5th Dec

With the last two Escape Wheels completed I think that all the CNC work is now done so I need a time of 'reflection' and checking all the components do fit together. I still have some lathe work to do on the 64T gears, Escape Wheels & Minute/Hour Train since they aren't yet mounted on their spindles.

6th Dec

I discovered today that not only had I not made the short spindle for the Minute/Hour train, I hadn't even done the engineering drawing for it! That wasn't such an issue really because it's a very small part and it took only 10 minutes to sort out. Fitting the Spindles to the Escape Wheel and 64T Gears proved interesting. The spacers had been made 3 or 4 weeks ago so naturally there had been some movement in the timber and I had to Ream the bores out again and drill & tap the M3 holes which clamp the Gear assemblies to the Spindles. It's amazing how long it takes to fit components like this together but at the end of the day I did at least have the gears mounted on all the spindles.

7th Dec

The first thing I did this morning was to see whether the gears on the three main spindles would mesh together. The rear frame was already fitted together but not glued and I haven't yet fixed the pinions absolutely to the gears because I want to be able to finish sand the surface and apply sanding sealer/MC Wax before final assembly but there is sufficient 'interference fit' to see whether rotating the Escape Wheel causes the whole train to rotate.

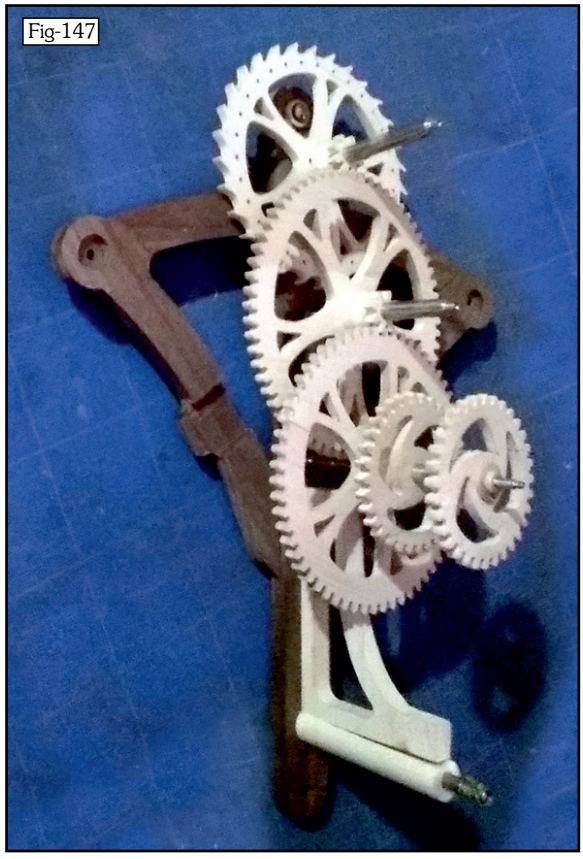
Fig-147

It was encouraging to find that I could 'spin' the Escape Wheel and the whole train moved. The problem manifested itself when I then fitted the front frame which forced the spindles to be parallel which proved that there is insufficient clearance between the Gear and Pinion mesh. I could rotate the Escape Wheel about a quarter turn which means that the error is not great but still unacceptable. To some extent this was to be expected because I tend to work (draw) to an 'ideal' size.

There are a number of ways to effect a solution;

1 - re-cut the location of the bearing seats in the frame - 1mm each would be ample.

2 - Make an abrasive stick and 'file' each tooth - or make a jig to do the same thing on the mill using a burr.

3 - re-make the pinions using an effective diameter 1mm smaller.

The first option may well affect the mesh between the main Driving Wheel and the 32T Gear on the centre spindle which would complicate matters further.

Nº 2 would be tedious and liable to make each tooth different.


Fig-148

The third seems to be the best option and would also give me a chance to correct the small 'irritations' in the way that the CNC process cut the 'hubs' which fit in the gears. Fig-148 shows the hub damage due to the method I used to cut them. The Pinion on the right is how they should be but the one on the left shows that the thin wall has broken away - this is due to cutting a circle with an end-mill and proves that it is important to use CNC where the benefits are to be

Making the 8 Pinions went pretty much without a hitch but I then considered With hindsight, I would now just CNC the pinion leaves (teeth) and then turn and bore the hubs on the lathe holding the Pinion in a four jaw chuck.

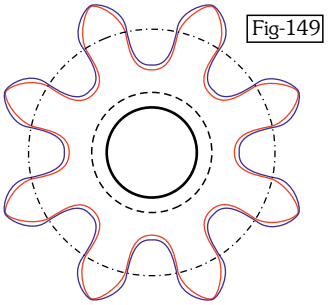
Fig-149

The blue line in Fig-149 is the original outline/profile of the 8T Pinion and the Red line is the re-worked profile. A two minute job in CorelDRAW!

I've created the new DFX & G-Code files to make 8 Pinions and found out why there is a 'bind' - I'd created the G-Code for the gear outline 'finishing cut' specifying a 1.5mm cutter but the cutter I fitted is 1mm Ø !!

8th Dec

Making the 8 Pinions went pretty much without a hitch but I then considered how I was going to hold them in the lathe to both remove the excess material from the back but also turn the hub & bore.

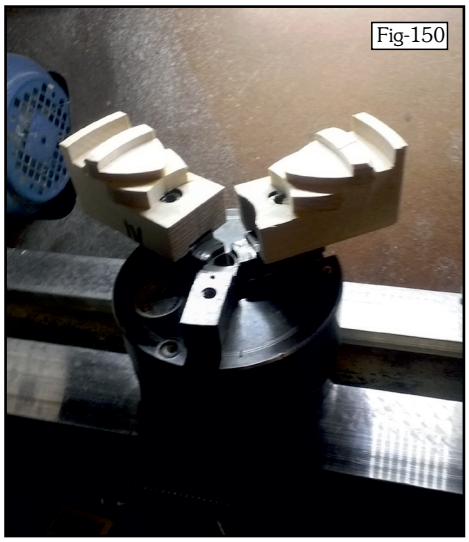
Fig-150

I've mentioned previously that I have what I've termed 'Beech Jaws' to hold the larger gears. These are simply blocks of Beech which I'd previously made to fit on the three jaw engineering chucks that I have. They are fixed to 'Soft' jaws which I've drilled & tapped. For Fig-150 I've removed one of the Beech Jaws so that you can see exactly how this works.

I can prepare the jaws to hold any component truly concentric by first clamping a small piece of steel in the metal jaws and then bore the Beech close to the diameter of the new part that I need to hold. I can also simply glue a new block of wood to the Beech - the triangular blocks are in fact Maple that came out of the gears - and just recut them as often as necessary.

This methodology is very good but has a limitation due to being only 3 jaw which is generally no problem when needing to hold objects which are already 'round' but not when you start with a square. An 8 tooth gear/pinion is effectively a square component so could not be held easily - even if I were to glue new blocks to make the grip smaller.

I do also have a 4 jaw self-centering chuck with 'carriers' - for which I also have a number of jaws but they are all 'hard' so can't be machined for absolute concentricity. Notwithstanding that limitation, having made Beech Jaws for the 3 Jaw chuck I saw no reason that I couldn't do the same for the 4 Jaw. The small irritation that had stopped me doing this previously was the fact that the carriers on the 4 jaw have a circular location ridge which would be difficult if not impossible to cut on the mill without de-mounting the vice and fitting a dividing head but now I have a CNC machine those constraints vanish.


Fig-151

It still took me all morning to design, draw, G-Code and make 4 Ash jaws but the result will be a massive benefit to future projects. I drilled & counterbored holes for both screw holes in each jaw but the next time I make them I'll only use the outermost one. This will allow me to hold much smaller objects. . . . . I could remove the innermost screws and glue a new block in place of course but I have already finished the 8T Pinions and fitted them to the spindles. The jaws - along with the Pinion blank and finished Pinion are in Fig-151 & 2.

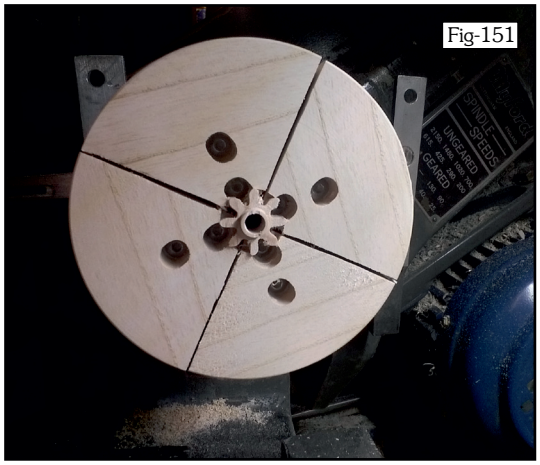
Fig-151