of any kind, express or implied about the completeness, accuracy or reliability with respect to this document and any sentiments expressed are not necessarily supported by FMES. Any reliance you place on this document is therefore strictly at your own risk

“Springs and things”

This document was written by Neil Furze and was originally published by the Worthing Model Engineering Society in Winter 2024

Recently our “Speedy” Adrian Vickers had shown signs of age and needed serious attention. One glaring problem was the suspension as when the boiler had a reasonable water level, and in addition the tanks were fully laden too, the axle boxes were seen to be fully driven into the horns. This led to concerns that the locomotive could well decide to step off the tracks if the suspension was unable to offer a smoothed ride and allow for the ups and downs of the rails especially on the tighter curves. (A problem we initially encountered with our Britannia in its early days).

Investigation showed that springs, of which there are two per axle box, so totalling 12, were weak and strangely were also of different sizes - the free length ranging from about 0.7” to almost an inch. The spring material seemed to be the same, measuring 48 thou or if you prefer 1.2 mm or even 18 gauge, and the active turns would appear to be 8. We have no surviving drawings of the build to fall back on, and other sources of information were sadly lacking any spring specifications. Seeing what was on offer with the usual engineering supplies market was one possibility.

Interestingly no supplier gives the spring rate of what's on offer so not being the designer (LBSC in



our case) I had no idea what was needed and certainly no intention of experimenting with the motley collection of what was fitted so I decided to investigate making my own of 3/8in diameter, 18 gauge and overall length of 1in or so including non-active turns and see how they turned out.

First question: what wire? B&Q offered steel wire 1.2 mm diameter nominally 8 metres long and coiled safely on a half round channel for the princely sum of £3.27 certainly worth investigating it certainly seemed springy enough but feeding and handling it could prove hazardous as uncoiling might well be asking for trouble. It's amazing how much energy is stored in a coil of springy wire and as our eyes are about as tough as the skin on a tomato they need protecting. I considered that goggles or safety glasses would be insufficient as any exposed part of my face and neck wouldn't benefit from being punctured either. I searched Amazon and purchased a full-face protective visor similar to what or two strange people adopted during the Covid mask panic.

Second question: What do you wind springs on? The answer is a mandrel which leads to what size?

When wound on a a rod and the tension is released the newly formed spring goes “boing” and the coils become shorter and of a greater diameter both internally and externally. The only thing under control was the diameter of the mandrel. Asking Google regarding *Helical Spring Mandrel Design* points to <https://daycounter.com/Calculators/Springs>. This simple calculator asks for coil diameter, wire diameter and wire material. You can use whatever units you like, but all must be the same. For this exercise I used 0.375”, 0.0048” and B&Q wire and the answer came out 0.285in. Using some 10mm scrap rod about 2” out of approximately.

90mm piece of it (should be about twice the length of the spring being made), was turned down to 0.285in with the end centred to allow use a live centre. The start of the wire needed to be secured; some designs call for a suitable hole drilled through the 10mm diameter bit and the wire bent 90 deg and stuffed in, I decided to tap the hole 4mm and secure the wire with a 12mm cap screw. The step from 10mm down to .285” should be angled, not sharp to allow the wire to glide down to the business part of the mandrel.



Third question: How do you deliver the wire? Well, by making a device to fit into the lathe tool holder as shown. A gash piece of 25 x 12 steel was butchered into the shape shown. The 1.5mm hole was angled upwards at 10 degrees to ultimately present the wire to the mandrel top surface in generally the desired direction. This was suggested by *blondie hacks, springs* on You tube, but only an “L” shaped part of the tool and not the piece I finished with.

Fourth question: How do you wind the spring? Now begins the learning curve, and you'll make many



springs, some good, some bad and some a disaster, but this does work. With the wire being presented to the top of the mandrel the chuck will have to be wound in the reverse direction to that used for normal turning, and by hand too, not just because that's a good way to unwind the chuck on a Myford but for safety and to have complete control over the process.

So, you set up for thread cutting at 10 tpi but don't engage the half nut. Set the saddle to present the wire to under the cap screw on the mandrel and lock it down; and now is a good time for the live centre to be positioned. Manually wind the wire on and using the saddle and feed the wire on to the turned part of the mandrel. Make 3 complete tight turns keeping an eye on the saddle else you'll over lay one turn on another, then engage the half nut.



After you've made a complete turn, you can see where your first turn has just left the close 3 turns at the start.

Mark the wire at this point with a marker for reference and mentally say "one" or even out loud if no one is nearby. Now continue laying the wire down manually with the half nut still engaged keeping count as you complete a turn with reference to your mark. When you have counted, in this case to 8, do another full turn and disengage the half nut and using manual control of the saddle lay down another 2 or 3 close turns.

At this point you may cut the new spring free; this is where you get the "boing" and the spring assumes its final dimensions inner, outer and length. The wire is very tough and unless you have a very small pair of bolt cutters it's best to use a metal cutter with a Dremel to make the cut; an angle grinder is not recommended.

Removed from the mandrel you now have a spring that's not quite like you thought you were going to get, as during the release the inner and outer dimensions increased but at the cost on the total number of turns. Deep joy.



Fifth Question: How do I keep tension in the wire when winding? Blondie hacks suggests you hold the wire, presumably with your third hand. That where the extra part of my tool holder feeder came in. I used a piece of Aluminium bar held down with 2.5mm cap heads to pinch the wire and apply a friction brake to the wire. Nothing precise just a guesstimate by the pull required to pull it over the mandrel.

Final Question. How do you finish it off? You now have to trim off the excess coils at the ends so that from where the first active coil leaves the static ones there's about 2 static ones left, similarly the other end is dressed, using the Dremel again. The two ends are cleaned up with a finisher so they are to all intents and purposes square.



Conclusions:

One school of thought suggests that the springs could be tempered now. This involves wrapping them in steel wool then making a sandwich with an outer wrapper of aluminium foil and placing in an oven at gas mark 8 (230c or 450f) for 20 mins. I didn't think I would survive this exercise as the anti rust additive added to steel wool will pollute the oven and anything cooked therein for a considerable length of time, certainly longer than my existence once the better half discovered what I'd done.

The demo spring just made ended up with an overall length of 1.054 inches - the fun is getting several of them to end up the same. The answer appears to be consistency during winding especially the point when the active turns separate and rejoin again at the end. The outer diameter indicated 0.362" about 13 thou under the expected size and the inner diameter 0.265 so that should hopefully clear $\frac{1}{4}$ inch.

For our Speedy springs I used music wire, Roslau - that's of German origin and polished as well from Hugh Craig Harpsichords in deepest Gloucestershire.