9th Dec

Having made eight new 8T Pinions and fitting them to the spindles that were to hand I realized that there were another four 8T Pinions needed as well as four 10T Pinions. These are for the gears which were not in the workshop simply because I needed more space and I'd forgotten them.

This meant that I had to create another drawing, DXF file and G-Code but having done multiple Pinions before I found that I changed the way that I handled the G-Code. Previously I had cut away a circle around the outside of each Pinion and then used a drill MOP to take away the main bulk of the space between the teeth only later using the outline to first do a rough cut and then a finishing cut. This time I used only the outline to first cut a swathe with a 4mm end mill leaving the teeth 1.3mm oversize followed by a 2mm burr leaving 0.4mm and finished with a 1mm end mill. The first two went 7mm deep and the last one 6mm. The Pinion leaves need to finish at 5mm thick so there would be ample 'meat' to trim both faces on the lathe in the event that the top face sustained some damage - which I don't think it has.

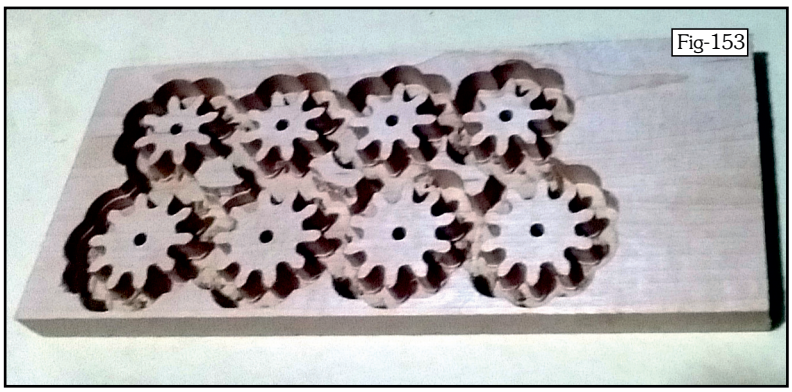


Fig-153

This method I think is much more efficient and ultimately produced a block (Fig-153) which will be simple to separate on the small bandsaw.

10th Dec

That still took some time and I needed to be cautious when trimming the excess from individual Pinions! Removing the inner screws from the Ash jaws and boring them out to glue on Maple pads was definitely worth while and made gripping these Pinions for the second operation much better.

The new - slimmer leaved and smaller - Pinions are definitely better but to be absolutely sure that they will run freely I need to glue up the frames so that I can fix the locations of the bearings. The jig (read - flat board with screw blocks!) that I used to glue up the Dials was easily re-worked to apply pressure to each joint but it's a one at a time job so will take a day or two to complete the 8 frames.


Fig-154

11th Dec

When I spoke about gluing up the Dials, I mentioned that I would use a 50mm Ø sanding disk but forgot to take a photo – Fig-154 shows the same process but used on the frame. The pad is held in the collet on the mill and the height adjusted to suit the distance between the flat board (40mm Formica faced kitchen worktop offcut) held in a vice. I started with 60grit and will eventually get down to 320g.

17th Dec

The past few days have been spent correcting some errors I made due a naïve belief that it would be wise to cut all the recesses for the Bearings etc. at the same time that the frame sections were made. It certainly seemed sensible at the time but once the frames were glued together it became obvious that the ***exact*** location of the bearing positions needed to be determined relative to the main spindle (which carries the hands) and with the knowledge of the mesh of the Pinions & Gears. Even a difference of 0.1mm in the position of adjacent spindles can make a difference to a clock running for 5 minutes or 24 hours.

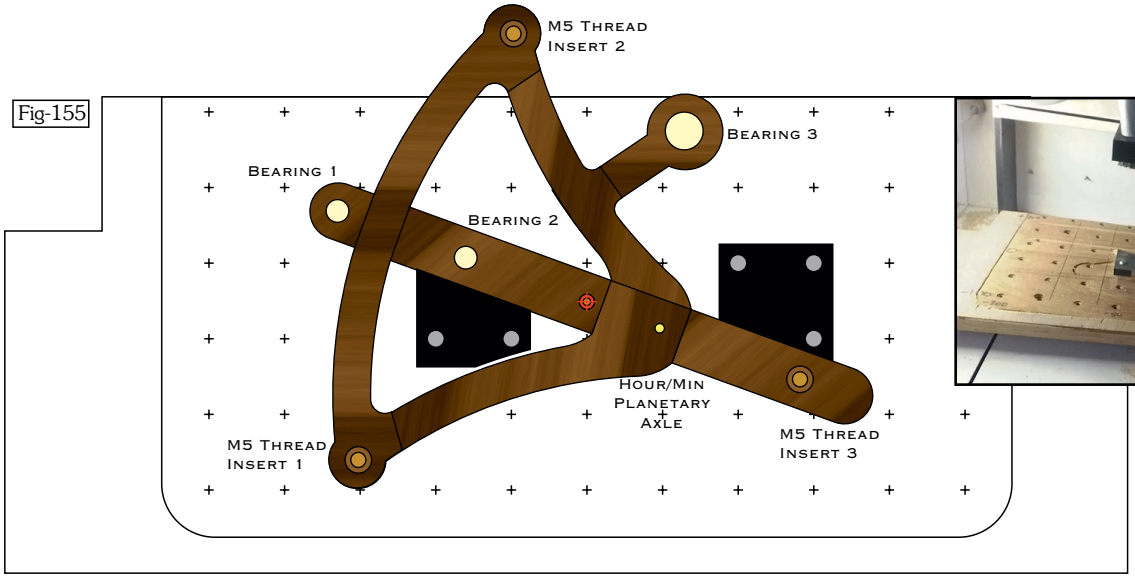
I was very pleased with the way that the frames went together as far as the joints mating was concerned but the position of the winding spindle holes caused some concern. This was primarily to do with the short Section D joint being an 'easy' fit. Add to this the issue that necessitated the re-cutting of the Pinions and I decided that it would be prudent to simply bite the bullet and re-cut all the bearing recesses, along with the positions of the frame spacers.

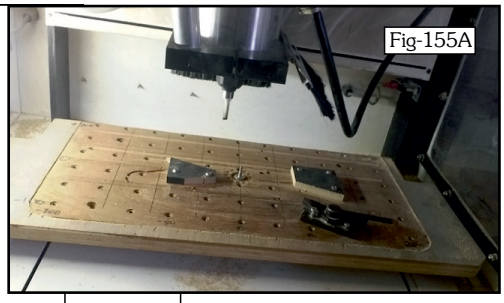
A great deal of head scratching was needed and some experimentation which ultimately detracted from the process of photo recording - ie. not being clear in my own mind what I wanted to do I resorted to my 'norm' of just getting on with the job in hand. So, I'll add some drawings to show how I solved the various problems that arose.

Because the Gear/Pinion mesh would benefit from 'a little extra' separation, (which I had determined by trialing the fit of the hour/minute planetary gear pair) I decided that the most efficient way to reposition the bearings would be to machine a recess and insert a new piece of wood into which I could cut a new bearing recess. This would allow me to add 0.2mm to the centre distance. Greater than this and I would be in danger of compromising the escapement. The position of the hour/minute planetary gear doesn't matter quite so much so I made that 1mm greater than originally designed.

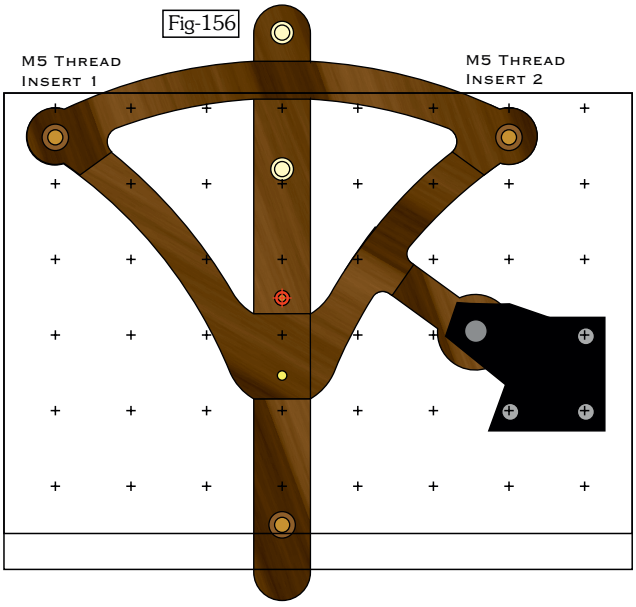
The Denford has a maximum capacity of 400mm in the X Axis and 200mm in the Y Axis so cannot totally accommodate the assembled frame without some judicious positioning. Fig-155 shows how I positioned the frame to cut recesses for the new bearing inserts. I chose to use Maple and make this correction a 'feature' :)

The black blocks are positioning aids which were machined with reference to the table centre locating peg (Red Cross). The Frame was kept in position by fitting three clamps.

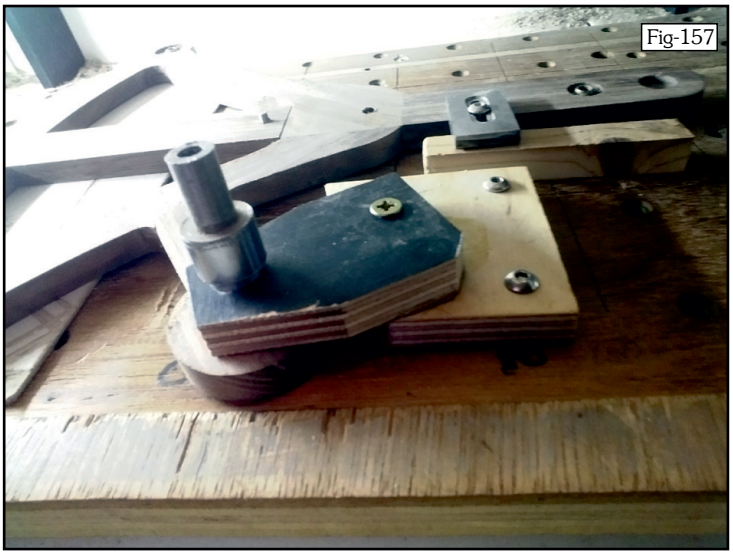




Using this set-up I could machine the three Bearings along with the Hour/Min Axle and M5 Thread Insert 3. To cut the other Thread Insert recesses I had to re-position the frame as in Fig-156 which took a little more ingenuity as far as accurate positioning is concerned. By now the Bearing recesses had been machined and I knew exactly where Bearing 3 had to be so could create another G-Code file to cut a matching location hole in an overhanging Jig Block. At the time of writing this I had already taken a photo of a similar Jig Block so although out of sequence, Fig-157 will give you a better idea how this 'overhang' Jig Block allowed me to use a locating 'Peg'.



D'oh! - preparing this photo I discovered that I ***had*** taken a photo of the first positioning Jig Blocks - but for a different purpose - so that will be Fig-155A.



My original intention was to screw the M5 Threaded inserts directly into the frame but once I'd decided to use inserted blocks to reposition the Bearings, it became obvious that doing the same with the Inserts made more sense. It is important that Threaded Inserts are screwed into 'face' rather than 'end' grain and turning small blocks of face grain timber on a lathe has its own limitations so after making a

prototype by hand, I created a G-Code file to make 12 from an off-cut of Walnut. I didn't bother with cutting the outside circle, just machined 12 holes with matching recesses and part cut separating slots. This allowed me to screw the threaded inserts in on the mill so that I could then mount them on the lathe to machine to finished size which would guarantee that the insert was correctly centred when glued into the frame. Fig-158 is a montage of two photo's taken from top and bottom of the mounted insert after part machining.

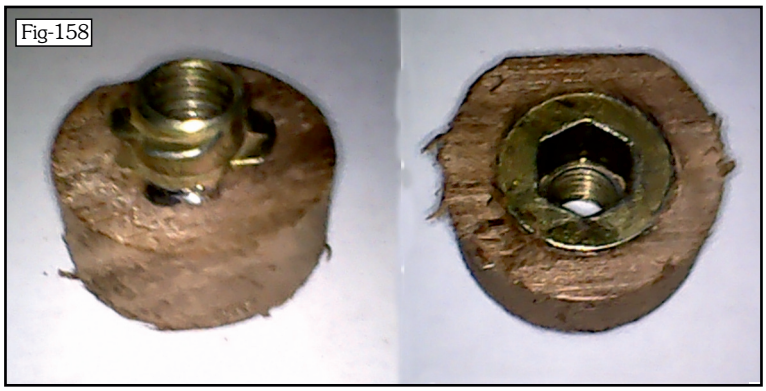


Fig-158

Writing this 'after the fact' has meant that I've missed out some salient details as well as not taking photo's!. Specifically I haven't mentioned how I made the Maple inserts which had to be glued in place and sanded down to a level surface before machining the final recesses for the bearings.

This was a simple matter of taking a 22mm wide strip of 8mm thick Maple and writing a G-Code file to cut 4 x 20mm Ø and 8 x 12mm Ø 'buttons'. They were cut 7mm deep and then separated on the small bandsaw. Once the 'buttons' were glued in place the frames were returned to the Mill to have the excess sanded off before going back on the Denford to have the real Bearing recesses machined. This was also necessary for the Thread Insert repair blocks of course though they didn't need a second operation.

Having spent all morning trying to remember what I've actually done over the past week, I think I am nearly up to date so can at least add a photo of the current state of the front Frame (Fig-159) showing all the corrections.


Fig-159

I now have to do the same with the Rear Frame which will entail solving all the same problems again but in the opposite hand! Hopefully it won't take as long!

Before posting this update I'll add a photo of the Front Frame but with the spacing rods and some of the gears/pinions in place.


Fig-160