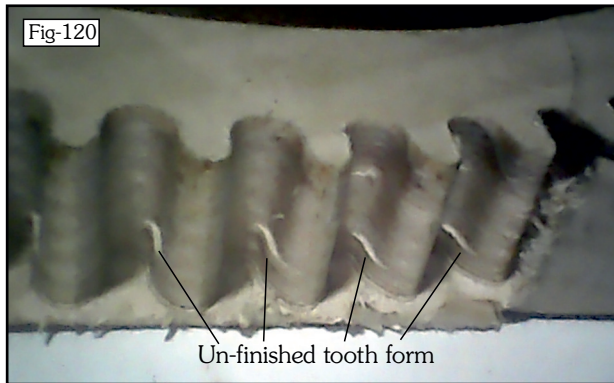


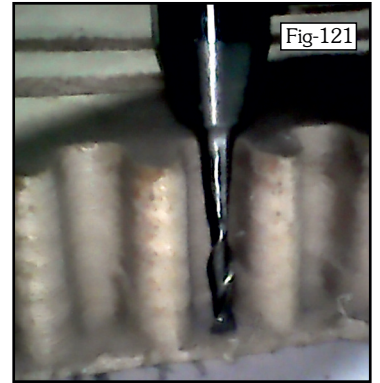
17TH NOV

I left the Denford working away last night and was disappointed to find yet another broken burr and an unfinished gear when I went in the workshop this morning. I can't see why three new burrs from the same batch have succumbed to the smaller stresses - after I reduced feed, increased speed and halved depth of cut but it seems prudent to change tactics. To that end I've taken a day off to ponder the options.



It's too late now to do anything with the gear in Fig-120 since I've taken it off the Denford table and the chance of re-mounting in the identical location within the 0.01mm tolerance that would be useful is impossible so I'll have to finish the last 2mm of each tooth by hand.

I have mounted the next blank and run the G-Code as far as roughing out the teeth. Whilst that was running I looked at what cutters I had that would



handle the 9mm depth. All the Burrs will, but the smallest I have (above the 0.8mm) is 1.8 and the small end mills won't go deeper than 7mm.

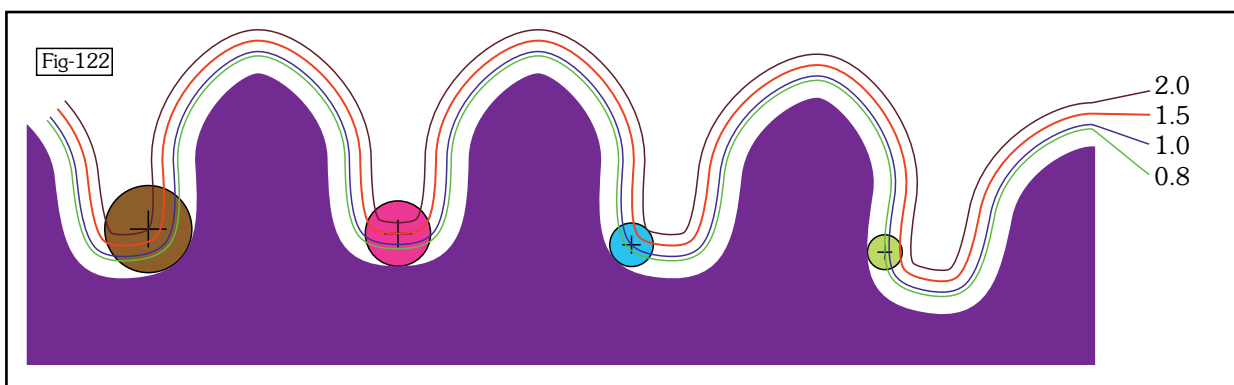
Not to be defeated, I decided to modify a 1.5mm end mill by grinding away part of the shank such that it wouldn't foul the top of the teeth - Fig-121 shows the result.

Tomorrow I'll run the G-Code to finish the teeth with the 1mm end mill which can get down to 7mm and create new code to use the 1.5mm cutter for the last 2mm. Because the 1.5mm cutter won't be able to get quite as close to the ideal tooth form, it will mean that I'll still have to do some 'fettling' on the teeth once I've cleaned the face of the gear to 8mm thick - but I won't have run out of the 0.8mm burrs!!

17TH NOV

Sleeping on a problem - I often find - has a beneficial effect and, after I'd set the G-Code running using the 1.5mm modified cutter, I had a look at what options my mind had brought to the fore overnight.

My concern was that the gear tooth form could not be followed closely with a 2mm Ø cutter - ie. that there would be potential for binding because the 'root' hadn't been fully cleaned out - this was only from a 'thought process' rather than empirical study. So, - I've now done a drawing of the tooth form at a 10x enlargement and along that plotted the path of the centre-line of the cutters at 2.0, 1.5, 1.0 & 0.8mm Ø.



As you can see from the drawing which is Fig-122, I was surprised to find that my concerns were totally unfounded. Even a 2mm cutter will reach into the deepest recesses of the root so all my faffing about - read that as breaking tooling!! - over the past three days has been without benefit :( Unless of course you consider that the learning curve has its own benefit!

I think that I'll still use the 1.5mm cutter (especially since I've already increased its reach) because it is an 'Up-Cut End Mill' rather than a 'Burr' so should leave a cleaner finish.

I've just checked and even a 3mm Ø cutter would still cut down to the root correctly but a 1/8" (3.175mm) would not, and I've only been able to source Up-Cut end mills at 1, 1.5 and 3.175mm Ø (at sensible prices anyway).

18TH NOV

The last 72T Main Drive Gear did get completed using the modified 1.5mm end mill and all four were finished to 8mm thick on the lathe where I also finish bored out the centre hold to fit the positioning Boss and the Ratchet clearance recess. All four are assembled (Fig-123) on their spindles along with the Ratchet and Winding Drum but without the Pawls or Pawl Pins - the Pins will be a press fit and I only want to do that operation once so it will be left until after I've applied the 'finish' which will be Sanding Sealer and MC Wax.

I also found time to cut the slot in the Lower Frame Spacer to accommodate the Frame Brace.

Initially, I thought to cut the slot on the Milling machine but soon realized that it would be both quicker and more accurate to do it on the Denford - primarily due to the difficulty of getting the parts absolutely level in the Milling Vice. The Denford table is, by design, flat and

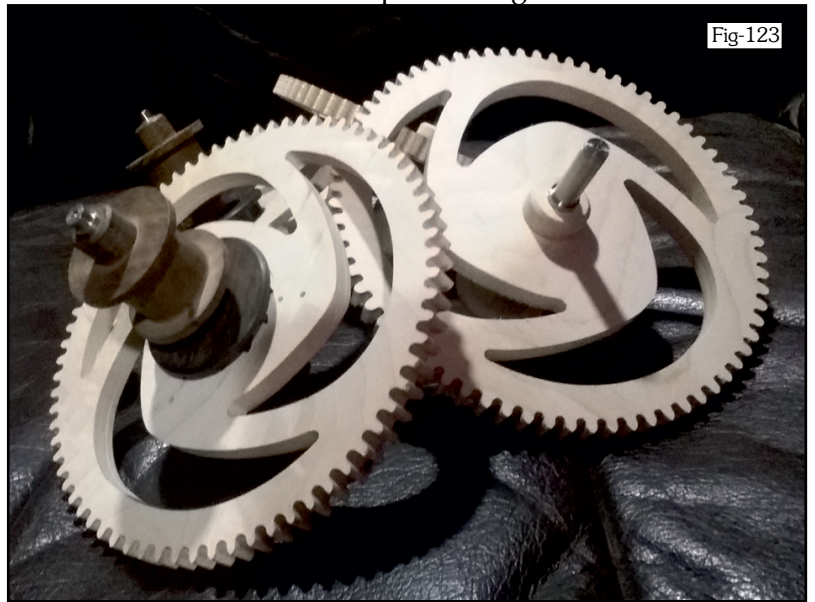


Fig-123



Fig-124

level so setting up a clamp to accurately position the 16mm Ø spacers was a few moments work and the actual machining would only take 2 minutes at most — it just meant that I had to spend 30 minutes or so drawing the tool paths and creating the G-Code. I suspect that it would have taken an hour to do the job on the Mill with the prospect of error.

The M5 threaded inserts which will eventually be screwed into the Front Frame have all been fitted to the clamping spindles so that I know that I have sufficient and don't need to order more stock. Fig-124 has one of the rear frames loose assembled with the Frame Brace, Spacer & Clamp spindle.

19TH NOV

Back to CNC and Gears - When I made the 32T Gears I was still drilling and counterboring holes in the basic stock to machine the surface down close to the finished thickness but I've learned from making the 72T gears that

putting the part finished Gear on the lathe to skim to finished thickness is easier to do - both as far as holding and machining is concerned. For the 30T gears I made today I didn't even cut the 400 x 64 x 10 Maple blank down to the 297mm length that I needed to cover the four so there was room to fit a 10T Pinion on as well - I needed another due to knocking a part assembled unit over and after a week of hunting still can't find the Pinion that was in the assembly. Now I've made another I'm sure it will turn up!

Up to now I've left the 'waste' at the thickness of the blank and used a Jeweller's saw to cut the components out, thinking that I might want to use the 'waste' for other projects but I now have boxes full of off-cuts of Maple and Walnut and am less of a scrooge :) so when I prepared the drawing for these gears I planned in an area to be machined away so that the gears could be cut off and held in the lathe chuck.



Fig-125

Thin card/paper strips to adjust the Y axis position



Fig-126

In Fig-125 you can see the gears with the waste removed and Fig-126 after they've been separated on the band-saw ready for finishing on the lathe. Because the width of the blank was very close to the O/D of the gears, I had to be very precise with the positioning in the Y axis such that even adding strips of paper/thin card made a difference.