14th Oct

The larger segment went to plan with no problems but the smaller one gave me a few anxious moments as I watched the 3mm cutter get closer to the clamping screws than I have bargained for! It just cleared the first but partially unscrewed the second. I was ready with the Emergency Stop though and once I'd turned down the head, removing the damage, I could re-secure the blank and continue the G-Code from where it had stopped.

This was caused by my 'thrift' :) since I'd decided to 'save' the 50mm of Maple that was left over after cutting the two lengths needed and I'd also put just two clamping holes on the centre-line rather than 6 holes on the edge as I'd had to do with the large blank. You'll see the difference in Fig-71 & 72.


Fig-71


Fig-72

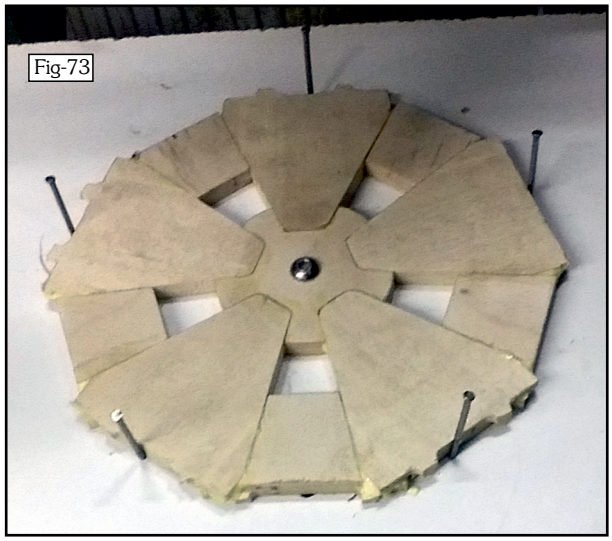
Fig-73

After separation and a little clean up, I found it a little challenging to get all segments to sit nicely together until I hit upon the idea to screw the centre down. Once I'd done that, the glue-up was straight forward. I was anticipating having to screw 10 blocks in a circle and add wedges to press them all to the centre but eventually was happy with just a panel pin against the end of the long segment. (Fig-73) Whether it will 'move' overnight is another matter!

15th Oct

There is a slight 'bowing' due no doubt to the fact that I didn't take enough care after hammering the pins in to also clamp the whole assembly 'flat'. Nothing that a short time on the Linisher couldn't overcome but I'll know for the next one.

Spent the morning re-doing the G-Code for the spokes, Teeth and Pins. The later was of some concern since I want them to be a press fit - though they will be glued as well - and although CNC machining is accurate, the actual diameter of a drilled hole is governed by not only the diameter of the drill used but also by how accurately it is held in the collet. Because I made my own holder for 1/8" shank cutters (Fig-74) I was anticipating some minor 'wobble' and when I'm looking at 2mm Ø, a 1.9mm might well cut just a smidge oversize and when I measured the St-Steel pin material at 1.97mm it seemed sensible to do some test holes.

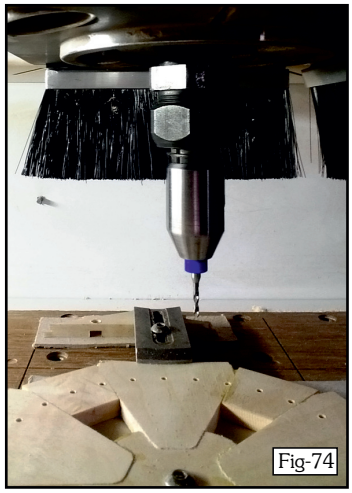
Fig-74

I was pleasantly surprised to find that the very first test hole with a 1.9mm dill proved to be accurate and a good 'press fit'.

Because the drill was in place, it made sense to keep it there and change the order of operations, so, as you can see in Fig-74, the 30 holes for the Escape Wheel Pins were drilled before the Spokes or Teeth were machined.

The CNC operation went pretty much to plan though there were times when I thought that my 3mm cutter was cutting oversize - it turned out that I had left the offset between roughing and finishing the same so the second cut although being with a smaller cutter only trimmed a little out of the places there the larger cutter couldn't reach. The re-writing of the G-Code soon sorted that so I now have one of the four Escape Wheels (Fig-75) ready to have the pins inserted. It still needs to have a recess machined to take the spacer between it and the Pinion which will also carry the grub-screw which locks it to the spindle. The centre hole needs to be enlarged as well but these two ops were always going to be done on the lathe.


Fig-75

I'm quite happy with the thickness at 5mm but because I have the 15mm thick Maple I'm minded to simply cut that down the middle and adjust the depth of the joints once I've cleaned up the surface so the other three may well finish up at 6mm or just over. That will just mean that the spacers need to be a bit shorter. The current design is 16mm so there's enough 'meat' in there for the 3mm grub-screw even if it goes down to 14mm.

16th Oct

I have to visit a wood-yard (Whitmore's Timber - Claybrooke Magna) this afternoon to select a Walnut board for the rest of the Frame and Dial so I started to make some of the spindles, specifically those for the Escape Wheel and 2nd Train since they are both the same length but with a different shoulder to position the gears offset to each other. These need to be concentric so I can't trust even a newly bored set of soft chuck jaws to hold true when they are reversed. Therefore the only option is to turn them between centres which eliminates all potential concentricity errors. I had all 8 spindles machined to length, centre-drilled each end and one end fitted to the 8 x 4 x 3mm Deep Groove Ball Bearings before going to Whitmore's.

A vast selection of Superior Grade Black Walnut boards and the yard-man couldn't have been more helpful in allowing me to see many before selecting what we each considered the best ---- or so I thought!! ---- everything went well and he even pointed me to their 'offcuts' section where I found a 1.2m length of 8 x 1 Canadian Hard Maple @ £15. Took a while to deal with paper-work and payment but I was on my way less than 40 minutes after arriving. Only when I got home did I actually measure what I had :(

Neither he nor I used a tape measure, I just accepted what he said was a 6" board - it turned out to be a 5" board - actually 130mm wide but unfortunately just not wide enough to get my cutting list out of. Another 10mm and I might have been able to re-arrange the cutting up. So I now have to return it on Monday to select another.

So, back to the spindles - mind you, I can at least have a go at the Maple over the weekend to see whether my concerns over the grain direction are really worth the hassle of making 10/11 segment composite Gears.

The Escape and 2nd Train Spindles are now done - Fig-76 shows them complete with the bearings.


Fig-76

17th Oct

With the Walnut not available and the spindles made, I thought to make the 8T Pinion which goes on the same spindle as the Escape Wheel.

As all the pinions will come from the same 10mm thick Maple stock, it made sense to set them all out in one drawing so that there would be minimal waste due to having to provide clamping holes, and, after a couple of attempts I finished up with the layout in Fig-77 where I've separated the four different Pinions by applying a colour. Combining all four meant that I had to think carefully about the depth of cut when creating the G-Code and the order in which each MOP should be made but that's nothing new.

I was also aware that these small components also had quite delicate 1mm thick walls which, when assembled (glued in), would be perfectly good but in isolation may well prove an issue so I made the 'finish' cut on these parts 0.2mm. The fact that I'm using a 1mm Ø cutter for the finish also had a bearing on that decision!

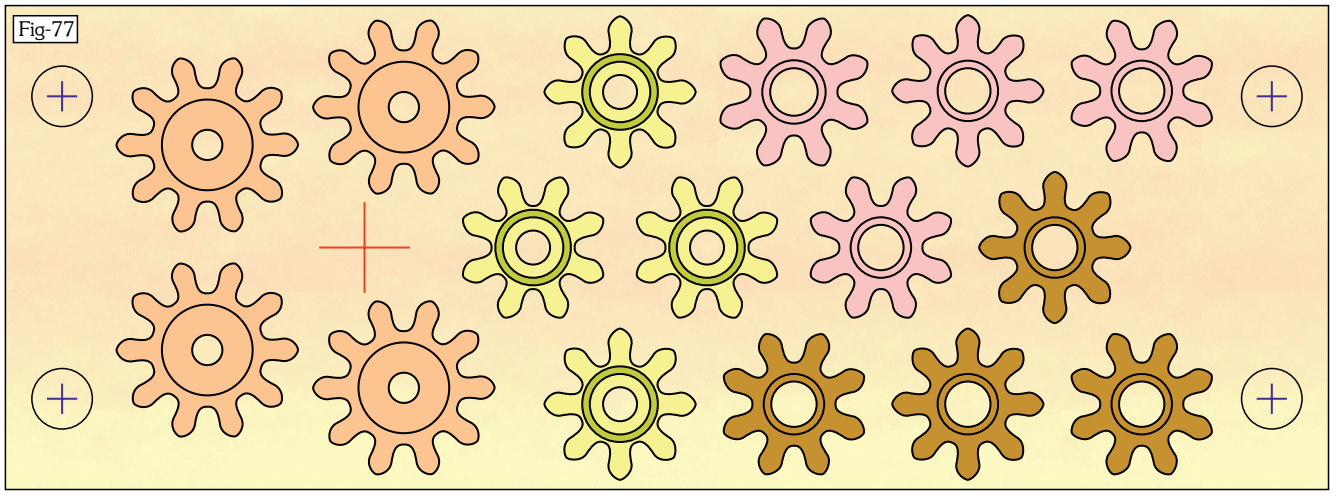
Fig-77

I've learned a little about how Maple handles when cut with an up-cutting end-mill - it leaves 'whiskers' which need to be removed by hand, well riffler file - I may have to make another two, if so then I'll change the cutting order so that the surface is removed after the teeth have been cut, that should eliminate the clean-up, though the reasons for cutting the surface first was to make the depth of cut short enough to be covered by the flute length of the 1mm end mill (and that is still a valid reason) so there may have to be a two stage process where most of the waste is removed leaving a ½mm for a final cut.

Because the Gears are 5mm thick and the 8T ones have a 3mm boss there was at least 2mm and as much as 4mm to clear from the opposite side of the blank so it was always going to be necessary to turn the billet over. When I designed the G-Code, I made a point of creating a Pocket MOP to deal with this but still leave a 1mm bridge between each Gear tooth and the main body. Fig-78 is after the second operation with the gears still held in place but machined to the correct thickness. Most of the Pinions could be broken out but I did need to cut through some of the Maple with a Jeweller's Piercing Saw.

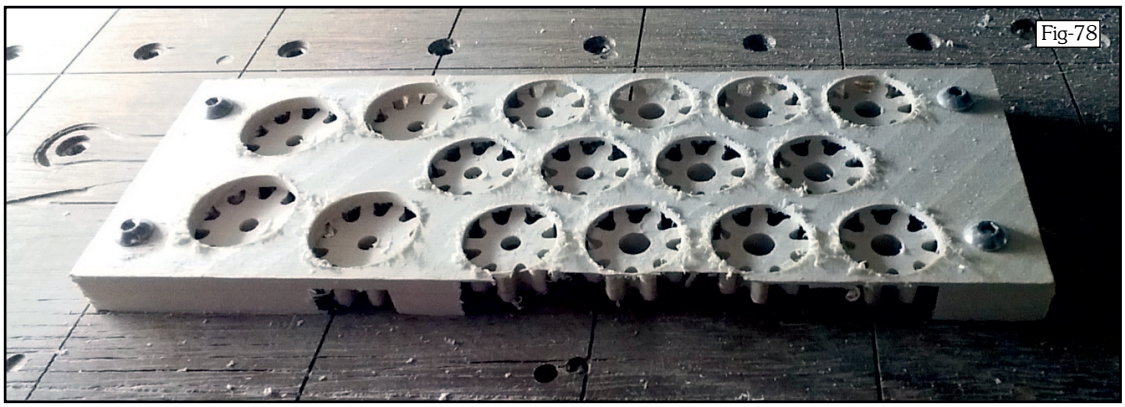
Fig-78