Stella – Upgrade to run on 32mm track.

I designed and built the original 'Stella' to run on my 45mm garden railway but subsequent to the publication of the book a number of readers have enquired about a 32mm version. Often on models of this type it is possible to slide the wheels inwards but with Stella this is not so straightforward as the gear train gets in the way. So in response to many requests I have redesigned the gear train and some other components so that a dual gauge version can be built. In doing this redesign I have endeavoured to change as little as possible from the original so that the vast majority of the design is unchanged and the techniques given in the book are still valid. There are no changes to the engine part of the model nor to the side frames, stretchers, buffer beams, smoke box and burner.

The gear wheels are different but run on the same centres. The axles are now all 4mm stainless which means that all the ball-race bearings are 4mm inside diameter, 8mm outside and 3mm wide. (4x8x3). The wheel hubs have been shortened to permit the wheels being mounted closer and there are a few differences in the assembly.

Driving Wheels – See new drawing D13x

The main differences between the new wheels and the original is that the rear bosses have been reduced in length to 7mm rather than 10mm and they are drilled and reamed 4mm to fit the new axles. I gave the reduced boss length some thought as it is this boss that is gripped in the 3 jaw chuck to facilitate the machining of the fronts and treads of the wheels. When machining the 32mm treads the chuck is only holding 7mm of a 10mm diameter stub which is not ideal. To improve matters I did two things. Firstly I under-cut the rear of the wheels where the bosses join so that when reversed the backs of the wheels can be pushed hard against the chuck jaws to make sure all 7mm is being gripped. Secondly, before machining the fronts I cross drilled the bosses and fitted temporary 10mm long M3 screws. These were only screwed into the bosses by a couple of threads to avoid interfering with position of the 4mm central hole yet to be machined. When mounting each wheel in the chuck I lightly closed the jaws and then turned the wheel clockwise until the associated screw head impinged on a jaw and then fully tightened the chuck. This way the screw acted as a mini driving dog to help impart torque from the chuck to the wheel.

Gear Wheel Drive Train – See new drawing D14x

The plastic gear wheels differ in the numbers of teeth from the originals to achieve a more compact drive train and the method of mounting on the axles also differs. This latter change is necessary as for 32mm track the back-to-back distance is reduced from 40mm to a mere 28mm. There is no room for brass bushes as given in the original D14a drawing so the gear wheels have been secured with 1.5mm dia split pins. To facilitate this, the axles have been increased in diameter from 3mm to 4mm so they can be cross drilled 1.7mm without losing too much strength.

On the original model the gear wheels could be aligned on their shafts by adjusting the brass bushes. But without these bushes the cross drilling of the various shafts must be precise. So let me expand on the subject of cross drilling. The approach I used in Chapter 1 was used again but it was necessary to make an additional jig from 8mm steel strip to accommodate the bosses of the plastic wheels. See photo 1 below. The gear wheels had bosses of 10, 12 and 15mm nominal diameter and as I can only drill to 10mm I had to bore the 12 and 15mm holes. Additionally the larger wheels had 6mm bores so needed sleeves to reduce their sizes to 4mm. I have included a drawing of the new jig. It is essential that the 1.7mm vertical holes in the edge are all 3mm from the reference face. Also the holes in the reference face need to be counter sunk sufficiently so that the backs of the gear wheels can be pressed hard again this face when the bosses are pushed into the jig. Again see photo 1 below. The sleeves were turned first and pushed into the wheels with a trace of super-glue. Each wheel was pushed into the appropriate hole in the jig and cross drilled 1.7mm. See photo 2 below. Note that the thickness of the jig is greater than the depth of the bosses so the vice holds the wheel hard against the reference face. This will become significant when we get to the cross drilling of the axles, but before this I made eight brass collars 10mm dia and 4mm wide. Each was fitted with an M3 grub screw in a similar fashion to the driving wheel bosses. These were used to keep the axles in place in the final model but before then they were used as an aid to positioning the gear wheels on the shafts. The photos will explain and see the diagram on the cross drilling jig drawing.

Changing gauge

The driving wheels can be set for either 32mm or 45mm gauge. To facilitate this I made three gauge-pieces out of 32mm aluminium tube and some scrap brass. See photo 6. Pieces 28 and 40mm long were made from the tube with their ends squared in the lathe and their lengths precise. They were then cut lengthwise so the halves would fit around the gear wheel in the middle of the drive axle. For 32mm running one driving wheel is set to be 7mm in from the frames and then the back-to-back distance to the other wheel is set to 28mm. For 45mm running the 7mm gauge is used edgewise, somewhat like a feeler gauge, and this sets the first wheel just clear of the frames and the second wheel is then set back-to-back at 40mm.

Conclusion

Other than the changes mention above the rest of the build is as per the book. Hopefully modellers that build for 32mm track will enjoy making this somewhat unusual model as much as I have enjoyed its design and build.

Happy modelling to you all,

Peter Scott

Photo 1

This shows the gear wheels after they were cross drilled. I made my jigs in two parts merely because it suited the scrap metal I had to hand. It is worth noting that there are three holes that accommodate 10mm dia parts. One permits the 3mm drilling of the gudgeon pin assembly, the next permits the 2.7mm drilling of the driving wheel bosses that are tapped M3 and lastly a hole that enables 1.7mm drilling for the 1.5mm spilt pins.

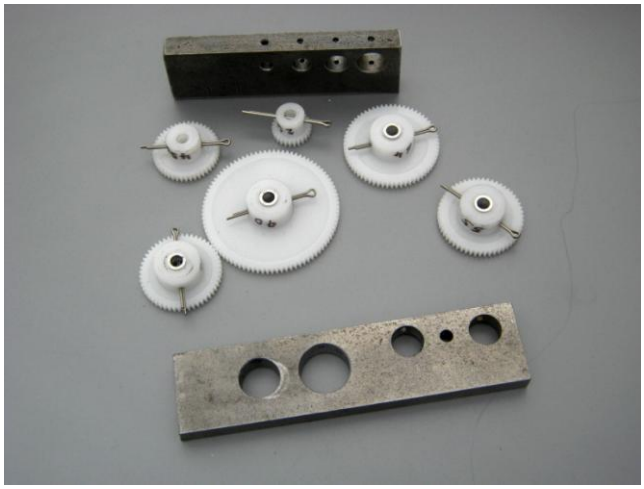


Photo 2 – see also the Cross Drilling Jig drawing

This shows a gear wheel being held in the jig that is itself held in the drill vice. The jig was packed up so that it rested true and square onto the surface of the vice between the jaws. When cross drilling the axles it was necessary to pack the jig such that the axles were just clear of the top of the jaws but such that the edge of the collars could still be gripped by the vice. See photo 3.

Photo 3

Axle ready to be cross drilled with the 3mm spacer in place that is the same width as the gear teeth. The spacer and axle are held close against the jig by the collar that was hard against the face of the gear wheel when the axle was offered up into the model. Hence the jig will cause the hole in the axle to line up with that drilled previously in the wheel boss. See the diagram on the cross drilling jig drawing.

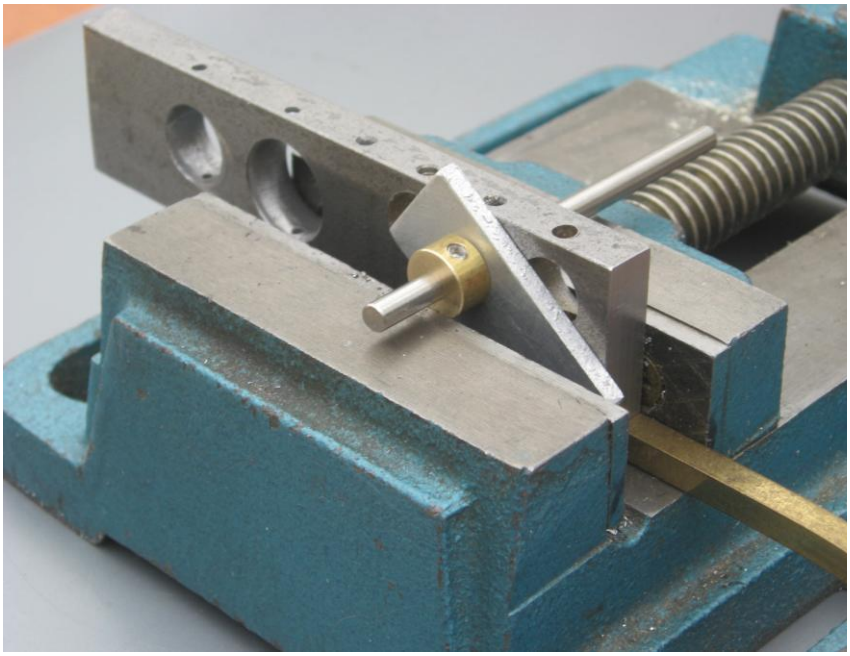


Photo 3 – see also Drawing D14x

This shows the assembled gear train. The spit pins have yet to be shortened. Additionally, on the 90 toothed wheel it was necessary to counter sink the hole in the boss so that the head of the spit pin could clear the frame of the engine. Starting with the 55 tooth wheel on the driving axle each wheel was offered up in situ and the position of it face 'marked' by one of the spare collars. On the lower lay-shaft The 45 toothed wheel is too close to the 64 toothed wheel to have a spare collar adjacent to its front so a collar was placed hard up against the boss and when removed from the frames another collar was fixed next to the front of the wheel before the first collar and the wheel were removed. In all there are five holes to drill in the axles but given that I decided to offer up each wheel in turn to ensure precise meshing with its partner this was something that took me all morning to do. This was done with the engine in place in the frames as the wheels must clear the moving parts and mesh with the crank shaft pinion, but for clarity the engine has been removed for this photo.

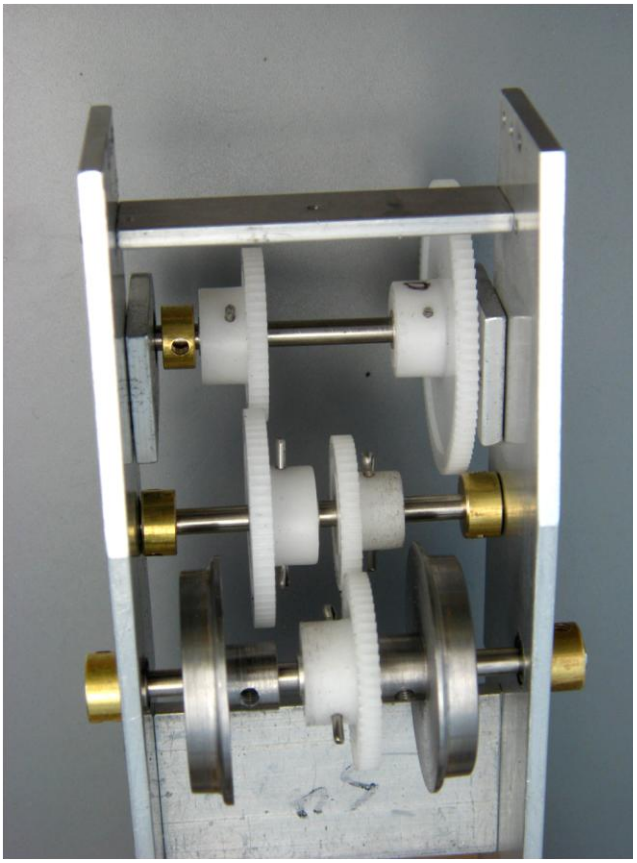


Photo 5

Drive train seen from the top

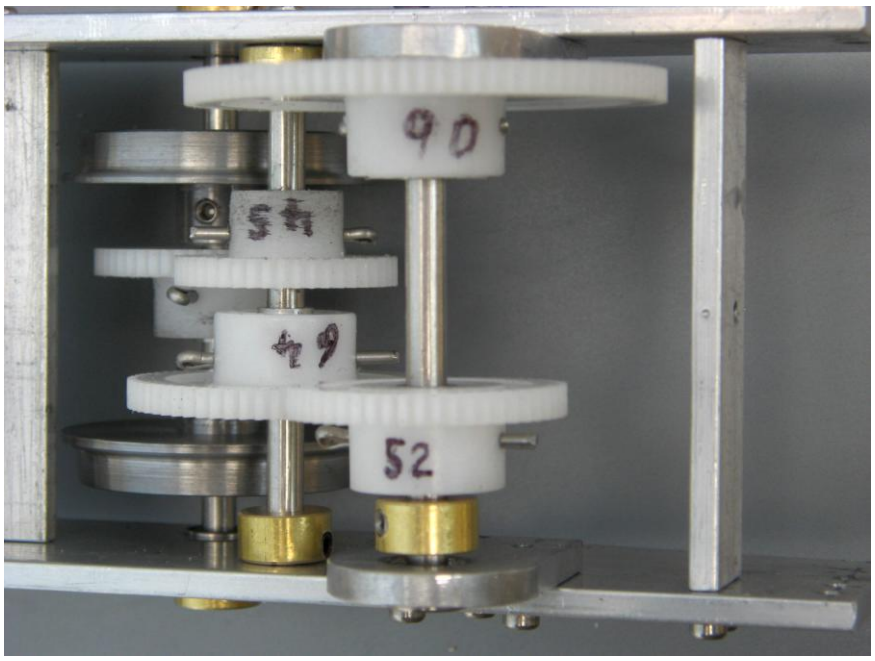
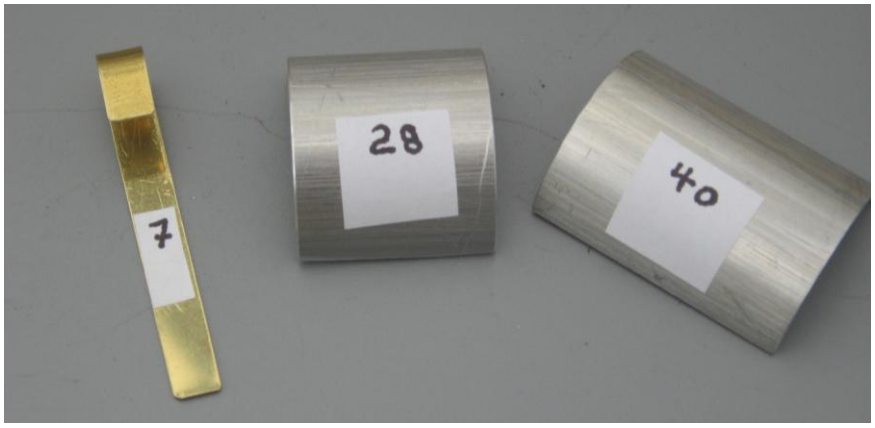


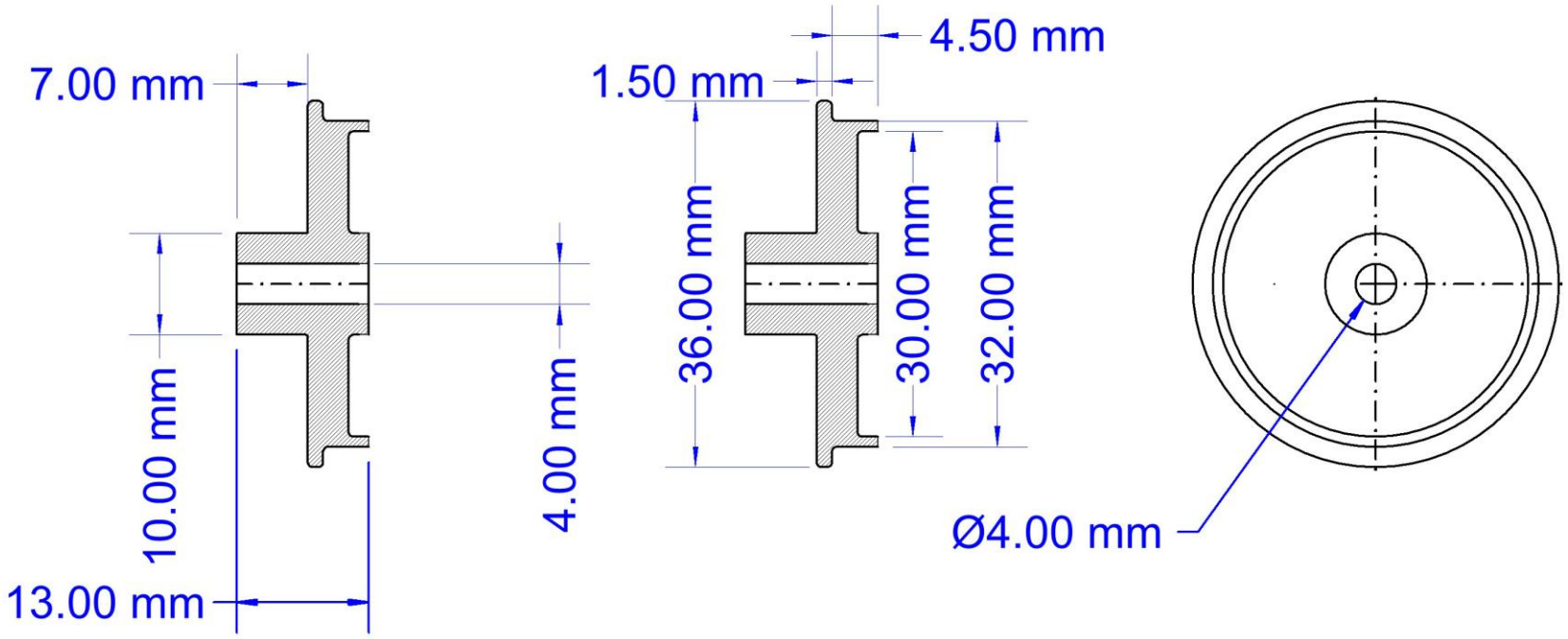
Photo 6

The various devices used to set the wheels to the correct spacing when changing from 32mm to 45mm gauge.



D13x - Driving Wheels x4 Steel 32mm Track

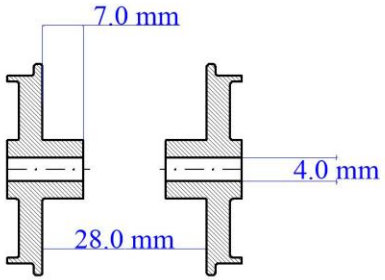
Hubs cross drilled 2.7mm then tapped M3 for grub screws

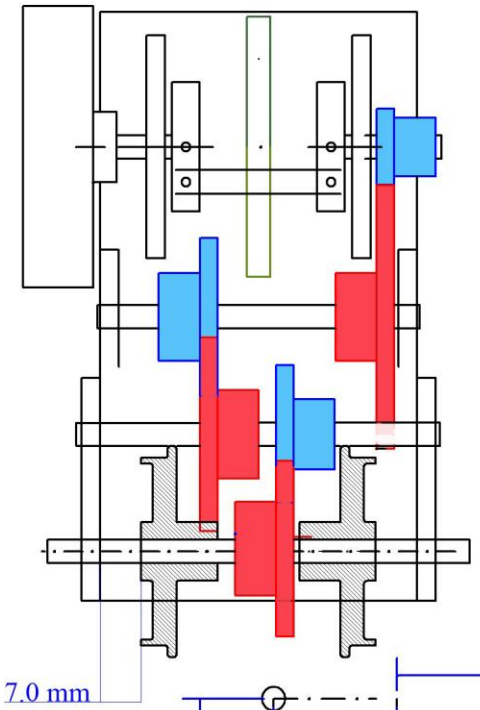


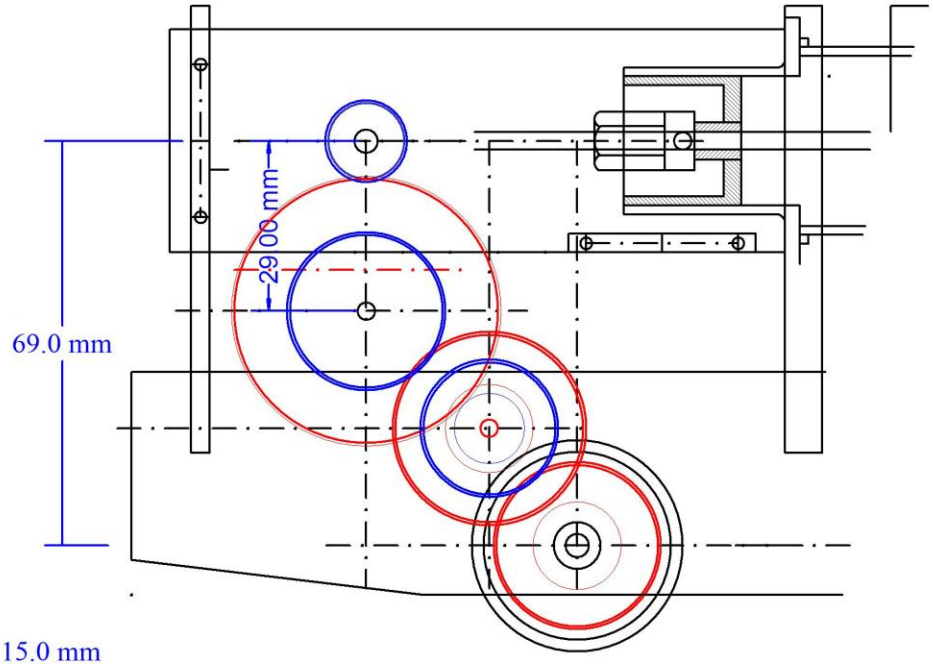
Back-to-back distance for 32mm track is 28mm
Back-to-back distance for 45mm track is 40mm

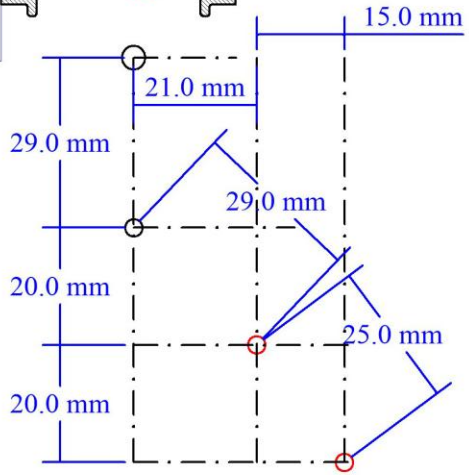
3 degree taper on wheel treads - see book

D14x - Gear Wheel Drive Train - 32mm Track









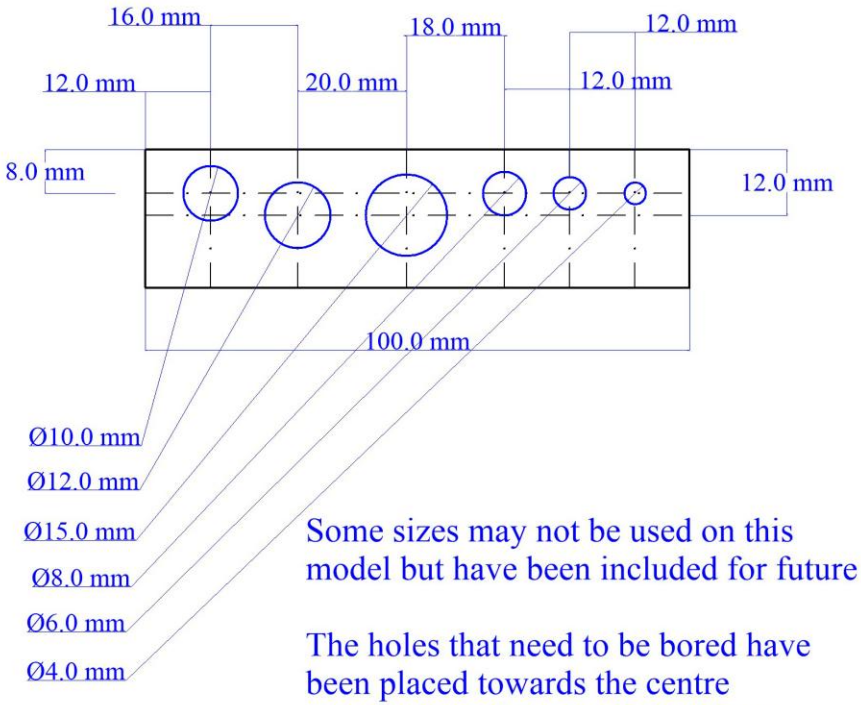
Axles 4mm dia stainless
2 x 72mm for locomotive wheels
1 x 61mm lay shaft
1 x 55mm lay shaft

Bearings - shielded
4mm int - 8mm ext - 3mm wide
12 used on the whole model

Commercial plastic gear wheels.
Mod 0.5
26 drives 90
52 drives 64
45 drives 55
5.21:1 reduction

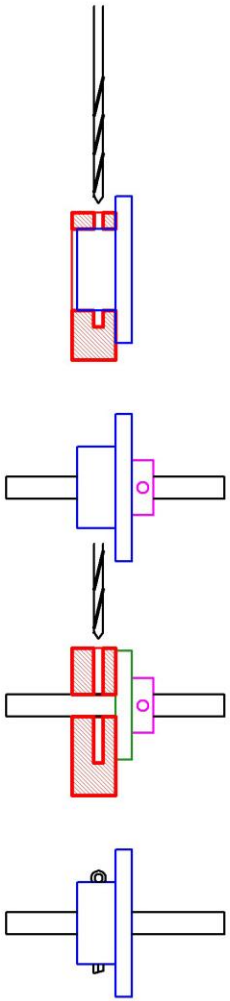
Cross Drilling Jig

Vertical holes all 1.7mm dia and 3mm in from edge



Some sizes may not be used on this model but have been included for future use

The holes that need to be bored have been placed towards the centre to make it easier to hold the blank in the 4 jaw chuck



Step 1
Place gear wheel into the appropriate sized hole in the jig and cross drill 1.7mm

Step 2
Place gear wheel on shaft in locomotive and line up with the meshing gear wheel, then slide collar up to wheel and secure collar. Then remove from model.

Step 3
Place a spacer, that is the same width as the gear teeth, on the axle and slide axle, spacer and collar into the 4mm hole in the jig and cross drill the axle

Step 4
Slide gear wheel onto axle and fix with a 1.5mm split pin. Gear wheel should now mesh with its mating wheel