

# ModelWorks



## Burrell Builder's Diary 2003-2006



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# Introduction

This book contains an edited printout of my web diary which is located at <http://www.burrellbuilder.co.uk>. I have produced this version since printing directly from a web browser does not produce satisfactory results. In particular text and/or pictures are sometimes lost at the page breaks.

The diary contains a chronological account of the construction of a 4" Scale Burrell Agricultural Traction Engine supplied in 23 pre-machined kits by:

ModelWorks International (Sales) Ltd,  
3 Riley Close,  
Royal Oak,  
Daventry,  
Northamptonshire  
NN11 8QT  
Telephone: 0 1327 301030

The diary was written concurrently with construction starting November 2003 and later entries sometimes contain updates on previously completed kits. In notable cases a warning note has been added to the earlier account when I subsequently found problems though I cannot guarantee this. The web version is extensively hyperlinked and unfortunately these do not work on paper and where possible I have replaced these with a reference to the kit number.

The planned kit sequence 1 through 24 represents a sensible order in which to build a traction engine but unfortunately, due to production problems, ModelWorks (MW) were unable to stick to this. All went in sequence until kit 11 but after that the order was 11, 15, 24, 18, 13, 12, 16, 14, 19, 20, 17, 21, 22, 23.

In formatting the diary for printing I have attempted to place the entries in chronological order but sometimes, when work was proceeding on several fronts, this is only approximate. I would like to thank Jack for editing the diary.

I am not a typical steam enthusiast or Model Engineer and do not have a wealth of practical experience. Before early retirement I was a chartered engineer working in the avionics industry. I was a "thinking engineer" and often used pure brain power to solve real world problems. I tend to work from first principals and build from these using a range of engineering and computational skills to a practical solution. This is appropriate when working with emerging technologies, where there is a limited practical knowledge base, but the same is not true for steam.



## ModelWorks Burrell Builder's Diary

In the diary you will find entries in which I analyse a problem, list the possible solutions and select a way forward. Old hands reading the diary will probably wonder why I went to such effort to solve a problem for which they "know" the answer – it is just the way I am. While on occasions I come up with novel solutions there are times when I get it completely wrong.

Many years ago I dabbled with Model Engineering and acquired a small lathe and mill. I made a few stationary engines, but lost interest and the tools began to rust. When I moved house I initially planned to dispose of them, but as the new house had a suitable room, I decided to re-create the workshop.

I felt I had to christen the workshop and, without much thought, embarked on Anthony Mount's Sliding Cylinder Engine. I found building this engine difficult and it stretched my abilities but its completion gave me renewed confidence.

This new-found confidence did not stretch to the steam generation department and when I saw ModelWorks' advert for the 1/5 scale Pride of Penrhyn steam wagon (POP) I saw this as my route into live steam. The deciding factor for me was that the kits came complete with all the fittings and sundry items necessary to complete the model.

I had great fun sorting out the finished model with improvements and additions and drove it at rallies.

The POP whetted my appetite for live steam vehicles but I wanted something much bigger. For this I again turned to ModelWorks because they provided machined parts and a 4 inch traction engine is well beyond the capacity of my workshop.



Julia Old, June 2006

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## Kit 1 – Front Wheels

# Kit 1 - Front Wheels

ModelWorks 4 inch Scale Burrell Agricultural Traction Engine  
Kit 1 arrived at the beginning of November 2003

**Monday:** I only had time to unpack and check the kit. I am impressed; if ModelWorks keep this standard up, the Burrell is going to be a fine model. The rims would appear to be turned from solid and have an impressive finish, probably too good. The spokes are laser cut and will 'just' require cleaning up.



The contents of Kit 1

## ModelWorks Burrell Builder's Diary



**Tuesday:** Instead of standard rivets the Burrell uses rivet nuts & bolts. These save time and a lot of noise. The spokes are laser cut and following MW recommendation I cleaned them up using a flap wheel. This is not a fast job and today I have cleaned up and fitted five.



The fitted rivet bolts have a nice side on the outside and a bolt on the inside. I expect the bolt will not notice once the wheel is painted.

Unlike normal model engineering practice, the MW wheels are not constructed on a jig. A jig is not necessary because of the high accuracy with which the parts can be made using CNC machines.



The first wheel completed to step 2.

## Kit 1 – Front Wheels



**Wednesday:** The first wheel nearly completed showing araldite oozing out prior to trimming. I foolishly did this relatively late at night and I now am now waiting for this to go plastic so that it can be trimmed before it sets hard. I should have allowed at least 8 hours for this step; it took ages for the araldite to go plastic.

Construction was straight forward however I found it necessary to face a 10mm socket (in a lathe) so that it could grip the rivet nuts. The lip on the socket was preventing it getting a good hold on the hexagonal part at the bottom of the rivet nut. Since the rivet bolt does not have a head in the conventional sense it is wise not to be too enthusiastic cleaning up the laser cut holes in the spokes. By leaving these slight undersize and driving the rivet bolt in using the dolly supplied, the bolt is gripped preventing it from spinning when the nut is tightened.



**Friday, Saturday, Sunday:** The second wheel was a repeat of the first, though I did manage to fit the first five spokes incorrectly. Luckily I spotted this and was able to drive the bolts out with a drift and start again. The araldite took 6½ hours to go plastic and another hour to trim. A tip I have received from Allan is that Acetone can be used to clean up any excess araldite before it goes off.

# Taster Version

This PDF file is of the same quality as used by the printer.

Pages have been removed since the full version is over 20Mb

## Kit 17 - Differential Gears

ModelWorks 4 inch Scale Burrell Agricultural Traction Engine  
Kit 17 was delivered Friday 1st July



**Friday:** I don't think this kit is going to take long to assemble but it contains a lot of expensive machining. As usual the machining of the gears is impressive particularly the bevel gear BU41702 since it is integral with a spur gear. To machine this as one piece I assume a shaper was used rather than a milling machine.

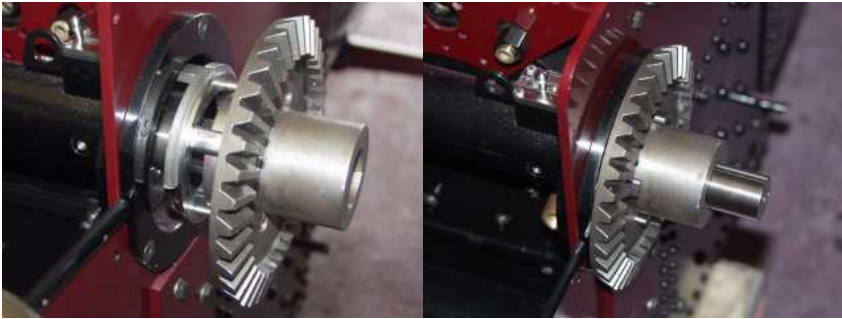
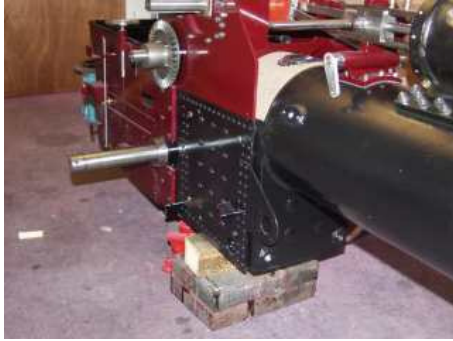
This kit contained a replacement reverser quadrant as expected, but we will have to wait until next month for the crankshaft spur gears.



## ModelWorks Burrell Builder's Diary

I have put the Burrell back on blocks rather than relying on the bottle jacks. So far I have fitted the inner bevel gear and the pinion gear at the other end of the shaft. A fair amount of fettling was required, but nothing I could not sort out with a file.

The differential is wondrously complex and as it is hidden I intended to include shots to show the internal works. The shot below shows the four prong ring that may be slid out to lock the differential.



**Saturday:** My first task was to assemble the compensating centre that houses the bevel gears. I noticed that the top and bottom pinion bushes as bagged did not agree with the isometric drawing. I concluded that they were in the wrong bags and that the fat bush goes closest to the hub (as per ISO 17C).

The apertures in the compensating centre need to be enlarged to accommodate the bushed pinions. I have deferred this until I have completed dry assembly so that I can see which face it is best to attack. For now I have omitted the top bush.



*(3/6/05) When it came to it, I reduced the thickness of the bottom bush (the fat one) such that the assembled height of the bushed pinion was 1.000". This was far easier than trying to file the cast iron centre. I noticed that the pinion was turning in the bush rather than the pinion shaft so I Loctited the bushes to the pinions.*

## Kit 17 – Differential Gears

As the bronze centre bush is a tight press fit I needed to improvise a bearing puller. There are four flats on the bush and they must **exactly** align with the recesses in the centre. I scribed lines on the bush to mark the position of the flats so that I could start it off in the correct position. Despite my precautions the flats were slightly misaligned (about 1/2mm around the circumference). I was miffed to discover that this was enough to prevent the prongs of the locking ring from engaging. Fortunately I was able to rectify this by reshaping the flats using my milling machine. Had I known the criticality of the positioning, I would have taken more trouble to ensure perfect alignment of the flats.

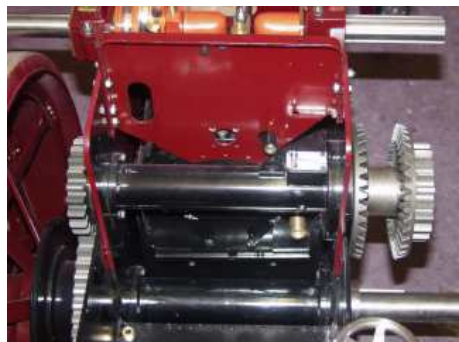


On fitting the centre to the engine I found that I could engage the locking ring but it was a lot stiffer than I would like - something I will have to work on.



The outside bevel bush was also a tight press fit into the outside bevel gear and required the use of an improvised bearing puller. I found that I had to ease both the inside and outside circumference of the thrust washer in order to get it to fit.

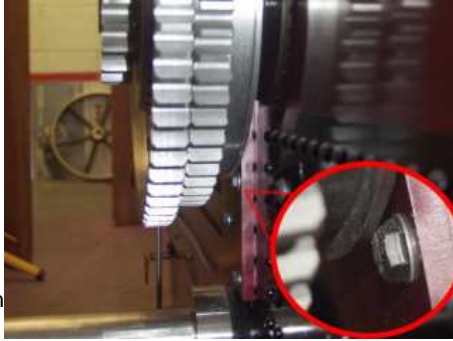
On completing the assembly I found the whole thing locked up when I tightened the final screw.



To investigate the cause I removed the compensating centre and found that this freed things up. Initially I suspected that the centre was binding between the inner and outer bevel gears, i.e. that the thrust washer was not thick enough. This turned out to be a blind alley and I had to look elsewhere for the source of the problem

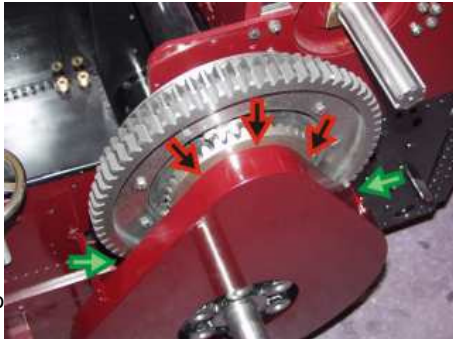
## ModelWorks Burrell Builder's Diary

A rubbing sound alerted me to a clash between the brake drum and one of the bolts securing the hornplates. My first thought was to remove the washer but this did not provide sufficient clearance to prevent the rub. I have now temporarily removed the bolt and am able to tighten up the differential without it jamming.



A word of warning - the small dowel that locks the RH main gear spur washer can easily disappear into the second shaft as the hole is deeper than the length of the pin; either Loctite it in place or partially plug the hole.

The last part of the instructions alerts us to a clash between gear guard and the outer bevel gear (red arrows). I also observed that there is insufficient clearance between 1st gear and the guard (green arrow). I will probably trim about 1/4" from the edge between the two top supports.

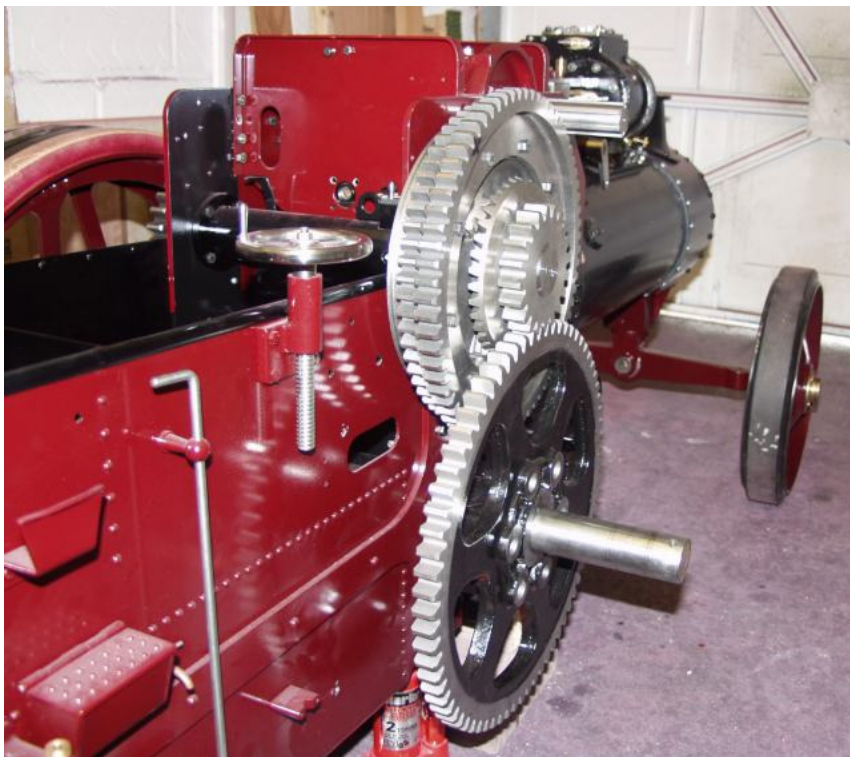


I shall now remove the differential so that I can paint it. As usual I am in a quandary as to what to paint and what to leave bare.

**Tuesday 19th July:** Now that I have returned from the Guildford MES rally, I have turned my attention back to the Burrell. Despite my loathing of angle grinders I decided to follow Steve's recommendation. Using a pair of dividers I scribed a line 1/4" down and clamped the guard to my workmate. By taking light cuts with the angle grinder I was able to produce a fairly straight neat edge. I finished off with a file and to my surprise found I had hardly scratched the paint. I am hopeful that I can get away with a partial re-spray to attend to the freshly exposed edge.



## Kit 17 – Differential Gears



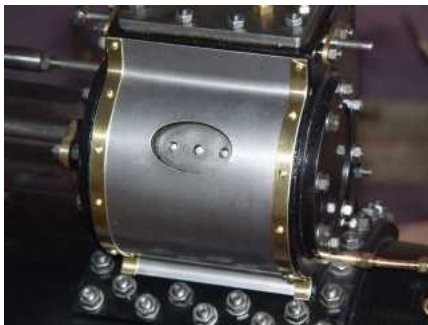
**Saturday 23 July:** Today I turned my attention to sorting out the right hand side of the engine. Despite receiving the steering at the beginning of October, I have not yet assembled it to the engine. I am a bit unsure how to fit the steering chains as only abridged instructions were included with kit 15 (pending further details at a later stage). I could not get the tension just right using the full length of the chain and for now I have one of the chains bolted onto the third link back. I would not be surprised if this is covered in our next instructions.



## ModelWorks Burrell Builder's Diary

Once fitted, I immediately disabled the steering by removing the front shackles and tying the chains to the perch bracket. This is because it is much easier to manoeuvre the Burrell around the garage by pushing on the tops of the front wheels. Not only does this provide agile steering, it also provides additional leverage. (Move the Burrell back 1" and the top will go back 2" giving a velocity ratio of 2:1)

The only other "new" component to fit was the gear guard



**Monday:** Spurred on by Mike's report of having all parts fitted I have continued to fit some of the residue I have dotted about the house. Today I tackled the cylinder cleading.

The cleading was a joy to fit since the pre-bent shape was an excellent fit and all of the holes lined up. I am glad I did not have to make it from scratch! I have just given it its first coat of paint.

I have also been working on the ashpan and grate. I don't how durable it will be but I have painted it with high heat matt black paint which I originally obtained from Halfords.

## MSRVS 21st Steam Rally Tewkesbury



## MSRVS 21st Steam Rally Tewkesbury

Saturday 24th June - Sunday 25th June

I have just returned from the Model Steam Road Vehicle Society's 21st Steam Rally held at the Tewkesbury Rugby club. As with Whissendine the highlight for me was the road runs.



Steam Up - Ready to Go (excellent smokeless coal was supplied)

## ModelWorks Burrell Builder's Diary



The rally was opened by Town Mayor Elect Councilor PJ Aldridge  
Riding with Chris's on his 3" Allchin 'Lark'



Near the start of the 1.3 mile Road Run around the streets of Tewkesbury

**MSRVS 21st Steam Rally Tewkesbury**



**Steaming along the main road into Tewkesbury**



**The Cross at the centre of Tewkesbury**

## ModelWorks Burrell Builder's Diary



Turn into Gander Lane - the final leg back to the field



Roy on his ModelWorks Burrell 'Ivor'

## MSRVS 21st Steam Rally Tewkesbury



I couldn't resist the challenge to pull this 2 ton truck.

I would like to thank the organizers of MSRVS rally, especially the police and marshals who made the road runs possible.

**Thursday 29 June:** Today a large jiffy bag arrived from ModelWorks containing replacement water lifter, injector water tap and hornplate bolts. It is reassuring to know that Modelworks have been working to resolve outstanding issues.

As I believe in "if it ain't broke don't fix it", I shall not be fitting any of these items. I made my own replacement water lifter (see the 'Steaming's' section) which is of similar design to the one supplied. I have found this invaluable for filling the tender and would recommend fitting the one supplied.

Replacing the hornplate socket button head screws with proper bolts is a good idea. I continue to monitor mine and, since fitting brass sleeves (see the 'The Final Bits' section), I have had less trouble. When I next have the wheels off I shall fit the bolts in the inaccessible locations but leave the button heads where they are in full view and easily checked.

## ModelWorks Burrell Builder's Diary



Replacement water lifter, injector water tap and hornplate bolts

The replacement injector water tap has been supplied in an attempt to get the 8 pint injector to work but Steve reports mixed results. Where the new tap fails to get the injector to work the problem is likely to be either an air leak in the new tap or a shortage of steam. There remains a significant restriction within the injector steam cock and anyone desperate for a working injector could try a replacement 3/8" pipe globe valve from RA Baker. Talking to Robert I have learned that his valve has a much larger internal passage and has the same threads as those supplied by ModelWorks.

### Finally

Over the last few weeks I have found myself calling my engine "Little Beastie". I am not sure when I began using this name, but I suspect it was after a bad priming in which the engine was covered in brown treated boiler water. Even though "Little Beastie" is an unconventional name for an engine, I have decided to go with it.

"Little Beastie" performed impeccably over the weekend and other than a few loose bolts I have no items requiring attention. At some point I knew the Burrell Diary would come to an end and, with the engine working well, I believe this time has now come.

I would like to thank ModelWorks and especially Steve Baldock for supplying me an engine that has proved itself to be an excellent performer. When I started the Burrell I had concerns that a kit-built engine would somehow be inferior. I have found that, unless I point out the engine's origins, rallygoers assume it has been made by a Model Engineer from castings (*but not by me!!!*).

- The End -